COMMONWEALTH OF KENTUCKY BEFORE THE PUBLIC SERVICE COMMISSION

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ELECTRONIC APPLICATION OF KENTUCKY)	
UTILITIES COMPANY FOR A CERTIFICATE OF)	
PUBLIC CONVENIENCE AND NECESSITY FOR)	CASE NO. 2022-00066
THE CONSTRUCTION OF TRANSMISSION)	
FACILITIES IN HARDIN COUNTY, KENTUCKY)	

RESPONSE OF KENTUCKY UTILITIES COMPANY TO COMMISSION STAFF'S FOURTH REQUEST FOR INFORMATION DATED MAY 11, 2022

FILED: MAY 20, 2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
COUNTY OF JEFFERSON	

The undersigned, **Robert M. Conroy**, being duly sworn, deposes and says that he is Vice President, State Regulation and Rates, for Kentucky Utilities Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge, and belief.

Robert M. Conroy

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 1649 day of 2022.

Notary Public

Notary Public ID No. <u>603947</u>

My Commission Expires:

July 11, 2022

VERIFICATION

COMMONWEALTH OF KENTUCKY	
COUNTY OF JEFFERSON	,

The undersigned, Elizabeth J. McFarland, being duly sworn, deposes and says that she is Vice President, Transmission, for Kentucky Utilities Company and an employee of LG&E and KU Services Company, and that she has personal knowledge of the matters set forth in the responses for which she is identified as the witness, and the answers contained therein are true and correct to the best of her information, knowledge, and belief.

Elizabeth J. McFayand

Subscribed and sworn to before me, a Notary Public in and before said County

and State, this 19th day of May

2022.

Notary Public

Notary Public ID No. 603967

My Commission Expires:

July 14, 2022

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 1

Responding Witness: Elizabeth J. McFarland

- Q-1. Refer to KU's response to Wade Family Farm Management, LLC's Second Request for Information (Wade Family's Second Request), Item 11, and KU's Response to Commission Staff's Third Request for Information (Staff's Third Request), Item 2. Provide any summaries, reports, or presentations produced in relation to any wetland delineation survey, geotechnical exploration, or field soil resistivity survey, or any other on-site field study KU has conducted in relation to the Glendale Megasite. Consider this an ongoing request during the pendency of this application.
- A-1. For substations, on-site field studies are still underway by KU on the Glendale Megasite for the substation locations. Phase 1 studies have been completed for the substation locations and the resulting Geophysics reports are attached. Phase 2 on-site field studies for the substation locations are ongoing, and reports will be provided upon completion.

For the transmission lines, geotechnical reports received to date are attached. The wetland delineation report has been completed for the proposed 200 foot right-of-way for the 345 kV transmission lines and is attached.



GEOPHYSICAL EVALUATION

LG&E-KU GLENDALE SOUTH SUBSTATION

Glendale, Kentucky

PREPARED FOR:

Matt Hambright, P.E. Black & Veatch 3550 Green Court Ann Arbor, MI 48105-1579

PREPARED BY:

Atlas Technical Consultants LLC 14 Sunnen Drive, Suite 143 St. Louis, MO 63143



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May 5, 2022

Atlas No. 322013SWG

Report No. 1

MR. MATT HAMBRIGHT, P.E. BLACK & VEATCH
3550 GREEN COURT
ANN ARBOR, MI 48105-1579

Subject: Geophysical Evaluation

LG&E-KU Glendale South Substation Project

Glendale, Kentucky

Dear Mr. Hambright:

In accordance with your authorization, Atlas performed a geophysical evaluation pertaining to the LG&E-KU Glendale South Substation Project located in Glendale, Kentucky. Specifically, our services included the performance of seven high-resolution multi-electrode electrical resistivity tomography (Sting-ERT) traverses, seven two-dimensional (2D) Multichannel Analysis of Surface Wave (MASW) seismic profiles, and seven Refraction Microtremor (ReMi) one-dimensional (1D) profiles at preselected areas of the project site. The primary purpose of the study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock at our evaluated locations. Our services were conducted on March 21 through April 11 of 2022. This report presents the methodology, equipment used, analysis, and findings.

We appreciate the opportunity to be of service on this project. Should you have any questions related to this report, please contact the undersigned at your convenience.

Sincerely,

Atlas Technical Consultants LLC

Eric R. Carlson, El (MO)
Project Geophysicist/Engineer

Ein Carlson

ASB/ERC/PFL/erc/ds

Distribution hambrightm@bv.com

Patrick F. Lehrmann, P.G. (CA, OR, MO) P.Gp.(CA) Principal Geologist/Geophysicist



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1. INTRODUCTION

In accordance with your authorization, Atlas performed a geophysical evaluation pertaining to the LG&E-KU Glendale South Substation Project located in Glendale, Kentucky (Figure 1). Specifically, our services included the performance of seven high-resolution multi-electrode electrical resistivity tomography (Sting-ERT) traverses, seven two-dimensional (2D) Multichannel Analysis of Surface Wave (MASW) seismic profiles, and seven Refraction Microtremor (ReMi) one-dimensional (1D) profiles at preselected areas of the project site. The primary purpose of the study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock at our evaluated locations. Our services were conducted on March 21 through April 11 of 2022. This report presents the methodology, equipment used, analysis, and findings.

2. SCOPE OF SERVICES

Our scope of services included the performance of seven Sting-ERT, seven MASW and seven 1D ReMi profiles at preselected locations within the study area. Specifically, we conducted the following scope of services for the project:

- Collection of electrical resistivity data along seven predetermined Sting-ERT traverses, STL-101 through STL-107, using an AGI SuperSting R8 resistivity meter and 56 stainless steel electrodes.
- Collection of 2D MASW data along seven predetermined MASW traverses, ML-101 through ML-107, using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones. Compilation and geophysical analysis of the data collected.
- Collection of 1D ReMi data at seven predetermined locations, RL-101 through RL-106.
 The ReMi data was collected using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones.
- Compilation, processing, and analysis of the data obtained.
- Preparation of this report presenting our findings and conclusions.

3. SITE AND PROJECT DESCRIPTION

The project site is located to the southeast of the intersection of Shipp Lane and Jaggers Road in Glendale, Kentucky (Figure 1). The site consists of open farm fields with varied grass and vegetation. A small dirt road runs through the western portion of the study area. To the south of the study area, an overhead power line runs in a generally east-west orientation.

Based on our discussions with project stakeholders, it is our understanding that the project site is in an area prone to karst features.



4. GEOPHYSICAL INSTRUMENTATION AND APPLICATIONS

Our evaluation included conducting seven Sting-ERT traverses, seven MASW traverses and seven 1D ReMi traverses for the purpose of delineating geophysical anomalies potentially associated with karst and to estimate depth to bedrock at our evaluated locations at the project site. The methodology of each geophysical technique applied is described in more detail below.

4.1 Sting-ERT Method

An AGI SuperSting R8 electrical resistivity meter was used to conduct electrical resistivity profiles at the site to characterize the electrical properties of the subsurface. Seven Sting-ERT profiles (STL-101 through STL-107) conducted along predetermined traverses are illustrated on Figure 2. It should be noted that STL-102 and STL-104 were relocated slightly to avoid surface obstructions (large brush piles). Electrical current was injected into the ground through 56 stainless steel electrodes and the electric potential difference between multiple electrodes pairs was measured simultaneously. When necessary, the area around the electrodes was moistened with a relatively small amount of salt water (potable water with a small amount of added table salt, sodium chloride) to reduce the contact resistance. The data was collected using a Dipole-Dipole with Strong Gradient electrode configuration. An 8-foot electrode spacing was used for each of the Sting-ERT traverses to achieve optimal resolution and the desired depth of investigation. The Sting-ERT transects performed were acquired using a roll-along configuration, with some overlap, to achieve the desired profile lengths of 888 feet for STL-101, 1,336 feet for STL-102, 888 feet for STL-103, 888 feet for STL-104, 888 feet for STL-105, 888 feet for STL-106, and 776 feet for STL-107. Table 1 shows the coordinates of each of the end stations for the Sting-ERT lines.

Table 1: Sting ERT Line Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.59571783	-85.90161657	STL-101 Station 0
37.5970692	-85.89906802	STL-101 Station 888
37.59513208	-85.90165904	STL-102 Station 0
37.59717331	-85.89783144	STL-102 Station 1336
37.5949558	-85.90004598	STL-103 Station 0
37.5963143	-85.89750981	STL-103 Station 888
37.59493258	-85.90006155	STL-104 Station 0
37.59692519	-85.9018233	STL-104 Station 888
37.59692577	-85.90060628	STL-105 Station 0
37.59492833	-85.8988548	STL-105 Station 888
37.59698127	-85.89929047	STL-106 Station 0
37.5949862	-85.89753036	STL-106 Station 888
37.59497673	-85.90078011	STL-107 Station 0
37.59710507	-85.90088777	STL-107 Station 776

The Sting-ERT data was processed, corrected for terrain (relative elevation) variations, and analyzed using EarthImager 2-D™ V2.1.7, a two-dimensional resistivity inversion software. The



inversion results are presented in color gradient apparent resistivity models that illustrate the electrical resistivity contrasts in the subsurface materials.

4.2 2D MASW Method

Surface waves (specifically, Rayleigh waves) recorded along lines ML-101 through ML-107 were performed at the same location and orientation as the Sting ERT profiles (Figure 2). It should be noted that ML-105 was shifted longitudinally to avoid surface obstructions and that due to the roll-along nature of the Sting-ERT traverses, the endpoints of the Sting-ERT lines continue further than those of the MASW traverses. Surface waves, generated by a hammer and plate (shot), were recorded using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones. The geophones were coupled to the ground surface using a Geostuff Landstreamer with geophones stationed 4 feet apart and shots conducted off the end of the lines. Prior to the collection of surface wave data, near and far field effects were evaluated for several shot offset distances at each traverse. The results indicated that the optimum offset distance for the shot point of the MASW study ranged from 40 feet to 72 feet for each traverse.

Three records, one second long, were recorded at each shot location. After each shot, the shot location and geophones were shifted 8 feet longitudinally along the profile direction and the line was reshot. The number of shots, spread length, and start and end stations are presented in Table 2. The station numbers (start and end points of the line) and their associated coordinates are shown in Table 3.

The recorded MASW data were processed using SurfSeis® (Kansas Geological Survey, 2012), a MASW software program. One dimensional (1-D) shear-wave (S-wave) velocity (Vs) profiles were generated for each shot location which represent the average condition across the length of the geophone array. Each individual 1-D profile is spatially plotted at the center of each geophone array. A two-dimensional color gradient model was then created from the 1-D models using the SurfSeis® interpolation scheme with relative elevation corrections. It should be emphasized that the 2-D profile represents the area between the midpoint of the first shot location and the midpoint of the last shot location. The actual model section length and start and end stations for the sections are also listed in Table 2.

Table 2: MASW Array Geometry

Line No.	No. of Shots	Total Spread Length (feet)	Profile Length/Start and End Stations (feet)
ML-101	100	892	800/(0-800)
ML-102	167	1428	1336/(0-1336)
ML-103	101	900	808/(0-808)
ML-104	101	900	808/(0-808)
ML-105	101	900	808/(95-903)
ML-106	101	900	808/(0-808)
ML-107	88	796	704/(0-704)



Table 3: MASW Line Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.59571783	-85.90161657	ML-101 Station 0
37.59693661	-85.89932157	ML-101 Station 800
37.59513208	-85.90165904	ML-102 Station 0
37.59717331	-85.89783144	ML-102 Station 1336
37.5949558	-85.90004598	ML-103 Station 0
37.59617934	-85.8977607	ML-103 Station 808
37.59493258	-85.90006155	ML-104 Station 0
37.59672858	-85.9016475	ML-104 Station 808
37.59692577	-85.90060628	ML-105 Station 0
37.59488	-85.898812	ML-105 Station 903
37.59698127	-85.89929047	STL-106 Station 0
37.5951844	-85.89770325	STL-106 Station 808
37.59497673	-85.90078011	STL-107 Station 0
37.59690862	-85.90087772	STL-107 Station 704

4.3 1D ReMi

The passive source 1-D ReMi technique uses recorded surface waves (specifically Rayleigh waves) that are contained in background noise to develop a shear-wave velocity profile of the study area down to a depth, in this case, of approximately 100 feet below existing ground surface at seven predetermined locations at the study area. The depth of exploration is dependent on the length of the line and the frequency content of the background noise. The results of the ReMi method, displayed as a one-dimensional profile, represents the average condition across the length of the line. The ReMi method does not require an increase of material velocity with depth; therefore, low velocity zones (velocity inversions) are detectable with ReMi. The mid-point locations of each ReMi traverse are detailed in Table 4.

Table 4: ReMi Mid-point Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.596675	-85.899815	RL-101
37.595403	-85.901144	RL-102
37.596706	-85.898702	RL-102N
37.595129	-85.899712	RL-103
37.596461	-85.901414	RL-104
37.596041	-85.899832	RL-105
37.595605	-85.898081	RL-106

A total of 15 records, each 32 seconds in duration, were recorded for lines RL-101 through RL-106; 10 records utilizing passive data collection of ambient ground vibration noise; and 5 records utilizing an active source generated by a 20-pound sledgehammer and a HDPE plastic strike plate. The active source data gathers included conducting hammer blows approximately



30 feet off the end of the geophone array. Data collected was then downloaded to a field computer and the data were later processed using Surface Plus 9.1 - Advanced Surface Wave Processing Software (Geogiga Technology Corp., 2020), which uses the refraction microtremor method (Louie, 2001) and other surface wave analysis methods. The program generates phase-velocity dispersion curves for each record and provides an interactive dispersion modeling tool to determine the best fitting model. The result is a 1-D shear-wave velocity model of the site with roughly 85 to 95 percent accuracy.

5. FINDINGS AND CONCLUSIONS

As previously discussed, the primary purpose of our study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock. Our study utilized Sting-ERT, MASW and ReMi methods. Figures 2, 3a and 3b present the approximate location of our traverses and the general conditions at the study areas, respectively.

Figures 4a through 4g depict the results from the Sting-ERT and MASW lines STL-101 through STL-107 and ML-101 through ML-107, respectively. The figures are presented in color gradient form with warm colors (red) representing relatively higher resistivity/shear wave velocity for the ERT/MASW, respectively. The cool colors (blue) representing relatively higher conductivity and lower shear wave velocity, respectively. The measured contact resistance (resistances between the electrode and the adjacent soil) along our transects were very low which resulted in good quality data and repeatable results for the ERT data. Strong winds presented some challenges in the collection of the MASW data; however, overall data quality (dispersion curves) for the MASW data was good. In general, our Sting-ERT profiles illustrate layers of somewhat resistive materials in the very near-surface, then several layers of relatively conductive materials, and more resistive materials at depth. Conductive and resistive pockets are also evident in the data.

Please note the 2D MASW seismic models depicted on the figures start at the mid-point of the first geophone array and terminate at the mid-point of the last geophone array. As illustrated in Figures 4a through 4g, the models regularly depict a thin horizon of relatively high velocity material in the near surface, underlain by relatively low velocity material, and higher velocity materials with increasing depth.

The shear wave velocity results and ERT results are relatively consistent, with some localized lateral and vertical variations in shear wave velocity and resistivity values. The responses observed between approximately 30 to 40 feet below existing ground surface are consistent with the typical the contrast in physical properties observed between soil and weathered bedrock/bedrock.

Also noted on Figures 4a through 4g are numerous anomaly locations on both the Sting-ERT and MASW profiles. Often, karst features have a combination of higher and/or lower resistive zones (depending on the saturation of the soils/rock) coupled with a lower velocity zone. Several anomaly locations noted along the profiles have both resistivity anomalies and lower velocity



anomalies which can be consistent with karst. Additional anomalies on either the Sting-ERT or the MASW profiles are noted which could also be associated with karst.

As discussed, the purpose of our ReMi study was to develop 1D shear-wave velocity profiles to be used for design and construction at the study site. Table 5 and Figures 5a through 5g present the results from our ReMi evaluation. It should be noted that when the 1-D ReMi surface wave velocity results (analogous to shear wave) show an IBC Vs100 velocity value that is close to the "border line" boundary between two IBC Vs100 Site Classes, the project geotechnical engineering consultant of record should be consulted regarding existing available site information and whether obtaining additional new geotechnical evaluation data such as boreholes, surface to downhole seismic (ASTM D7400), cross hole seismic (ASTM D4428), and/or additional 1-D ReMi data collections would be advisable. The project geotechnical engineering consultant of record may wish to consider the subsurface geologic stratigraphy and structure, soil mechanics, and soil modulus, along with the initial 1D ReMi results when assessing a "borderline" IBC Vs100 Seismic Site Class and whether additional geophysical or geotechnical evaluations are needed.

Table 5 - ReMi Vs 100' Results

Line Number (Orientation)	Depth (ft)	Shear-Wave Velocity (feet/second)	Average Shear-Wave Velocity (Vs100)	Site Class (IBC, 2019)
	0-5 855			
RL-101 (SW-NE)	5-13	756		
	13-20	521		
	20-25	950	1,298 ft/s	С
	25-42	1,654		
	42-66	1,751		
	66-100	1,884		
	0-5 992			
	5-13	851		
5	13-20	598		
RL-102 (SW-NE)	20-26	690	1,339 ft/s	С
(OW NE)	26-41	1,709		
	41-64	1,831		
	64-100	1,935		
	0-5 1,036			
	5-13	3 656		
	13-20	574		
RL-102N (SW-NE)	20-22	674	1,323 ft/s	С
(311-142)	22-41	1,704		
	41-63	1,696		
	63-100	1,896		



Line Number (Orientation)	Depth (ft)	Shear-Wave Velocity (feet/second)	Average Shear-Wave Velocity (Vs100)	Site Class (IBC, 2019)
	0-5	1,005		
	5-13	784		
	13-19	475		
RL-103 (SE-NW)	19-24	1,426	1,375 ft/s	С
(GE IVV)	24-40	1,830		
	40-64	1,854		
	64-100	1,874		
	0-5	873		
	5-12	904		
5 , ,,,	12-20	485		
RL-104 (SE-NW)	20-25	655	1,309 ft/s	С
(GE IVV)	25-41	1,853		
	41-66	1,878		
	66-100	1,906		
	0-5	620		
	5-12	697		
	12-19	693		
RL-105 (SE-NW)	19-24	588	1,311 ft/s	С
(GE IVV)	24-41	1,839		
	41-64	1,852		
	64-100	1,979		
	0-5	737		
	5-13	709		
5	13-20	673		
RL-106 (SE-NW)	20-27	610	1,265 ft/s	С
(02 1117)	27-42	1,820		
	42-65	1,834		
	65-100	1,890		

6. LIMITATIONS

The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, express or implied, is made regarding the conclusions and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request.

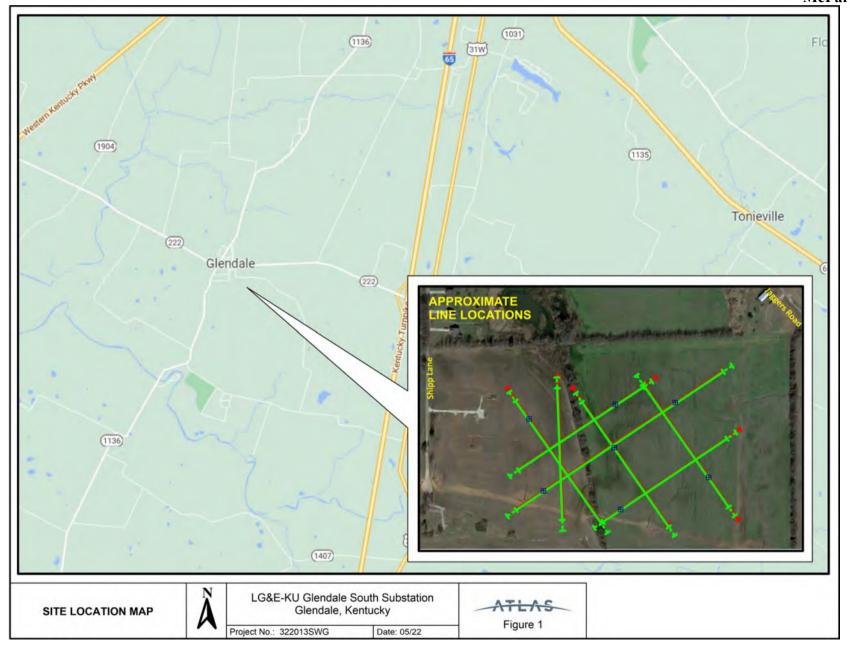


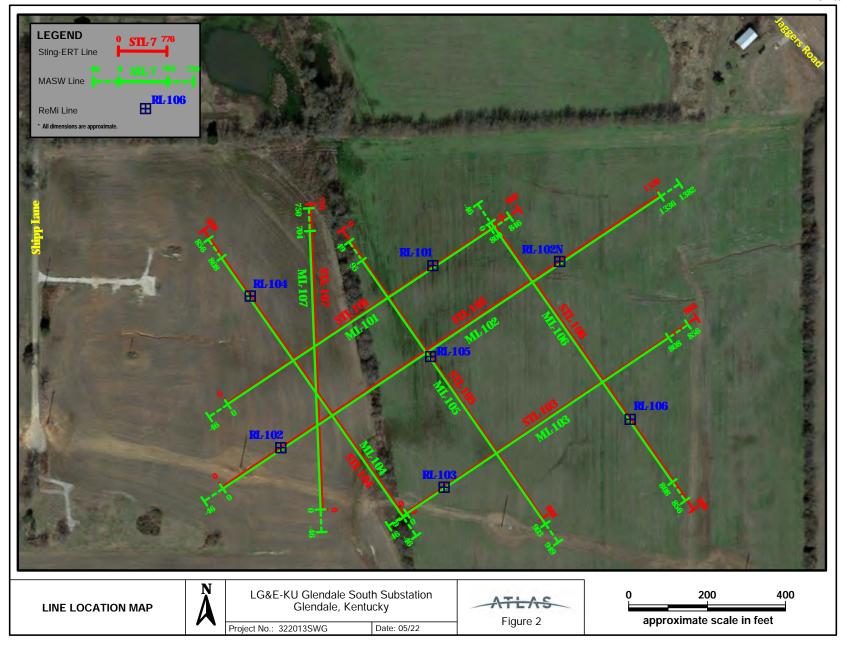
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7. SELECTED REFERENCES

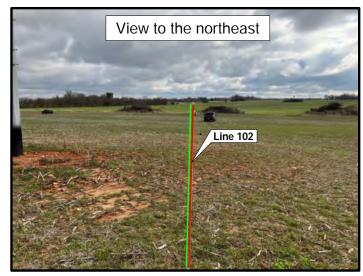
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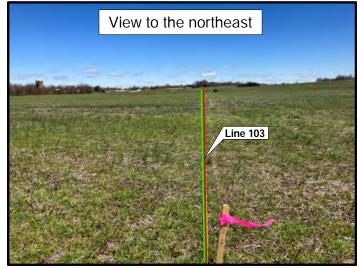
Attachment 1 to Response to PSC-4 Question No. 1
Page 12 of 29
McFarland

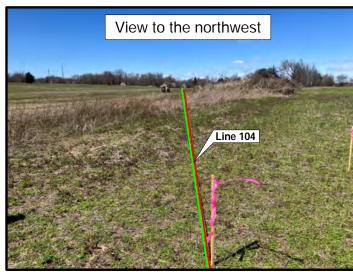












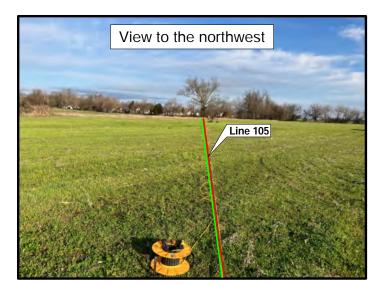
SITE PHOTOGRAPHS (Profiles 101 Through 104)

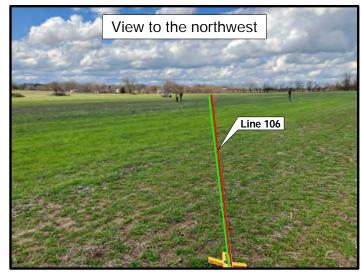
LG&E-KU Glendale South Substation Glendale, Kentucky

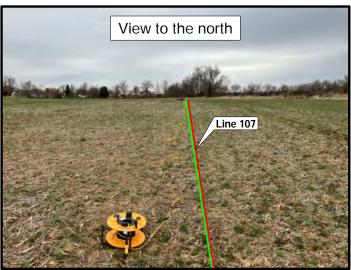
Project No.: 322013SWG

Date: 05/22









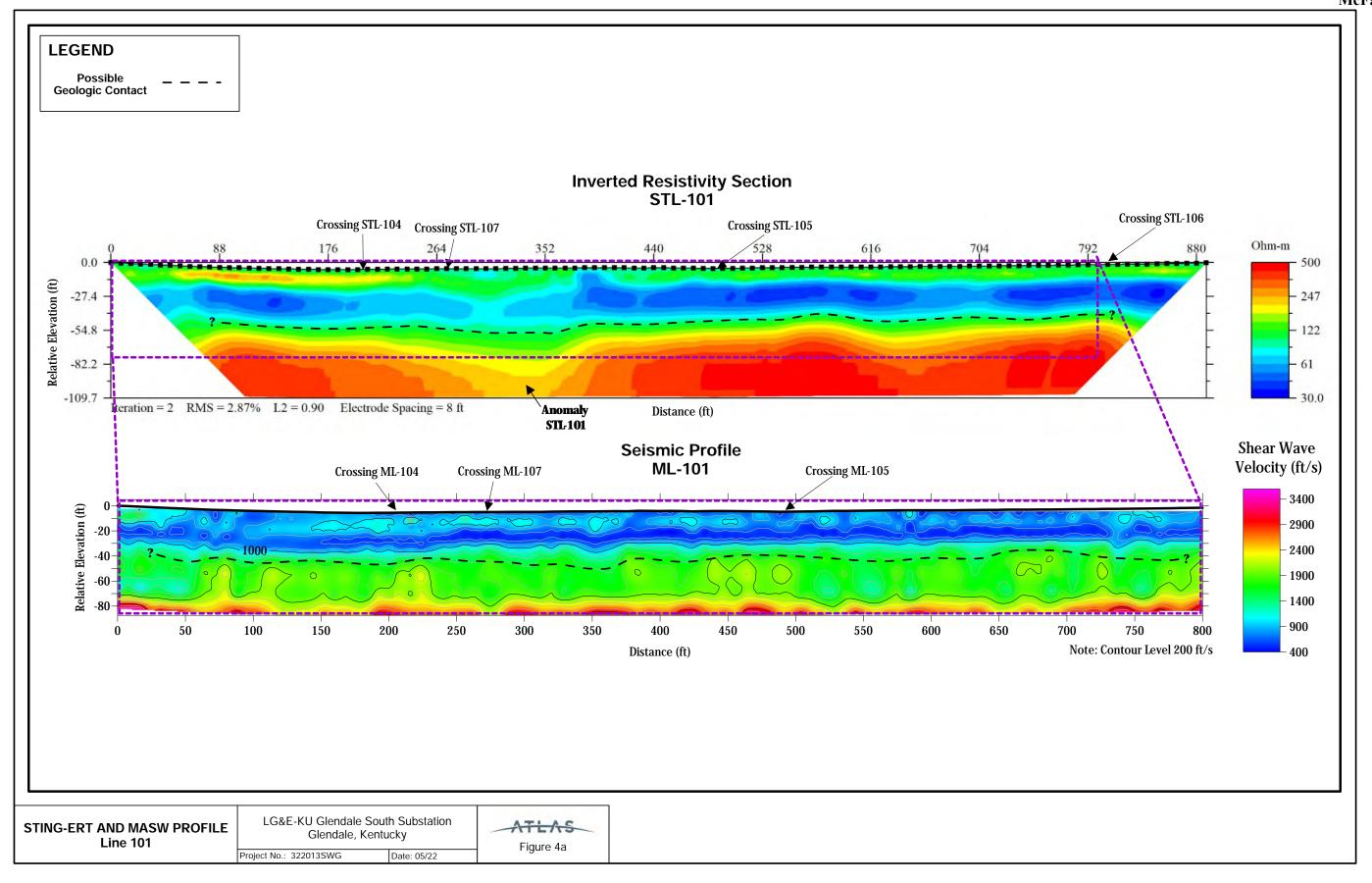
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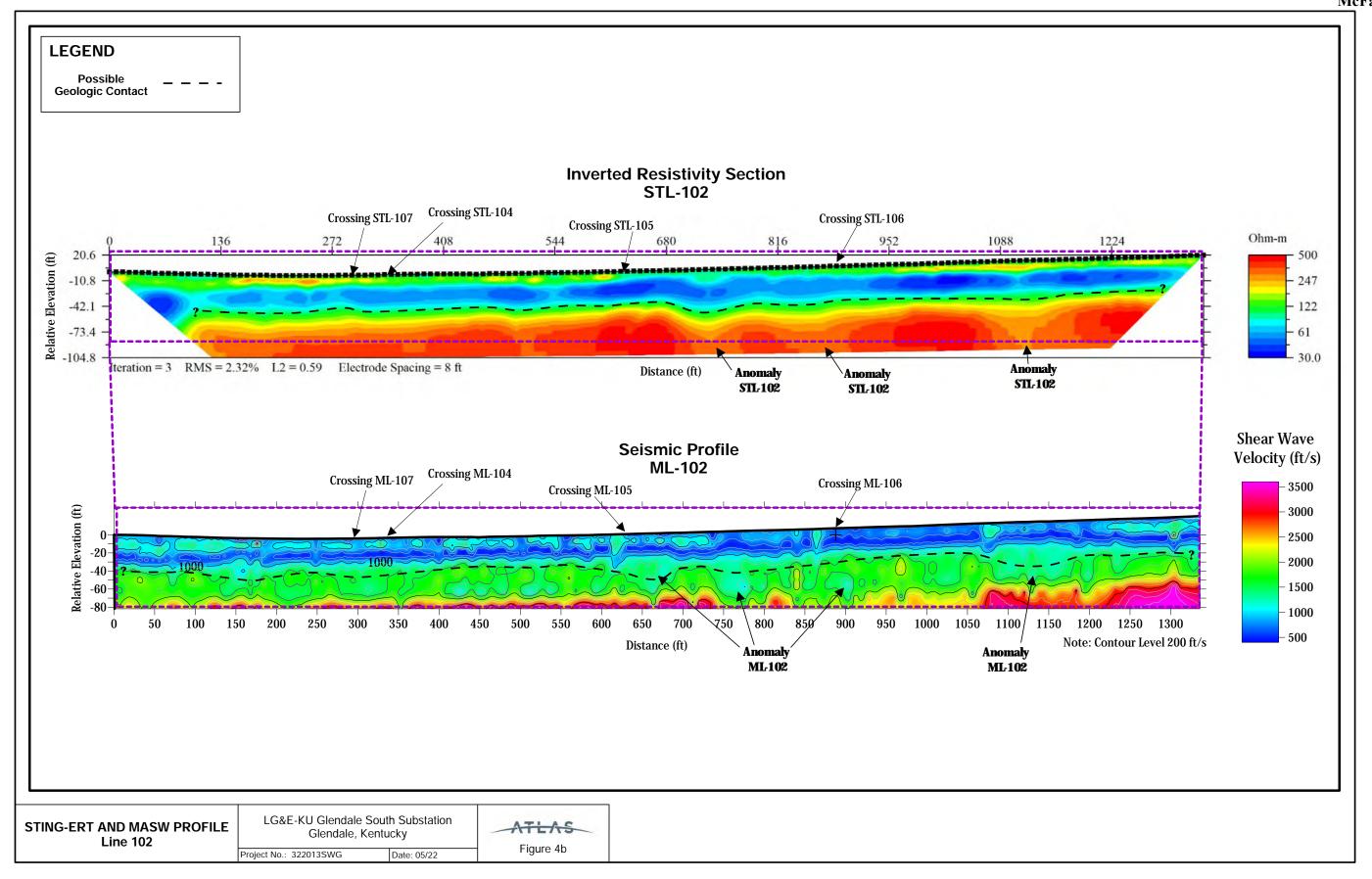
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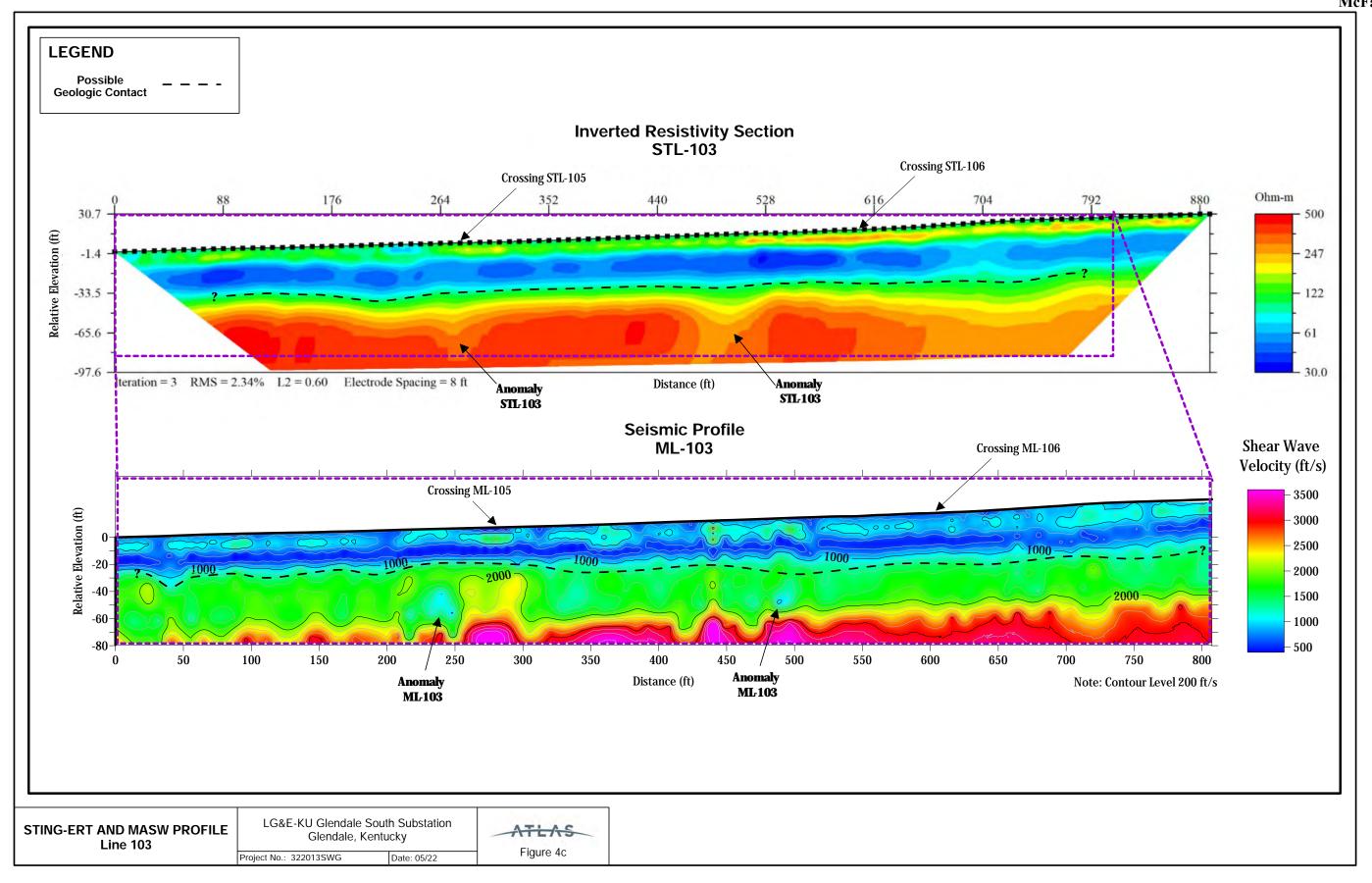
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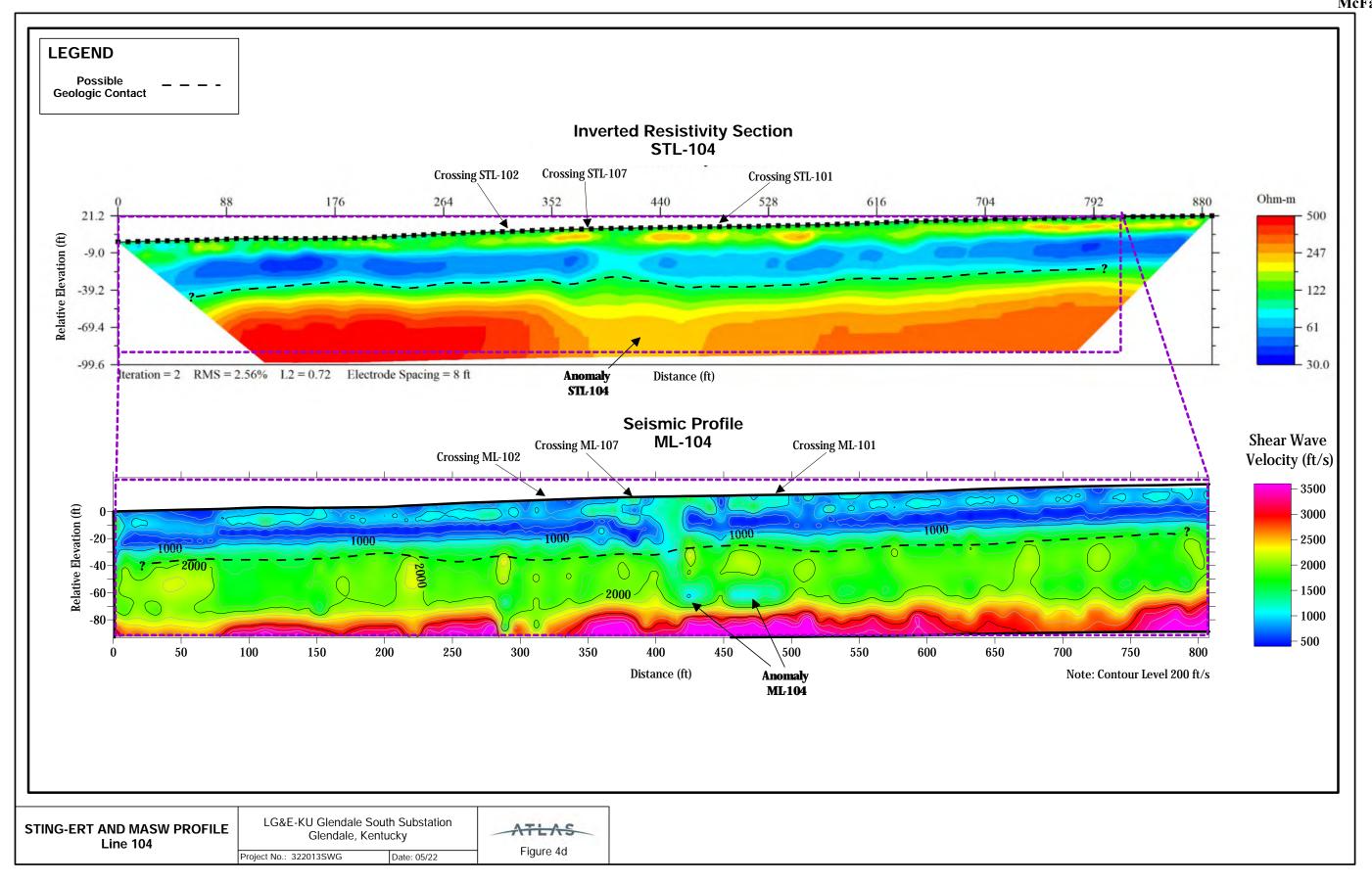
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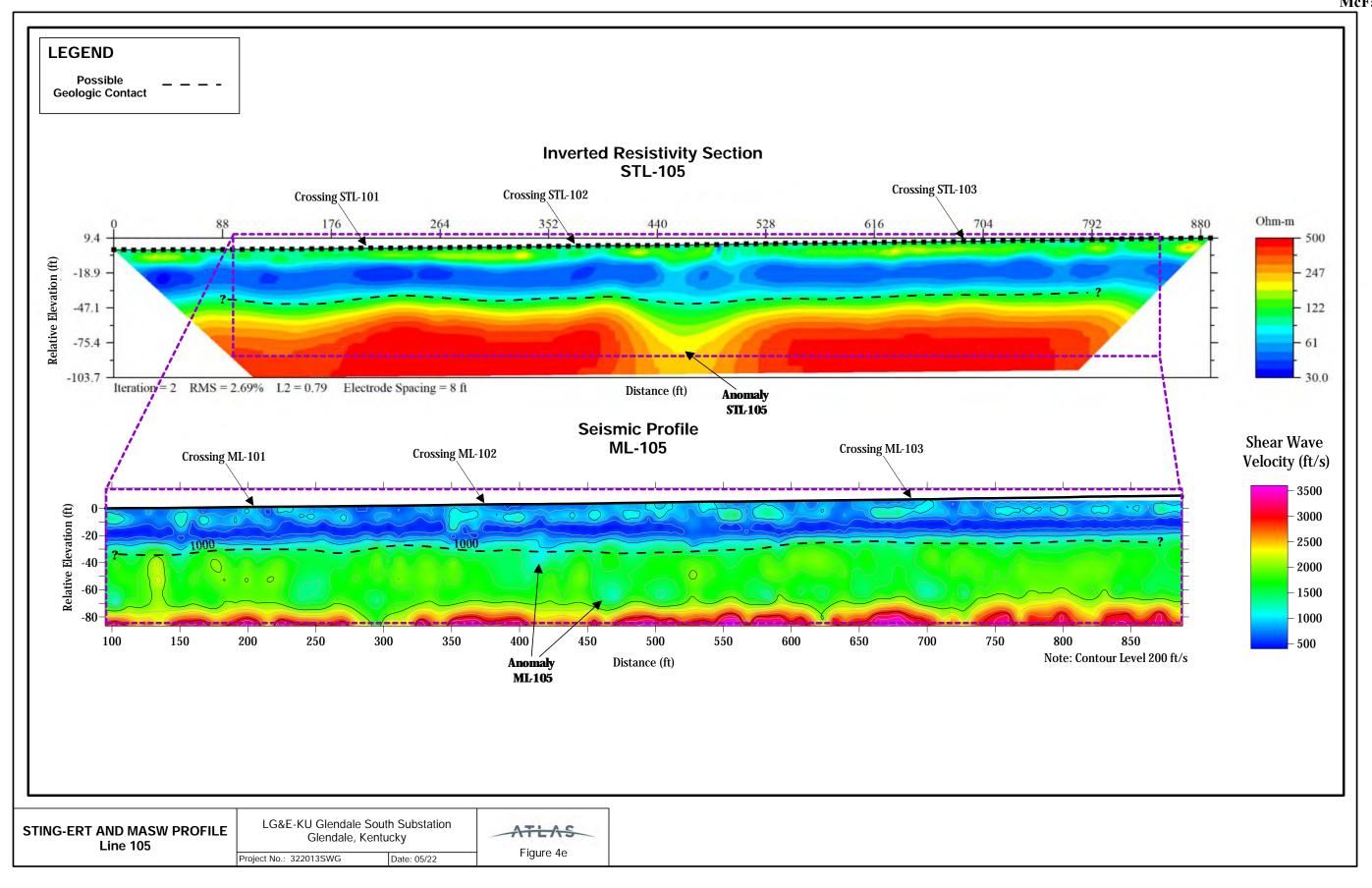


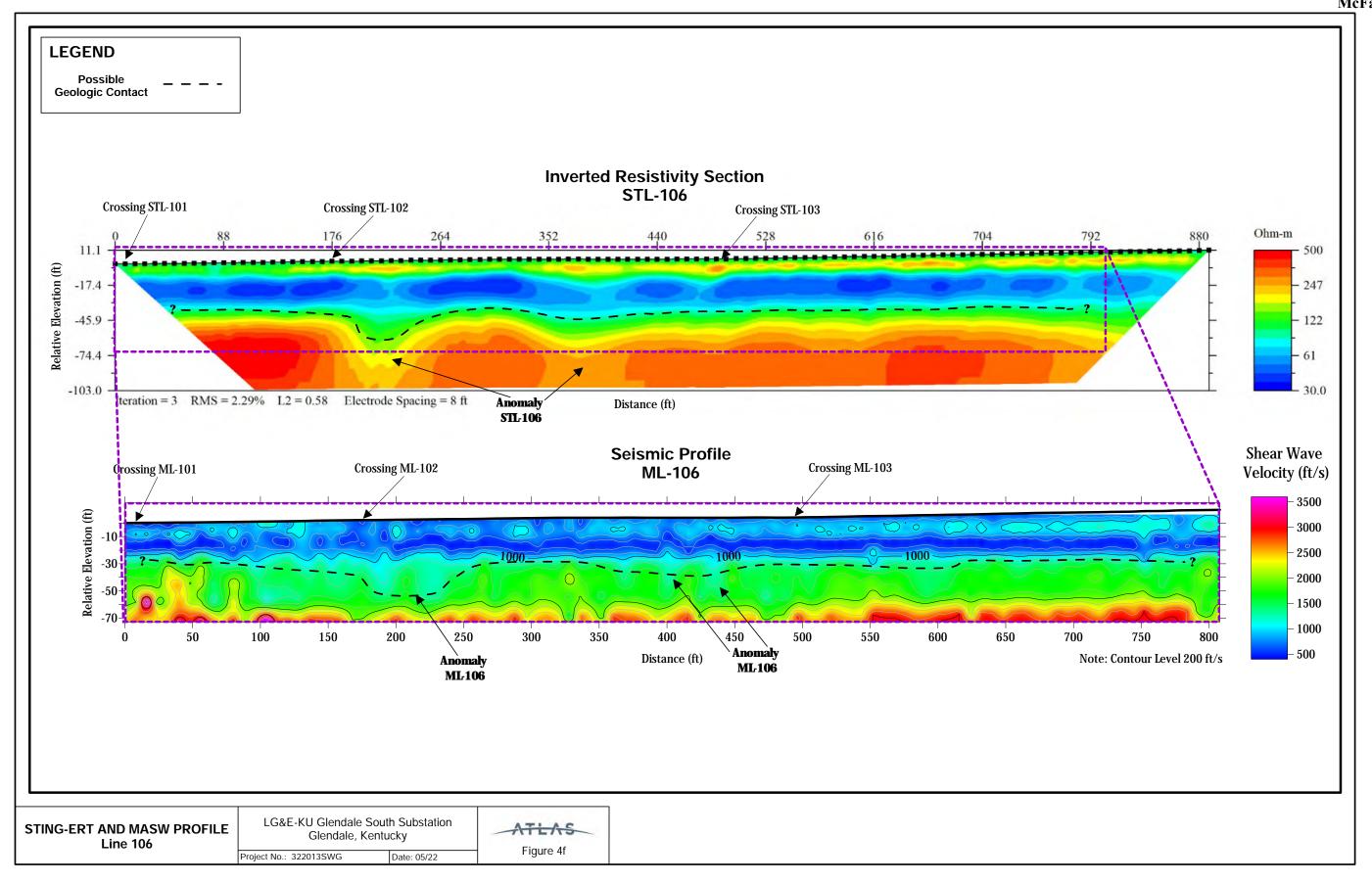


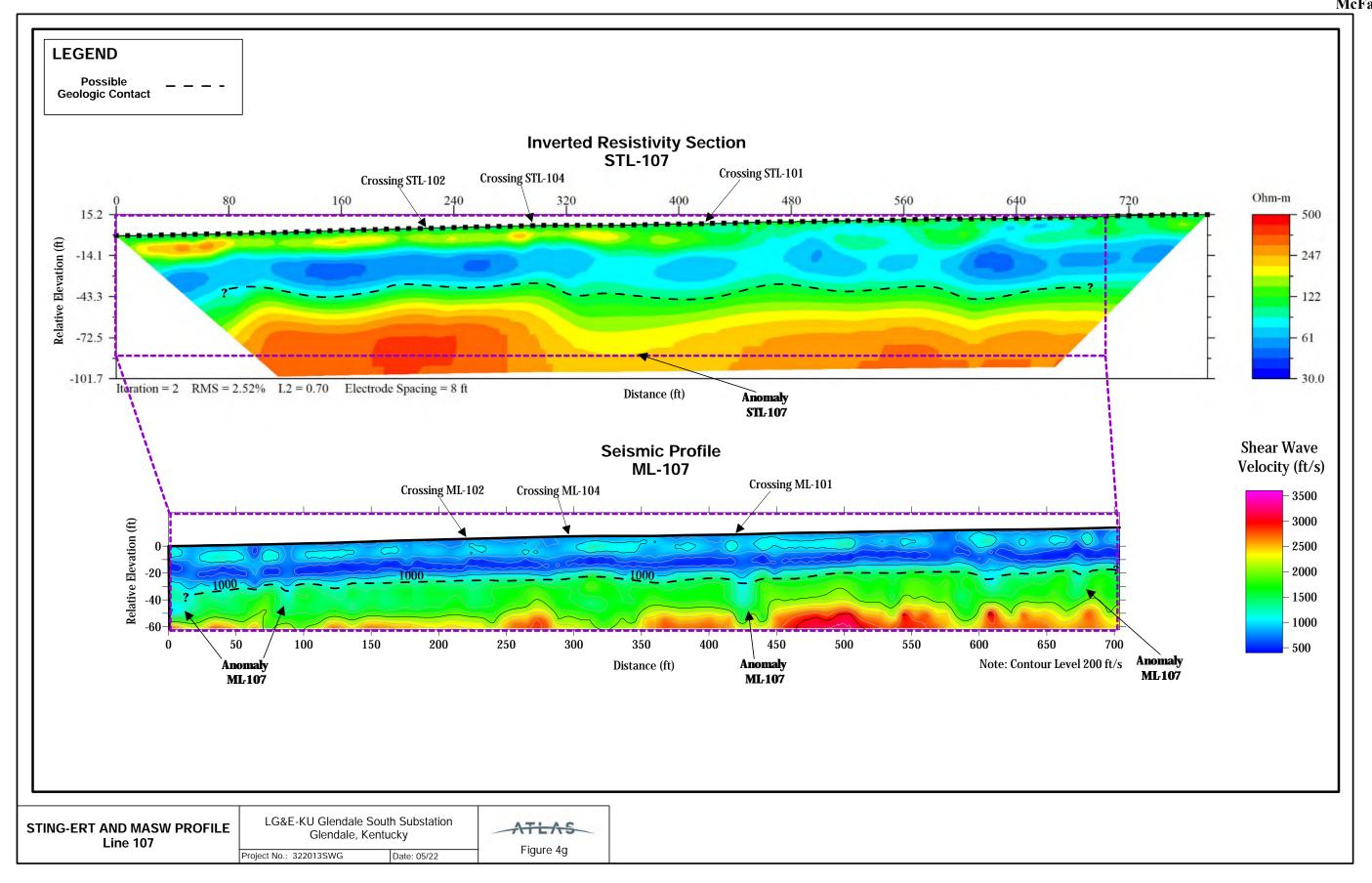


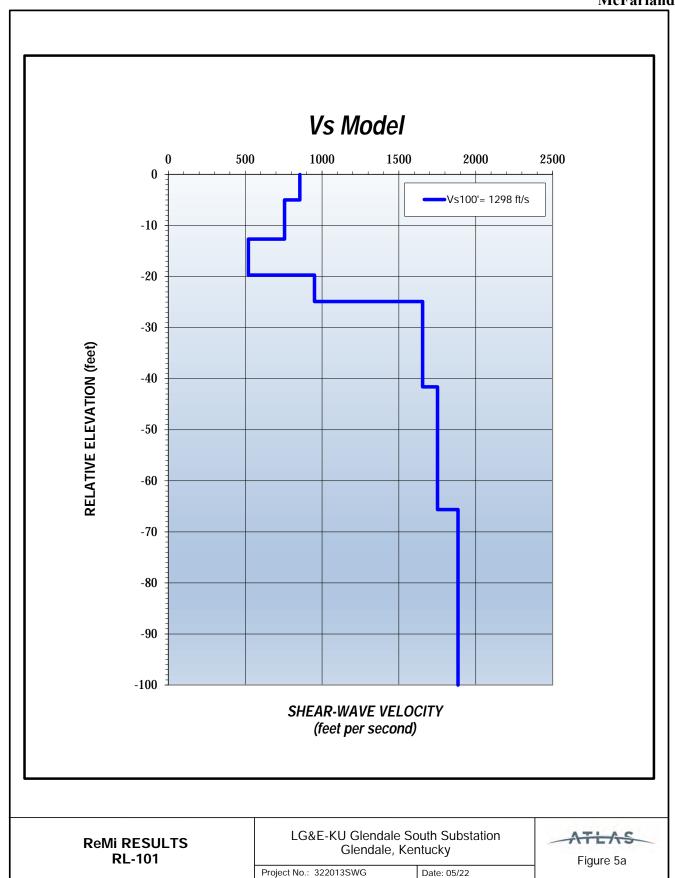


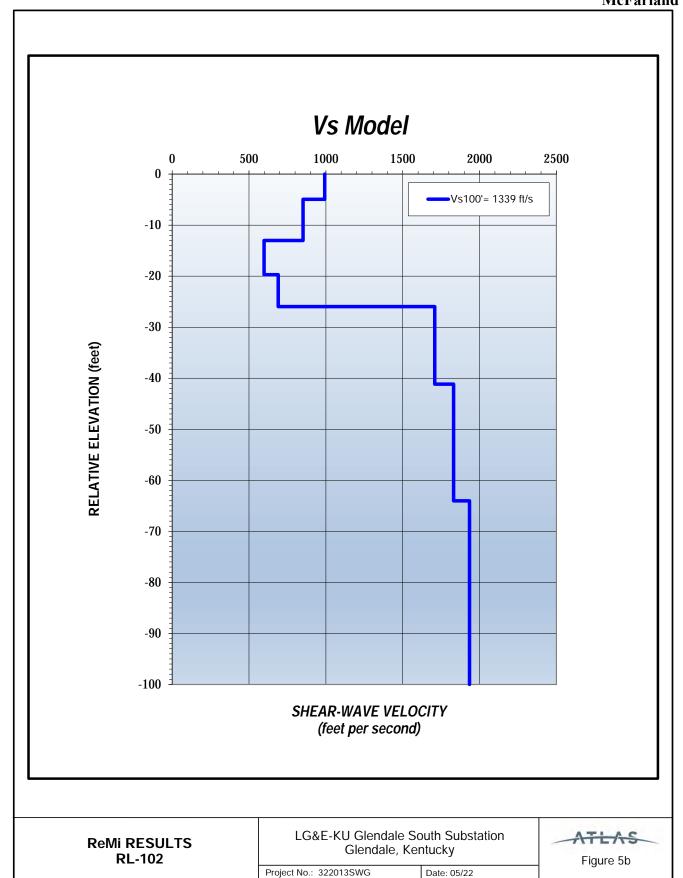


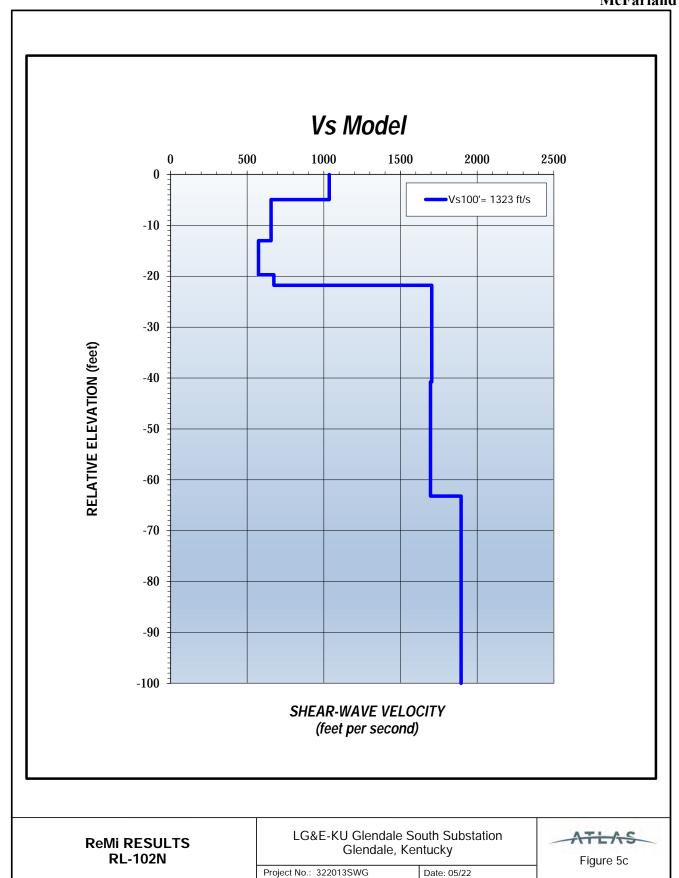


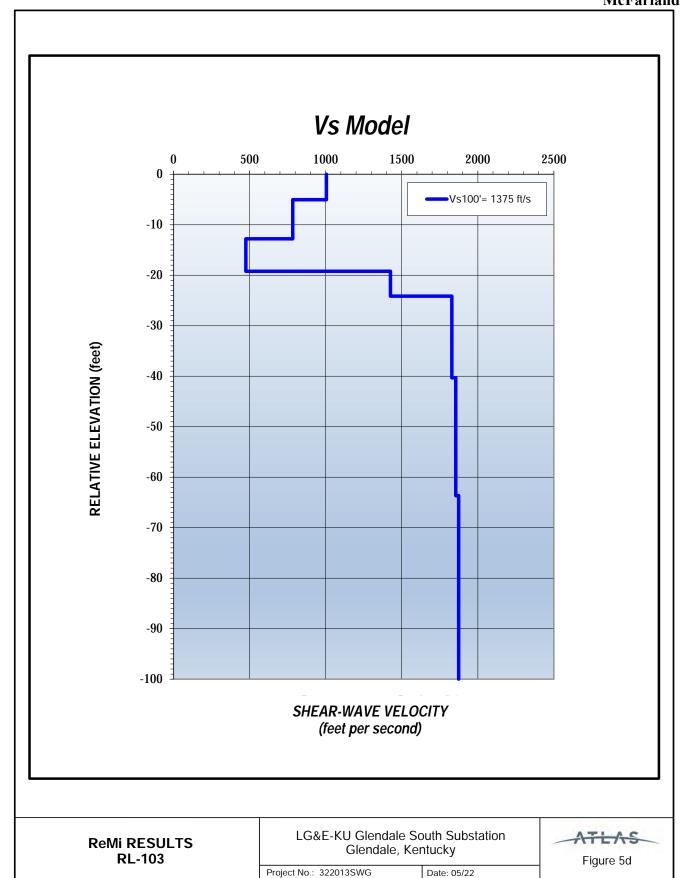


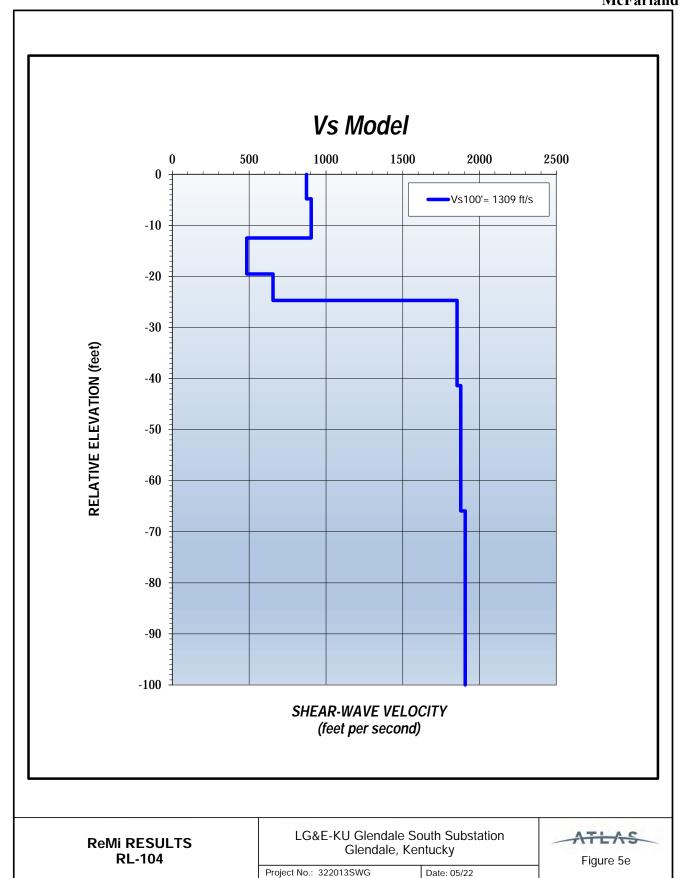


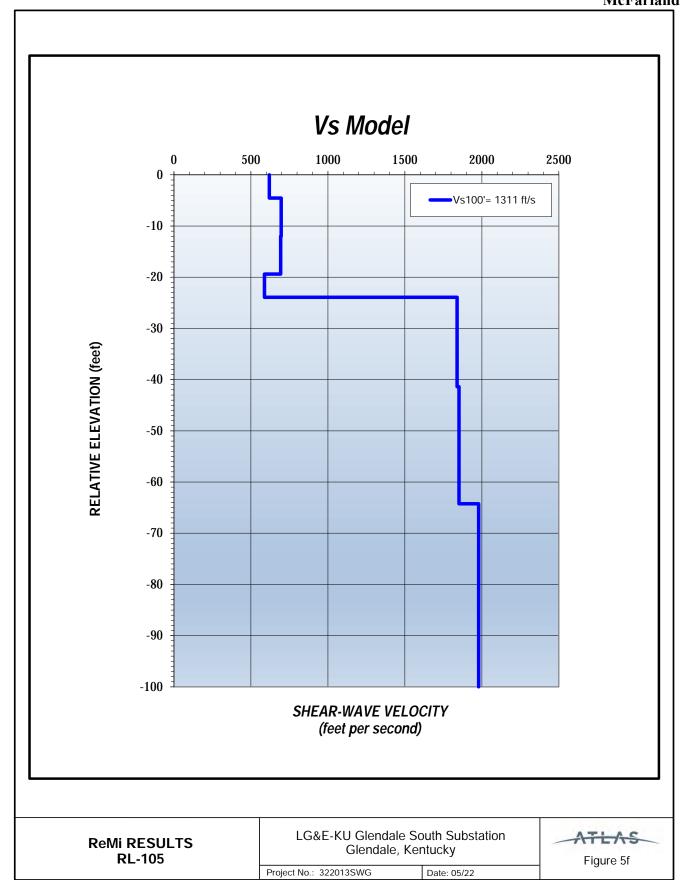


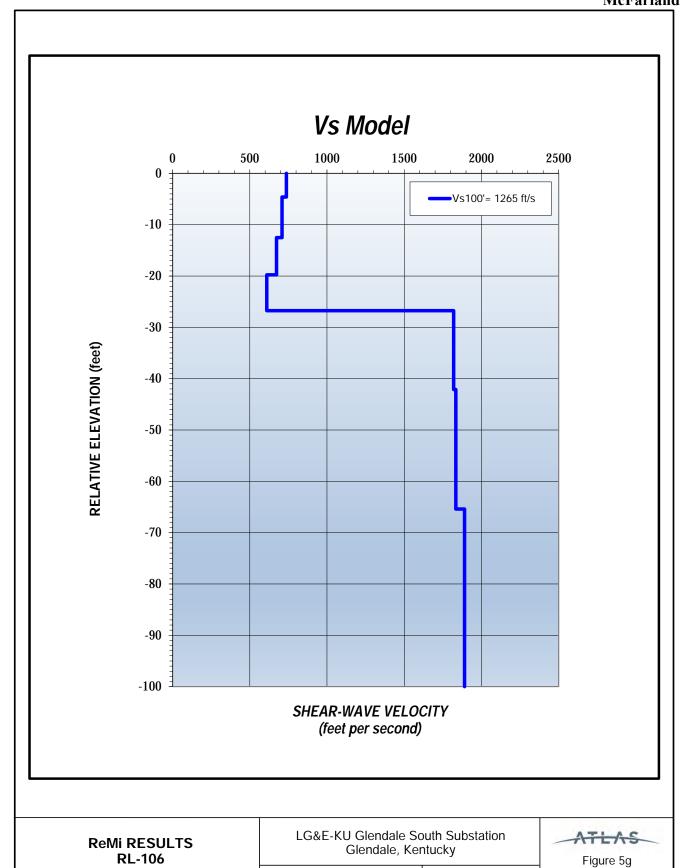












Project No.: 322013SWG

Date: 05/22



GEOPHYSICAL EVALUATION

LG&E-KU GLENDALE INDUSTRIAL SUBSTATION

Glendale, Kentucky

PREPARED FOR:

Matt Hambright, P.E. Black & Veatch 3550 Green Court Ann Arbor, MI 48105-1579

PREPARED BY:

Atlas Technical Consultants LLC 14 Sunnen Drive, Suite 143 St. Louis, MO 63143



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May 5, 2022

Atlas No. 322014SWG

Report No. 1

MR. MATT HAMBRIGHT, P.E. BLACK & VEATCH
3550 GREEN COURT
ANN ARBOR, MI 48105-1579

Subject: Geophysical Evaluation

LG&E-KU Glendale Industrial Substation Project

Glendale, Kentucky

Dear Mr. Hambright:

In accordance with your authorization, Atlas performed a geophysical evaluation pertaining to the LG&E-KU Glendale Industrial Substation Project located in Glendale, Kentucky. Specifically, our services included the performance of five high-resolution multi-electrode electrical resistivity tomography (Sting-ERT) traverses, five two-dimensional (2D) Multichannel Analysis of Surface Wave (MASW) seismic profiles, and six Refraction Microtremor (ReMi) one-dimensional (1D) profiles at preselected areas of the project site. The primary purpose of the study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock at our evaluated locations. Our services were conducted on March 21 through April 11 of 2022. This report presents the methodology, equipment used, analysis, and findings.

We appreciate the opportunity to be of service on this project. Should you have any questions related to this report, please contact the undersigned at your convenience.

Sincerely,

Atlas Technical Consultants LLC

Eric R. Carlson, EI (MO)
Project Geophysicist/Engineer

Ein Carlson

ASB/ERC/PFL/erc/ds

Distribution: hambrightm@bv.com

Patrick F. Lehrmann, P.G. (CA, OR, MO) P.Gp.(CA) Principal Geologist/Geophysicist



Figure 5c

Figure 5d

Figure 5e

Figure 5f

ReMi Results, RL-203

ReMi Results, RL-204

ReMi Results, RL-205

ReMi Results, RL-204N

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1. INTRODUCTION

In accordance with your authorization, Atlas performed a geophysical evaluation pertaining to the LG&E-KU Glendale Industrial Substation Project located in Glendale, Kentucky (Figure 1). Specifically, our services included the performance of five high-resolution multi-electrode electrical resistivity tomography (Sting-ERT) traverses, five two-dimensional (2D) Multichannel Analysis of Surface Wave (MASW) seismic profiles, and six Refraction Microtremor (ReMi) one-dimensional (1D) profiles at preselected areas of the project site. The primary purpose of the study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock at our evaluated locations. Our services were conducted on March 21 through April 11 of 2022. This report presents the methodology, equipment used, analysis, and findings.

2. SCOPE OF SERVICES

Our scope of services included the performance of five Sting-ERT, five MASW and six 1D ReMi profiles at preselected locations within the study area. Specifically, we conducted the following scope of services for the project:

- Collection of electrical resistivity data along five predetermined Sting-ERT traverses, STL-201 through STL-205 using an AGI SuperSting R8 resistivity meter and 56 stainless steel electrodes.
- Collection of 2D MASW data along five predetermined MASW traverses, ML-201 through ML-205 using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones. Compilation and geophysical analysis of the data collected.
- Collection of 1D ReMi data at six predetermined locations, RL-201 through RL-205. The ReMi data was collected using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones.
- Compilation, processing, and analysis of the data obtained.
- Preparation of this report presenting our findings and conclusions.

3. SITE AND PROJECT DESCRIPTION

The project site is located to the northeast of the intersection of Gilead Church Road and Jaggers Road in Glendale, Kentucky (Figure 1). The site consists of open farm fields with partially cut corn stalks and varied other vegetation. A small pond is located directly west of the study area.

Based on our discussions with project stakeholders, it is our understanding that the project site is in an area prone to karst features.



4. GEOPHYSICAL INSTRUMENTATION AND APPLICATIONS

Our evaluation included conducting five Sting-ERT traverses, five MASW traverses and six 1D ReMi traverses for the purpose of delineating geophysical anomalies potentially associated with karst and to estimate depth to bedrock at our evaluated locations at the project site. The methodology of each geophysical technique applied is described in more detail below.

4.1 Sting-ERT Method

An AGI SuperSting R8 electrical resistivity meter was used to conduct electrical resistivity profiles at the site to characterize the electrical properties of the subsurface. Five Sting-ERT profiles (STL-201 through STL-205) conducted along predetermined traverses are illustrated on Figure 2. Electrical current was injected into the ground through 56 stainless steel electrodes and the electric potential difference between multiple electrodes pairs was measured simultaneously. When necessary, the area around the electrodes was moistened with a relatively small amount of salt water (potable water with a small amount of added table salt, sodium chloride) to reduce the contact resistance. The data was collected using a Dipole-Dipole with Strong Gradient electrode configuration. An 8-foot electrode spacing was used for each of the Sting-ERT traverses to achieve optimal resolution and the desired depth of investigation. The Sting-ERT transects performed were acquired using a roll-along configuration, with some overlap, to achieve the desired profile lengths of 888 feet for STL-201, 776 feet for STL-202, 776 feet for STL-203, 552 feet for STL-204, and 552 feet for STL-205. Table 1 below shows the coordinates of each of the end stations for the Sting-ERT lines.

Table 1: Sting ERT Line Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.580045	-85.884607	STL-201 Station 0
37.579638	-85.881590	STL-201 Station 888
37.580498	-85.884249	STL-202 Station 0
37.578869	-85.882529	STL-202 Station 776
37.580324	-85.882980	STL-203 Station 0
37.578694	-85.881257	STL-203 Station 776
37.580174	-85.882561	STL-204 Station 0
37.579204	-85.884022	STL-204 Station 552
37.579996	-85.881333 STL-205 Station 0	
37.579024	-85.882791	STL-205 Station 552

The Sting-ERT data was processed, corrected for terrain (relative elevation) variations, and analyzed using EarthImager 2-D™ V2.1.7, a two-dimensional resistivity inversion software. The inversion results are presented in color gradient apparent resistivity models that illustrate the electrical resistivity contrasts in the subsurface materials.

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4.2 2D MASW Method

Surface waves (specifically, Rayleigh waves) recorded along lines ML-201 through ML-205 were performed at the same location and orientation as the Sting ERT profiles (Figure 2). It should be noted that due to the roll-along nature of the Sting-ERT traverses, the endpoints of the Sting-ERT lines continue further than those of the MASW traverses for Line 201, 202, and 203. Surface waves, generated by a hammer and plate (shot), were recorded using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones. The geophones were coupled to the ground surface using a Geostuff Landstreamer with geophones stationed 4 feet apart and shots conducted off the end of the lines. Prior to the collection of surface wave data, near and far field effects were evaluated for several shot offset distances at each traverse. The results indicated that the optimum offset distance for the shot point of the MASW study ranged from 40 feet to 72 feet for each traverse.

Three records, one second long, were recorded at each shot location. After each shot, the shot location and geophones were shifted 8 feet longitudinally along the profile direction and the line was reshot. The number of shots, spread length, and start and end stations are presented in Table 2. The station numbers (start and end points of the line) and their associated coordinates are shown in Table 3.

The recorded MASW data were processed using SurfSeis® (Kansas Geological Survey, 2012), a MASW software program. One dimensional (1-D) shear-wave (S-wave) velocity (Vs) profiles were generated for each shot location which represent the average condition across the length of the geophone array. Each individual 1-D profile is spatially plotted at the center of each geophone array. A two-dimensional color gradient model was then created from the 1-D models using the SurfSeis® interpolation scheme with relative elevation corrections. It should be emphasized that the 2-D profile represents the area between the midpoint of the first shot location and the midpoint of the last shot location. The actual model section length and start and end stations for the sections are also listed in Table 2.

Table 2: MASW Array Geometry

Line No.	No. of Shots	Total Spread Length (feet)	Profile Length/Start and End Stations (feet)
ML-201	106	940	848/(0-848)
ML-202	94	844	752/(0-752)
ML-203	94	844	752/(0-752)
ML-204	69	644	552/(0-552)
ML-205	69	644	552/(0-552)

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Table 3: MASW Line Coordinates (WGS 84)

Latitude	Longitude Line Number and Station	
37.580045	-85.884607	ML-201 Station 0
37.579652	-85.881726	ML-201 Station 848
37.580498	-85.884249	ML-202 Station 0
37.578920	-85.882581	ML-202 Station 752
37.580324	-85.882980 ML-203 Station 0	
37.578744	-85.881309	ML-203 Station 752
37.580174	-85.882561 ML-204 Station 0	
37.579204	-85.884022 ML-204 Station 552	
37.579996	-85.881333	ML-205 Station 0
37.579024	-85.882791	ML-205 Station 552

4.3 1D ReMi

The passive source 1-D ReMi technique uses recorded surface waves (specifically Rayleigh waves) that are contained in background noise to develop a shear-wave velocity profile of the study area down to a depth, in this case, of approximately 100 feet below existing ground surface at seven predetermined locations at the study area. The depth of exploration is dependent on the length of the line and the frequency content of the background noise. The results of the ReMi method, displayed as a one-dimensional profile, represents the average condition across the length of the line. The ReMi method does not require an increase of material velocity with depth; therefore, low velocity zones (velocity inversions) are detectable with ReMi. The mid-point locations of each ReMi traverse are detailed in Table 4.

Table 4: ReMi Mid-point Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.57994	-85.88389 RL-201	
37.57921	-85.88288 RL-202	
37.57909	-85.88168	RL-203
37.57931	-85.88384	RL-204
37.57990	-85.88295 RL-204N	
37.57970	-85.88176	RL-205

A total of 15 records, each 32 seconds in duration, were recorded for lines RL-201 through RL-205; 10 records utilizing passive data collection of ambient ground vibration noise; and 5 records utilizing an active source generated by a 20-pound sledgehammer and a HDPE plastic strike plate. The active source data gathers included conducting hammer blows approximately 30 feet off the end of the geophone array. Data collected was then downloaded to a field computer and the data were later processed using Surface Plus 9.1 - Advanced Surface Wave Processing Software (Geogiga Technology Corp., 2020), which uses the refraction microtremor method



(Louie, 2001) and other surface wave analysis methods. The program generates phase-velocity dispersion curves for each record and provides an interactive dispersion modeling tool to determine the best fitting model. The result is a 1-D shear-wave velocity model of the site with roughly 85 to 95 percent accuracy.

5. FINDINGS AND CONCLUSIONS

As previously discussed, the primary purpose of our study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock. Our study utilized Sting-ERT, MASW and ReMi methods. Figures 2 and 3 present the approximate location of our traverses and the general conditions at the study areas, respectively.

Figures 4a through 4e depict the results from the Sting-ERT and MASW lines STL-201 through STL-205 and ML-201 through ML-205, respectively. The figures are presented in color gradient form with warm colors (red) representing relatively higher resistivity/shear wave velocity for the ERT/MASW, respectively. The cool colors (blue) representing relatively higher conductivity and lower shear wave velocity, respectively. The measured contact resistance (resistances between the electrode and the adjacent soil) along our transects were very low which resulted in good quality data and repeatable results for the ERT data. The presence of corn stalks in the fields coupled with days of high winds presented some challenges in the collection of the MASW data; however, overall data quality (dispersion curves) for the MASW data was good. In general, our Sting-ERT profiles illustrate layers of somewhat resistive materials in the very near-surface, then several layers of relatively conductive materials, and more resistive materials at depth. Conductive and resistive pockets are also evident in the data.

Please note the 2D MASW seismic models depicted on the figures start at the mid-point of the first geophone array and terminate at the mid-point of the last geophone array. As illustrated in Figures 4a through 4e, the models regularly depict a thin horizon of relatively high velocity material in the near surface, underlain by relatively low velocity material, and higher velocity materials with increasing depth.

The shear wave velocity results and ERT results are relatively consistent, with some localized lateral and vertical variations in shear wave velocity and resistivity values. The responses observed between approximately 30 to 40 feet below existing ground surface are consistent with the typical the contrast in physical properties observed between soil and weathered bedrock/bedrock.

Also noted on Figures 4a through 4e are numerous anomaly locations on both the Sting-ERT and MASW profiles. Often, karst features have a combination of higher and/or lower resistive zones (depending on the saturation of the soils/rock) coupled with a lower velocity zone. Several anomaly locations noted along the profiles have both resistivity anomalies and lower velocity anomalies which can be consistent with karst. Additional anomalies on either the Sting-ERT or the MASW profiles are noted which could also be associated with karst.

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As discussed, the purpose of our ReMi study was to develop 1D shear-wave velocity profiles to be used for design and construction at the study site. Table 5 and Figures 5a through 5f present the results from our ReMi evaluation. It should be noted that when the 1-D ReMi surface wave velocity results (analogous to shear wave) show an IBC Vs100 velocity value that is close to the "border line" boundary between two IBC Vs100 Site Classes, the project geotechnical engineering consultant of record should be consulted regarding existing available site information and whether obtaining additional new geotechnical evaluation data such as boreholes, surface to downhole seismic (ASTM D7400), cross hole seismic (ASTM D4428), and/or additional 1-D ReMi data collections would be advisable. The project geotechnical engineering consultant of record may wish to consider the subsurface geologic stratigraphy and structure, soil mechanics, and soil modulus, along with the initial 1D ReMi results when assessing a "borderline" IBC Vs100 Seismic Site Class and whether additional geophysical or geotechnical evaluations are needed.

Table 5: ReMi Vs 100' Results

Line Number (Orientation)	Depth (ft)	Shear-Wave Velocity (feet/second)	Average Shear-Wave Velocity (Vs100)	Site Class (IBC, 2019)	
	0-5	776			
	5-15	1,001			
	15-24	703			
RL-201	24-32	745	1,279 ft/s	С	
(W-E)	32-50	1,744	1,279 108	C	
	50-67	1,776			
	67-86	1,808			
	86-100	1,818			
	0-4	539			
	4-16	915			
	16-25	1,031	1,283 ft/s		
RL-202	25-33	760		С	
(SE-NW)	33-50	1,721		C	
	50-67	1,760			
	67-86	1,792			
	86-100	1,818			
	0-4	563			
	4-15	921			
	15-23	718			
RL-203	23-29	815	1,301 ft/s	С	
(SE-NW)	29-50	1,721	1,301108		
	50-67	1,786			
	67-86	1,836			
	86-100	1,850			

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Line Number (Orientation)	Depth (ft)	Shear-Wave Velocity (feet/second)	Average Shear-Wave Velocity (Vs100)	Site Class (IBC, 2019)	
	0-4	969			
	4-15	1,154			
	15-18	711			
RL-204	18-28	602	1 250 ft/o	С	
(SW-NE)	28-50	1,778	1,352 ft/s	C	
	50-67	1,824			
	67-86	1,857			
	86-100	1,864		l	
	0-4	832		С	
	4-16	999			
	16-19	751			
RL-204N	19-30	636	1,317 ft/s		
(SW-NE)	30-50	1,760	1,317 145		
	50-67 1,83	1,832			
	67-86	1,864			
	66-100	1,920			
	0-4	515			
	4-15	959			
	15-19	759			
RL-205	19-29	712	1 204 ft/a	С	
(SW-NE)	29-50	1,800	1,284 ft/s		
	50-67	1,784			
	67-86	1,832			
	86-100	1,856			

6. LIMITATIONS

The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, express or implied, is made regarding the conclusions and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request.

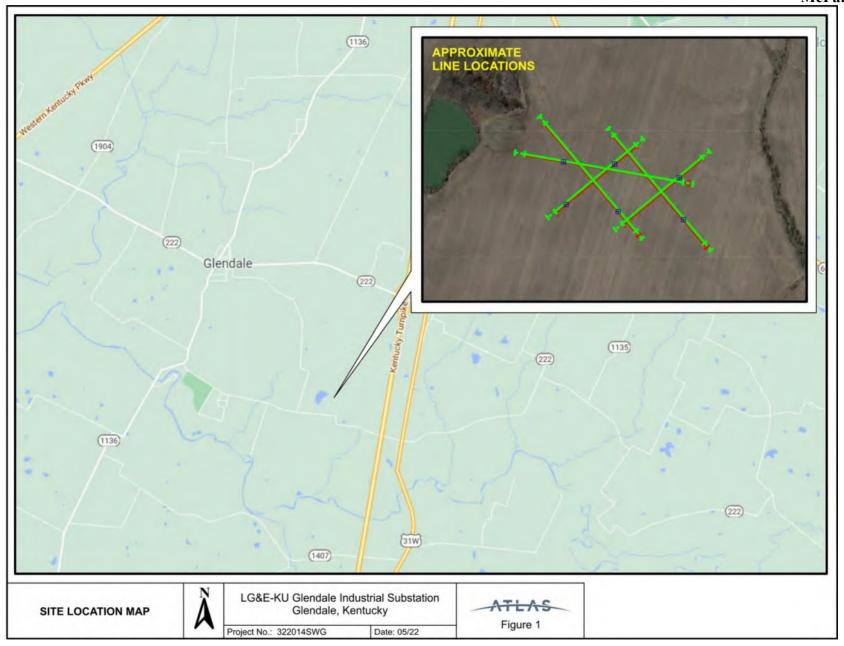
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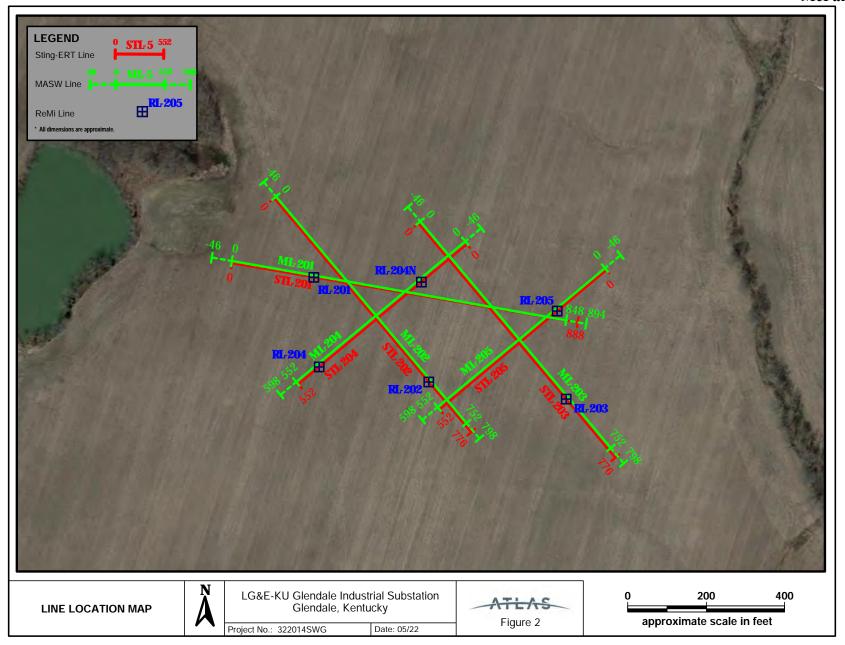


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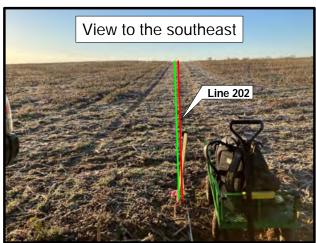
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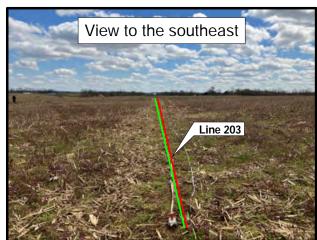
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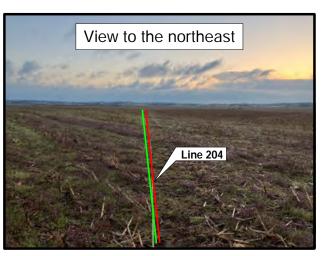


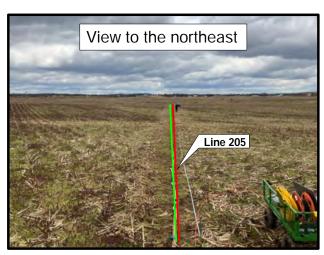












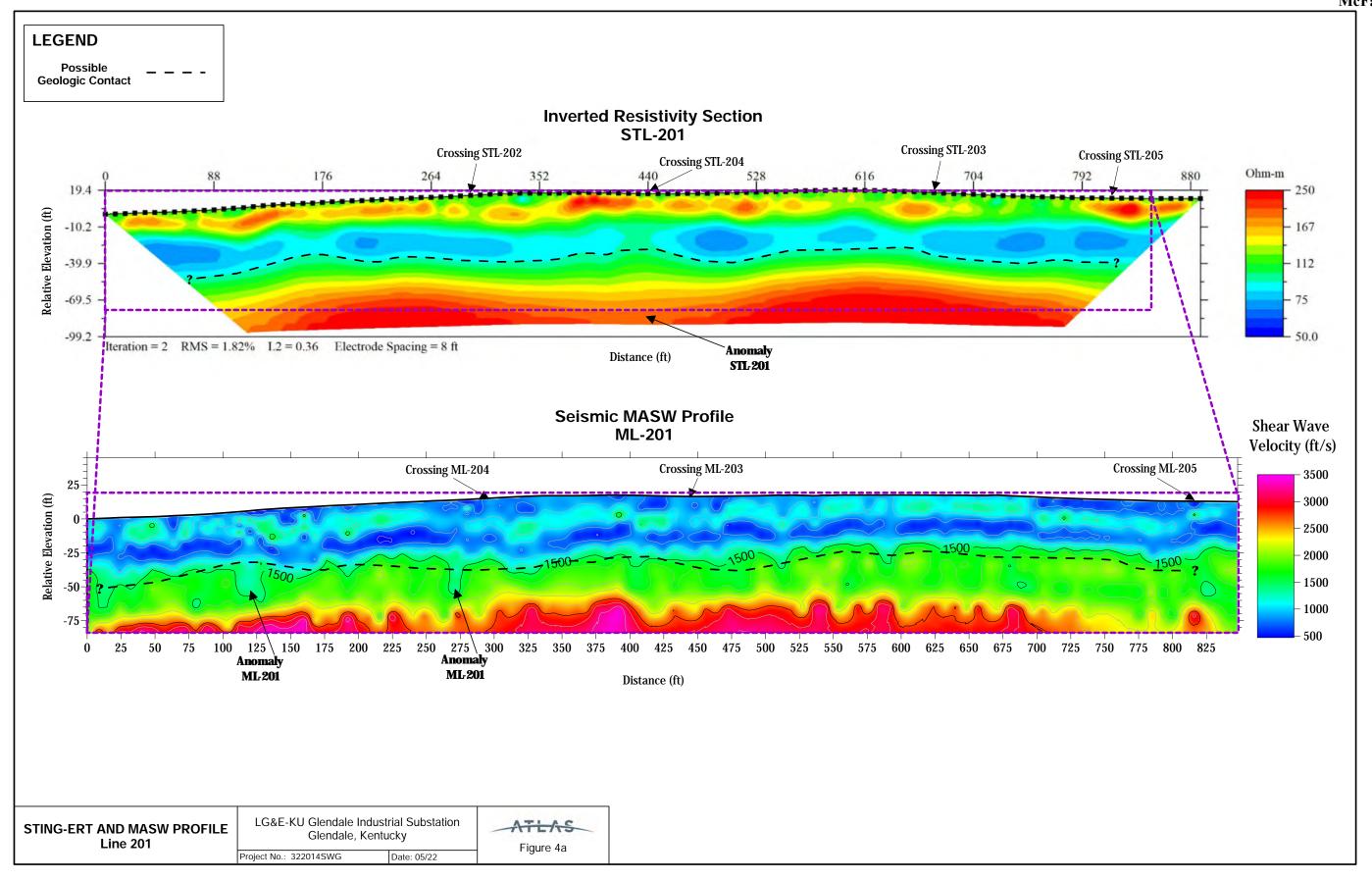
SITE PHOTOGRAPHS

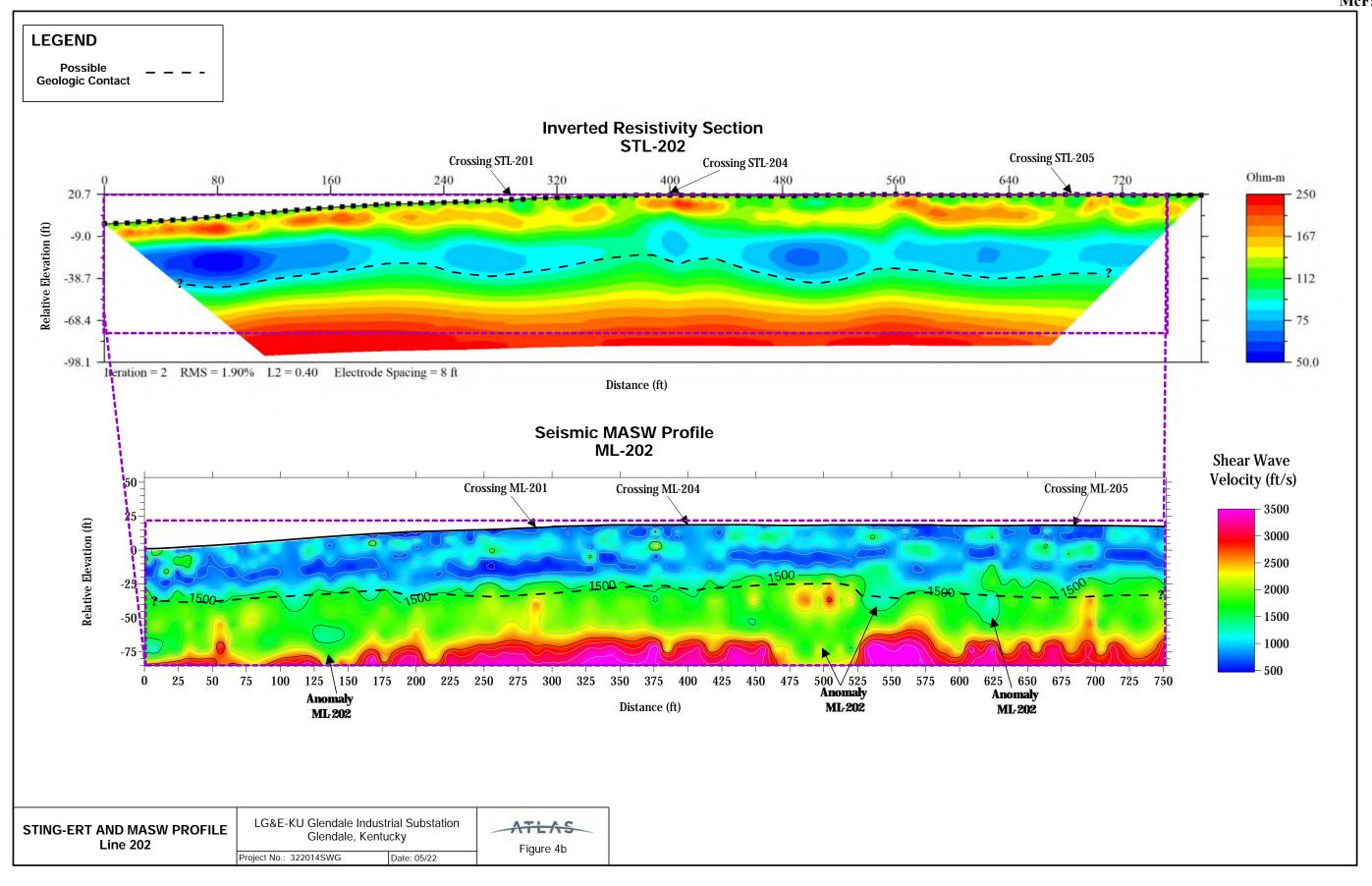
LG&E-KU Glendale Industrial Substation Glendale, Kentucky

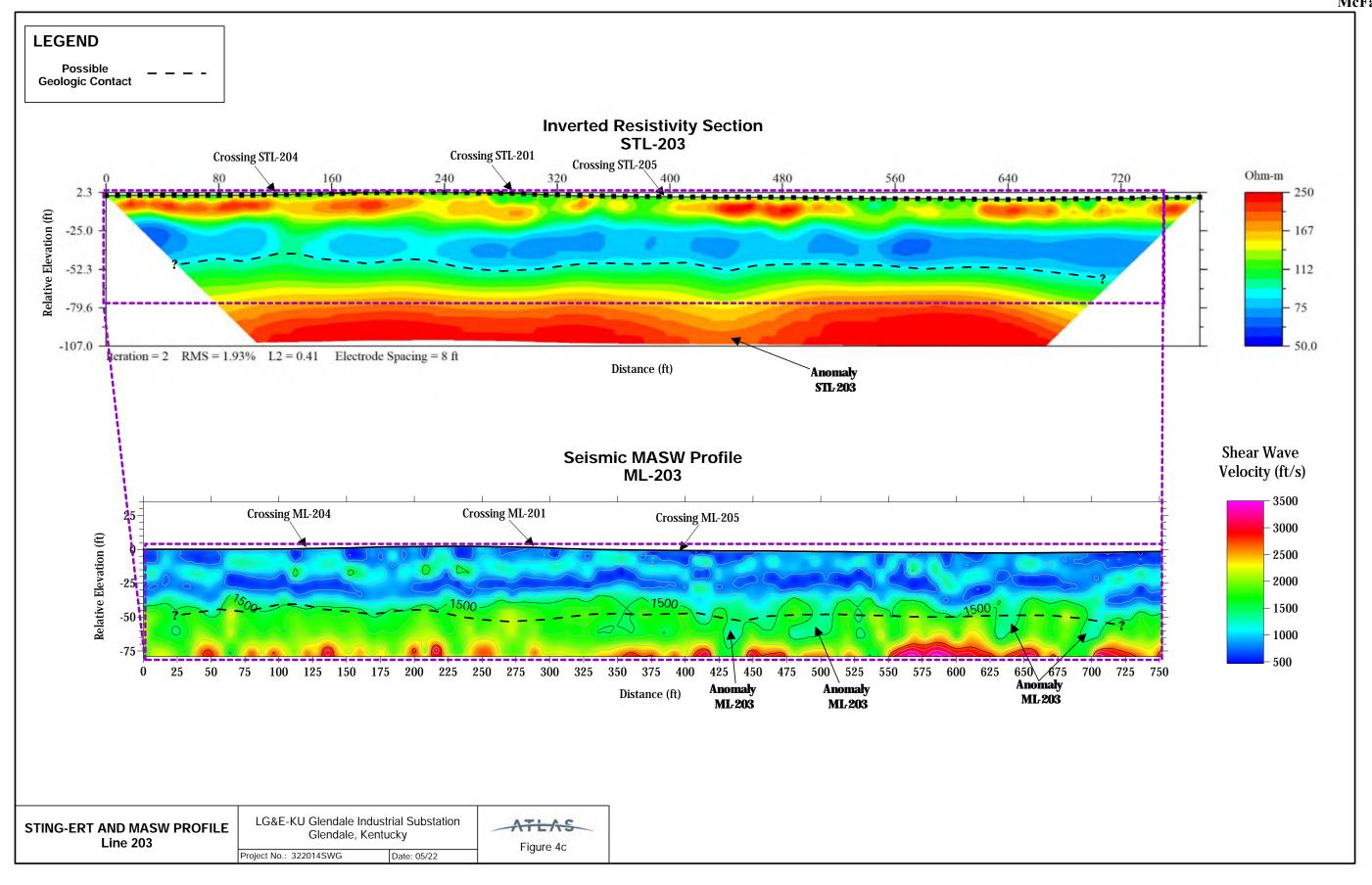
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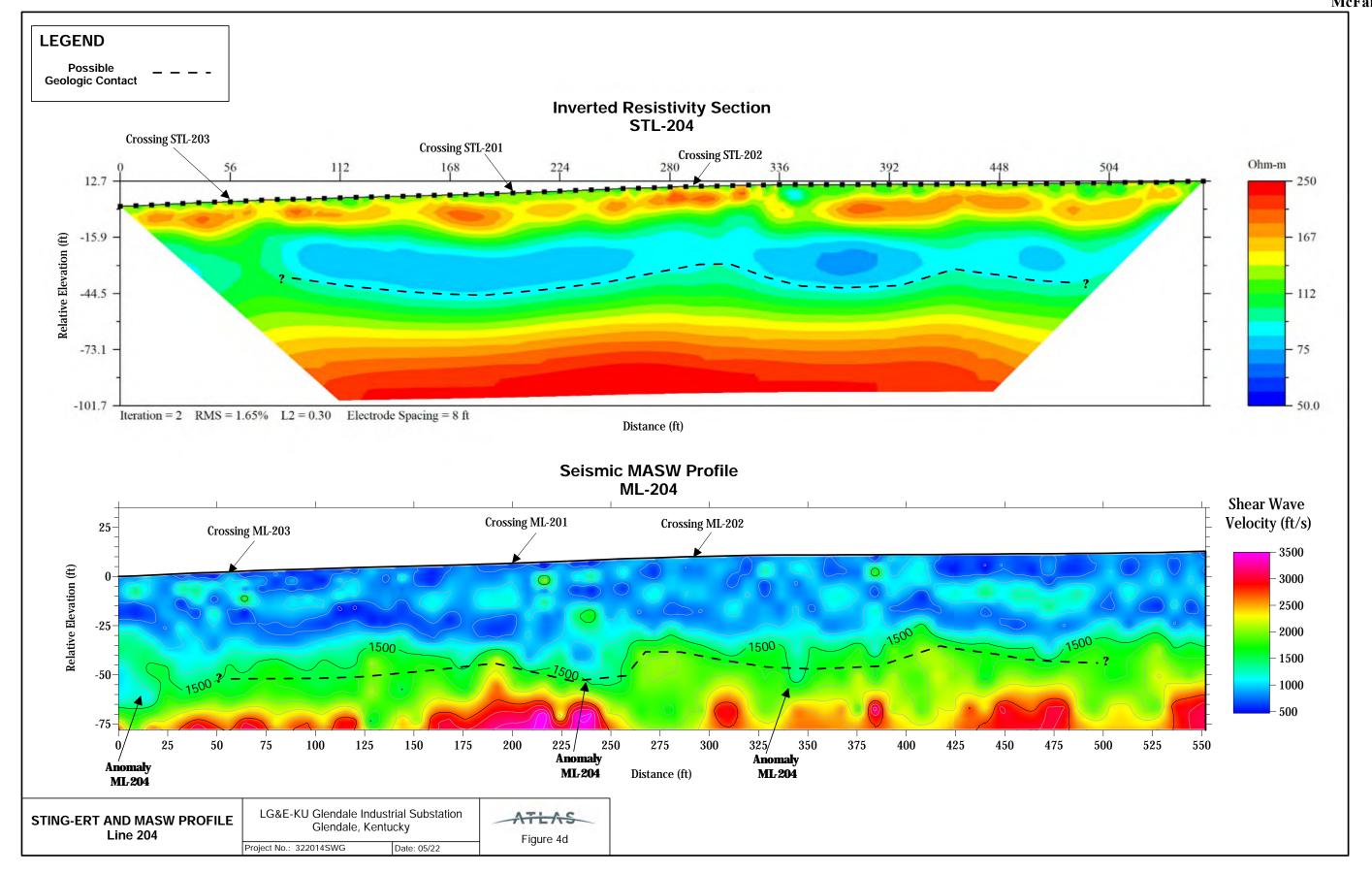
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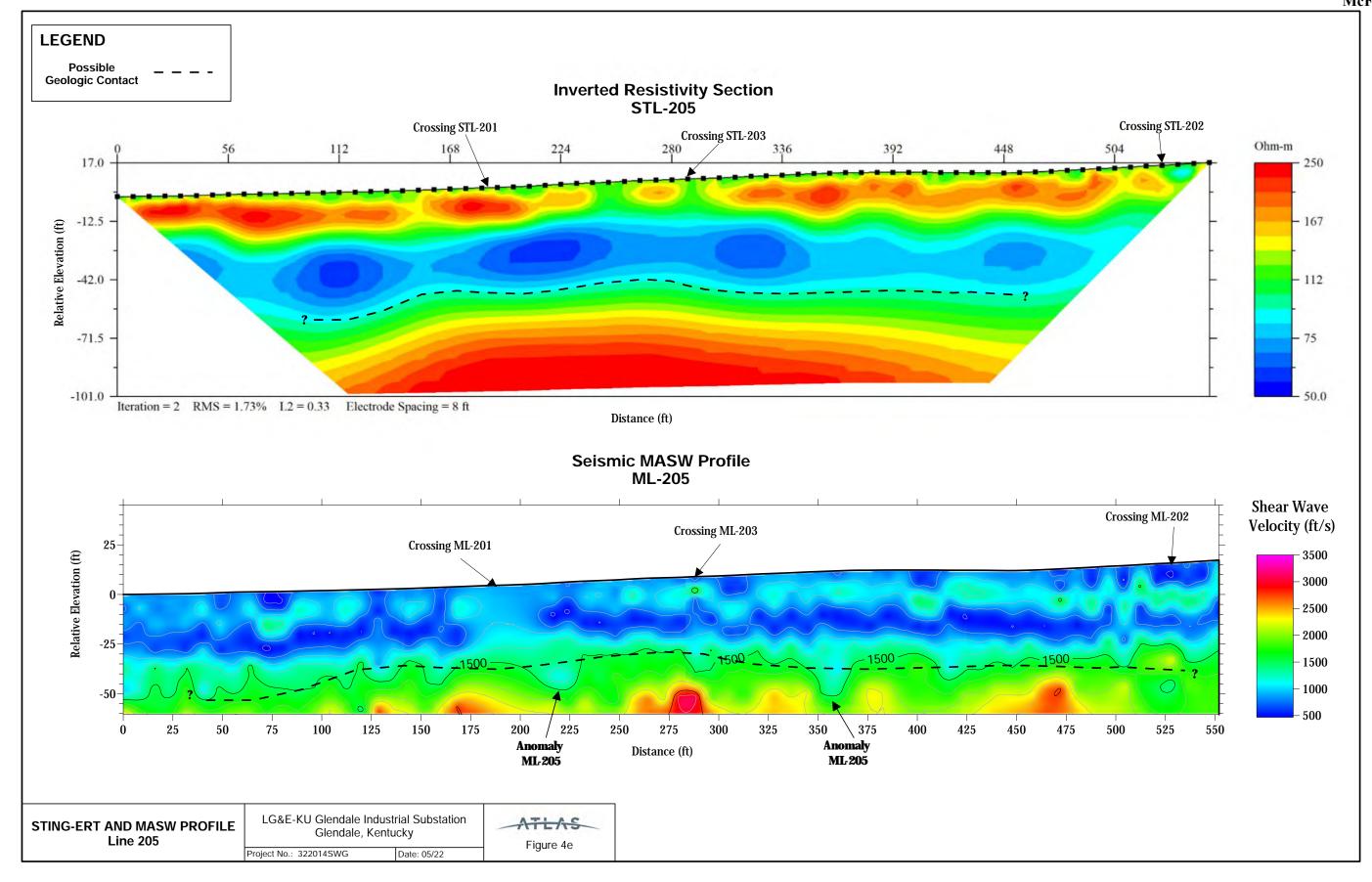


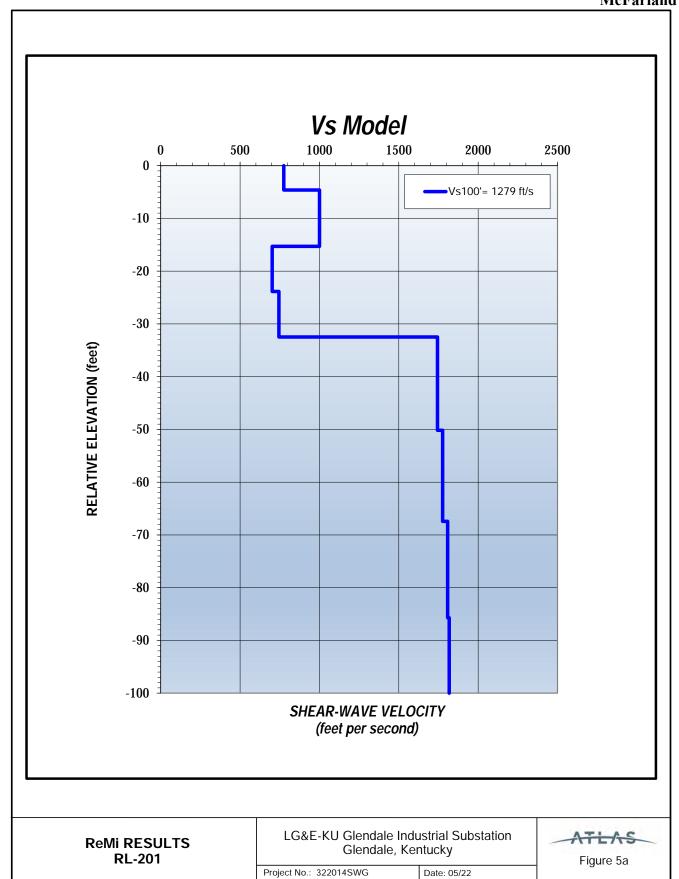


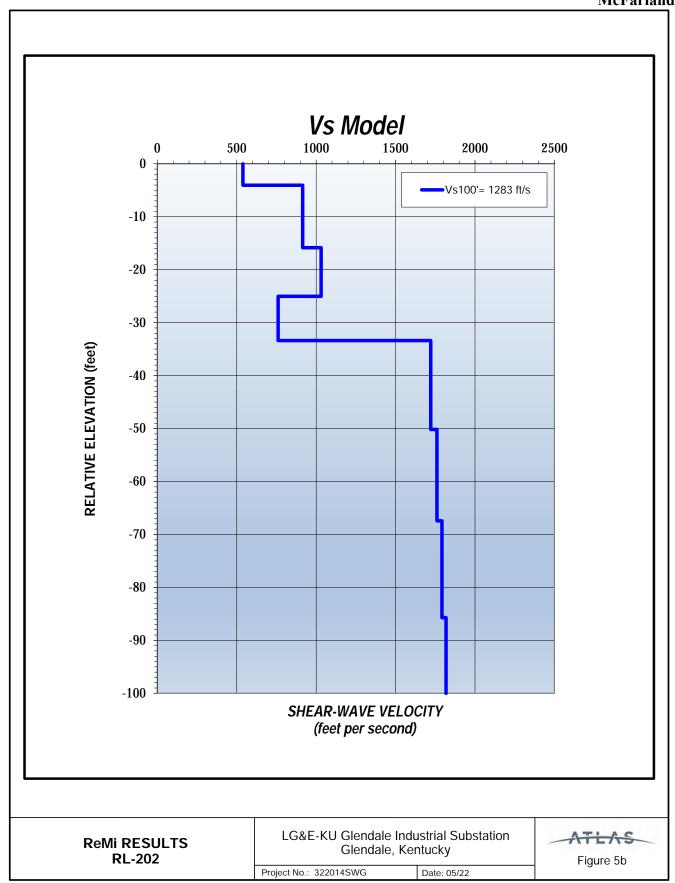


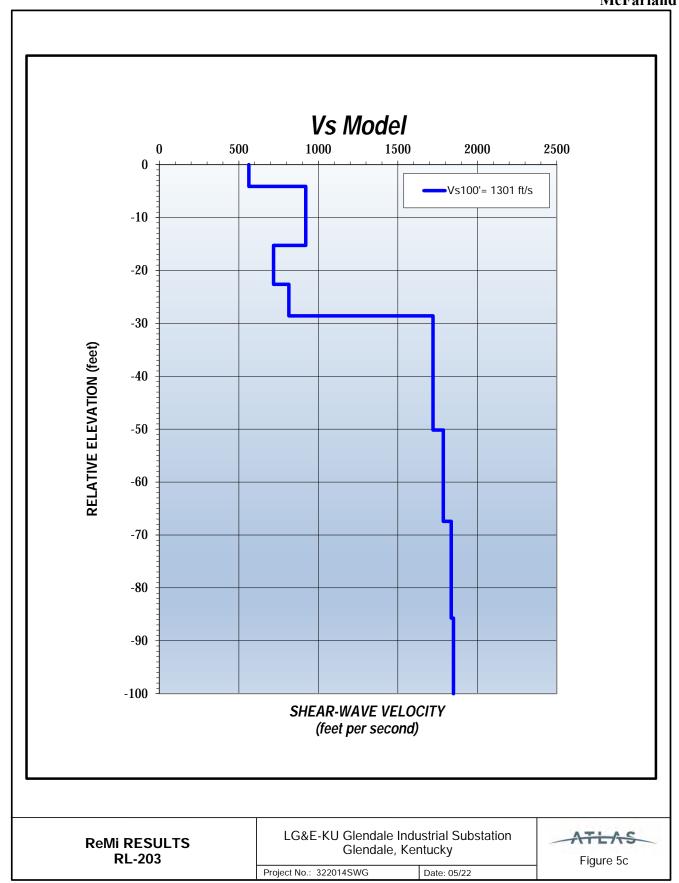


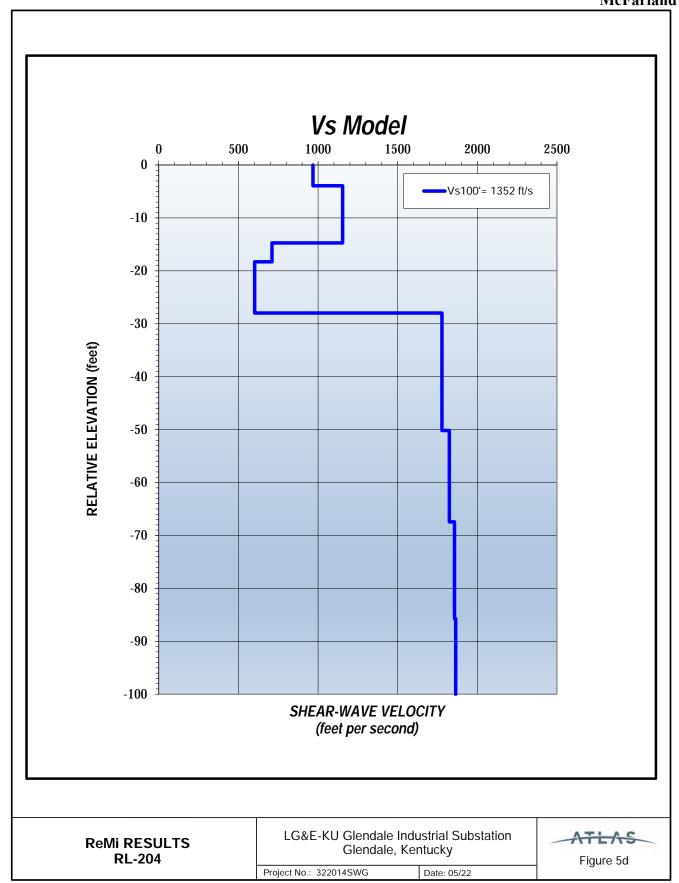


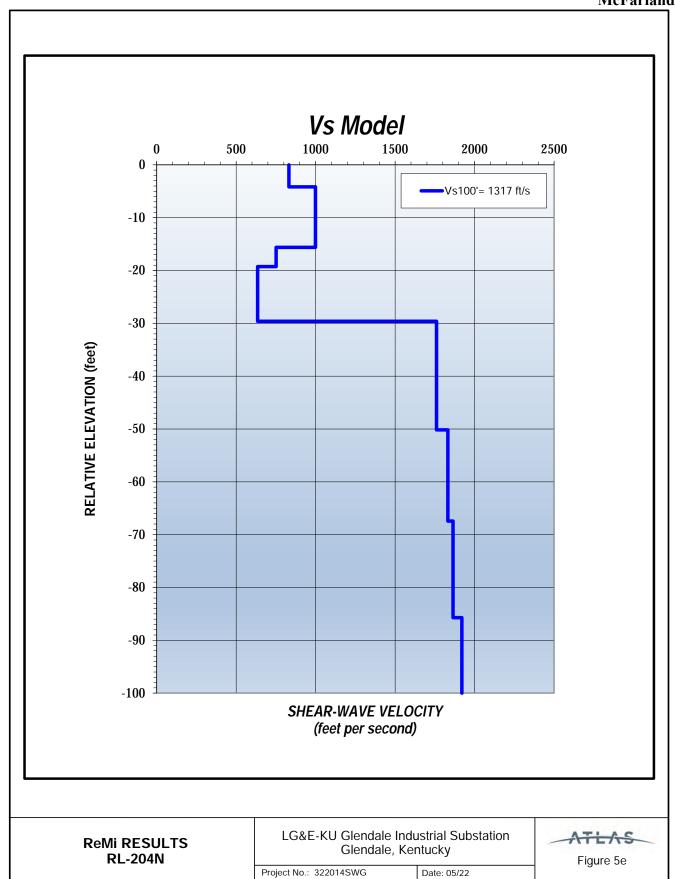


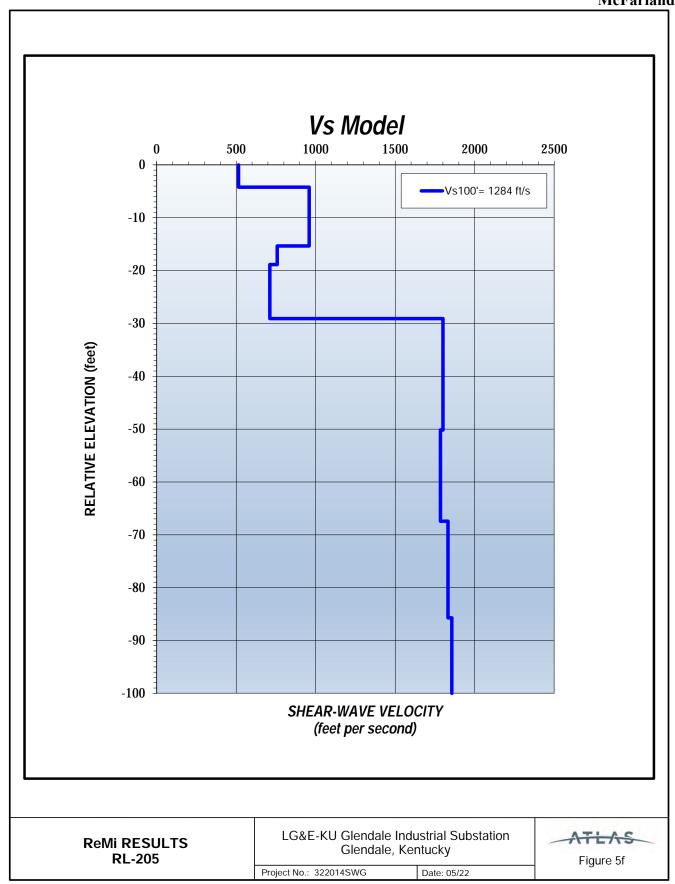














May 3, 2022

RE:



LG&E and KU One Quality Street Lexington, KY 40507

> Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 1E Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East project in Glendale, KY. This summary is provided for Structure 1E, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2								
Churchan	Churchina Heigh		Structure Height Centerl		Centerline	Structure 0	Trans.	Long.
Structure Number	Description	(ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)	
1E	Double Circuit	75	709.9	37°35′43.55″N	85°54′8.56″W	3,168	2,132	

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 43 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of ten inches. Beneath the surface material, lean clay and fat clay were encountered to the auger refusal depth. The lean clay was typically described as yellowish brown in color, moist and stiff in soil strength consistency. The fat clay was described as reddish brown to light brown

in color, containing varying amounts of gravel, moist to saturated and medium stiff to very stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 1E - Summary of Boring

			Surface	Auge	r Refusal
Hole			Elevation	Depth	Elevation
No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 1E	37°35′43.55″N	85°54′8.56″W	707.8	42.9	664.9

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 1E	CL	5.0-14.0	1.7	1.0
STR 1E	СН	14.0-33.0	1.5	0.8
STR 1E	CH	33.0-42.9	1.5	0.8

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial East Structure 1E

May 3, 2022 Page **3** of **3**

Structure	Depth		Estimated Strain	Initial Soil		
Number	Lithology	(feet)	at 50% Stress	Stiffness		
Number			(ε ₅₀)	(k _{py}) (pci)		
STR 1E	CL	5.0-14.0	0.01	200		
STR 1E	СН	14.0-33.0	0.01	200		
STR 1E	СН	33.0-42.9	0.007	200		

5.2 Axial Design Parameters — Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 1E	CL	5.0-14.0	125.0	1.7	0.9
STR 1E	СН	14.0-33.0	120.0	1.5	1.0
STR 1E	CH	33.0-42.9	57.6	1.5	1.0

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS. INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP

Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





Attachment 3 to Response to PSC-4 Question No. 1
Page 5 of 592
McFarland

APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

SPT N-VALUE	Qu/Qp (tsf)	PLASTI	PLASTICITY			
2 blows/ft or less	0 - 0.25	Degree of	Plasticity			
2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)			
4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7			
8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22			
15 to 30 blows/ft	2.00 - 4.00	High	over 22			
30 blows/ft or more	> 4.00	-				
	2 blows/ft or less 2 to 4 blows/ft 4 to 8 blows/ft 8 to 15 blows/ft 15 to 30 blows/ft	2 blows/ft or less 0 – 0.25 2 to 4 blows/ft 0.25 – 0.49 4 to 8 blows/ft 0.50 – 0.99 8 to 15 blows/ft 1.00 – 2.00 15 to 30 blows/ft 2.00 – 4.00	2 blows/ft or less 0 - 0.25 Degree of 2 to 4 blows/ft 0.25 - 0.49 Plasticity 4 to 8 blows/ft 0.50 - 0.99 Low 8 to 15 blows/ft 1.00 - 2.00 Medium 15 to 30 blows/ft 2.00 - 4.00 High			

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

<u>DENSITY</u>	SPT N-VALUE	PARTICLE SIZE IDENTIFICATION		
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more	
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter	
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch	
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch	
Very Dense	50 blows/ft or more		Fine − ¼ to ½ inch	
·		Sand	Coarse – 0.6mm to ¼ inch	
RELATIVE PROPO	RTIONS		Medium – 0.2mm to 0.6mm	
Descriptive Term	Percent			
Trace	1 - 10		Fine -0.05 mm to 0.2 mm	
Trace to Some	11 - 20			
Some	21 – 35	Silt	0.05mm to 0.005mm	
And	36 - 50			
		Clay	0.005mm	

NOTES

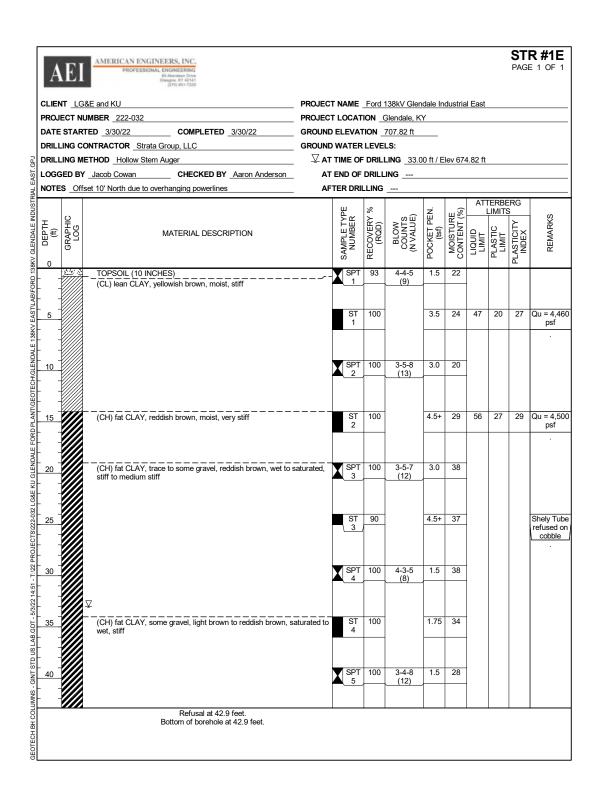
 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted.}$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

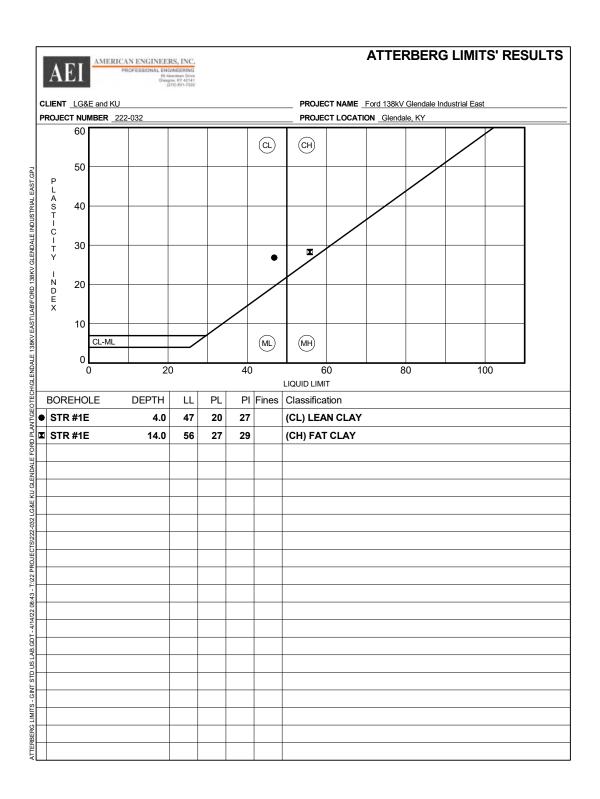
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APPENDIX C

Laboratory Testing Results

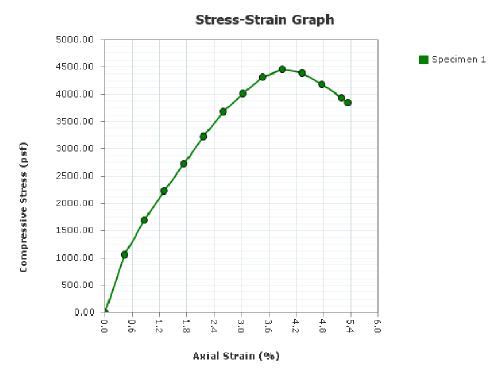




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 1
Sample Depth: 4.0-6.0 ft
Boring Number: STR 1E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/12/2022

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Checked By: ______ Date: ____

Report Created: 4/14/2022

Test Date: 4/12/2022

Unconfined Compression Test

ASTM D2166								
	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)	i							
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	i							
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	3.90				<u> </u>		!	
Specific Gravity: 2.72	Pla	stic Limit:	20		I	iquid Lim	it: 47	
Type: UD	Soil Clas	ssification:	CL					
Project: Ford 138kV Glendale Ind	ustrial East	t						
Project Number: 222-032								
Sampling Date: 4/12/2022								
Sample Number: ST 1								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 1E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 ailure Sket		rimen 6 re Sketch	Specime Failure Sl		ecimen 8 ure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: _____

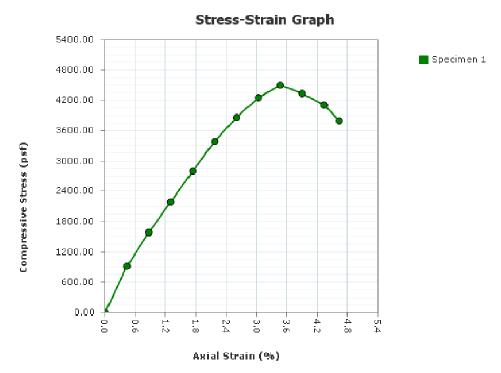
____ Date: __

Report Created: 4/14/2022 2

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 2
Sample Depth: 14.0-16.0 ft
Boring Number: STR 1E
Location: Glendale KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/12/2022

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Checked By: ______ Date: _____

Report Created: 4/14/2022

Unconfined Compression Test

ASTM D2166								
			S	pecimer	n Numbe	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	29.2							
Wet Density (pcf)	121.4							
Dry Density (pcf)	94.0							
Saturation (%):	98.4							
Void Ratio:	0.807							
Height (in)	5.7700							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	3.47							
Specific Gravity: 2.72	Pla	stic Limit:	27		I	iquid Limi	it: 56	
Type: UD		ssification:			-	orquia ziiii	00	
Project: Ford 138kV Glendale Ind	ustrial East	İ						
Project Number: 222-032								
Sampling Date: 4/12/2022								
Sample Number: ST 2								
Sample Depth: 14.0-16.0 ft								
Boring Number: STR 1E								
Location: Glendale KY Client Name: LG&E and KU								
Remarks:								
TOTALINO.								
Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen !	5 Spec	imen 6	Specime	n 7 Sp	ecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S	ketch F	ailure Sket	ch Failur	e Sketch	Failure Sk	etch Fail	ure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 4/12/2022 Checked By: _____ Date: _____

Report Created: 4/14/2022 2

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 3, 2022



One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 2E Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East project in Glendale, KY. This summary is provided for Structure 2E, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure	Structure	Height	Centerline	Structure Coordinates		Trans.	Long.
Number	Description	(ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
2E	Double Circuit	80	704.7	37°35′40.77″N	85°54′8.42″W	6,740	1,582

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 53 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of eight inches. Beneath the surface material, lean clay was encountered to a depth of nine feet. Fat clay was encountered from nine feet to the auger refusal depth. The lean clay was typically described as brown in color, moist and medium stiff to very stiff in soil strength

consistency. The fat clay was described as reddish brown to yellowish brown in color, containing trace to some gravel and trace amounts of sand, moist to saturated and medium stiff to stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 2E - Summary of Boring

			Surface	Auge	r Refusal
Hole			Elevation	Depth	Elevation
No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 2E	37°35′40.77″N	85°54′8.42″W	702.1	52.5	649.6

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

	142.00.1111.712 0001			
Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 2E	CL	5.0-9.0	1.8	1.0
STR 2E	CH	9.0-34.0	1.3	0.8
STR 2E	CH	34.0-52.5	0.8	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 5 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial East Structure 2E

May 3, 2022 Page **3** of **3**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

IUDI	C -1. L 1 IIC 30II I	ulullictel 3 i	or Design or Drinea	Jiidits
Structure		Depth	Estimated Strain	Initial Soil
Number	Soil Type	(feet)	at 50% Stress	Stiffness
Number			(ε ₅₀)	(k _{py}) (pci)
STR 2E	CL	5.0-9.0	0.02	200
STR 2E	CH	9.0-34.0	0.01	200
STR 2E	СН	34.0-52.5	0.02	

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 2E	CL	5.0-9.0	125.0	1.8	0.9
STR 2E	СН	9.0-34.0	120.0	1.3	1.0
STR 2E	СН	34.0-52.5	57.6	0.8	0.9

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- · Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Logs



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
2 blows/ft or less	0 - 0.25	Degree of	Plasticity
2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
15 to 30 blows/ft	2.00 - 4.00	High	over 22
30 blows/ft or more	> 4.00		
	2 blows/ft or less 2 to 4 blows/ft 4 to 8 blows/ft 8 to 15 blows/ft 15 to 30 blows/ft	2 blows/ft or less 0 - 0.25 2 to 4 blows/ft 0.25 - 0.49 4 to 8 blows/ft 0.50 - 0.99 8 to 15 blows/ft 1.00 - 2.00 15 to 30 blows/ft 2.00 - 4.00	2 blows/ft or less 0 - 0.25 Degree of 2 to 4 blows/ft 0.25 - 0.49 Plasticity 4 to 8 blows/ft 0.50 - 0.99 Low 8 to 15 blows/ft 1.00 - 2.00 Medium 15 to 30 blows/ft 2.00 - 4.00 High

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	<u>ORTIONS</u>		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm
		2	

NOTES

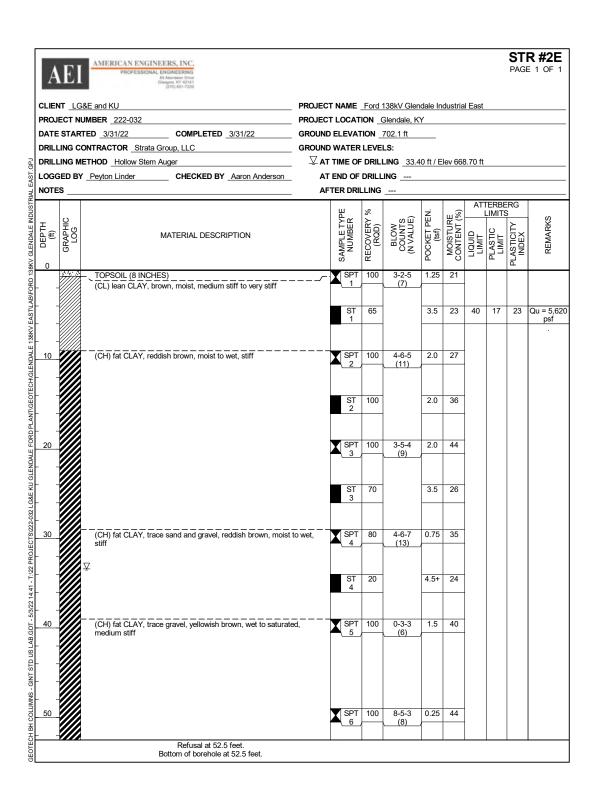
 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted.}$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

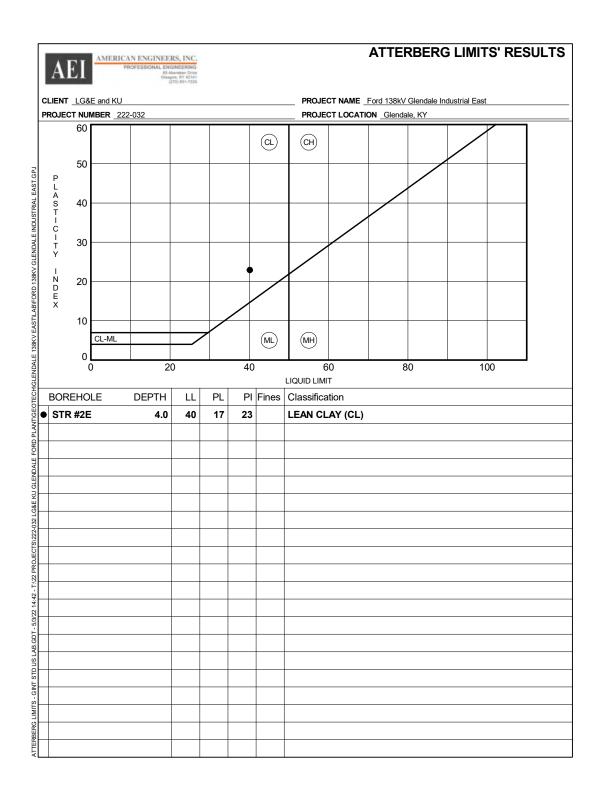
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APPENDIX C

Laboratory Testing Results

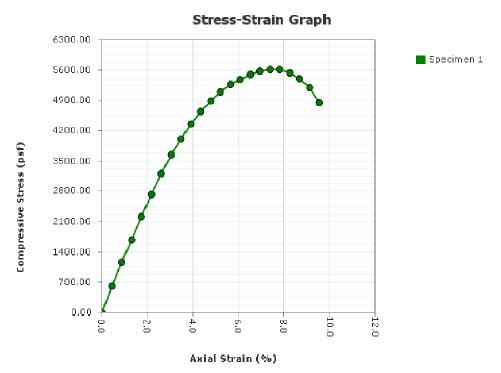




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 1
Sample Depth: 4.0-6.0 ft
Boring Number: STR 2E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 $\,$

Test Date: 4/12/2022 Checked By: _____ Date: _____

Report Created: 4/14/2022

Unconfined Compression Test

ASTM D2166								
			S	pecimer	n Numbe	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	22.9							
Wet Density (pcf)	125.7							
Dry Density (pcf)	102.3							
Saturation (%):	94.4							
Void Ratio:								
Height (in)								
Diameter (in)	2.8300							
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	i							
Strain Rate (in/min)								
Strain Rate (%/min):	i							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	7.81							
Specific Gravity: 2.72	Pla	stic Limit:	17		I	iquid Limi	it: 40	
Type: UD	Soil Clas	ssification:	CL					
Project: Ford 138kV Glendale Ind	ustrial East	t						
Project Number: 222-032								
Sampling Date: 4/12/2022								
Sample Number: ST 1								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 2E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 4/12/2022 Checked By: _____ Date: _____

Report Created: 4/14/2022 2

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



April 8, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE:

Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 5E Glendale, KY AEI Project No. 222-032



A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 5E, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure	Structure	Height	Centerline	Structure (Coordinates	Trans.	Long.			
Number	Description	(ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)			
5E	Double Circuit	85	703.9	37°35′41.361″N	85°53′50.411″W	7,408	1,852			

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 48 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of approximately eight inches. Beneath the surface material, lean clay was encountered to refusal depth in the boring. The lean clay was typically described as gray to brown in color, containing

Ford 138kV Glendale Industrial East Structure 5E April 8, 2022 Page **2** of **4**

varying amounts of sand and gravel, wet to saturated relative to optimum moisture content and very stiff to soft.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 5E - Summary of Boring

			Surface	Auger Refusal	
Hole			Elevation	Depth	Elevation
No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 5E	37°35′41.361″N	85°53′50.411″W	701.9	48.6	653.3

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 5E	CL	5.0-16.0	0.5	0.3
STR 5E	CL	16.0-48.6	0.35	0.2

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial East Structure 5E April 8, 2022 Page **3** of **4**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
STR 5E	CL	5.0-16.0	0.03	-
STR 5E	CL	16.0-48.6	0.03	-

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)	
STR 5E	CL	5.0-16.0	125.0	0.5	0.7	
STR 5E	CL	16.0-48.6	62.6	0.35	0.5	

^{*}Effective Unit Weight accounts for Buoyancy

Ford 138kV Glendale Industrial East Structure 5E April 8, 2022 Page **4** of **4**

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Log



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Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLASTICITY			
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity		
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)		
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7		
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22		
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22		
Hard	30 blows/ft or more	> 4.00				

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE SIZE IDENTIFICATION	
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – ½ to 1 inch
Very Dense	50 blows/ft or more		Fine − ¼ to ½ inch
•		Sand	Coarse – 0.6mm to ¼ inch
RELATIVE PROPO	<u>ORTIONS</u>		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

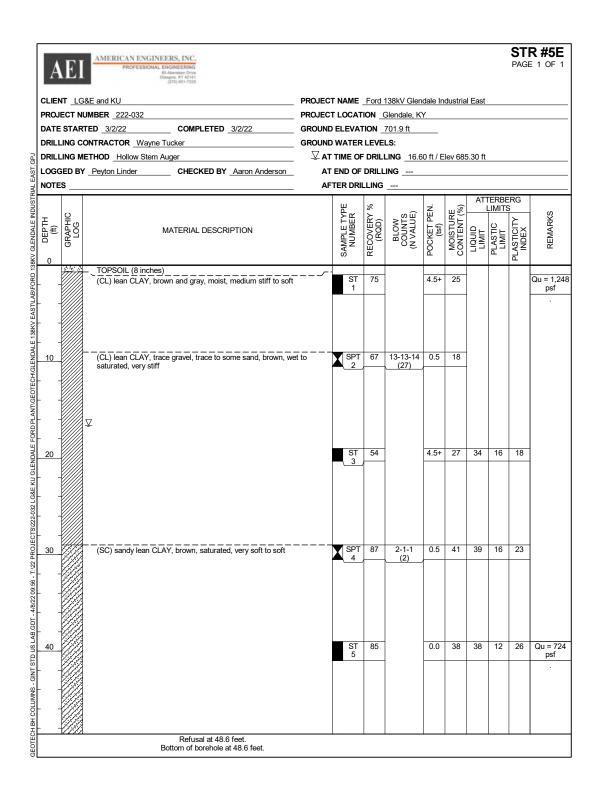
NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

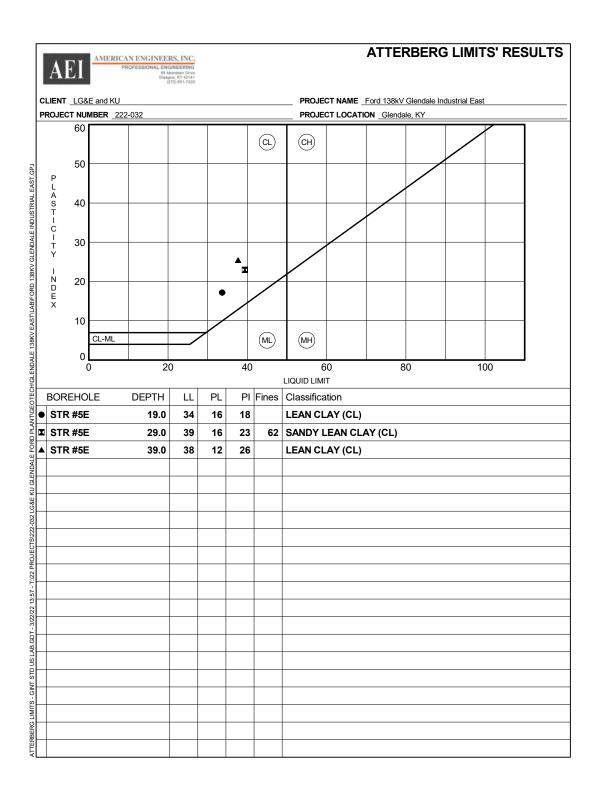
Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

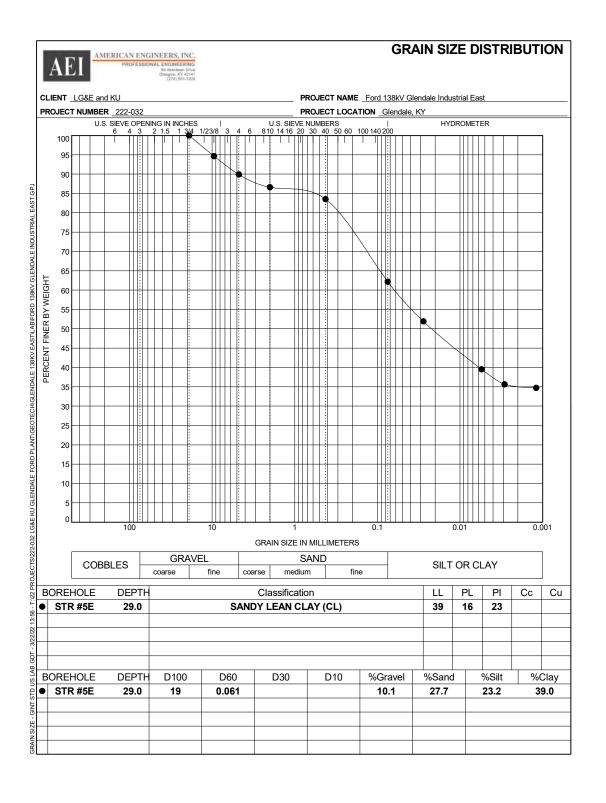


APPENDIX C

Laboratory Testing Results



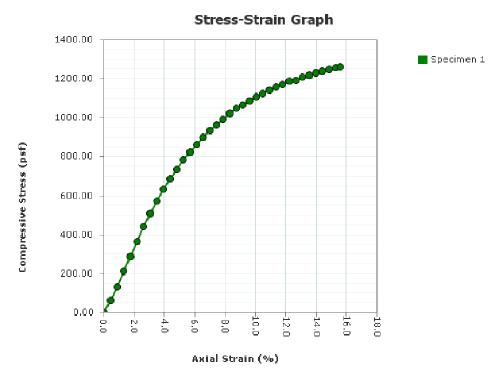




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/11/2022
Sampling Date: 3/11/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #5E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 $\,$

Test Date: 3/11/2022 Checked By: _____ Date: _____

Report Created: 3/22/2022 1

Unconfined Compression Test

Test Date: 3/11/2022

ASTM D2166								
			Sp	ecimer	n Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	26.5							
Wet Density (pcf)	120.2							
Dry Density (pcf)	95.0							
Saturation (%):	91.6							
Void Ratio:	0.787							
Height (in)	5.7300							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	i							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	1248.52							
Undrained Shear Strength (psf)								
Strain at Failure (%):	14.83							
0 10 0 11 10 50	DI		10					
Specific Gravity: 2.72		stic Limit	i			Liquid Limi	t: [0	
Type: UD	Soil Clas	ssification	:					
Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/11/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #5E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specim Failure S		Specimen 5 Failure Sketch		imen 6 e Sketch	Specime Failure Sk		pecimen 8 lure Sketch
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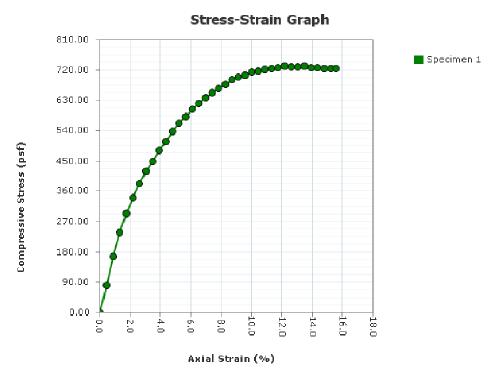
Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: _____ Date: ___

2 Report Created: 3/22/2022

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/11/2022
Sampling Date: 3/11/2022
Sample Number: ST 3
Sample Depth: 39.0-41.0 ft
Boring Number: STR #5E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/11/2022 Checked By: _____ Date: _____

Report Created: 3/22/2022

Unconfined Compression Test

Test Date: 3/11/2022

Specimen Number Before Test 1 2 3 4 5 6 7	8
Moisture Content (%): 34.0 Wet Density (pcf) 115.1 Dry Density (pcf) 85.9 Saturation (%): 94.6 Void Ratio: 0.978 Height (in) 5.7500 Diameter (in) 2.8200 Strain Limit @ 15% (in) 0.9 Height To Diameter Ratio: 2.04 Test Data 1 2 3 4 5 6 Failure Angle (°): 0 Strain Rate (in/min) 0.1 Strain Rate (%/min): 1.74	
Wet Density (pcf) 115.1 Dry Density (pcf) 85.9 Saturation (%): 94.6 Void Ratio: 0.978 Height (in) 5.7500 Diameter (in) 2.8200 Strain Limit @ 15% (in) 0.9 Height To Diameter Ratio: 2.04 Test Data 1 2 3 4 5 6 7 Failure Angle (°): 0 Strain Rate (in/min) 0.1 Strain Rate (%/min): 1.74	8
Dry Density (pcf) 85.9 Saturation (%): 94.6 Void Ratio: 0.978 Height (in) 5.7500 Diameter (in) 2.8200 Strain Limit @ 15% (in) 0.9 Height To Diameter Ratio: 2.04 Test Data 1 2 3 4 5 6 Failure Angle (°): 0 Strain Rate (in/min) 0.1 Strain Rate (%/min): 1.74	8
Saturation (%): 94.6 Void Ratio: 0.978 Height (in) 5.7500 Diameter (in) 2.8200 Strain Limit @ 15% (in) 0.9 Height To Diameter Ratio: 2.04 Test Data 1 2 3 4 5 6 Failure Angle (°): 0 Strain Rate (in/min) 0.1 Strain Rate (%/min): 1.74	8
Void Ratio: 0.978 Height (in) 5.7500 Diameter (in) 2.8200 Strain Limit @ 15% (in) 0.9 Height To Diameter Ratio: 2.04 Test Data 1 2 3 4 5 6 7 Failure Angle (°): 0 Strain Rate (in/min) 0.1 Strain Rate (%/min): 1.74	8
Height (in) 5.7500 Diameter (in) 2.8200 Strain Limit @ 15% (in) 0.9 Height To Diameter Ratio: 2.04 Test Data 1 2 3 4 5 6 7 Failure Angle (°): 0 Strain Rate (in/min) 0.1 Strain Rate (%/min): 1.74	8
Diameter (in) 2.8200	8
Strain Limit @ 15% (in)	8
Height To Diameter Ratio: 2.04 Test Data 1 2 3 4 5 6 7 Failure Angle (°): 0 Strain Rate (in/min) 0.1 Strain Rate (%/min): 1.74	8
Test Data 1 2 3 4 5 6 7 Failure Angle (°): 0 </td <td>8</td>	8
Failure Angle (°): 0 Strain Rate (in/min) 0.1 Strain Rate (%/min): 1.74	8
Strain Rate (in/min) 0.1 Strain Rate (%/min): 1.74	
Strain Rate (%/min): 1.74	
Unconfined Compressive Strength (psf) 724.43	
Undrained Shear Strength (psf) 362.21	
Strain at Failure (%): 14.78	
Specific Gravity: 2.72 Plastic Limit: 12 Liquid Limit: 38	
Type: UD Soil Classification: CL	
Project: Ford 138kV Glendale Industrial East	
Project Number: 222-032	
Sampling Date: 3/11/2022	
Sample Number: ST 3	
Sample Depth: 39.0-41.0 ft	
Boring Number: STR #5E	
Location: Glendale, KY	
Client Name: LG&E and KU	
Remarks:	
Specimen 1 Specimen 2 Specimen 3 Specimen 4 Specimen 5 Specimen 6 Specimen 7 Specimen 7 Specimen 7 Specimen 7 Specimen 8 Specimen 9	en 8
Failure Sketch Failur	

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: _____ Date: ___

2 Report Created: 3/22/2022

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



April 8, 2022



One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 6E Glendale, KY

AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 6E, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number		Structure	Height	Centerline	Structure (Coordinates	Trans.	Long.
		Description	(ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
	6E	Double Circuit	85	703.5	37°35′43.903″N	85°53′50.552″W	5,436	2,244

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 44 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of approximately nine inches. Beneath the surface material, lean clay and fat clay were encountered to refusal depth in the boring. The lean clay was typically described as brown to reddish

Ford 138kV Glendale Industrial East Structure 6E April 8, 2022 Page **2** of **4**

brown in color, containing varying amounts of gravel, moist to saturated relative to optimum moisture content and very stiff to medium stiff. The fat clay was typically described as gray, wet to saturated and stiff.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 6E - Summary of Boring

			Surface	Auge	r Refusal
Hole			Elevation	Depth	Elevation
No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 6E	37°35′43.903″N	85°53′50.552″W	703.4	43.6	659.8

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 6E	CL	5.0-18.0	2.3	0.8
STR 6E	CL	18.0-44.0	1.0	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial East Structure 6E April 8, 2022 Page **3** of **4**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ϵ_{50})	Initial Soil Stiffness (k _{py}) (pci)
STR 6E	CL	5.0-18.0	0.02	400
STR 6E	CL	18.0-44.0	0.02	200

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

	Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
	STR 6E	CL	5.0-18.0	125.0	2.3	1.0
Ī	STR 6E	CL	18.0-44.0	62.6	1.0	0.7

^{*}Effective Unit Weight accounts for Buoyancy

Ford 138kV Glendale Industrial East Structure 6E April 8, 2022 Page **4** of **4**

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

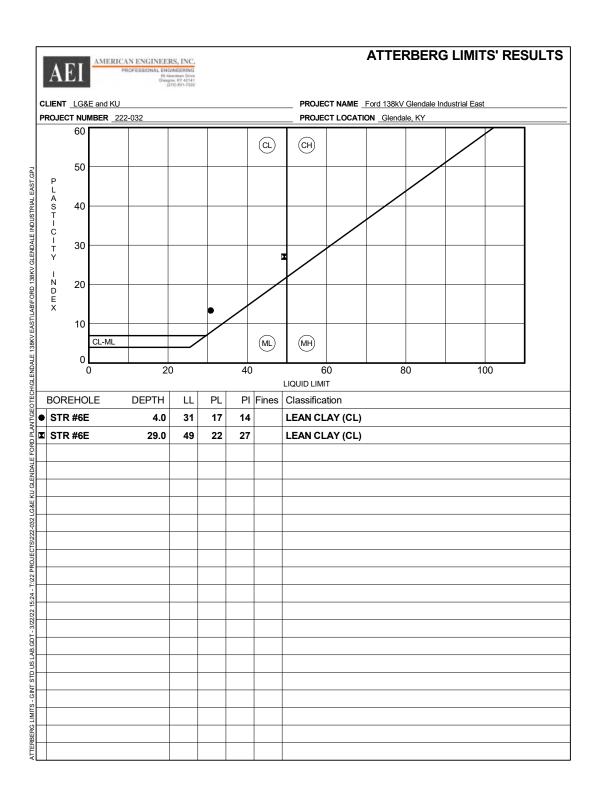
 $T:\ \ 10\ PROJECTS\ \ 210-000\ Folder\ Template\ \ Geotech\ \ REPORTS\ \ Class\ System.doc$

A	E	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING BARRIERS DOWN GRAPHIC PORT GRAPH									•	R #6E
		S&E and KU	PROJECT NAME Ford 138kV Glendale Industrial East PROJECT LOCATION Glendale, KY									
							Υ					
				ELEVA1								
,			GROUND WATER LEVELS:									
		IETHOD Hollow Stem Auger						lev 68	5.50 ft			
<u>"</u>		Y Peyton Linder CHECKED BY Aaron Anderson				ING						
NOTE	S		AF	TER DRII	LING							
DEPTH (#)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)		PLASTIC MIT LIMIT		REMARKS
0	74 18. 14	TOPSOIL (9 Inches)									ш.	
 		(CL) lean CLAY, brown to reddish brown, gray mottle, moist, s very stiff	tiff to	ST 1	85		4.0	22				Qu = 3,555 psf
5 5				ST 2	100		4.5+	20	31	17	14	Qu = 5,859 psf
10		(CL) lean CLAY, reddish brown, gray mottle, moist to saturated	 , stiff	SPT 3	47	6-6-7 (13)	3.5	22				
15		☑ (CL) lean CLAY, with gravel, reddish brown, saturated, very stif	-	▼ SPT	40	8-9-15	0.0	23				
20		medium stiff	110	4	40	(24)	0.0	20				
30				ST	50		1.5	29	49	22	27	Qu = 1,588
				5								psf
35				▼ SPT	67	3-4-6	0.5	37				
		(CH) fat CLAY, gray, moist to wet, stiff		SPT 6		(10)						
-		Refusal at 43.6 feet. Bottom of borehole at 43.6 feet.										

APPENDIX C

Laboratory Testing Results

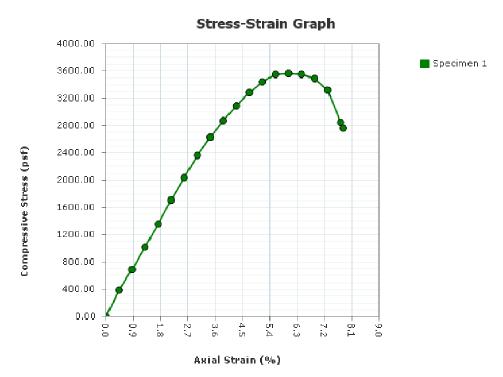




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/3/2022
Sampling Date: 3/3/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #6E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 3/3/2022

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Checked By: ______ Date: _____

Report Created: 3/18/2022

Unconfined Compression Test

ASTM D2166								
				ecimei	n Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%): Void Ratio:								
Void Kano: Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):			J	-	3	U	/	0
Strain Rate (in/min)	0.1							
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):								
Constitution in 1972	DI.	-11- T 111				T : : 1 T : :		
Specific Gravity: 2.72 Type: UD		stic Limit ssification	1			Liquid Limi	it: [0	
			. ; CL					
Project: Ford 138kV Glendale Ind	ustrial East							
Project Number: 222-032								
Sampling Date: 3/3/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #6E								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
Kendiks.								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure Sl		Specimen 5 Failure Sketcl		rimen 6 e Sketch	Specime Failure Sk		pecimen 8 lure Sketch

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

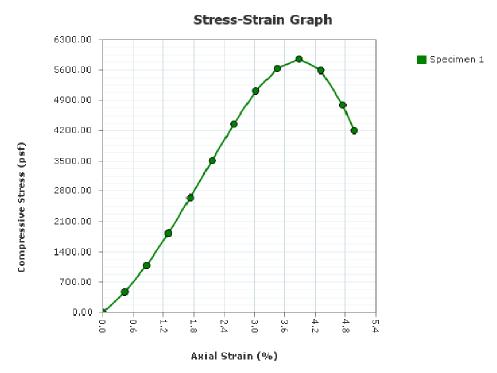
Checked By: ___ Test Date: 3/3/2022 ____ Date: __

2 Report Created: 3/18/2022

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/3/2022
Sampling Date: 3/3/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #6E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/3/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022 1

Unconfined Compression Test

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):	93.8							
Void Ratio:	0.566							
Height (in)	5.8000							
Diameter (in)	2.8600							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	5859.32							
Undrained Shear Strength (psf)	2929.66							
Strain at Failure (%):	3.88							
Specific Gravity: 2.72	Pla	stic Limit:	23		I	iquid Limi	it: 31	
Type: UD		ssification:	i		-	aquiu zari	01	
Project: Ford 138kV Glendale Ind	ustrial Easi	Ī						
Project Number: 222-032								
Sampling Date: 3/3/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #6E								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
Remarks.								
Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen 5	5 Spec	imen 6	Specime	n7 Sr	ecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S	ketch F	ailure Sket	ch Failur	e Sketch	Failure Sk	etch Fail	ure Sketch
							II	
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

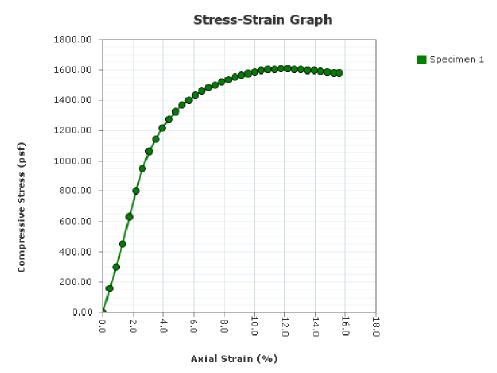
Test Date: 3/3/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022 2

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/3/2022
Sampling Date: 3/3/2022
Sample Number: ST 3
Sample Depth: 29.0-31.0 ft
Boring Number: STR #6E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 3/3/2022

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Checked By: ______ Date: _____

Report Created: 3/18/2022

Unconfined Compression Test

Test Date: 3/3/2022

ASTM D2166								
				pecimer	ı Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)	i							
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	i							
Strain Rate (in/min)								
Strain Rate (%/min):	i							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	14.78							
Specific Gravity: 2.72	Pla	stic Limit	: 22			Liquid Lim	it: 49	
Type: UD	Soil Cla	ssification	: CL					
Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/3/2022								
Sample Number: ST 3								
Sample Depth: 29.0-31.0 ft								
Boring Number: STR #6E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
	6 :		6	6		6 :		
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specim Failure S		Specimen 5 Failure Sketc		imen 6 e Sketch	Specime Failure Sl		pecimen 8 Ilure Sketch
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2 Report Created: 3/18/2022

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Checked By: ___

____ Date: __

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



April 14, 2022



RE:

One Quality Street Lexington, KY 40507

> Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 9E Glendale, KY

AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 9E, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Churchina		Churchine	Haiaba	Centerline Structure C		Coordinates	Trans.	Long.			
	Structure Number	Structure Description	Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)			
	9E	Double Circuit	85	725.6	37°35′49.184″N	85°53′39.077″W	1,640	2,330			

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 65 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of approximately six inches. Beneath the surface material, lean clay and fat clay were encountered to the auger refusal depth. The lean clay was typically described as light brown to reddish brown

Ford 138kV Glendale Industrial East Structure 9E

April 14, 2022 Page **2** of **4**

in color, containing trace to some sand, wet to moist and very stiff to stiff in soil strength consistency. The fat clay was described as reddish brown in color, containing varying amounts of gravel and sand, wet and very soft to stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 9E - Summary of Boring

			Surface	Auge	r Refusal
Hole			Elevation	Depth	Elevation
No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 9E	37°35′49.184″N	85°53′39.077″W	725.2	49.4	675.8

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 9E	CL	5.0-19.0	2.7	1.5
STR 9E	СН	19.0-50.0	0.5	0.3

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial East Structure 9E

April 14, 2022 Page **3** of **4**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Shear Strength (ϵ_{50})	Initial Soil Stiffness (k _{py}) (pci)
STR 9E	CL	5.0-19.0	0.03	400
STR 9E	СН	19.0-50.0	0.01	-

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

	Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
	STR 9E	CL	5.0-19.0	125.0	2.7	1.2
ĺ	STR 9E	СН	19.0-50.0	120.0	0.5	0.8

^{*}Effective Unit Weight accounts for Buoyancy

Ford 138kV Glendale Industrial East Structure 9E April 14, 2022 Page **4** of **4**

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLASTICITY					
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity				
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)				
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7				
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22				
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22				
Hard	30 blows/ft or more	> 4.00						

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – ½ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
•		Sand	Coarse – 0.6mm to ¼ inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

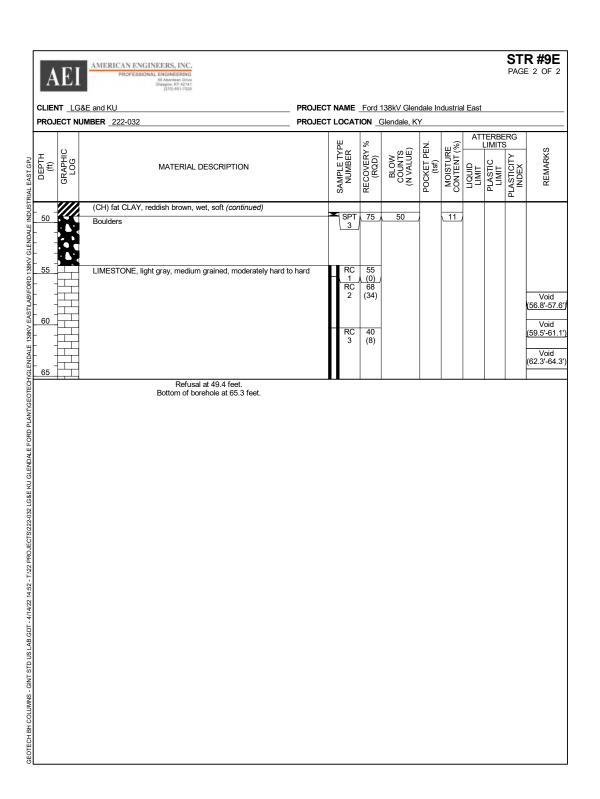
Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

 $T:\ \ 10\ PROJECTS\ \ 210-000\ Folder\ Template\ \ \ Geotech\ \ \ REPORTS\ \ Class\ System. doc$

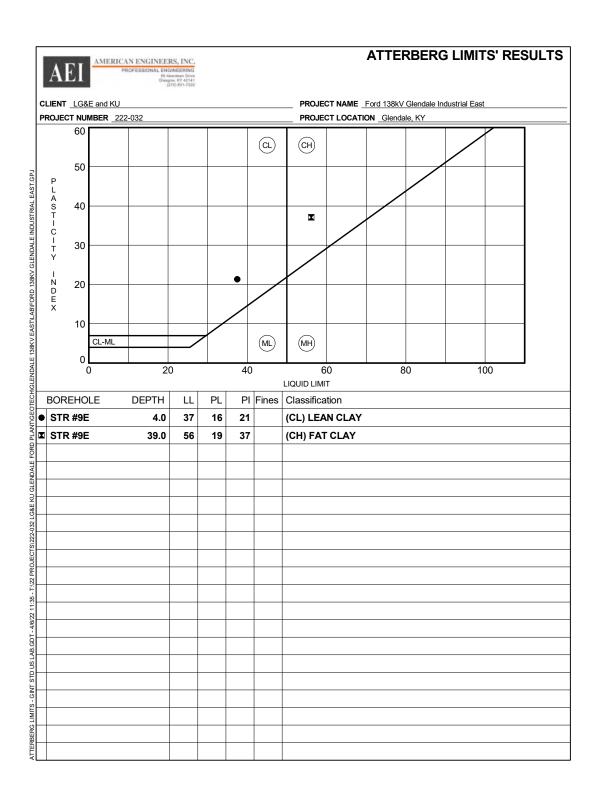
AEI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGANGEMENT Glasgon, KY 42141 (270) 881-7229									_	R #9E
CLIENT LG	i&E and KU	PROJEC	T NAME	Ford 1	138kV Glen	ndale In	dustria	al East			
PROJECT N	UMBER _222-032	PROJEC	T LOCAT	ION _	Glendale, K	Y					
DATE STAR	TED 3/9/22 COMPLETED 3/9/22										
DRILLING C	ONTRACTOR Wayne Tucker	GROUND	WATER	LEVE	LS:						
B DRILLING M	ETHOD _HSA/ Diamond impregnated coring bit	AT	TIME OF	DRILL	_ING						
E LOGGED BY	Peyton Linder CHECKED BY Aaron Anderson	AT	END OF	DRILL	ING						
NOTES		AF	TER DRI	LLING							
Sna			й	%		ż	@		TERBE LIMITS		
DRILLING M LOGGED BN LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY 9 (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID		PLASTICITY INDEX	REMARKS
	- TOPSOIL (6 INCHES)	7-								-	
NLABIFOR 1	(CL) lean CLAY, trace to some sand, light brown to reddish I to moist, very stiff to stiff	orown, wet	ST 1	100		4.5+	22				Qu = 3,800 psf
38KV EAST			ST 2	85		4.5+	20	37	16	21	Qu = 7,060 psf
3FENDALE 1			▼ SPT	100	3-5-8	4.5+	20	_			
GEOTECH			1_		(13)						
15 TORD PLANT											
20 SLENDALE I	(CH) sandy fat CLAY, trace gravel, reddish brown, wet to mo	ist, very	ST	80		0.25	35				Qu = 670
- LG&E KU G	soft to stiff		3								psf
25											
30			SPT 2	100	3-4-6 (10)	1.75	24				
414422 1453					(10)						
35 TABOOM - 1											
40 40	(CH) fat CLAY, reddish brown, wet, soft		ST 4	100		0.0	28	56	19	37	Qu = 1,160 psf
18 40											
GEOTECH	(Continued Next Page)										



APPENDIX C

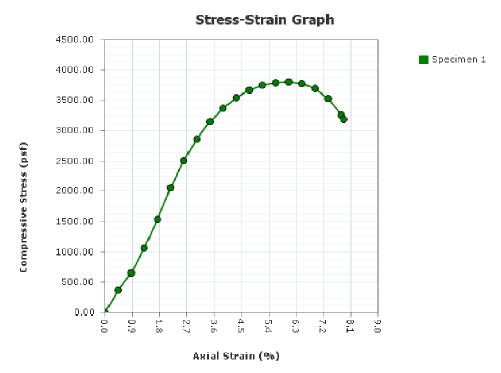
Laboratory Testing Results





Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/11/2022
Sampling Date: 3/11/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #9E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/11/2022 Checked By: _____ Date: _____

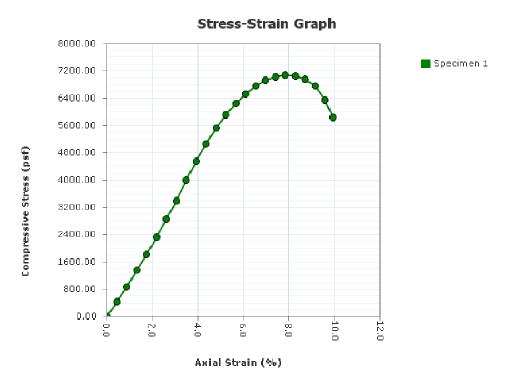
ASTM D2166								
			$\mathbf{S}_{\mathbf{J}}$	pecimen	Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	21.6							
Wet Density (pcf)	128.7							
Dry Density (pcf)	105.9							
Saturation (%):	97.2							
Void Ratio:	0.604							
Height (in)	5.7800							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	6.06							
Specific Gravity: 2.72	Pla	astic Limit:	0			Liquid Limit	. 0	
Type: UD		ssification:	i			Erquiu Emin	! .	
			:					
Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/11/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #9E								
Location: Glendale, KY Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: ___

Test Date: 3/11/2022 ___ Date: _ 2

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/11/2022
Sampling Date: 3/11/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #9E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 $\,$

Test Date: 3/11/2022 Checked By: _____ Date: _____

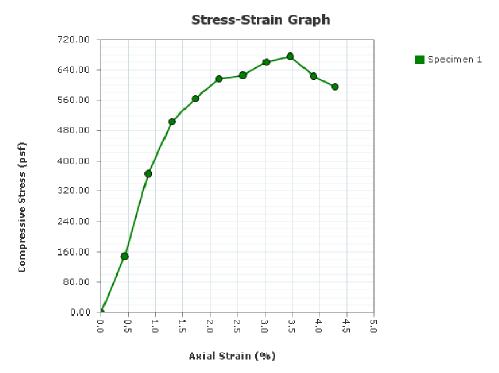
Test Date: 3/11/2022

ASTM D2166								
			Sp	ecimer	n Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	20.4							
Wet Density (pcf)	129.6							
Dry Density (pcf)	107.6							
Saturation (%):	96.2							
Void Ratio:	0.578							
Height (in)	5.7400							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	7062.83							
Undrained Shear Strength (psf)	3531.41							
Strain at Failure (%):	8.28							
Specific Gravity: 2.72	DL	stic Limit	. 16			Liquid Limi	t. 27	1
Type: UD		ssification	1			Liquia Limi	II. 37	
Type. ; OD	Jon Cia	ssirication	· ¡ CL					
Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/11/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #9E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: _____ Date: ___

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/11/2022
Sampling Date: 3/11/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR #9E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 $\,$

Test Date: 3/11/2022 Checked By: _____ Date: _____

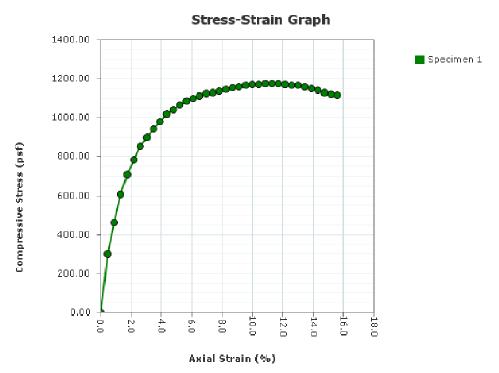
ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):	86.8							
Void Ratio:								
Height (in)	5.7800							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	676.56							
Undrained Shear Strength (psf)	338.28							
Strain at Failure (%):	3.46							
Specific Gravity: 2.72	Pla	stic Limit:	0		I	iquid Lim	it: 0	
Type: UD		ssification:				1	! -	
	(
Project: Ford 138kV Glendale Ind	ustrial Easi	Ī						
Project Number: 222-032								
Sampling Date: 3/11/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR #9E								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
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Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen 5	Spec	imen 6	Specime	en 7 Sp	ecimen 8
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/11/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032 Received Date: 3/11/2022 Sampling Date: 3/11/2022 Sample Number: ST 4 Sample Depth: 39.0-41.0 ft Boring Number: STR #9E Location: Glendale, KY Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: ___ Date: _

Report Created: 4/6/2022

Test Date: 3/11/2022

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	13.00				<u> </u>		<u> </u>	
Specific Gravity: 2.72	Pla	stic Limit:	19		I	Liquid Limi	it: 56	
Type: UD	Soil Clas	ssification:	СН					
Project: Ford 138kV Glendale Ind	ustrial East	t						
Project Number: 222-032								
Sampling Date: 3/11/2022								
Sample Number: ST 4								
Sample Depth: 39.0-41.0 ft								
Boring Number: STR #9E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 ailure Sket		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/11/2022 Checked By: _____ Date: _____

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 2, 2022



One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 14E Glendale, KY AEI Project No. 222-032



1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 14E, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

144.6 21 144.6 244.6							
Structure	Structure	Height	Centerline	Structure (Coordinates	Trans.	Long.
Number	Description	(ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
14E	Double Circuit	90	717.2	37°35′55.719″N	85°53′12.314″W	5,160	2,054

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 54 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered to a depth of about eight inches. Beneath the surface material, lean clay and fat clay were encountered to refusal depth in the boring. The lean clay was typically described as light brown to gray in color, containing varying

Ford 138kV Glendale Industrial East Structure 14E

May 2, 2022 Page **2** of **4**

amounts of sand, wet and stiff to medium stiff in soil strength consistency. The fat clay was described as reddish brown in color, containing some sand, wet to moist and medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 14E - Summary of Boring

			Surface	Auge	r Refusal
Hole			Elevation	Depth	Elevation
No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 14E	37°35′55.719″N	85°53′12.314″W	714.5	40.6	673.9

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

			Soil Undrained	Modulus of
Structure Number	Lithology	Depth (feet)	Shear Strength	Deformation (ksi)
			(ksf)	
STR 14E	CL	5.0-16.0	0.7	0.4
STR 14E	CH	16.0-40.6	0.7	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial East Structure 14E May 2, 2022 Page **3** of **4**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Shear Strength (ϵ_{50})	Initial Soil Stiffness (k _{py}) (pci)
STR 14E	CL	5.0-16.0	0.02	200
STR 14E	СН	16.0-40.0	0.008	200

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 14E	CL	5.0-16.0	125.0	0.7	0.7
STR 14E	СН	16.0-40.0	57.6	0.7	0.7

^{*}Effective Unit Weight accounts for Buoyancy

Ford 138kV Glendale Industrial East Structure 14E May 2, 2022 Page **4** of **4**

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

 $T:\ \ 10\ PROJECTS\ \ 210-000\ Folder\ Template\ \ Geotech\ \ REPORTS\ \ Class\ System.doc$

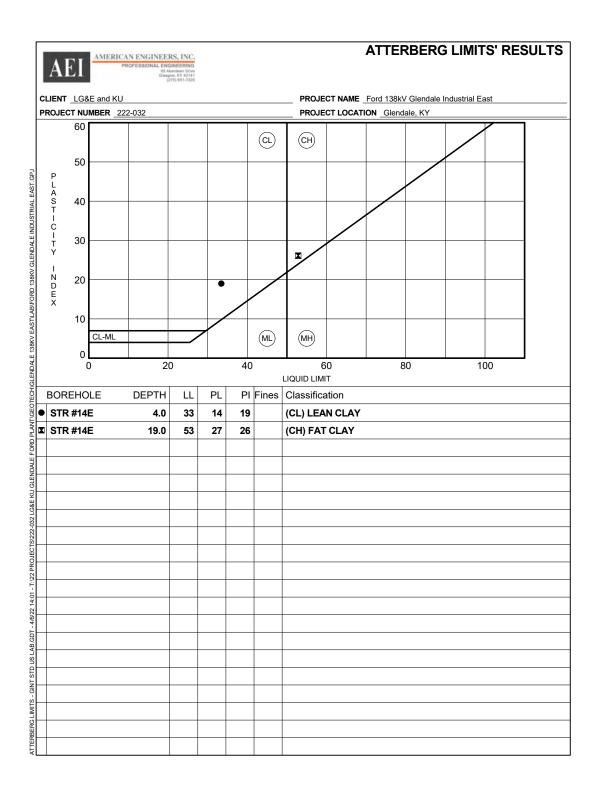
	A	EI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING Olderford District Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control								S		#14E 1 OF 2
	CLIE	NT LG	&E and KU	PROJECT NAME Ford 138kV Glendale Industrial East									
ı			UMBER _222-032				Glendale, I						
			TED <u>3/14/22</u>	GROUNE									
			ETHOD HSA/ Diamond impregnated coring bit				LING <u>16.3</u>	30 ft / F	Elev 69	98.20 f	ì		
5			Peyton Linder CHECKED BY Aaron Anderson				ING						
8	NOTE			AF	TER DRI	LLING							
2					ш	%		_;	· ·		ERBE		
GLEINDALE INDO	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC	PLASTICITY INDEX	REMARKS
200	0	71 18. 74	_ TOPSOIL (8 INCHES)									₽.	
ADITORO.	 		(CL) lean CLAY, light brown, gray mottle, wet, stiff		ST 1	90		2.5	21				Qu = 2,080 psf
NV EMS IN	5				ST 2	80		2.0	22	33	14	19	Qu = 3,060 psf
INDALE 130													•
I EUNIGE	10		(CL) lean CLAY, trace to some sand, gray, wet, medium s	tiff	SPT 1	93	3-3-3 (6)	1.5	22				
PLAN I GEC	 												
JALE FURD			(CH) fat CLAY, some sand, reddish brown, wet to moist, r	nedium									
NO GLEIN	20				ST 3	85		3.25	35	53	27	26	Qu = 1,540 psf
-USZ LG&E	 												
NEO 1 3/222	25												
- 1.42 FRU													
2/22 00:30	30				SPT 2	100	2-4-4 (8)	1.5	26				
AD.GD 3,													
2000	35												
NID - CNIN	 - 40				ST	31			30				
DION HOLD			weathered LIMESTONE, light gray, medium grained, mod hard to hard, thin to thick bedded	erately	RC 1	68 (47)							
	 - 45	H	(Continued Next Page)										Clay seam (43.4'-45.0')

	A	El	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING 65 Namessure Units (EUR) 655-7220									# 14E 2 OF 2
	CLIEN	NT LC		PROJECT	NAME	Ford	138kV Gle	ndale	Industi	ial Ea	st	
	PROJ	ECT N	UMBER _222-032 F	PROJECT	LOCAT	ION _	Glendale, ł	(Y				
FASI GLS	HL (H)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	L	PLASTIC HEALD IN THE STATE OF T	REMARKS
BILOND ISBN GLENDALE INDOS IN	50		weathered LIMESTONE, light gray, medium grained, moder hard to hard, thin to thick bedded (continued)	rately	RC 2	36 (0) 54 (20)						Clay filled void (47.2'-48.6') Void (49.4'-50.5')
			Refusal at 40.6 feet. Bottom of borehole at 54.4 feet.									

APPENDIX C

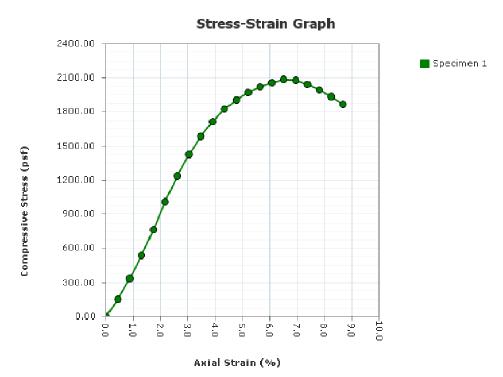
Laboratory Testing Results





Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/15/2022
Sampling Date: 3/15/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #14E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/15/2022 Checked By: _____ Date: _____

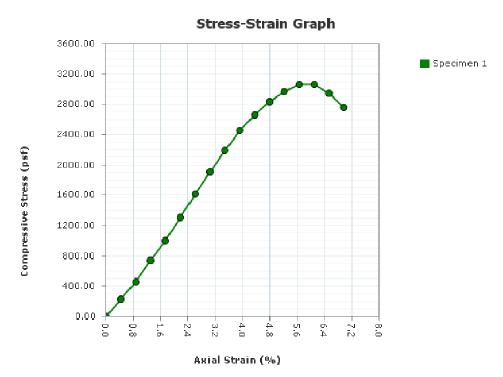
ASTM D2166				•						
	Specimen Number									
Before Test	1	2	3	4	5	6	7	8		
Moisture Content (%):										
Wet Density (pcf)										
Dry Density (pcf)	i									
Saturation (%):										
Void Ratio:										
Height (in)										
Diameter (in)										
Strain Limit @ 15% (in)	i									
Height To Diameter Ratio:										
Test Data	1	2	3	4	5	6	7	8		
Failure Angle (°):	i									
Strain Rate (in/min)										
Strain Rate (%/min):	i									
Unconfined Compressive Strength (psf)										
Undrained Shear Strength (psf)										
Strain at Failure (%):	6.94									
Specific Gravity: 2.72	Pla	stic Limi	t: 0			Liquid Lim	it: 0			
Type: UD	Soil Classification: CL									
Project: Ford 138kV Glendale Ind	netrial Fac	ļ.								
Project Number: 222-032	ustriai Las	ı								
Sampling Date: 3/15/2022										
Sample Number: ST 1										
Sample Depth: 1.0-3.0 ft										
Boring Number: STR #14E										
Location: Glendale, KY										
Client Name: LG&E and KU										
Remarks:										
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specim Failure S		Specimen 5 Failure Sketcl		imen 6 e Sketch	Specime Failure Sk		pecimen 8 lure Sketch		
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	<u> </u>					<u> </u>				

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Checked By: ___ Test Date: 3/15/2022 ____ Date: __

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/15/2022
Sampling Date: 3/15/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #14E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/15/2022 Checked By: _____ Date: _____

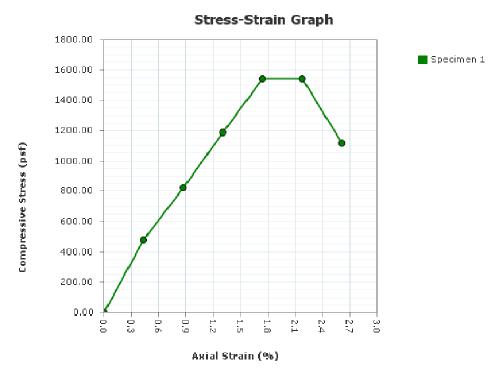
Test Date: 3/15/2022

ASTM D2166								
			\mathbf{S}_{i}	pecimei	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	i							
Wet Density (pcf)								
Dry Density (pcf)	:							
Saturation (%):								
Void Ratio:	:							
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	i							
Strain Rate (in/min)	i							
Strain Rate (%/min):	:							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	6.10							
Specific Gravity: 2.72	Pla	astic Limit:	14		ī	iquid Lim	it: 33	
Type: UD		ssification:	i		-	orquie ziiii		
			:					
Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/15/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #14E								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
Remarks.								
Specimen 1 Specimen 2 Specimen 3	Specim	en 4	Specimen 5	Spec	imen 6	Specime	n 7 St	pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		ailure Sketo		e Sketch	Failure Sk		lure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: ___ _ Date: _

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/15/2022
Sampling Date: 3/15/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR #14E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 3/15/2022

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Checked By: ______ Date: _____

ASTM D2166								
Specimen Number								
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	35.4							
Wet Density (pcf)	119.9							
Dry Density (pcf)	88.5							
Saturation (%):	104.9							
Void Ratio:	0.918							
Height (in)	5.7400							
Diameter (in)	2.8200							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)	770.62							
Strain at Failure (%):	2.18							
Specific Gravity: 2.72	Pla	stic Limit:	27		I	iquid Lim	it: 53	
Type: UD	Soil Clas	ssification:	CL			_	•	
Project: Ford 138kV Glendale Inde	ustrial East							
Project Number: 222-032								
Sampling Date: 3/15/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR #14E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure Sl		Specimen 5 ailure Sket		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/15/2022 Checked By: _____ Date: _____

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 3, 2022

RE:



One Quality Street Lexington, KY 40507

> Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 15E Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 15E, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure	Centerline Structure Coordinates					Trans.	Long.	
Number	Structure Description	Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)	
15E	Double Circuit	95	719.9	37°35′52.52″N	85°53′5.45″W	5,267	2,104	

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 50 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered to a depth of about seven inches. Beneath the surface material, lean clay was encountered to the pre-determined termination depth (50 feet). The lean clay was typically described as brown to gray to reddish brown in color, containing varying amounts of sand and gravel, moist to saturated and medium stiff to stiff in soil strength consistency.

Ford 138kV Glendale Industrial East Structure 14E

May 3, 2022 Page **2** of **3**

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was **not** encountered in Structure 15E.

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 2: MFAD Geotechnical Design Parameters

1 4 5 6 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7									
			Soil						
Structure		Depth	Undrained	Modulus of					
Number	Lithology	(feet)	Shear	Deformation					
Number		(leet)	Strength	(ksi)					
			(ksf)						
STR 15E	CL	5.0-27.0	1.4	0.8					
STR 15E	CL	27.0-50.5	0.8	0.4					

Lateral soil parameters recommended for drilled shaft design are shown below in Table 3 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 3: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ϵ_{50})	Initial Soil Stiffness (k _{py}) (pci)
STR 15E	CL	5.0-27.0	0.02	200
STR 15E	CL	27.0-50.0	0.02	-

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 4. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown

Ford 138kV Glendale Industrial East Structure 14E

May 3, 2022 Page **3** of **3**

et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 4: Axial Soil Parameters for Design of Drilled Shafts

rable in state con raidineters for pesign of princa shares									
Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)				
STR 15E	CL	5.0-27.0	125.0	1.4	0.9				
STR 15E	CL	27.0-50.0	62.6	0.8	0.8				

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





Attachment 3 to Response to PSC-4 Question No. 1
Page 126 of 592
McFarland

APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY SPT N-VALUE		Qu/Qp (tsf)	PLASTICITY		
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity	
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)	
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7	
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22	
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22	
Hard	30 blows/ft or more	> 4.00			

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – ½ to 1 inch
Very Dense	50 blows/ft or more		Fine – ¼ to ½ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	<u>ORTIONS</u>		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

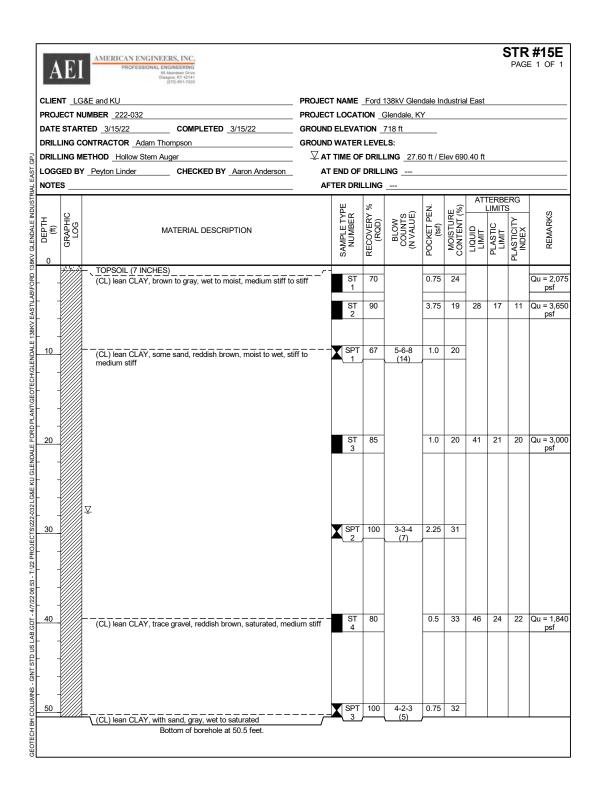
NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

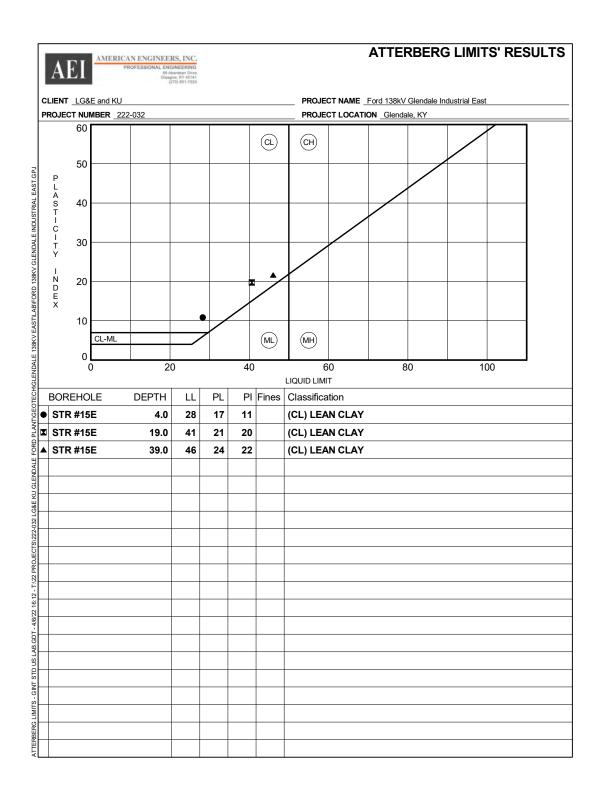
Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density



APPENDIX C

Laboratory Testing Results

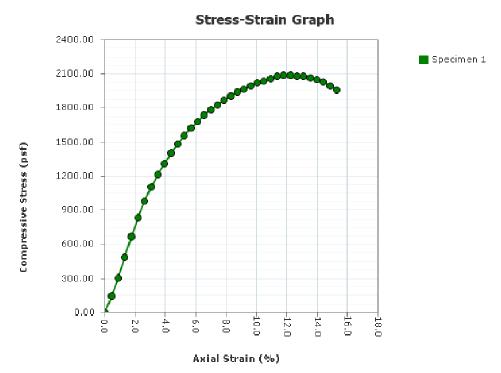




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/16/2022
Sampling Date: 3/16/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR 15E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/16/2022 Checked By: _____ Date: _____

Unconfined Compression Test

Test Date: 3/16/2022

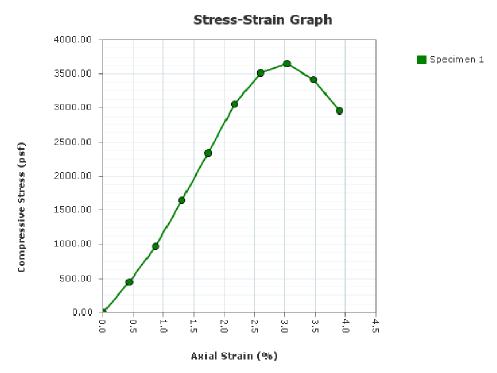
ASTM D2166								
			$\mathbf{S}_{\mathbf{j}}$	pecimen	Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	24.4							
Wet Density (pcf)	123.4							
Dry Density (pcf)	99.2							
Saturation (%):	93.2							
Void Ratio:	0.711							
Height (in)	5.7300							
Diameter (in)	2.8200							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	2078.59							
Undrained Shear Strength (psf)	1039.30							
Strain at Failure (%):	13.09							
6 17 6 11 10 70	DI	T				T 1 T		
Specific Gravity: 2.72		astic Limit:	i			Liquid Limi	t: 0	
Type: UD	Son Cla	ssification:	CL					
Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/16/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR 15E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: ___ ___ Date: _

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/16/2022
Sampling Date: 3/16/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR 15E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/16/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166								
			$\mathbf{S}_{\mathbf{J}}$	pecimen	Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	18.7							
Wet Density (pcf)	132.1							
Dry Density (pcf)	111.3							
Saturation (%):	96.7							
Void Ratio:	0.526							
Height (in)	5.7700							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	3.03							
Specific Gravity: 2.72	Pla	stic Limit:	17			Liquid Limi	t· 28	
Type: UD		ssification:	i			ziquiu ziiii		
Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/16/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 15E								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
Kenars.								
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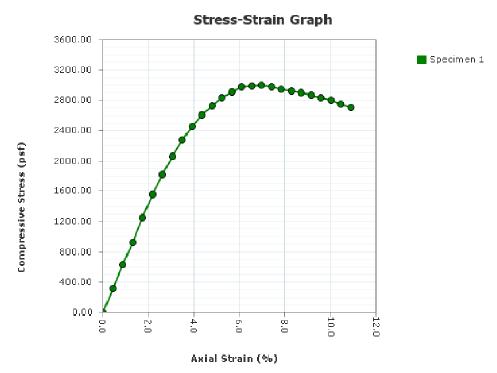
Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/16/2022 Checked By: ___ ___ Date: _

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032 Received Date: 3/16/2022 Sampling Date: 3/16/2022 Sample Number: ST 3 Sample Depth: 19.0-21.0 ft Boring Number: STR 15E Location: Glendale, KY Client Name: LG&E and KU

Remarks:

Test Date: 3/16/2022

Checked By: ___ Date: _

Unconfined Compression Test

ASTM D2166								
			$\mathbf{S}_{\mathbf{J}}$	pecimen	Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	25.6							
Wet Density (pcf)	126.7							
Dry Density (pcf)	100.9							
Saturation (%):	102.1							
Void Ratio:	0.683							
Height (in)	5.7400							
Diameter (in)	2.8300							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	6.97							
Specific Gravity: 2.72	Pla	astic Limit:	21			Liquid Limi	t· 41	
Type: UD		ssification:	i			ziquiu ziiii	!	
Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/16/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR 15E								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
Kenars.								
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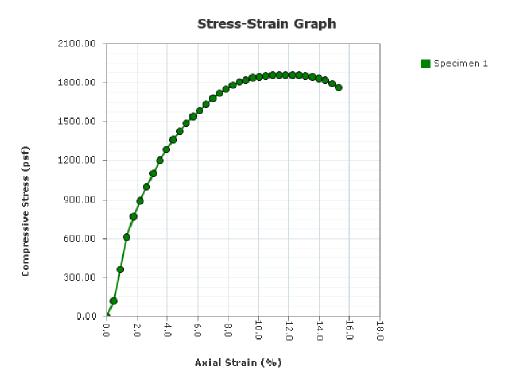
Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/16/2022 Checked By: ___ ___ Date: _

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032 Received Date: 3/16/2022 Sampling Date: 3/16/2022 Sample Number: ST 4 Sample Depth: 39.0-41.0 ft Boring Number: STR 15E Location: Glendale, KY Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Date: _

Unconfined Compression Test

ASTM D2166								
				pecimer	ı Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:	0.686							
Height (in)	5.7300							
Diameter (in)	2.8200							
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)	922.19							
Strain at Failure (%):	13.53							
Specific Gravity: 2.72	Pla	stic Limit:	24		I	iquid Limi	it: 46	
Type: UD	Soil Clas	ssification:	CL				•	
Project: Ford 138kV Glendale Ind	ustrial East							
Project Number: 222-032								
Sampling Date: 3/16/2022								
Sample Number: ST 4								
Sample Depth: 39.0-41.0 ft								
Boring Number: STR 15E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure Sl		Specimen 5 ailure Sketo		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/16/2022 Checked By: _____ Date: _____

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 3, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 18E Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 18E, a single circuit, tangent steel pole which will be supported by direct embedment.

Table 1: Tower Details

10000 = 10000										
Structure	Structure	Height	Centerline	Structure 0	Coordinates	Trans.	Long.			
Number	Description	(ft)	Elevation (ft)	Latitude (DMS)	Latitude (DMS) Longitude (DMS)		Moment (ft-k)			
18E	Single Circuit	110	713.1	37°35′37.74″N	85°53′8.66″W	494	210			

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 26 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered to a depth of about eight inches. Beneath the surface material, lean clay and fat clay were encountered to the boring termination depth. The lean clay was typically described as brown to gray in color, wet to moist and stiff in soil strength consistency. The fat clay was typically described as reddish brown to

Ford 138kV Glendale Industrial East Structure 18E

May 3, 2022 Page **2** of **3**

light brown in color, containing varying amounts of sand and gravel, moist to saturated and stiff to medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was not encountered in Boring 18E.

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 2: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 18E	CL	5.0-9.0	1.2	0.8
STR 18E	СН	9.0-26.0	1.0	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 3 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 3: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (kpy) (pci)		
STR 18E	CL	5.0-9.0	0.02	200		
STR 18E	СН	9.0-26.0	0.01	200		

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 4. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the

Ford 138kV Glendale Industrial East Structure 18E

May 3, 2022 Page **3** of **3**

Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 4: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)							
STR 18E	CL	5.0-9.0	125.0	1.2	0.7							
STR 18E	СН	9.0-26.0	120.0	1.0	0.8							

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling</u>: Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	Qu/Qp (tsf) PLASTIC				
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity			
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)			
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7			
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22			
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22			
Hard	30 blows/ft or more	> 4.00	-				

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – ½ to 1 inch
Very Dense	50 blows/ft or more		Fine – ¼ to ½ inch
·		Sand	Coarse - 0.6mm to 1/4 inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

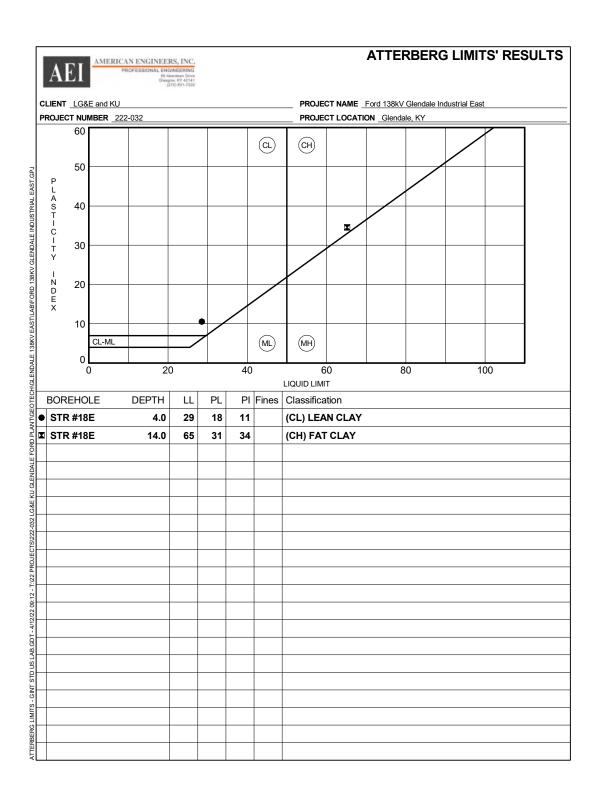
Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

2	AEI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING GRAPH, V7.4741 (20) 651-720										#18E 1 OF 1
DRILLING CONTRACTOR Adam Thompson				GROUND WATER LEVELS: \$\sum \text{AT TIME OF DRILLING} \frac{20.00 \text{ ft / Elev 693.00 \text{ ft}}}{\text{Elev 693.00 \text{ ft}}}\$								
DEPTH O	GRAPHIC LOG	MATERIAL DESCRIPTION	Ar	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)		PLASTIC LIMIT LIMIT		REMARKS
LAB/FORD 13		TOPSOIL (8 INCHES) (CL) lean CLAY, brown to gray, wet to moist, stiff		ST 1	90		2.75	22				Qu = 2,490 psf
E 138KV EAST				ST 2	95		4.5+	19	29	18	11	Qu = 2,510 psf
OTECH/GLENDAL		(CH) fat CLAY, some sand, trace gravel, reddish brown, v moist, stiff to medium stiff	vet to	SPT 1	100	5-6-7 (13)	3.75	23				
FORD PLANTIGE				ST 3	100		3.25	19	65	31	34	Qu = 1,940 psf
E KU GLENDALE		(CH) fat CLAY with gravel, light brown, wet to saturated, r stiff	 nedium	SPT 2	100	3-4-4 (8)	1.0	41				
25 228.032		Bottom of borehole at 26.0 feet.		ST 4	70		0.5	41				
GEOTECH BH COLUMNS - GINT STD US LAB GDT - 59222 15:46 - T;\(22) PROJECTS S\(222\) PROJECTS S\(2222\) PROJECTS S\(2222\) PROJECTS S\(2222\												

APPENDIX C

Laboratory Testing Results

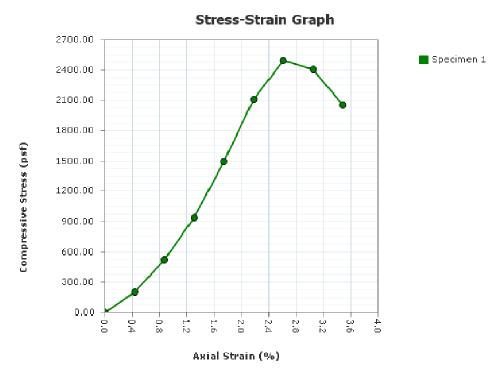




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/16/2022
Sampling Date: 3/16/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #18E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/16/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022

Unconfined Compression Test

ASTM D2166										
	Specimen Number									
Before Test	1	2	3	4	5	6	7	8		
Moisture Content (%):	17.8									
Wet Density (pcf)	131.4									
Dry Density (pcf)	111.6									
Saturation (%):	92.8									
Void Ratio:	0.522									
Height (in)	5.7400									
Diameter (in)	2.8500									
Strain Limit @ 15% (in)	0.9									
Height To Diameter Ratio:	2.01									
Test Data	1	2	3	4	5	6	7	8		
Failure Angle (°):	0									
Strain Rate (in/min)										
Strain Rate (%/min):										
Unconfined Compressive Strength (psf)										
Undrained Shear Strength (psf)										
Strain at Failure (%):	2.61									
Specific Gravity: 2.72	Pla	stic Limit:	0		I	iquid Limi	it: 0			
Type: UD	Soil Clas	Classification: CL								
Project: Ford 138kV Glendale Ind	ustrial East									
Project Number: 222-032	dotrar zao.	•								
Sampling Date: 3/16/2022										
Sample Number: ST 1										
Sample Depth: 1.0-3.0 ft										
Boring Number: STR #18E										
Location: Glendale, KY										
Client Name: LG&E and KU										
Remarks:										
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen Sket		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch		
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

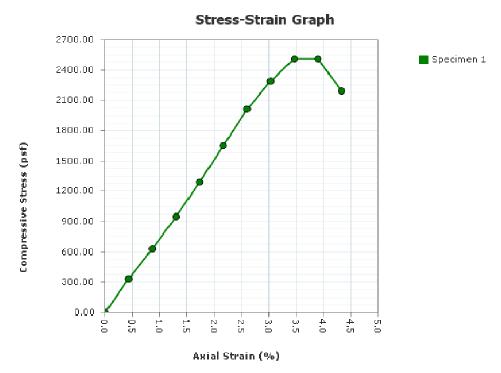
Test Date: 3/16/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022 2

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/16/2022
Sampling Date: 3/16/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #18E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/16/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022

Test Date: 3/16/2022

Unconfined Compression Test

ASTM D2166								
				pecimen	Numb			
Before Test	1	2	3	4	5	6	7	. 8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)	i							
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	i							
Strain Rate (in/min)								
Strain Rate (%/min):	i							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	3.90							
Specific Gravity: 2.72	Pla	stic Limi	t: 18			Liquid Lim	it: 29	
Type: UD	Soil Cla	ssification	n: CL					
Project: Ford 138kV Glendale Ind	netrial Fact	ŀ						
Project Number: 222-032	ustriai Las							
Sampling Date: 3/16/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #18E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specim Failure S		Specimen 5 Failure Sketo		men 6 Sketch	Specime Failure Sl		pecimen 8 ilure Sketch
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Report Created: 3/18/2022 2

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

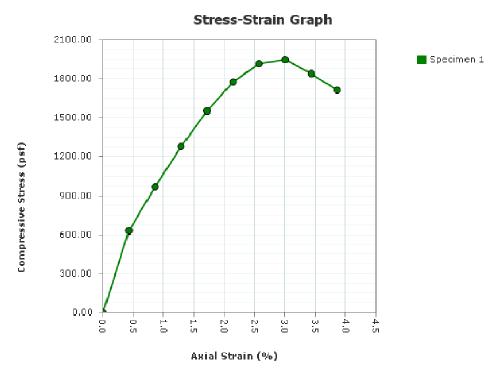
Checked By: ___

____ Date: __

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/17/2022
Sampling Date: 3/17/2022
Sample Number: ST 3
Sample Depth: 14.0-16.0 ft
Boring Number: STR #18E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/17/2022 Checked By: _____ Date: _____

Unconfined Compression Test

Test Date: 3/17/2022

ASTM D2166								
				pecimer				
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)	84.2							
Saturation (%):								
Void Ratio:	1.017 5.8300							
Height (in) Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):			3	-	3	U	/	0
Strain Rate (in/min)	0.1							
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):								
6 16 6 1 2 2 2	DI	T				T · · 1 T · ·		
Specific Gravity: 2.72 Type: UD		stic Limit:				Liquid Limi	t: U	
			; CL					
Project: Ford 138kV Glendale Ind	ustrial East	t						
Project Number: 222-032								
Sampling Date: 3/17/2022								
Sample Number: ST 3								
Sample Depth: 14.0-16.0 ft								
Boring Number: STR #18E								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
Remarko.								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure Sl		Specimen 5		imen 6 e Sketch	Specime Failure Sk		oecimen 8 lure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: ___

_ Date: _

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 3, 2022

RE:



LG&E and KU One Quality Street Lexington, KY 40507

> Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 26E Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 26E, a single circuit, tangent steel pole which will be supported by direct embedment.

Table 1: Tower Details

	Churchina	Centerline Structure Co	Coordinates	Trans.	Long.				
Structure Number		Structure Description	Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)	
ĺ	26E	Single Circuit	110	690.8	37°34′54.11″N	85°53′18.12″W	485	209	

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 26 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface to a depth of about eight inches. Beneath the surface material, lean clay and fat clay were encountered to the boring termination depth. The lean clay was typically described as brown to gray in color, containing trace gravel, wet and soft to stiff in soil strength consistency. The fat clay was typically

Ford 138kV Glendale Industrial East Structure 26E

May 3, 2022 Page **2** of **3**

described as brown to reddish brown in color, containing trace gravel, wet to saturated and medium stiff to stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was not encountered in Boring 26E.

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 2: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 26E	CL	5.0-14.0	0.5	0.3
STR 26E	СН	14.0-26.0	1.0	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 3 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 3: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
STR 26E	CL	5.0-14.0	0.01	-
STR 26E	CH	14.0-26.0	0.02	200

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 4. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the

Ford 138kV Glendale Industrial East Structure 26E

May 3, 2022 Page **3** of **3**

Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 4: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 26E	CL	5.0-14.0	125.0	0.5	0.6
STR 26E	СН	14.0-26.0	57.6	1.0	0.8

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

SPT N-VALUE	Qu/Qp (tsf)	PLASTI	<u>CITY</u>
2 blows/ft or less	0 - 0.25	Degree of	Plasticity
2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
15 to 30 blows/ft	2.00 - 4.00	High	over 22
30 blows/ft or more	> 4.00		
	2 blows/ft or less 2 to 4 blows/ft 4 to 8 blows/ft 8 to 15 blows/ft 15 to 30 blows/ft	2 blows/ft or less 0 - 0.25 2 to 4 blows/ft 0.25 - 0.49 4 to 8 blows/ft 0.50 - 0.99 8 to 15 blows/ft 1.00 - 2.00 15 to 30 blows/ft 2.00 - 4.00	2 blows/ft or less 0 - 0.25 Degree of 2 to 4 blows/ft 0.25 - 0.49 Plasticity 4 to 8 blows/ft 0.50 - 0.99 Low 8 to 15 blows/ft 1.00 - 2.00 Medium 15 to 30 blows/ft 2.00 - 4.00 High

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium $-\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine – 1/4 to 1/2 inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted.}$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

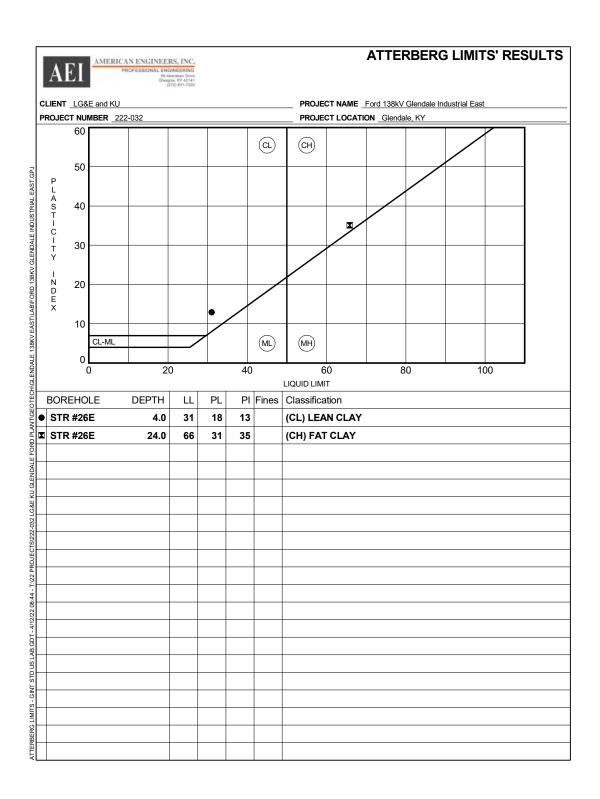
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PROJ	JECT N	UMBER _222-032 PROJ	PROJECT NAME Ford 138kV Glendale Industrial East PROJECT LOCATION Glendale, KY GROUND ELEVATION 690.4 ft									
			JND WA									
		<u> </u>				_ING _16.5	0 ft / E	lev 67	3.90 ft			
LOG	GED BY	Peyton Linder CHECKED BY Aaron Anderson	AT EN	D OF	DRILL	ING						
NOTE	S		AFTER	DRIL	LING							
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	AAMPI H IGNA P	NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC FIMIT LIMIT		REMARKS
			/- -	ST 1	80		0.5	23				Qu = 1,1110 psf
5				ST 2	90		2.75	21	31	18	13	Qu = 1,050 psf
10			X	SPT 1	73	3-4-6 (10)	1.75	24	-			·
15 15		(CH) fat CLAY, trace gravel, brown to reddish brown, wet to saturate medium stiff to stiff $ abla$	ed,	ST 3	100		2.5	30	-			Qu = 1,550 psf
20 20 -			X	SPT 2	100	5-4-6 (10)	2.25	39	-			
25				ST 4	90		1.0	40	66	31	35	Qu = 2,590 psf
2		Bottom of borehole at 26.0 feet.										
DECLIECTION OF JOIN 15 I U.O. LABIGUI - 5/3/22 I S. II - 1:22 PROJ												

APPENDIX C

Laboratory Testing Results

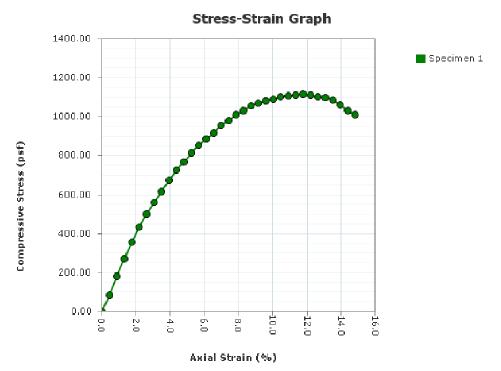




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/18/2022
Sampling Date: 3/18/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR 26E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 $\,$

Test Date: 3/18/2022 Checked By: _____ Date: _____

Unconfined Compression Test

Test Date: 3/18/2022

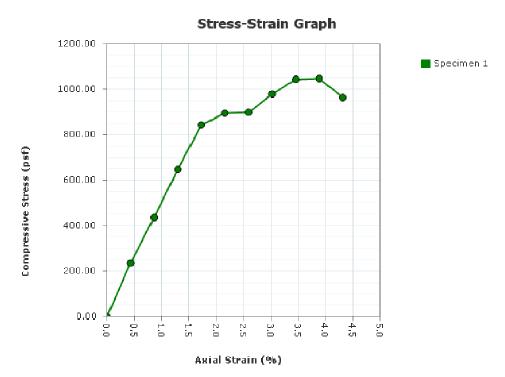
ASTM D2166				•	NT -			
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Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf) Dry Density (pcf)								
Saturation (%):	i							
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:	i							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	i							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	1112.19							
Undrained Shear Strength (psf)								
Strain at Failure (%):	12.22							
Specific Gravity: 2.72	Pla	stic Limit	:: 0			Liquid Limi	it: 0	
Type: UD	Soil Clas	ssification	: CL			1	:	
Project: Ford 138kV Glendale Ind	netrial Fact	ŀ						
Project Number: 222-032	ustriai Lasi	·						
Sampling Date: 3/18/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR 26E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: ___ ____ Date: __

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/18/2022
Sampling Date: 3/18/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR 26E
Location: Glendale
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/18/2022 Checked By: _____ Date: _____

Unconfined Compression Test

Test Date: 3/18/2022

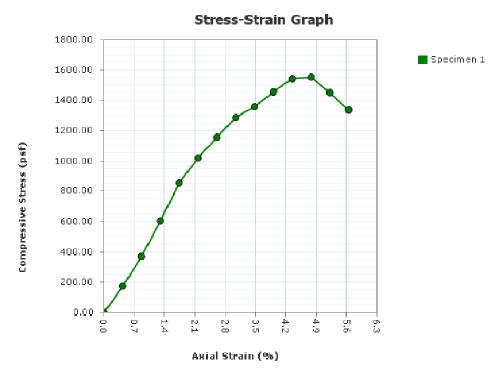
ASTM D2166								
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Before Test		2	3	4	5	6	7	8
Moisture Content (%):	20.9							
Wet Density (pcf)	128.3							
Dry Density (pcf)	106.2							
Saturation (%):	94.8							
Void Ratio:	0.599							
Height (in)	5.7900							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1048.71							
Undrained Shear Strength (psf)	524.35							
Strain at Failure (%):	3.89							
Specific Gravity: 2.72	DI:	stic Limit	. 18			Liquid Limi	t· 21	
Type: UD		ssification				Elquia Ellin	1. 131	
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Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/18/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 26E								
Location: Glendale								
Client Name: LG&E and KU Remarks:								
Remarks.								
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: _____ Date: ___

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 4/11/2022
Sampling Date: 4/11/2022
Sample Number: ST 3
Sample Depth: 14.0-16.0 ft
Boring Number: STR 26E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 4/11/2022 Checked By: _____ Date: _____

Test Date: 4/11/2022

Unconfined Compression Test

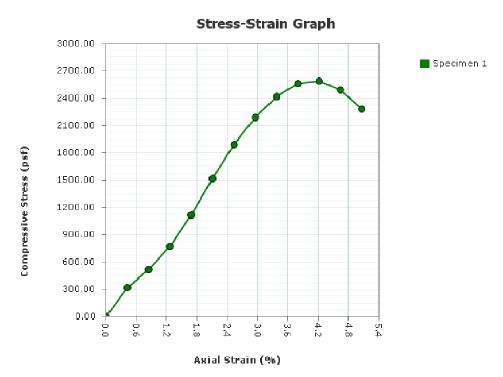
ASTM D2166								
				pecimer	ı Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)	778.30							
Strain at Failure (%):	4.77							
Specific Gravity: 2.72	Pla	stic Limit	: 0			Liquid Limi	it: 0	
Type: UD		ssification	i			1	:	
Project: Ford 138kV Glendale Ind	uctrial East	<u> </u>						
Project Number: 222-032	ustriai Lasi	ı						
Sampling Date: 4/11/2022								
Sample Number: ST 3								
Sample Depth: 14.0-16.0 ft								
Boring Number: STR 26E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3	Specime		Specimen 5		imen 6	Specime		Specimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S	ketch	Failure Sketc	n Failur	e Sketch	Failure Sk	etch Fa	ilure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: ___ _ Date: _

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/18/2022
Sampling Date: 3/18/2022
Sample Number: ST 4
Sample Depth: 24.0-26.0 ft
Boring Number: STR 26E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 $\,$

Test Date: 3/18/2022 Checked By: _____ Date: _____

Unconfined Compression Test

Test Date: 3/18/2022

ASTM D2166								
				pecimer	n Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	4.22					<u> </u>		
Specific Gravity: 2.72	Pla	stic Limit	: 31			Liquid Limi	it: 66	
Type: UD	Soil Clas	sification	: CH					
Project: Ford 138kV Glendale Ind	ustrial East							
Project Number: 222-032								
Sampling Date: 3/18/2022								
Sample Number: ST 4								
Sample Depth: 24.0-26.0 ft								
Boring Number: STR 26E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: ___ ____ Date: __

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



April 21, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 28E Glendale, KY AEI Project No. 222-032



A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 28E, a double circuit, angle dead end steel pole which will be supported by drilled shaft.

Table 1: Tower Details

Churchina	Churchine	Centerline Structure Coordinates		Coordinates	Trans.	Long.	
Structure Number	Structure Description	Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
28E	Double Circuit	90	688.9	37°34′43.39″N	85°53′20.45″W	4266	834

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 57 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered to a depth of about eleven inches. Beneath the surface material, lean clay and fat clay were encountered to the auger refusal depth. The lean clay was typically described as dark brown to reddish brown in color, wet and very

Ford 138kV Glendale Industrial East Structure 18E

April 21, 2022 Page **2** of **3**

soft in soil strength consistency. The fat clay was typically described as reddish brown to gray in color, containing varying amounts of gravel, wet and medium stiff to hard in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 28E - Summary of Boring

			Surface	Auge	r Refusal
Hole			Elevation	Depth	Elevation
No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 28E	37°34′43.39″N	85°53′20.45″W	688.8	35.9	652.9

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 28E	CL	5.0-9.0	0.5	0.3
STR 28E	СН	9.0-36.0	1.2	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial East Structure 18E

April 21, 2022 Page **3** of **3**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Shear Strength (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)			
STR 28E	CL	5.0-9.0	0.02	- (npy) (poi)			
STR 28E	СН	9.0-36.0	0.02	200			

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 28E	CL	5.0-9.0	125.0	0.5	0.5
STR 28E	СН	9.0-36.0	120.0	1.2	0.9

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	<u>PRTIONS</u>		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

 Qu:
 Unconfined Compressive Strength
 N:
 Standard Penetration Value (see above)

 Qp:
 Unconfined Comp. Strength (pocket pent.)
 omc:
 Optimum Moisture content

 LL:
 Liquid Limit, % (Atterberg Limit)
 PL:
 Plastic Limit, % (Atterberg Limit)

 PI:
 Plasticity Index
 mdd:
 Maximum Dry Density

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A	EI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING Shortlenn Divis Glasgan, IV 47141 (271) 981-7220	STR #28E PAGE 1 OF 2									
DATE STARTED _3/17/22 COMPLETED _3/17/22				GROUND WATER LEVELS: AT TIME OF DRILLING								
O DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC LIMIT		REMARKS
		TOPSOIL (11 INCHES) (CL) lean CLAY, dark brown to reddish brown, wet, very soft to	stiff	ST 1	95		0.75	26				Qu = 520 psf
5				ST 2	70		2.5	32	45	25	20	Qu = 2,260 psf
DRILLI		(CH) fat CLAY, trace to some gravel, reddish brown to gray, well medium stiff to hard	.,	SPT 1	100	4-4-3	2.25	35	51	26	25	Qu = 3,350 psf
30				SPT 2	100	30-22-12 (34)	0.25	27				Cobble encountere while drivin spoon
 		weathered LIMESTONE, light gray, medium grained, moderately to hard, thin to thick bedded	/ hard	RC 1	45 (23)							
40				RC 2	16 (0)							Clay seam (38.4'-39.0' Fractured layer (39.1'-44.0'
40 45				RC 3	68 (0)							(39.1'-44.0'

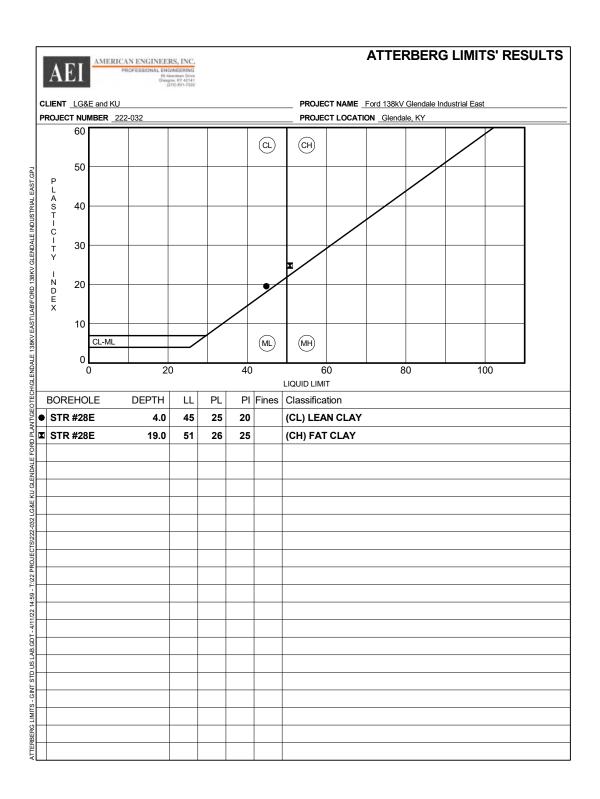
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A	EI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING 65 American Drive (50) (70) 651-720							S		#28E 2 OF 2
		&E and KU PRO			I38kV Glen Glendale, K		dustria	l East			
DEPTH (ft)		MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)		PLASTIC LIMIT	PLASTICITY S	REMARKS
50		weathered LIMESTONE, light gray, medium grained, moderately h to hard, thin to thick bedded (continued) LIMESTONE, light gray, medium grained, moderately hard to hard thin to thick bedded	 RC 4	72 (20)							Vertical
55			RC 5	100 (43)							Vertical fracture (53.3'-54.3')
SECTION BY COLUMNS - CIRT STD US LAB GDT - 4/27/22 1-7/22 PROJECTS S/22/20/22 LOSE NO GLENDALE FORD PLANTICE CHOICE HORGENDALE 198NV BASTUAGEN TO SERVINGE TO CHOICE HORGENDALE 198NV BASTUAGEN TO CHOICE 198NV BASTUAGEN TO CHOICE 198NV BASTUAGE											

APPENDIX C

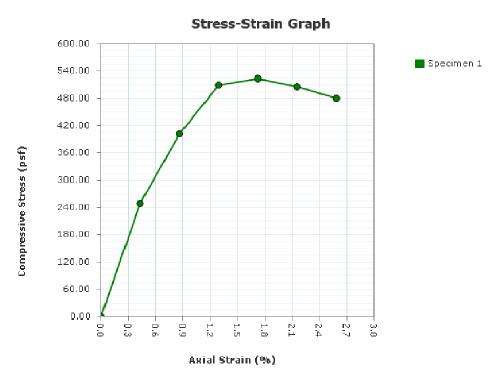
Laboratory Testing Results





Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/18/2022
Sampling Date: 3/18/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR 28E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/18/2022 Checked By: _____ Date: _____

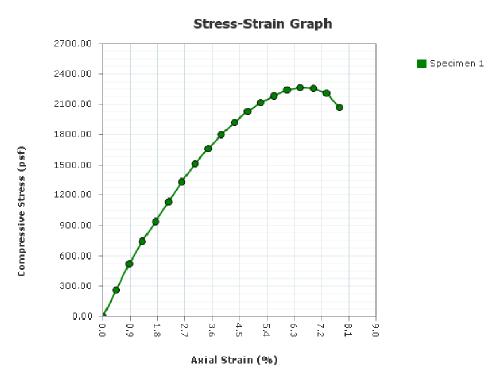
ASTM D2166								
			S	pecimer	n Numb	er		
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	25.7							
Wet Density (pcf)								
Dry Density (pcf)	94.1							
Saturation (%):	86.9							
Void Ratio:								
Height (in)	5.8000							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	1.72							
Specific Gravity: 2.72	Pla	astic Limit:	0		I	Liquid Lim	it: 0	
Type: UD		ssification:			•	orquia omi	!	
72 1			:					
Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/18/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR 28E								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
Remarks.								
Specimen 1 Specimen 2 Specimen 3	Specim	en 4	Specimen !	5 Spec	imen 6	Specime	n7 Sr	ecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		ailure Sket		e Sketch	Failure Sk		ure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/18/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/18/2022
Sampling Date: 3/18/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR 28
Location: Glenadale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 $\,$

Test Date: 3/18/2022 Checked By: _____ Date: _____

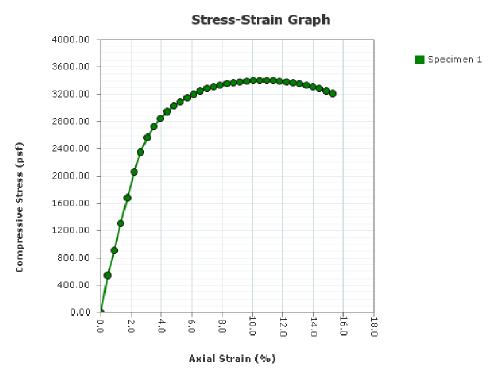
ASTM D2166								
			S	pecimer	n Numbe	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	32.4							
Wet Density (pcf)	118.6							
Dry Density (pcf)	89.6							
Saturation (%):	98.4							
Void Ratio:	0.895							
Height (in)	5.7700							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	6.93							
Specific Gravity: 2.72	Pla	stic Limit:	25		I	iquid Limi	t: 45	
Type: UD	Soil Clas	ssification:	CL			1	:	
Project: Ford 138kV Glendale Ind	uetrial Fact	<u>+</u>						
Project Number: 222-032	astrar Las	•						
Sampling Date: 3/18/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 28								
Location: Glenadale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 ailure Sket		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
ranure Sketch Fanure Sketch Fanure Sketch	Fallure 5	Ketch F	allure Sketi	Fallur	e Sketch	Fallure 5k	etch Faii	ure sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/18/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/18/2022
Sampling Date: 3/18/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR 28
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 $\,$

Test Date: 3/18/2022 Checked By: _____ Date: _____

Test Date: 3/18/2022

ASTM D2166								
				pecimen				
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:		0	2	4	_		7	0
Test Data	1 0	2	3	4	5	6	7	8
Failure Angle (°): Strain Rate (in/min)								
Strain Rate (III/ IIIII) Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):								
Strum at Fundic (70).	15.07					:		:
Specific Gravity: 2.72		stic Limit:				Liquid Limi	t: 51	
Type: UD	Soil Clas	ssification:	CH					
Project: Ford 138kV Glendale Ind	ustrial East	:						
Project Number: 222-032								
Sampling Date: 3/18/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR 28								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3	C	4	C	C		Specime	- 7 C	0
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure Sl		Specimen 5 ailure Sketc		imen 6 e Sketch	Failure Sk		pecimen 8 lure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: ___ _ Date: _

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 3, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE:

Report of Geotechnical Exploration Ford 138kV Glendale Industrial East Structure 31E Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 31E, a double circuit, angle dead end steel pole which will be supported by drilled shaft.

Table 1: Tower Details

	14410 = 14410											
	Churchina	Churching	Height (ft)	Centerline	Structure 0	Trans.	Long.					
	Structure Number	Structure Description		Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)				
ĺ	31E	Double Circuit	85	697.3	37°34′41.03″N	85°53′3.26″W	2,686	1,268				

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 60 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface to a depth of about nine inches. Beneath the surface material, lean clay and fat clay were encountered to the auger refusal depth. The lean clay was typically described as brown in color, wet and soft to very stiff in soil strength consistency. The fat clay was typically described as reddish brown to

Ford 138kV Glendale Industrial East Structure 31E

May 3, 2022 Page **2** of **3**

gray in color, containing varying amounts of sand and gravel, wet and stiff to medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 31E - Summary of Boring

			Surface	Auger Refusal	
Hole			Elevation	Depth	Elevation
No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 31E	37°34'41.03"N	85°53′3.26″W	697.1	49.5	647.6

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

	rable of thirts decreamined besign rarameters									
Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)						
STR 31E	CL	5.0-9.0	1.3	0.8						
STR 31E	CH	9.0-49.5	1.0	0.6						

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial East Structure 31E

May 3, 2022 Page **3** of **3**

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)	
STR 31E	CL	5.0-9.0	0.03	200	
STR 31E	CH	9.0-49.5	0.03	200	

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

	Table 517 Blair 5011 Tarameters for Design 51 Drinea Shares									
Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)					
STR 31E	CL	5.0-9.0	125.0	1.3	0.8					
STR 31E	CH	9.0-49.5	120.0	1.0	1.0					

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

SPT N-VALUE	Qu/Qp (tsf)	<u>PLASTICITY</u>			
2 blows/ft or less	0 - 0.25	Degree of	Plasticity		
2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)		
4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7		
8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22		
15 to 30 blows/ft	2.00 - 4.00	High	over 22		
30 blows/ft or more	> 4.00	_			
	2 blows/ft or less 2 to 4 blows/ft 4 to 8 blows/ft 8 to 15 blows/ft 15 to 30 blows/ft	2 blows/ft or less 0 - 0.25 2 to 4 blows/ft 0.25 - 0.49 4 to 8 blows/ft 0.50 - 0.99 8 to 15 blows/ft 1.00 - 2.00 15 to 30 blows/ft 2.00 - 4.00	2 blows/ft or less 0 - 0.25 Degree of 2 to 4 blows/ft 0.25 - 0.49 Plasticity 4 to 8 blows/ft 0.50 - 0.99 Low 8 to 15 blows/ft 1.00 - 2.00 Medium 15 to 30 blows/ft 2.00 - 4.00 High		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted}.$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

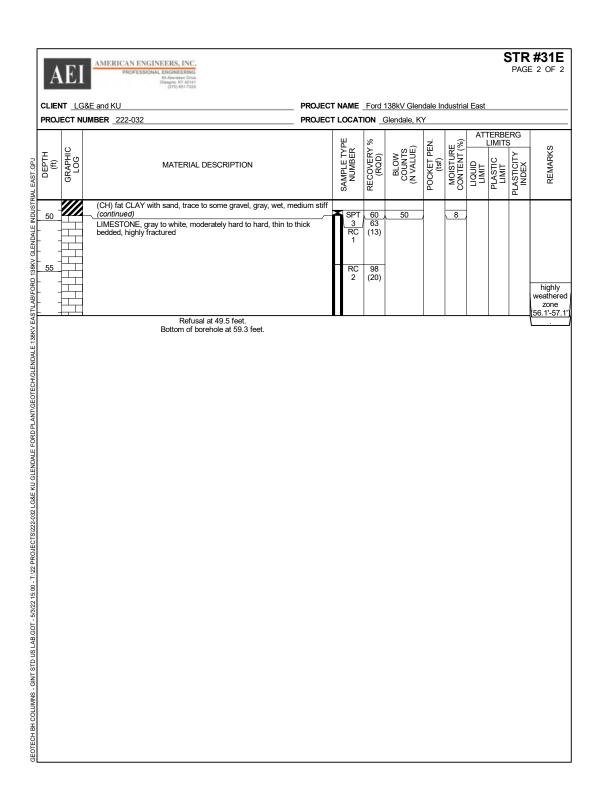
Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

 $T:\ \ 10\ PROJECTS\ \ 210-000\ Folder\ Template\ \ Geotech\ \ REPORTS\ \ Class\ System.doc$

	A	E	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING PROFESSIONAL SUBMITTERS Glasgow, KY 42141 (207) 951-7209								5		#31E = 1 OF 2
	PROJ	ECT N	S&E and KU UMBER _222-032	PROJEC	LOCAT	ION _	138kV Glen Glendale, K		dustria	l East			
			COMPLETED 3/18/22 COMPLETED 3/21/22 CONTRACTOR Adam Thompson										
2			IETHOD HSA/ Diamond impregnated coring bit				LING						
AST.G	LOGG	SED BY	Y Peyton Linder CHECKED BY Aaron Anderson	AT	END OF	DRILL	.ING						
RIALE	NOTE	S		AF	TER DRII	LING							
ALE INDUST	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	VERY % QD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)		ERBE IMITS	}	REMARKS
38KV GLEND) DE				SAMPL	RECOVERY (RQD)	R COL	POCKE	MOIS	LIQUID	PLASTIC LIMIT	PLASTICITY INDEX	REM
AB\FORD 1,	 		TOPSOIL (9 INCHES) (CL) lean CLAY, brown, wet, soft to very stiff	· ~ -	ST 1	100		1.75	24				Qu = 710 psf
KV EAS1∟∪	5				ST 2	95		2.75	22	37	19	18	Qu = 4,600 psf
NDALE 138													
rech/gler	10		(CH) fat CLAY, trace to some gravel, reddish brown, moist to to medium stiff	wet, stiff	SPT 1	100	5-6-7 (13)	3.5	25	-			
.ANT/GEO	 												
E FORD PI													
J GLENDAL					ST 3	85		1.5	30				Qu = 5,090 psf
32 LG&E KI	 												
CTS\222-03	25												
122 PROJE	30				SPT	40	5-3-5	2.0	35				
2 15:00 - T.					2		(8)	_					
GDT - 5/3/2	35												
LD US LAB.	 												
S - GINT STD US	40		(CH) fat CLAY with sand, trace to some gravel, gray, wet, me	dium stiff	ST 4	100		0.75	35	68	24	44	Qu = 1,630 psf
I COLUMN:	 												
EOTECH Br	45 												

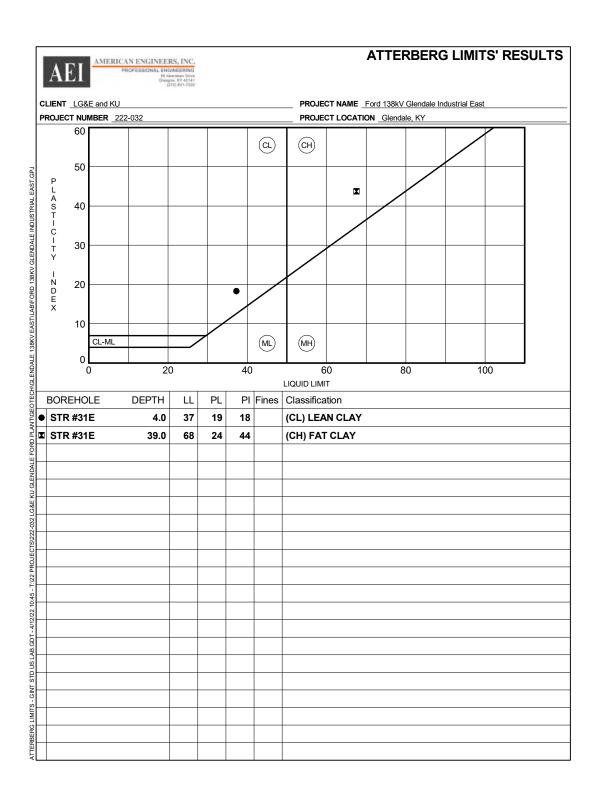
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APPENDIX C

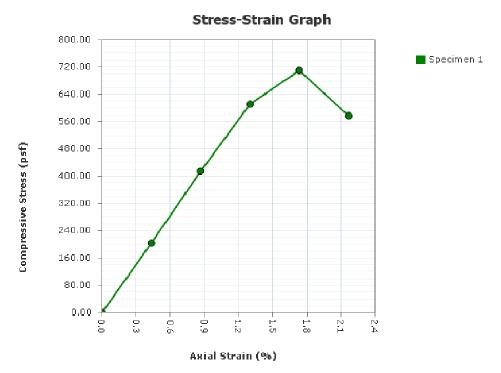
Laboratory Testing Results





Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/21/2022
Sampling Date: 3/21/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #31E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Test Date: 3/21/2022 Checked By: _____ Date: _____

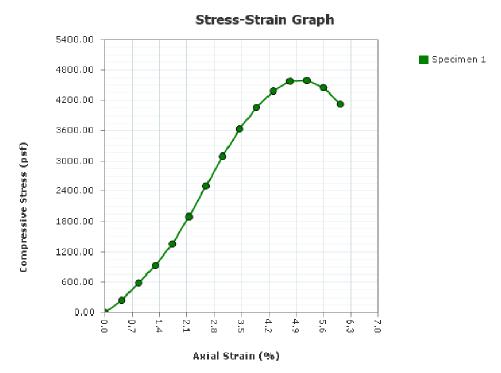
Test Date: 3/21/2022

ASTM D2166								
m 4 m				pecimei	n Numb			
Before Test Moisture Content (%):	1 24.5	2	3	4	5	6	7	8
Wet Density (pcf)	122.0							
Dry Density (pcf)	98.0							
Saturation (%):	90.9							
Void Ratio:	0.732							
Height (in)	5.7700							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	710.98							
Undrained Shear Strength (psf)								
Strain at Failure (%):	1.73		<u> </u>		<u> </u>	<u> </u>	<u> </u>	
Specific Gravity: 2.72	Pla	stic Limit	: 0			Liquid Limi	t: 0	
Type: UD	Soil Clas	sification	: CL					
Project: Ford 138kV Glendale Indo	ustrial East							
Project Number: 222-032								
Sampling Date: 3/21/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #31E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure Sl		Specimen 5 Failure Sketc		rimen 6 e Sketch	Specime Failure Sk		pecimen 8 lure Sketch

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 Checked By: ___ ____ Date: __

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/21/2022
Sampling Date: 3/21/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #31E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032 $\,$

Test Date: 3/21/2022 Checked By: _____ Date: _____

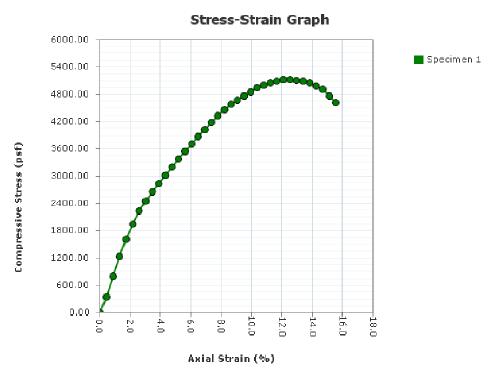
ASTM D2166								
				pecimen				
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%): Void Ratio:								
Void Katio: Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):		_		_	9			
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	5.17							
Specific Gravity: 2.72	D1°	stic Limit:	10			Liquid Limi	it: 37	
Type: UD		ssification:	1			Liquid Liiii	11. 37	
			i CE					
Project: Ford 138kV Glendale Ind	ustrial East	t						
Project Number: 222-032								
Sampling Date: 3/21/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft Boring Number: STR #31E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 Failure Sketch		imen 6 e Sketch	Specime Failure Sk		pecimen 8 lure Sketch
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Checked By: ___ Test Date: 3/21/2022 _ Date: _

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032 Received Date: 3/21/2022 Sampling Date: 3/21/2022 Sample Number: ST 3 Sample Depth: 19.0-21.0 ft Boring Number: STR #31E Location: Glendale, KY Client Name: LG&E and KU

Remarks:

Test Date: 3/21/2022

Checked By: __ Date: _

ASTM D2166								
				pecimer	Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):	97.1							
Void Ratio:	0.834							
Height (in)								
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	13.39							
Specific Gravity: 2.72	Pla	astic Limit:	0		I	iquid Limi	it: 0	
Type: UD		ssification:						
	15							
Project: Ford 138kV Glendale Inde	ustriai Easi	Ţ.						
Project Number: 222-032								
Sampling Date: 3/21/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR #31E								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
ixiliars.								
Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen 5	Spec	imen 6	Specime	n 7 Sp	ecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S	ketch F	ailure Sket	h Failur	e Sketch	Failure Sk	etch Fail	ure Sketch
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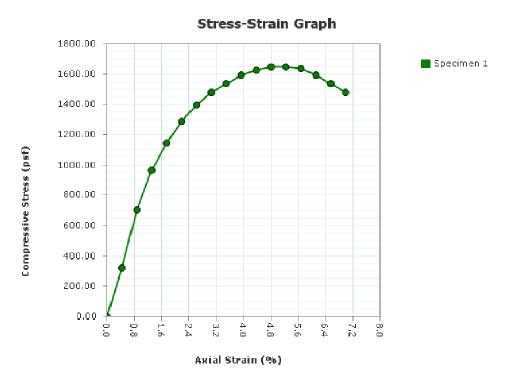
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i	i	11	i i	1.1	i i	i i
- 1	1	1.1	1 1	1.1	1 1	11
i	i	i i	i i	ii	i i	i i
i	i	i i	i i	ii	i i	i i
i	i	i i	i i	ii	i i	i i
i	i	i i	i i	i i	i i	i i
i	i	i i	i i	i i	i i	i i
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Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Checked By: ___ Test Date: 3/21/2022 _ Date: _

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial East

Project Number: 222-032
Received Date: 3/21/2022
Sampling Date: 3/21/2022
Sample Number: ST 4
Sample Depth: 39.0-40.2 ft
Boring Number: STR #31E
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial East Project Number; 222-032

Test Date: 3/21/2022 Checked By: _____ Date: _____

ASTM D2166								
			$\mathbf{S}_{\mathbf{I}}$	pecimer	n Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	35.3							
Wet Density (pcf)	117.1							
Dry Density (pcf)	86.6							
Saturation (%):	99.9							
Void Ratio:	0.962							
Height (in)	5.7200							
Diameter (in)	2.8600							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.00							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	1638.54							
Undrained Shear Strength (psf)	819.27							
Strain at Failure (%):	5.68							
Constitution 14 272	DI.	-(1-T-11)	24			T t t T t t		
Specific Gravity: 2.72		stic Limit				Liquid Limi	11: 68	
Type: UD	5011 Clas	ssification	СП					
Project: Ford 138kV Glendale Ind	ustrial Eas	t						
Project Number: 222-032								
Sampling Date: 3/21/2022								
Sample Number: ST 4								
Sample Depth: 39.0-40.2 ft								
Boring Number: STR #31E								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3	Specim	on 1	Specimen 5	Cara	imen 6	Specime	n 7 C-	pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		Specimen 5 Failure Sketc		e Sketch	Failure Sk		lure Sketch
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Test Date: 3/21/2022 Checked By: _____ Date: ___

2 Report Created: 4/11/2022

Project Name: Ford 138kV Glendale Industrial East Project Number: 222-032

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

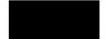
Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 5, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 1BW Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West line in Glendale, KY. This summary is provided for Structure 1BW, a single circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Churchina	Churchine	Hainba	Centerline	Structure 0	Coordinates	Trans.	Long.
Structure Number	Structure Description	Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
1BW	Single Circuit	80	707.3	37°35′47.44″N	85°54′10.63″W	989	290

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 55 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of eleven inches. Beneath the surface material, lean clay was encountered to a depth of 29 feet. Fat clay was encountered from 29 feet to the boring termination depth. The lean clay was typically described as brown to reddish brown in color, wet and medium stiff to stiff in soil strength consistency. The fat

Ford 138kV Glendale Industrial West Structure 1BW

May 5, 2022 Page **2** of **3**

clay was typically described as reddish brown, containing trace to some gravel, wet to saturated and stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 1BW - Summary of Boring

			Surface	Auger Refusal*	
			Elevation	Depth	Elevation
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 1BW	37°35′47.44″N	85°54′10.63″W	707.0	35.0*	672.0*

^{*}Refusal occurred on Boulder

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)								
STR 1BW	CL	5.0-29.0	1.5	0.8								
STR 1BW	СН	29.0-54.5	1.0	0.6								

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
STR 1BW	CL	5.0-29.0	0.025	200
STR 1BW	СН	29.0-54.5	0.010	200

May 5, 2022 Page **3** of **3**

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (qs) (ksf)	
STR 1BW	CL	5.0-29.0	125.0	1.5	1.0	
STR 1BW	СН	29.0-55.0	120.0	1.0	1.0	

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





Attachment 3 to Response to PSC-4 Question No. 1
Page 234 of 592
McFarland

APPENDIX B

Boring Logs



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling</u>: Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLASTICITY				
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity			
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)			
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7			
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22			
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22			
Hard	30 blows/ft or more	> 4.00					

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
4 blows/ft or less	Boulders	12 inch diameter or more
4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
30 to 50 blows/ft		Medium – 1/2 to 1 inch
50 blows/ft or more		Fine – ¼ to ½ inch
	Sand	Coarse – 0.6mm to 1/4 inch
RTIONS		Medium – 0.2mm to 0.6mm
<u>Percent</u>		
1 - 10		Fine -0.05 mm to 0.2 mm
11 - 20		
21 – 35	Silt	0.05mm to 0.005mm
36 - 50		
	Clay	0.005mm
	4 blows/ft or less 4 to 10 blows/ft 10 to 30 blows/ft 30 to 50 blows/ft 50 blows/ft or more RTIONS Percent 1 - 10 11 - 20 21 - 35	4 blows/ft or less 4 to 10 blows/ft 10 to 30 blows/ft 30 to 50 blows/ft 50 blows/ft or more Sand RTIONS Percent 1 - 10 11 - 20 21 - 35 36 - 50 Boulders Cobbles Gravel Savel Savel Savel Sand Sand

NOTES

 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted.}$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

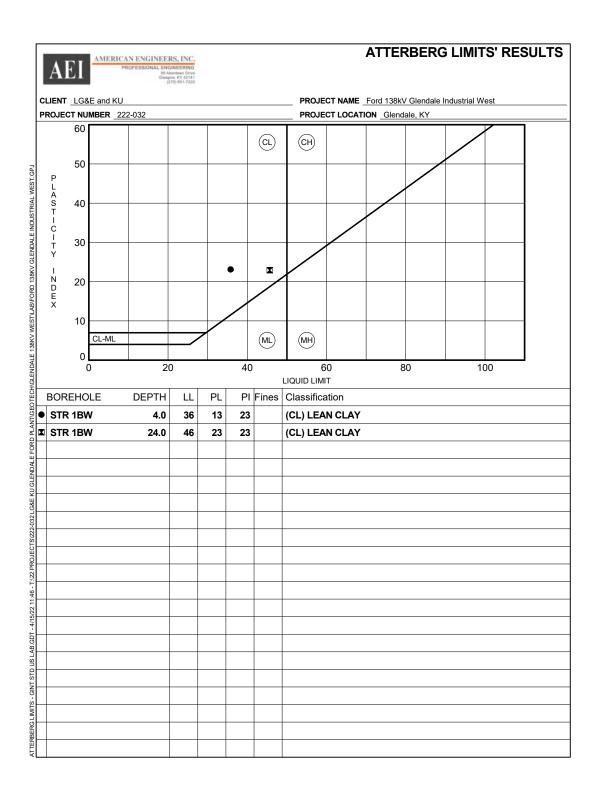
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CLIE	NT LG	&E and KU	PROJECT NAME	Ford	138kV Gle	ndale	Indust	rial W	est			
		JMBER 222-032	PROJECT LOCA			ΚY						
DATI	E STAR	TED 3/28/22 COMPLETED 3/29/22	GROUND ELEVA	TION	707 ft							
DRIL	LING C	ONTRACTOR Strata Group, LLC	GROUND WATER	R LEVE	LS:							
פ		ETHOD HSA/ Diamond impregnated coring bit	AT TIME O	F DRIL	LING							
LOG	GED BY	Jacob Cowan CHECKED BY Aaron Anderson	AT END OF	DRILL	ING							
NOT	ES		AFTER DR	ILLING								
8			М	%	_	ż	@	AT	TERBE LIMITS	ERG		
DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID		PLASTICITY INDEX	REMARKS	
0	7 1/2 . 7	TOPSOIL (11 INCHES)	SPT		3-3-5	1.25	24			Δ.		
-		(CL) lean CLAY, brown to reddish brown, wet, medium sti			(8)	-		1				
5	<i>\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\</i>											
			ST	70		3.75	23	36	13	23	Qu = 4,820	
≱ }-	<i>-{////</i>		1					-		_	psf	
138	<i>\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\</i>										•	
	*////											
10	-{////		SPT 2	100	4-5-6 (11)	2.5	24					
5	<i>\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\</i>			1		1						
] - 15	-{/////		ST	100		3.5	26	-				
13			2			0.0						
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-	-{/////											
20			SPT	100	3-5-6	2.0	28	1				
5	-{/////		3	\vdash	(11)	 		1				
9	-////											
1325			-	100		0.0	07	40	00	00	0 4.000	
25	-{////		ST 3	100		3.0	27	46	23	23	Qu = 1,860 psf	
2												
2	-////											
30		(CH) fat CLAY, trace to some gravel, reddish brown, wet	SPT	100	3-4-7	1.75	36	1				
8-		saturated, stiff	4	+-	(11)	+-		+				
+												
1000												
35			ST 4	100		1.0	36	-			Used NQ	
<u>-</u>				1							coring steel	
3											to reach termination	
40											depth Boring	
40											refused on	
SIMINO.	-///										a boulder at 35.0'	
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45												
45	-///											
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		(Continued Next Page)										

A	EI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING SO AND COMMON CONTROL (1970) 885-7229								5	STR PAGE	1BW 2 OF 2
CLIE	NT LG	&E and KU	PROJECT NAME Ford 138kV Glendale Industrial West									
PRO.	JECT N	JMBER <u>222-032</u> F	PROJECT L	OCAT	ION _	Glendale, ł	(Y					
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DAMAN DISTRIBUTION OF THE PROPERTY OF THE PROP	NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	L	PLASTIC IMIT		REMARKS
50		(CH) fat CLAY, trace to some gravel, reddish brown, wet to saturated, stiff (continued)										
	****	Refusal at 35.0 feet. Bottom of borehole at 54.5 feet.						1				
50												

APPENDIX C

Laboratory Testing Results

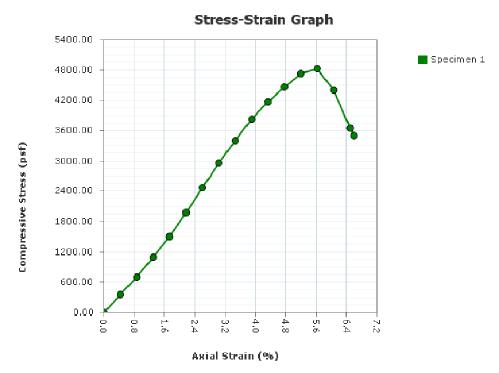




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 1
Sample Depth: 4.0-6.0 ft
Boring Number: STR 1BW
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/12/2022 Checked By: ______ Date: _____

Unconfined Compression Test

ASTM D2166								
			$\mathbf{S}_{]}$	pecimer	Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf) Strain at Failure (%):								
Strain at Failure (%):	3.62	i	<u> </u>			<u> </u>		
Specific Gravity: 2.72	Pla	stic Limit:	13		I	iquid Limi	t: 36	
Type: UD	Soil Cla	ssification:	CL					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/12/2022								
Sample Number: ST 1								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 1BW								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specim Failure S		Specimen 5 ailure Sketc		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
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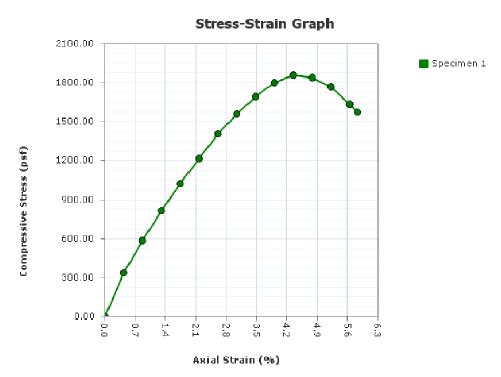
Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/12/2022 Checked By: ___ _ Date: _

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 3
Sample Depth: 24.0-26.0 ft
Boring Number: STR 1BW
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/12/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Unconfined Compression Test

ASTM D2166								
				pecimer	ı Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)	2.8700							
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	4.34						<u> </u>	
Specific Gravity: 2.72	Pla	stic Limit:	13		I	iquid Limi	it: 36	
Type: UD	Soil Clas	ssification:	CL					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/12/2022								
Sample Number: ST 3								
Sample Depth: 24.0-26.0 ft								
Boring Number: STR 1BW								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
<u> </u>								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 ailure Sketo		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/12/2022 Checked By: _____ Date: _____

Report Created: 4/15/2022 2

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 5, 2022



One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 1W Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 1W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Churchina	Churchine	Hainba	Centerline	Structure 0	Trans.	Long.		
Structure Number	Structure Description	Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)	
1W	Double Circuit	85	708.8	37°35′46.46″N	85°54′11.10″W	1,105	1,486	

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 42 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of ten inches. Beneath the surface material, lean clay was encountered to a depth of 19 feet. Fat clay was encountered from 19 feet to the auger refusal depth. The lean clay was typically

described as yellowish brown with gray mottling, moist to wet and stiff to very stiff in soil strength consistency. The fat clay was typically described as reddish brown in color, containing trace to some gravel, wet to saturated and stiff to very soft to medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 1W - Summary of Boring

			Surface	Auge	r Refusal
			Elevation	Depth	Elevation
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 1W	37°35′46.46″N	85°54′11.10″W	706.8	42.0	664.8

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 1W	CL	5.0-19.0	1.6	0.9
STR 1W	CH	19.0-24.0	1.7	0.9
STR 1W	CH	24.0-42.0	0.6	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial West Structure 1W

May 5, 2022 Page **3** of **4**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ϵ_{50})	Initial Soil Stiffness (k _{py}) (pci)
STR 1W	CL	5.0-19.0	0.04	200
STR 1W	СН	19.0-24.0	0.02	200
STR 1W	СН	24.0-42.0	0.02	-

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 1W	CL	5.0-19.0	125.0	1.6	1.0
STR 1W	СН	19.0-24.0	120.0	1.7	1.0
STR 1W	СН	24.0-42.0	57.6	0.6	0.7

^{*}Effective Unit Weight accounts for Buoyancy

Ford 138kV Glendale Industrial West Structure 1W

May 5, 2022 Page **4** of **4**

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





O SOIL TEST BORING

ALL BORING LOCATIONS ARE APPROXIMATE

APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling</u>: Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	<u>PLASTICITY</u>			
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity		
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)		
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7		
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22		
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22		
Hard	30 blows/ft or more	> 4.00	•			

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY SPT N-VALUE		PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
-		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO			Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 – 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted.}$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

 Qu:
 Unconfined Compressive Strength
 N:
 Standard Penetration Value (see above)

 Qp:
 Unconfined Comp. Strength (pocket pent.)
 omc:
 Optimum Moisture content

 LL:
 Liquid Limit, % (Atterberg Limit)
 PL:
 Plastic Limit, % (Atterberg Limit)

 PI:
 Plasticity Index
 mdd:
 Maximum Dry Density

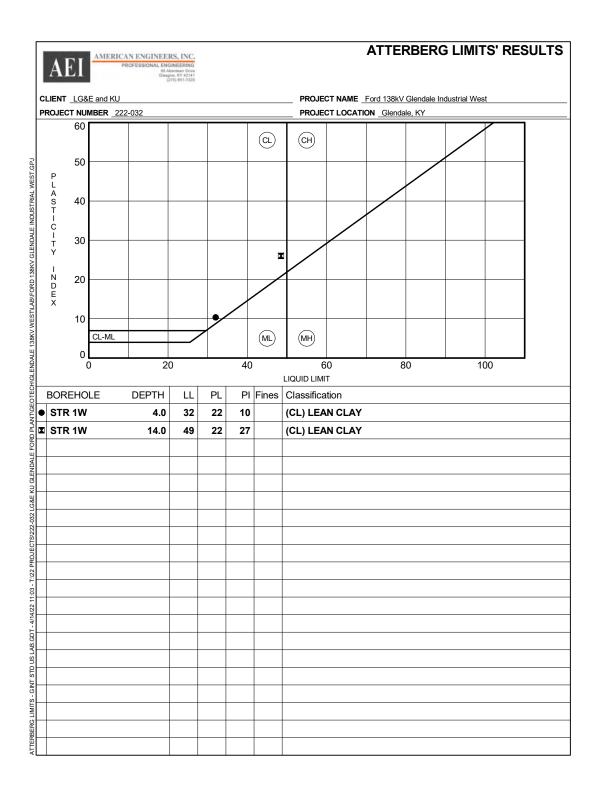
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P	CLIENT LG&E and KU PROJECT NUMBER 222-032 DATE STARTED 3/29/22 COMPLETED 3/29/22 DRILLING CONTRACTOR Strata Group, LLC DRILLING METHOD Hollow Stem Auger			PROJECT LOCATION Glendale, KY GROUND ELEVATION 706.8 ft GROUND WATER LEVELS: AT TIME OF DRILLING 24.00 ft / Elev 682.80 ft									
ul.		S	/ Jacob Cowan CHECKED BY Aaron Anderson		TER DRI		ING 						
5	O (ff)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	I	PLASTIC IMIT		REMARKS
1	-		TOPSOIL (10 INCHES) (CL) lean CLAY, yellowish brown with gray mottling, moist to stiff to very stiff	to wet,	SPT 1	93	4-5-4 (9)	3.0	24				
SONV WEST LAB	5		Suit to very suit		ST 1	95		4.5+	21	32	22	10	Qu = 3,620 psf
- I - I - I - I - I - I - I - I - I - I	10				SPT 2	100	4-8-9 (17)	3.5	22				
LAND TEAN I GEOTIE	15				ST 2	80		2.5	29	49	22	27	Qu = 3,270 psf
L VO GENDALE	20 -		(CH) fat CLAY, trace to some gravel, reddish brown, wet to saturated, stiff to very soft to medium stiff		SPT 3	100	4-4-6 (10)	2.0	29				
100000000000000000000000000000000000000	25 -		₹		ST 3	75		3.5	39				Qu = 4,330 psf
1000	30				SPT 4	33	0-0-0 (0)	0.5	37				
žΓ	35				ST 4	35		-	48				Shelby Tube crushed by
20018 1819 - 581	40 -				SPT 5	100	4-3-2 (5)	<0.25	52				cobbles .
GEOTECH BH COLUMNS - GINT STD US LAB			Refusal at 42.0 feet. Bottom of borehole at 42.0 feet.			-		•	•		•		

APPENDIX C

Laboratory Testing Results

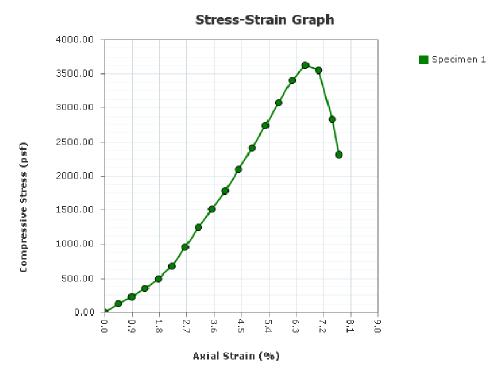




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 1
Sample Depth: 4.0-6.0 ft
Boring Number: STR 1W
Location: Glendale KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/12/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166			C	•	NT 1			
Defens Test		2		pecimer			-	
Before Test	1 20.1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf) Dry Density (pcf)								
Saturation (%):	i							
Void Ratio:								
Height (in)	:							
Diameter (in)								
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:	i							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):		_						
Strain Rate (in/min)	i							
Strain Rate (%/min):	i							
Unconfined Compressive Strength (psf)	3623.97							
Undrained Shear Strength (psf)	1811.98							
Strain at Failure (%):	6.60							
Specific Gravity: 2.72	Pla	astic Limit:	22			Liquid Limi	t. 32	
Type: UD		ssification:				Elquia Ellin	10.	
			:					
Project: Ford 138kV Glendale Ind	lustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/12/2022								
Sample Number: ST 1								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 1W Location: Glendale KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specim Failure S		Specimen 5 ailure Sketo		imen 6 e Sketch	Specime Failure Sk		pecimen 8 lure Sketch
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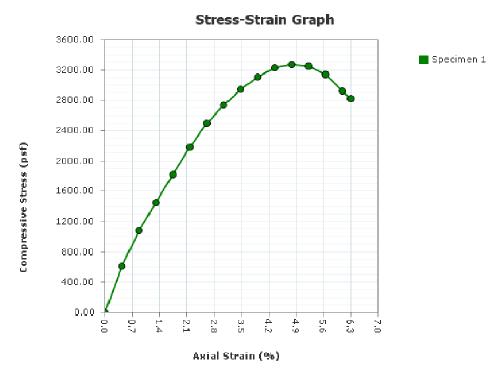
Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/12/2022 Checked By: ___ _ Date: _

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 1
Sample Depth: 14.0-16.0 ft
Boring Number: STR 1W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/12/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166								
				pecimei	n Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):	105.0							
Void Ratio:	0.761							
Height (in)								
Diameter (in)	2.8100							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.05							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	3272.93							
Undrained Shear Strength (psf)	1636.47							
Strain at Failure (%):	4.78							
Specific Gravity: 2.72	DI.	stic Limit:	100			Liquid Lim	:1. 10	
			i		1	Liquia Lim	IT: 49	
Type: UD	5011 Clas	ssification:	CL					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/12/2022								
Sample Number: ST 1								
Sample Depth: 14.0-16.0 ft								
Boring Number: STR 1W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 Failure Sketo		eimen 6 e Sketch	Specime Failure Sl		becimen 8 lure Sketch
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/12/2022 Checked By: ___ ___ Date: __

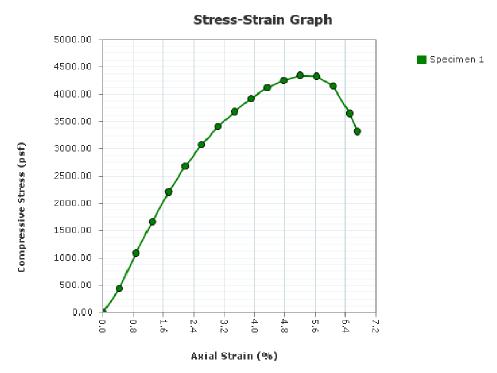
Report Created: 4/14/2022

2

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 3
Sample Depth: 24.0-26.0 ft
Boring Number: STR 1W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/12/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Unconfined Compression Test

ASTM D2166								
			$\mathbf{S}_{\mathbf{l}}$	pecimer	Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)	i							
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)	1							
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	5.63							
Specific Gravity: 2.72	Pla	stic Limit:	0		I	Liquid Limi	t: 0	
Type: UD		ssification:	i					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/12/2022								
Sample Number: ST 3								
Sample Depth: 24.0-26.0 ft								
Boring Number: STR 1W Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Terrarko.								
Specimen 1 Specimen 2 Specimen 3	Specim	en 4	Specimen 5	Spec	imen 6	Specime	n7 Sı	pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S	ketch F	ailure Sketc	h Failur	e Sketch	Failure Sk	etch Fai	lure Sketch
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/12/2022 Checked By: ___ _ Date: _

2 Report Created: 4/14/2022

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 5, 2022

RE:



LG&E and KU One Quality Street Lexington, KY 40507

> Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 2W Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West project in Glendale, KY. This summary is provided for Structure 2W, a double circuit, tangent dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Characteristic	Characteria	11-1-64	Centerline	Structure C	Trans.	Long.	
Structure Number	Structure Description	Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
2W	Double Circuit	105	714.3	37°35′44.24″N	85°54′12.55″W	1,055	4,790

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 50 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of five inches. Beneath the surface material, lean clay was encountered to a depth of 19 feet. Fat clay was

Ford 138kV Glendale Industrial West Structure 2W

May 5, 2022 Page **2** of **3**

encountered from 19 feet to the auger refusal depth. The lean clay was typically described as brown to reddish brown in color, wet and very stiff to stiff in soil strength consistency. The fat clay was typically described as reddish brown to brown in color, containing trace to some gravel, saturated to wet and stiff to medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 2W - Summary of Boring

			Surface	Auge	r Refusal
			Elevation	n Depth Elevation	
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 2W	37°35′44.24″N	85°54′12.55″W	711.7	49.3	662.4

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

	Tubic of IVIII / ID GCC II	commean Des	ng arannet	
Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 2W	CL	5.0-19.0	1.9	1.0
STR 2W	CH	19.0-49.3	1.4	0.8

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial West Structure 2W

May 5, 2022 Page **3** of **3**

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ϵ_{50})	Initial Soil Stiffness (k _{py}) (pci)
STR 2W	CL	5.0-19.0	0.02	200
STR 2W	СН	19.0-49.3	0.01	200

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 2W	CL	5.0-19.0	125.0	1.9	1.0
STR 2W	CH	19.0-49.3	120.0	1.4	1.1

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer

Dusty Barrett, PE, PMP Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





O SOIL TEST BORING

DRAWING NOT TO SCALE ALL BORING LOCATIONS ARE APPROXIMATE

VECTS/222-032 LGAE KU Glendale r/Geotech/Glendale 138kV West r/Support Hormation <u>}-1</u>

APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
•		Sand	Coarse – 0.6mm to ¼ inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

 Qu:
 Unconfined Compressive Strength
 N:
 Standard Penetration Value (see above)

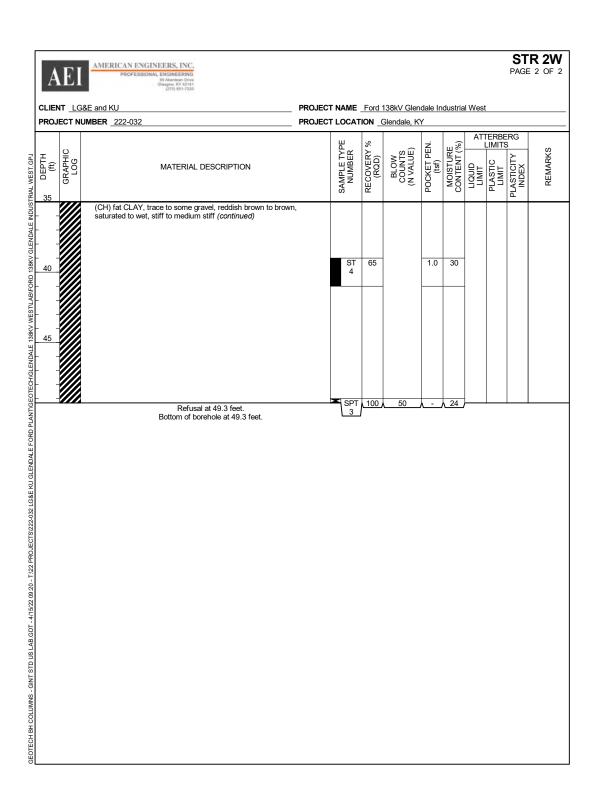
 Qp:
 Unconfined Comp. Strength (pocket pent.)
 omc:
 Optimum Moisture content

 LL:
 Liquid Limit, % (Atterberg Limit)
 PL:
 Plastic Limit, % (Atterberg Limit)

 PI:
 Plasticity Index
 mdd:
 Maximum Dry Density

 $T:\label{thm:continuous} T:\label{thm:continuous} T:\label{thm:continuous} T:\label{thm:continuous} PROJECTS\cite{Continuous} Class System.doc$

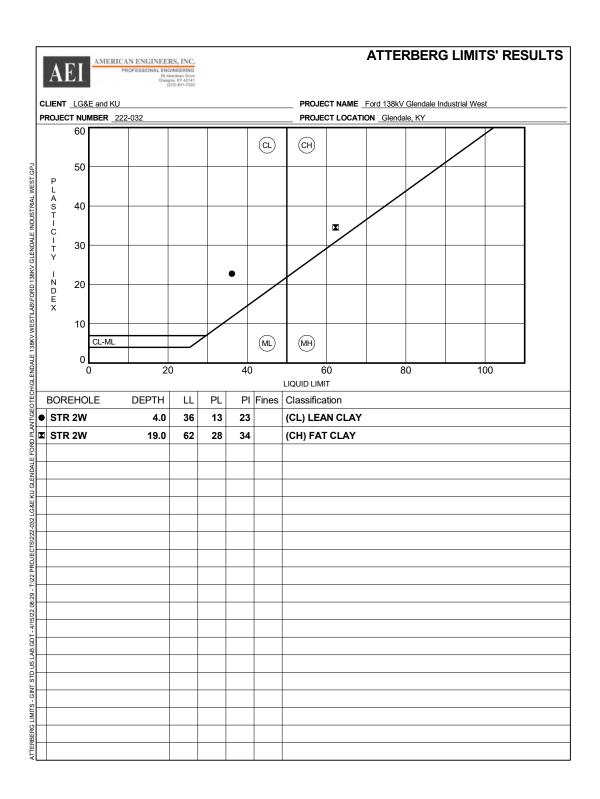
	A	EI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGAMERING GRAPHIC DIVIN GRAPH, VA 2141 (272) 851-7223										R 2W E 1 OF 2
F	PROJ	ECT N		PROJECT	LOCAT	ION _	I38kV Glen Glendale, K		dustria	l West	<u>:</u>		
-			TED _3/30/22 COMPLETED _3/30/22 ONTRACTOR _Adam Thompson			_		—					
<u>.</u>	RILL	ING M	ETHOD Hollow Stem Auger				.ING						
≤I .	.OGG		/ Adam Cash CHECKED BY Aaron Anderson		END OF TER DRII		ING						
H SIN						%					TERBE		
38KV GLENDALE IN	0 (#)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY 9 (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC	PLASTICITY INDEX	REMARKS
- I LABIFORD				f	ST 1	90		4.5+	25				
ALE 138KV WE	5				ST 2	85		2.0	23	36	13	23	Qu = 4,550 psf
ANI/GEOIECH/GLENDA	- - - 10				SPT 1	100	5-6-7 (13)	-	23				
U GLENDALE FORD PLA	- - - 15												
EC13/222-032 LG&E	-		(CH) fat CLAY, trace to some gravel, reddish brown to brown		ST	100		3.5	27	62	28	34	Qu = 3,660
2 09:20 - 1:V22 PROJECT	<u>20</u> - -		saturated to wet, stiff to medium stiff		3								psf
- 4/15/2	- 25												
SID US LAB.GD	-												
OMNS - GINI STD	30				SPT 2	67	4-4-4 (8)	-	38				
EOTECH BH COLUMN.	- - -												
5	35		(Continued Next Page)										



APPENDIX C

Laboratory Testing Results

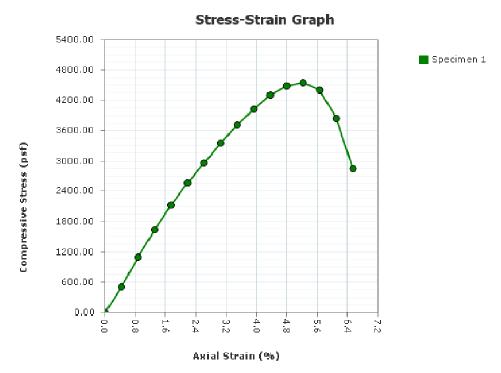




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032 Received Date: 4/12/2022 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: STR 2W Location: Glendale, KY Client Name: LG&E and KU

Remarks:

Test Date: 4/12/2022

Checked By: ___ Date: _

Report Created: 4/14/2022

Unconfined Compression Test

ASTM D2166								
			Sr	oecimer	Numb	er		
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	20.5							
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):	i							
Void Ratio:	0.594							
Height (in)	5.7400							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	4556.59							
Undrained Shear Strength (psf)	2278.29							
Strain at Failure (%):	5.23							
Specific Gravity: 2.72	D1a	stic Limit:	12			Liquid Limi	i+. 26	
Type: UD		ssification:	i			Elquiu Ellii	11. 30	
			i CL					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/12/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 2W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen 5	Spec	imen 6	Specime	n 7 S	pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		ailure Sketch		e Sketch	Failure Sk		ilure Sketch
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	i				İ			
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

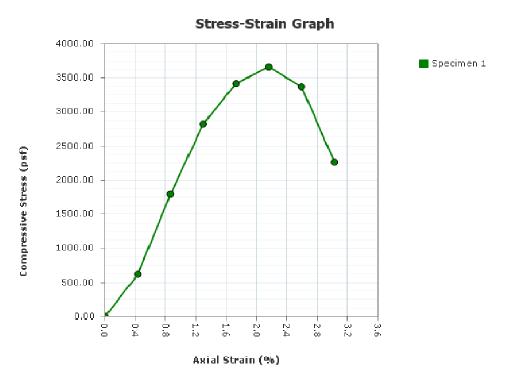
Test Date: 4/12/2022 Checked By: ___

2 Report Created: 4/14/2022

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR 2W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/12/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Report Created: 4/15/2022

Unconfined Compression Test

ASTM D2166								
			$\mathbf{S}_{\mathbf{J}}$	pecimer	Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)	87.0							
Saturation (%):	78.4							
Void Ratio:	0.952							
Height (in)	5.7900							
Diameter (in)	2.8000							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.07							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)	1832.76							
Strain at Failure (%):	2.16							
Specific Gravity: 2.72	Pla	astic Limit:	28		ī	iquid Limi	t: 62	
Type: UD		ssification:	i		1	aquiu Emi	. 02	
			CII					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/12/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR 2W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3	Specim	en 4	Specimen 5	Snec	imen 6	Specime	n 7 Sr	ecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		ailure Sketc		e Sketch	Failure Sk		ure Sketch
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/12/2022 Checked By: ___ _ Date: _

2 Report Created: 4/15/2022

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 5, 2022



One Quality Street Lexington, KY 40507

RE:

Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 3W Glendale, KY AEI Project No. 222-032



A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West project in Glendale, KY. This summary is provided for Structure 3W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Haiaba	Centerline	Structure 0	Trans.	Long.	
		Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
3W	Double Circuit	110	707.1	37°35′40.75″N	85°54′14.84″W	3,929	6,705

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 50 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of six inches. Beneath the surface material, lean clay was encountered to a depth of 14 feet. Fat clay was encountered from 14 feet to the boring termination depth. The lean clay was typically

described as reddish brown to brown in color, moist and very stiff in soil strength consistency. The fat clay was typically described as reddish brown to brown in color, containing varying amounts of gravel (gravel contents increased with depth), moist to saturated and medium stiff to very stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was not encountered at Structure 3W.

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 2: MFAD Geotechnical Design Parameters

	Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
ĺ	STR 3W	CL	5.0-14.0	2.5	1.5
	STR 3W	СН	14.0-50.5	1.4	0.8

Lateral soil parameters recommended for drilled shaft design are shown below in Table 3 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 3: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)	
STR 3W	CL	5.0-14.0	0.015	400	
STR 3W	СН	14.0-50.5	0.015	200	

Ford 138kV Glendale Industrial West Structure 3W

May 5, 2022 Page **3** of **3**

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 4. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 4: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 3W	CL	5.0-14.0	125.0	2.5	1.1
STR 3W	СН	14.0-50.5	120.0	1.4	1.1

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





DRAWING NOT TO SCALE ALL BORING LOCATIONS ARE APPROXIMATE

CHECKED BY: D. BARRETT DATE 04-13-2022 A. ANDERSON AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220

PROJECT: FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 3W GLENDALE, KY CLIENT: LG&E and KU BORING LAYOUT

APPENDIX B

Boring Logs



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling</u>: Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY Very Soft	SPT N-VALUE	Qu/Qp (tsf)	PLASTICITY				
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity			
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)			
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7			
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22			
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22			
Hard	30 blows/ft or more	> 4.00					

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
4 blows/ft or less	Boulders	12 inch diameter or more
4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
30 to 50 blows/ft		Medium – 1/2 to 1 inch
50 blows/ft or more		Fine – ¼ to ½ inch
	Sand	Coarse – 0.6mm to 1/4 inch
RTIONS		Medium – 0.2mm to 0.6mm
Percent		
1 - 10		Fine -0.05 mm to 0.2 mm
11 - 20		
21 – 35	Silt	0.05mm to 0.005mm
36 - 50		
	Clay	0.005mm
	4 blows/ft or less 4 to 10 blows/ft 10 to 30 blows/ft 30 to 50 blows/ft 50 blows/ft or more RTIONS Percent 1 - 10 11 - 20 21 - 35	4 blows/ft or less 4 to 10 blows/ft 10 to 30 blows/ft 30 to 50 blows/ft 50 blows/ft or more Sand RTIONS Percent 1 - 10 11 - 20 21 - 35 36 - 50

NOTES

 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted.}$

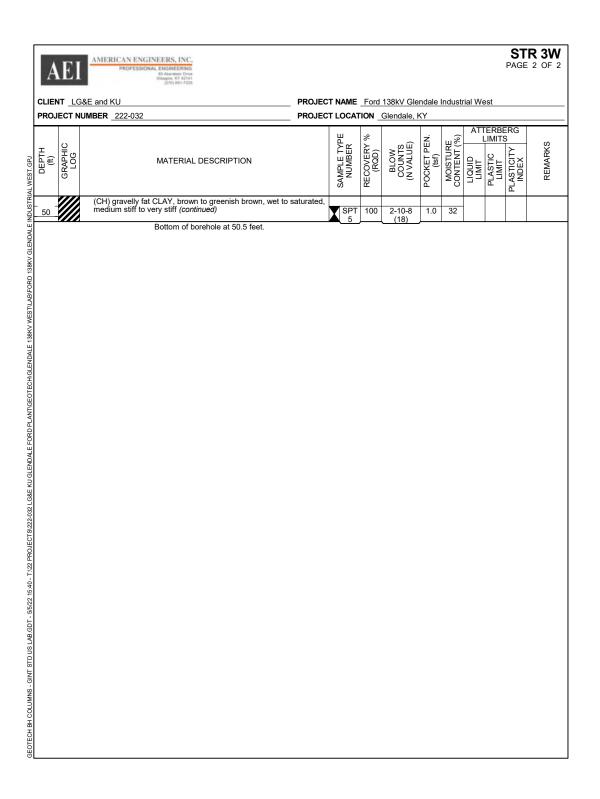
Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

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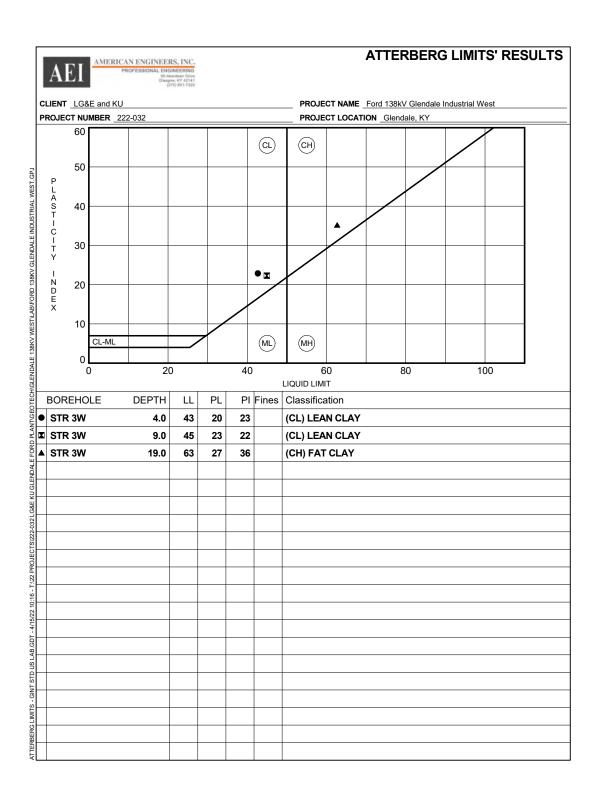
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CLI	ENT LG	&E and KU	PROJECT N	NAME	Ford	138kV Gle	ndale l	ndustr	ial We	est		
	ROJECT NUMBER 222-032			PROJECT LOCATION Giendale, KY								
DA	DATE STARTED 3/29/22 COMPLETED 3/29/22			LEVAT	ION _	704.6 ft						
	RILLING CONTRACTOR Adam Thompson			/ATER	LEVE	LS:						
ופ	RILLING METHOD Hollow Stem Auger			ME OF	DRILL	ING						
LO	GGED BY	Aaron Anderson CHECKED BY Aaron Anderson	AT EN	ND OF	DRILL	ING						
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DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	71.77.71	- 、TOPSOIL (6 INCHES)	<i>c</i> -								ш	
		(CL) lean CLAY, reddish brown to brown, moist, very stiff	′									
5				ST 1	85		2.5	22	43	20	23	Qu = 5,630 psf
10				ST 2	100		4.0	24	45	23	22	Qu = 4,350 psf
15		(CH) fat CLAY, reddish brown, moist, stiff to very stiff	X	SPT 1	100	3-4-6 (10)	3.25	24				
20				ST 3	65		2.0	24	63	27	36	Qu = 4,570 psf
25		(CH) fat CLAY, trace to some gravel, reddish brown with bl mottle, moist to wet, medium stiff	lack	SPT 2	100	2-4-6 (10)	2.5	21				
30			X	SPT 3	87	4-4-3 (7)	1.5	30				
1 1 1 1				07			4.5					
35				ST 4	75		1.5	32				
40		(CH) gravelly fat CLAY, brown to greenish brown, wet to sa medium stiff to very stiff	aturated,	ST 5	65		2.0	35				
45			¥	SPT	100	6-5-3	1.0	43				
-		(Continued Next Page)		4_		(8)						



APPENDIX C

Laboratory Testing Results

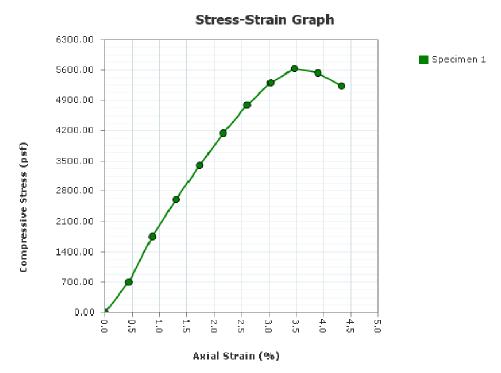




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/11/2022
Sampling Date: 4/11/2022
Sample Number: ST 1
Sample Depth: 4.0-6.0 ft
Boring Number: STR 3W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 $\,$

Test Date: 4/11/2022 Checked By: _____ Date: _____

Report Created: 4/13/2022

Unconfined Compression Test

ASTM D2166								
				pecimei	n Numb			
Before Test	1	. 2	3	4	5	6	7	8
Moisture Content (%):	i							
Wet Density (pcf)	i							
Dry Density (pcf)	i							
Saturation (%):	i							
Void Ratio:	;							
Height (in)	i							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	5635.80							
Undrained Shear Strength (psf)	2817.90							
Strain at Failure (%):	3.47							
Specific Gravity: 2.72	D1.	astic Limit:	20		Т	Liquid Lim	i+ 12	
Type: UD		ssification:			1	Elquiu Ellii	11. [43	
* .			:					
Project: Ford 138kV Glendale Inc	lustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/11/2022								
Sample Number: ST 1								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 3W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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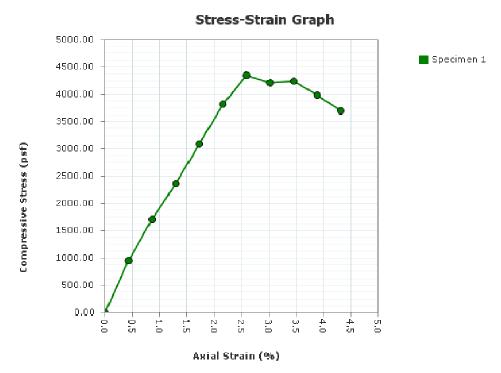
Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ___ Test Date: 4/11/2022 _ Date: _

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/11/2022
Sampling Date: 4/11/2022
Sample Number: ST 2
Sample Depth: 9.0-11.0 ft
Boring Number: STR 3W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/11/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Test Date: 4/11/2022

Unconfined Compression Test

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)	2.8500							
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	2.59							
Specific Gravity: 2.72	Pla	stic Limit:	23		I	iquid Limi	it: 45	
Type: UD	Soil Clas	ssification:	CL				•	
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/11/2022								
Sample Number: ST 2								
Sample Depth: 9.0-11.0 ft								
Boring Number: STR 3W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 Checked By: _____

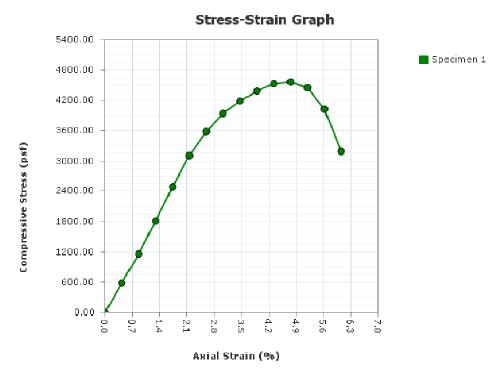
Report Created: 4/13/2022 2

_ Date: _

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR 3W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/12/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Unconfined Compression Test

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	36.2							
Wet Density (pcf)	116.4							
Dry Density (pcf)	85.5							
Saturation (%):	99.8							
Void Ratio:	0.986							
Height (in)	5.7800							
Diameter (in)								
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	4.76		<u> </u>					
Specific Gravity: 2.72	Pla	stic Limit:	27		I	Liquid Limi	it: 63	
Type: UD	Soil Clas	ssification:	CH				•	
Project: Ford 138kV Glendale Ind	netrial Was	·+						
Project Number: 222-032	ustriar vvc.	,,,						
Sampling Date: 4/12/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR 3W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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1	1	1		- 11		1	1.1	

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/12/2022 Checked By: ___ _ Date: _

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 5, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 6W Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West project in Glendale, KY. This summary is provided for Structure 6W, a double circuit, tangent steel pole which will be supported by direct embedment.

Table 1: Tower Details

	140.0 21 101101 204410								
Structure	Structure	Height	Centerline	Structure 0	Trans.	Long.			
Number	Description	(ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)		
6W	Double Circuit	115	675.2	37°35′21.48″N	85°54′13.97″W	942	288		

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 26 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of five inches. Beneath the surface material, lean clay was encountered to a depth of nine feet. Fat clay was encountered from nine feet to the auger refusal depth. The lean clay was typically

Ford 138kV Glendale Industrial West Structure 6W

May 5, 2022 Page **2** of **3**

described as brown in color, moist to wet and soft in soil strength consistency. The fat clay was typically described as reddish brown to brown and gray in color, containing varying amounts of gravel, wet and medium stiff to stiff in soil strength consistency. A small layer of gravel (less than 0.5 feet in thickness) was encountered around 25 feet. The gravel layer was typically described as poorly graded, gray in color, angular to subangular and dense in relative density.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was not encountered in Boring 6W.

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

		rable 5: What dedicentifical besign randification							
	Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)				
	STR 6W	CL	5.0-9.0	0.5	0.3				
ĺ	STR 6W	СН	9.0-26.4	1.0	0.6				

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
STR 6W	CL	5.0-9.0	0.006	-
STR 6W	СН	9.0-26.4	0.02	-

Ford 138kV Glendale Industrial West Structure 6W

May 5, 2022 Page **3** of **3**

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 6W	CL	5.0-9.0	125.0	0.5	0.5
STR 6W	CH	9.0-26.4	120.0	1.0	0.8

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout



<u>LEGEND</u>

SOIL TEST BORING

DRAWING NOT TO SCALE ALL BORING LOCATIONS ARE APPROXIMATE

DATE: 04-13-2022 DRAWN BY: A. ANDERSON

AMERICAN ENGINEERS, INC.

DESIGNING YOUR FUTURE
65 Aberdeen Drive Glasgow KY
270.651.7220

CHECKED BY D. BARRETT PROJECT:

FORD 138kV GLENDALE
INDUSTRIAL WEST
STRUCTURE 6W
GLENDALE, KY

CLIENT:

BORING
LAYOUT

BORING
LAYOUT

Attachment 3 to Response to PSC-4 Question No. 1
Page 314 of 592
McFarland

APPENDIX B

Boring Logs



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples are considered to provide disturbed samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
4 blows/ft or less	Boulders	12 inch diameter or more
4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
30 to 50 blows/ft		Medium – 1/2 to 1 inch
50 blows/ft or more		Fine – ¼ to ½ inch
	Sand	Coarse – 0.6mm to 1/4 inch
RTIONS		Medium – 0.2mm to 0.6mm
<u>Percent</u>		
1 - 10		Fine -0.05 mm to 0.2 mm
11 - 20		
21 – 35	Silt	0.05mm to 0.005mm
36 - 50		
	Clay	0.005mm
	4 blows/ft or less 4 to 10 blows/ft 10 to 30 blows/ft 30 to 50 blows/ft 50 blows/ft or more RTIONS Percent 1 - 10 11 - 20 21 - 35	4 blows/ft or less 4 to 10 blows/ft 10 to 30 blows/ft 30 to 50 blows/ft 50 blows/ft or more Sand RTIONS Percent 1 - 10 11 - 20 21 - 35 36 - 50

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

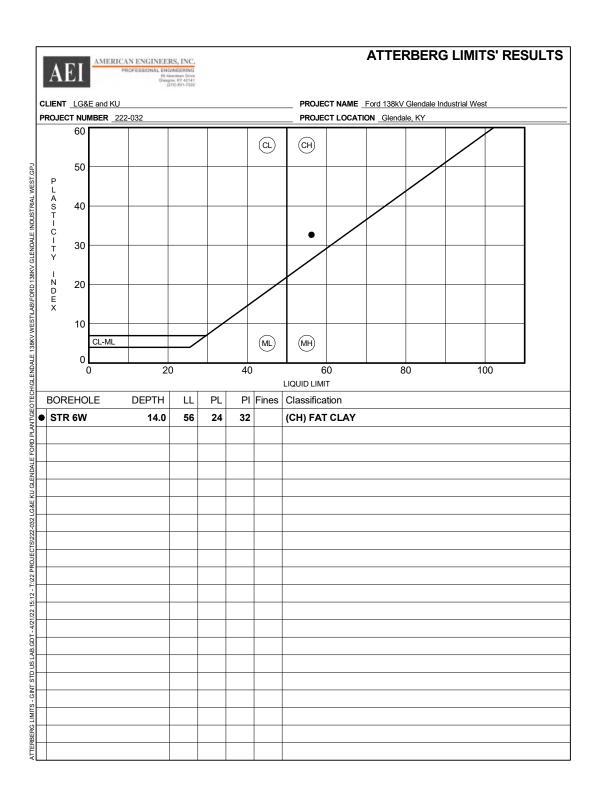
Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

	A	EI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERS Biograms Over Glasgow, KY 4244 (270) 651-720	STR 6W PAGE 1 OF 1									
VEST. GPJ					PROJECT LOCATION Glendale, KY GROUND ELEVATION 675.5 ft GROUND WATER LEVELS: AT TIME OF DRILLING								
ISONA GLENDALE INDUSTRIA	O DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC LIMIT		REMARKS
LABIFORD 13			TOPSOIL (5 INCHES) (CL) lean CLAY, brown, moist to wet, soft	^-	ST 1	100		1.0	24	-			Qu = 1,045 psf
ENDALE 138KV WEST	5				ST 2	90		0.5	22				
ORD PLAN I GEO! ECH/GLEND	10		(CH) fat CLAY trace to some gravel, brown to reddish bro greenish brown, wet, stiff to medium stiff	wn and	SPT 1	100	4-5-6 (11)	2.25	31				
GØE NU GLENDALE I	15				ST 3	100		4.5+	30	56	24	32	Qu = 2,700 psf
PRUJECT S/222-032 LG	 . 20				SPT	93	3-2-3	2.0	29				
15:45 - 1:722 PROJ					2		(5)						
AB.GDI - 5/5/22 1	. <u>-</u> 25		(GP) poorly graded GRAVEL, gray, angular to subangular (CH) fat CLAY, brown to gray, wet, stiff	, dense,-	ST 4 SPT 3	100	36-8-4 (12)	1.0	30	-			Qu = 1,980 psf
GEOTECH BH COLUMNS - GINT STUDIS LAB			Bottom of borehole at 26.4 feet.										

APPENDIX C

Laboratory Testing Results

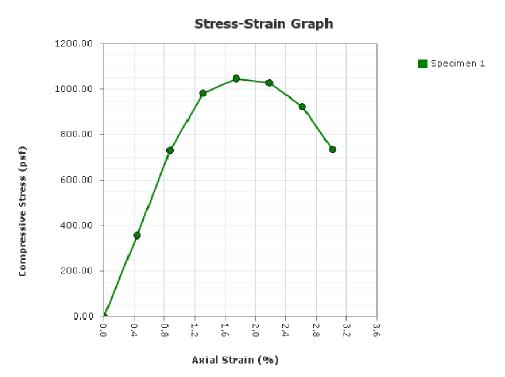




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032 Received Date: 4/15/2022 Sampling Date: 4/15/2022 Sample Number: ST 1 Sample Depth: 1.0-3.0 ft Boring Number: STR 6W Location: Glendale, KY Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 Checked By: ___ Date: _

Unconfined Compression Test

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	. 8
Moisture Content (%):								
Wet Density (pcf)	i							
Dry Density (pcf)	:							
Saturation (%):								
Void Ratio:	:							
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:			2	1	_			0
Test Data Failure Angle (°):	1 0	2	3	4	5	6	7	8
Strain Rate (in/min)								
Strain Rate (III/ IIIII) Strain Rate (%/min):	i							
Unconfined Compressive Strength (psf)	:							
Undrained Shear Strength (psf)								
Strain at Failure (%):								
							·	-
Specific Gravity: 2.72		stic Limit:	i		I	Liquid Lim	it: [0	
Type: UD	Soil Clas	ssification:	CL					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/15/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR 6W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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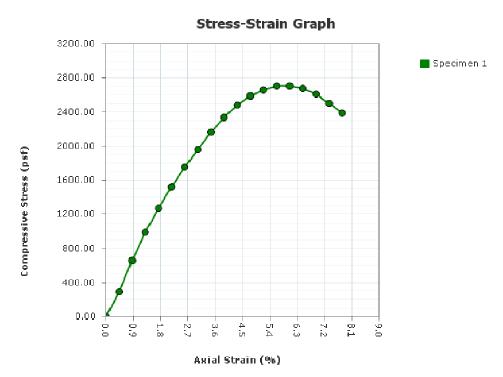
Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/15/2022 Checked By: ___ _ Date: _ 2

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/7/2022
Sampling Date: 4/7/2022
Sample Number: ST 3
Sample Depth: 14.0-16.0 ft
Boring Number: STR 6W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/7/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Unconfined Compression Test

ASTM D2166								
			S	pecimer	n Numbe	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	30.2							
Wet Density (pcf)	119.7							
Dry Density (pcf)	91.9							
Saturation (%):	97.1							
Void Ratio:	0.847							
Height (in)	5.7800							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	2707.58							
Undrained Shear Strength (psf)								
Strain at Failure (%):	6.06							
Specific Gravity: 2.72	Pla	astic Limit:	24		ī	Liquid Limi	it: 56	
Type: UD		ssification:			1	nquia Emi	11. 100	
			:					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/7/2022								
Sample Number: ST 3								
Sample Depth: 14.0-16.0 ft								
Boring Number: STR 6W								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
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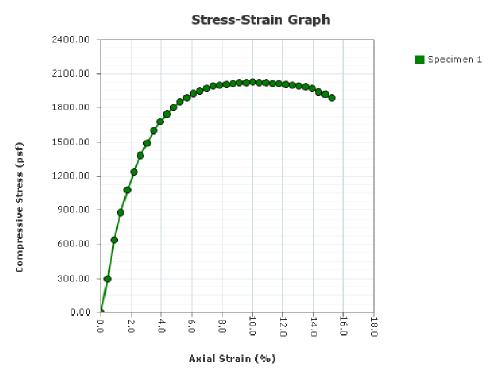
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Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/7/2022
Sampling Date: 4/7/2022
Sample Number: ST 4
Sample Depth: 24.0-26.0 ft
Boring Number: STR 6W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/7/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Unconfined Compression Test

ASTM D2166								
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Height								
Diameter								
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Height To Diameter R								
Test I		2	3	4	5	6	7	8
Failure Angle								
Strain Rate (in/r	' i							
Strain Rate (%/n	' i							
Unconfined Compressive Strength (- / ;							
Undrained Shear Strength (- / ;							
Strain at Failure	(%): 13.48							
Specific Gravity: 2.72	Pl	astic Limit:	0		I	iquid Lim	it: 0	
Type: UD	Soil Cla	ssification:	CH			_	•	
Project: Ford 138kV Glenda	e Industrial We	st						
Project Number: 222-032	e maastrar vve							
Sampling Date: 4/7/2022								
Sample Number: ST 4								
Sample Depth: 24.0-26.0 ft								
Boring Number: STR 6W								
Location: Glendale, KY								
Client Name: LG&E and KU								
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ___ Test Date: 4/7/2022 _ Date: _ 2

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 5, 2022

RE:



LG&E and KU One Quality Street Lexington, KY 40507

> Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 9W Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West project in Glendale, KY. This summary is provided for Structure 9W, a double circuit, tangent dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure	Structure	Height	Centerline	Structure (Trans.	Long.	
Number	Description	(ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
9W	Double Circuit	115	681	37°35′2.94″N	85°54′13.14″W	1,488	7,265

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 54 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of five inches. Beneath the surface material, lean clay was encountered to a depth of nine feet. Fat clay was encountered from nine feet to the auger refusal depth. The lean clay was typically

Ford 138kV Glendale Industrial West Structure 9W

May 5, 2022 Page **2** of **4**

described as brown to reddish brown in color, moist to wet and medium stiff to stiff in soil strength consistency. The fat clay was typically described as reddish brown in color, containing varying amounts of gravel, wet to saturated and stiff to soft in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 9W - Summary of Boring

			Surface	Auge	r Refusal
			Elevation	Depth	Elevation
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 9W	37°35′2.94″N	85°54′13.14″W	680.9	35.5	645.4

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)	
STR 9W	CL	5.0-9.0	2.0	1.3	
STR 9W	СН	9.0-35.5	1.0	0.6	

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial West Structure 9W

May 5, 2022 Page **3** of **4**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)	
STR 9W	CL	5.0-9.0	0.024	200	
STR 9W	СН	9.0-35.5	0.023	-	

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

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Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 9W	CL	5.0-9.0	125.0	2.0	0.9
STR 9W	СН	9.0-35.5	120.0	1.0	0.9

^{*}Effective Unit Weight accounts for Buoyancy

Ford 138kV Glendale Industrial West Structure 9W

May 5, 2022 Page **4** of **4**

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





Attachment 3 to Response to PSC-4 Question No. 1
Page 335 of 592
McFarland

APPENDIX B

Boring Logs



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	<u>ORTIONS</u>		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

 Qu:
 Unconfined Compressive Strength
 N:
 Standard Penetration Value (see above)

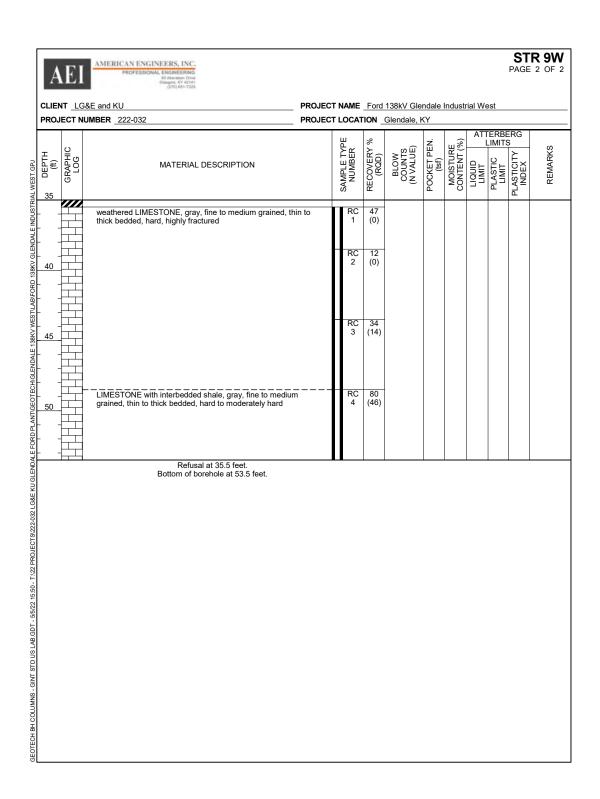
 Qp:
 Unconfined Comp. Strength (pocket pent.)
 omc:
 Optimum Moisture content

 LL:
 Liquid Limit, % (Atterberg Limit)
 PL:
 Plastic Limit, % (Atterberg Limit)

 PI:
 Plasticity Index
 mdd:
 Maximum Dry Density

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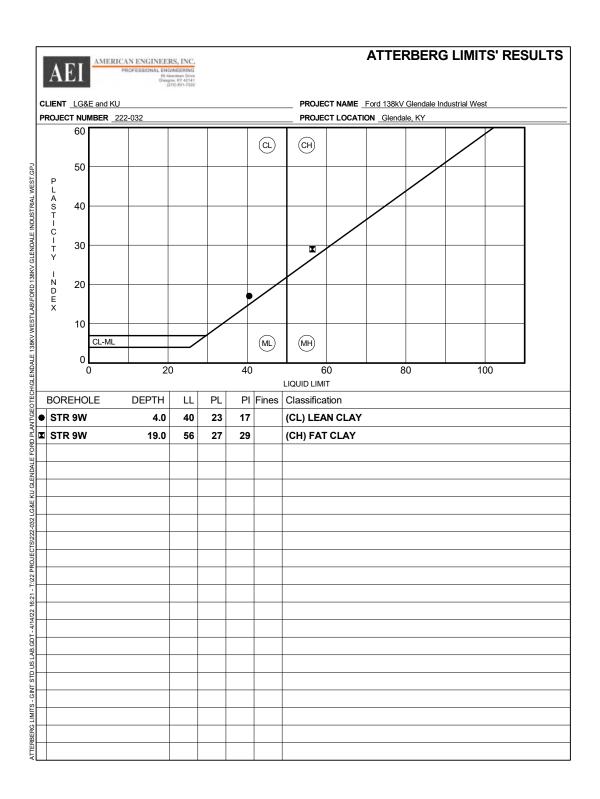
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APPENDIX C

Laboratory Testing Results

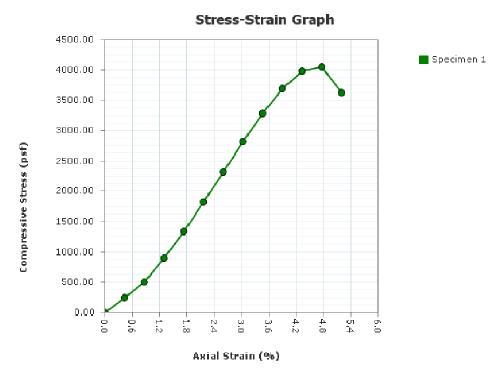




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/7/2022
Sampling Date: 4/7/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR 9W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/7/2022 Checked By: _____ Date: _____

Unconfined Compression Test

Test Date: 4/7/2022

ASTM D2166								
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Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:				4	_			
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf) Strain at Failure (%):								
Strain at Failure (%).	4.//	i	<u> </u>		<u> </u>	<u> </u>		:
Specific Gravity: 2.72	Pla	stic Limit:	23		I	iquid Limi	t: 40	
Type: UD	Soil Cla	ssification:	CL					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/7/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 9W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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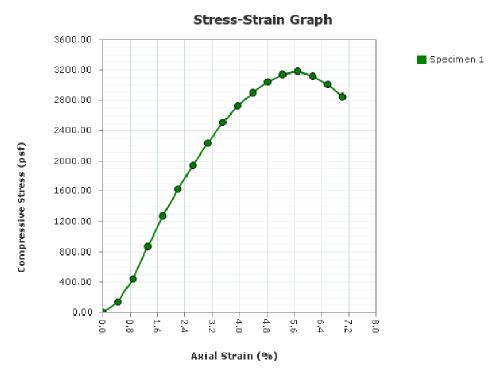
Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 Checked By: ___

_ Date: _

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/7/2022
Sampling Date: 4/7/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR 9W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/7/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166								
			S	pecimer	ı Numbe			
Before Test	1	2	3	4	5	6	7	. 8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):	107.8							
Void Ratio:	0.937							
Height (in)	5.7000							
Diameter (in)	2.8000							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	3189.72							
Undrained Shear Strength (psf)	1594.86							
Strain at Failure (%):	5.70							
Specific Gravity: 2.72	Dla	stic Limit:	. 27		т	Liquid Limi	t. E6	
Type: UD		ssification:	i		L	iquia Liiii	11. 100	
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Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/7/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR 9W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ___ Test Date: 4/7/2022 _ Date: _

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 12, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 10W Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 10W, a double circuit, tangent dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure	Cturatura	Height	Centerline	Structure Coordinates		Trans.	Long.
Number	Structure Description	(ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
10W	Double Circuit	115	679.2	37°34′59.21″N	85°54′12.97″W	1,586	7,263

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of 39 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of seven inches. Beneath the surface material, lean clay was encountered to a depth of nine feet. Fat clay was encountered from nine feet to the auger refusal depth. The lean clay was typically

Ford 138kV Glendale Industrial West Structure 10W

May 12, 2022 Page **2** of **3**

described as brown to reddish brown in color, moist and very stiff in soil strength consistency. The fat clay was typically described as red to gray, containing trace to some gravel, moist and very stiff to medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 10W - Summary of Boring

			Surface	Auge	r Refusal
			Elevation	Depth	Elevation
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 10W	37°34′59.21″N	85°54′12.97″W	679.8	29.8	650.0

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength	Modulus of Deformation (ksi)
			(ksf)	
STR 10W	CL	5.0-9.0	2.3	1.4
STR 10W	СН	9.0-29.8	0.7	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial West Structure 10W

May 12, 2022 Page **3** of **3**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ϵ_{50})	Initial Soil Stiffness (k _{py}) (pci)			
STR 10W	CL	5.0-9.0	0.018	400			
STR 10W	СН	9.0-29.8	0.007	-			

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Table 3. Axial 3011 Farailleters for Design of Diffied Sharts									
Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)				
STR 10W	CL	5.0-9.0	125.0	2.3	1.0				
STR 10W	СН	9.0-29.8	120.0	0.7	0.7				

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





Attachment 3 to Response to PSC-4 Question No. 1
Page 354 of 592
McFarland

APPENDIX B

Boring Logs



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples are considered to provide disturbed samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	<u>ORTIONS</u>		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm
		2	

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

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A	E	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING Bragen, 87 42141 (20) 953-7229										R 10W = 1 OF 2
PRO	JECT N	IUMBER 222-032 ICTED 3/25/22 COMPLETED 3/25/22	PROJECT NAME Ford 138kV Glendale Industrial West PROJECT LOCATION _Glendale, KY GROUND ELEVATION 679.828 ft									
פ		IETHOD HSA/ Diamond impregnated coring bit				LING						
Ú	GED B' ES	Y Adam Cash CHECKED BY Aaron Anderson				.ing 						
Į NOI			AI						ATT	ERBE	RG	
DEPTH (ft)	GRAPHIC	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIMIT	PLASTIC IIMIT	PLASTICITY INDEX	REMARKS
	-	TOPSOIL (7 INCHES) (CL) lean CLAY, brown to reddish brown, moist, very stiff	~	ST 1	100		1.0	24				
5	-			ST 2	85		2.5	23	41	20	21	Qu = 4,650 psf
10		(CH) fat CLAY, trace to some gravel, red to gray, moist, ve to medium stiff	ery stiff	SPT 1	100	4-17-10 (27)	-	26				
15												
20				ST 3	75		1.75	24	58	28	30	Qu = 1,570 psf
1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2												
25												
30		weathered LIMESTONE with clay seams, gray, fine to me	dium	SPT 2 RC	100 48 (19)	2-50	-	30				
35		grained, thin to thickly bedded, hard, highly fractured		1 RC	38							

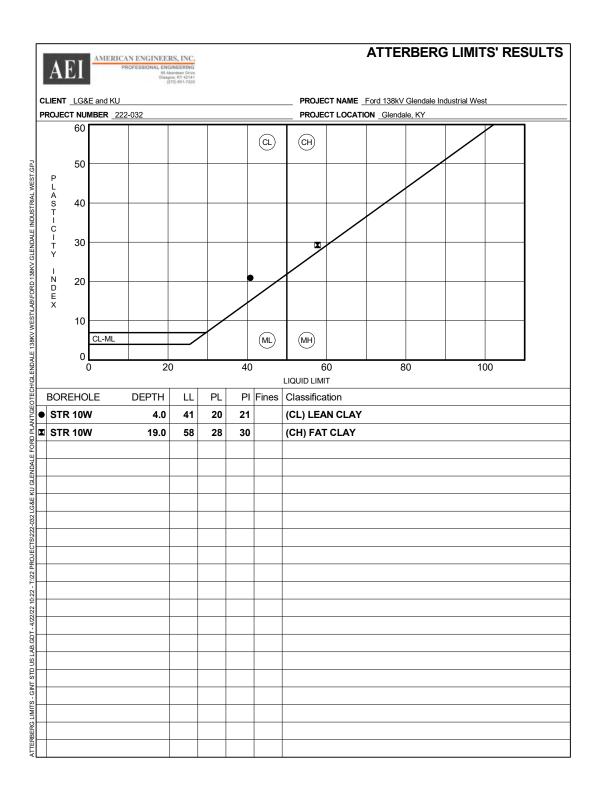
(Continued Next Page)

A	AE	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING 65 Adminston Driver (1997) 1574-1241 (2010) 1574-1240								;	STR PAGE	10W 2 OF 2
1			PROJECT NAME Ford 138kV Glendale Industrial West PROJECT LOCATION Glendale, KY									
PRO	DECI	NUMBER _222-032			ION _	Jendale, r	(Y		ΔΤΤ	ERBE	RG	
DEPTH 35	GRAPHIC	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	IMITS		REMARKS
		weathered LIMESTONE with clay seams, gray, fine to med grained, thin to thickly bedded, hard, highly fractured (continuation)	dium inued)	2	(12)							
		Refusal at 29.8 feet. Bottom of borehole at 39.0 feet.	•									

APPENDIX C

Laboratory Testing Results

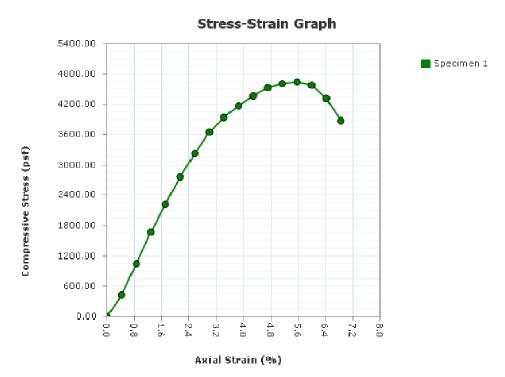




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032 Received Date: 4/11/2022 Sampling Date: 4/11/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: STR 10W Location: Glendale, KY Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 Checked By: ___ Date: _

Report Created: 4/22/2022

Test Date: 4/11/2022

Unconfined Compression Test

ASTM D2166								
			Sp	ecimer	Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	23.5							
Wet Density (pcf)								
Dry Density (pcf)	102.4							
Saturation (%):	i							
Void Ratio:	0.659							
Height (in)	5.8400							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.06							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.71							
Unconfined Compressive Strength (psf)	4651.13							
Undrained Shear Strength (psf)	2325.56							
Strain at Failure (%):	5.57							
Specific Gravity: 2.72	DI:	stic Limit:	20			Liquid Limi	t· 11	
Type: UD		ssification:	i			Elquia Ellin	. 1	
			i CE					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/11/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 10W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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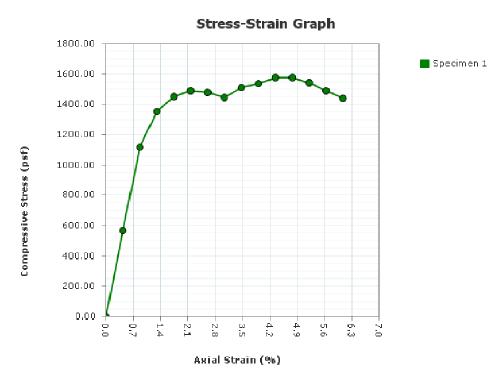
Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/11/2022 Checked By: ___

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/11/2022
Sampling Date: 4/11/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR 10W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/11/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Unconfined Compression Test

Before Test		_		•	NT 1	_	_	_
Betore Lesi				pecimei	n Numb			
	_	2	3	4	5	6	7	8
Moisture Content (%):	i							
Wet Density (pcf)	i							
Dry Density (pcf)	i							
Saturation (%):	i							
Void Ratio								
Height (in)	i							
Diameter (in)								
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio								
Test Data		2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	i							
Strain Rate (%/min):	i							
Unconfined Compressive Strength (psf)	i							
Undrained Shear Strength (psf)	i							
Strain at Failure (%):	4.77							<u> </u>
Specific Gravity: 2.72	Pla	astic Limit:	: 28]	Liquid Lim	it: 58	
Type: UD	Soil Cla	ssification:	CH					
Project: Ford 138kV Glendale In	dustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/11/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR 10W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Chefit Name: EG&E and NU								
Remarks:								
Remarks:								
Remarks: Specimen 1 Specimen 2 Specimen 3	Specime Failure S		Specimen 5		eimen 6	Specime Failure Si		ecimen 8
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/11/2022 Checked By: ___ _ Date: _ 2

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 5, 2022

RE:



One Quality Street Lexington, KY 40507

> Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 11W Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 11W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Churchina		C4	Haiaha	Centerline	Structure 0	Trans.	Long.	
	Structure Number	Structure Description	Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
	11W	Double Circuit	110	667.0	37°34′51.56″N	85°54′12.63″W	9,855	5,467

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 44 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of seven inches. Beneath the surface material, lean clay was encountered to a depth of nine feet. Fat clay was encountered from nine feet to the auger refusal depth. The lean clay was typically

Ford 138kV Glendale Industrial West Structure 11W

May 5, 2022 Page **2** of **3**

described as brown to red in color, moist to wet and very stiff in soil strength consistency. The fat clay was typically described as red to brown and gray in color, containing varying amounts of gravel, moist to saturated and stiff to very soft in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 14W - Summary of Boring

			Surface	Auge	r Refusal
			Elevation	Depth	Elevation
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 11W	37°34′51.56″N	85°54′12.63″W	667.0	32.8	634.2

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 11W	CL	5.0-9.0	2.1	1.3
STR 11W	СН	9.0-32.8	0.5	0.3

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial West Structure 11W

May 5, 2022 Page **3** of **3**

Structure		Depth	Estimated Strain	Initial Soil
Number	Soil Type	(feet)	at 50% Stress	Stiffness
Number		(reet)	(ε ₅₀)	(k _{py}) (pci)
STR 11W	CL	5.0-9.0	0.015	200
STR 11W	СН	9.0-32.8	0.020	_

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 11W	CL	5.0-9.0	125.0	2.1	1.0
STR 11W	CH	9.0-32.8	120.0	0.5	0.7

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer

Dusty Barrett, PE, PMP Director of Geotechnical Services

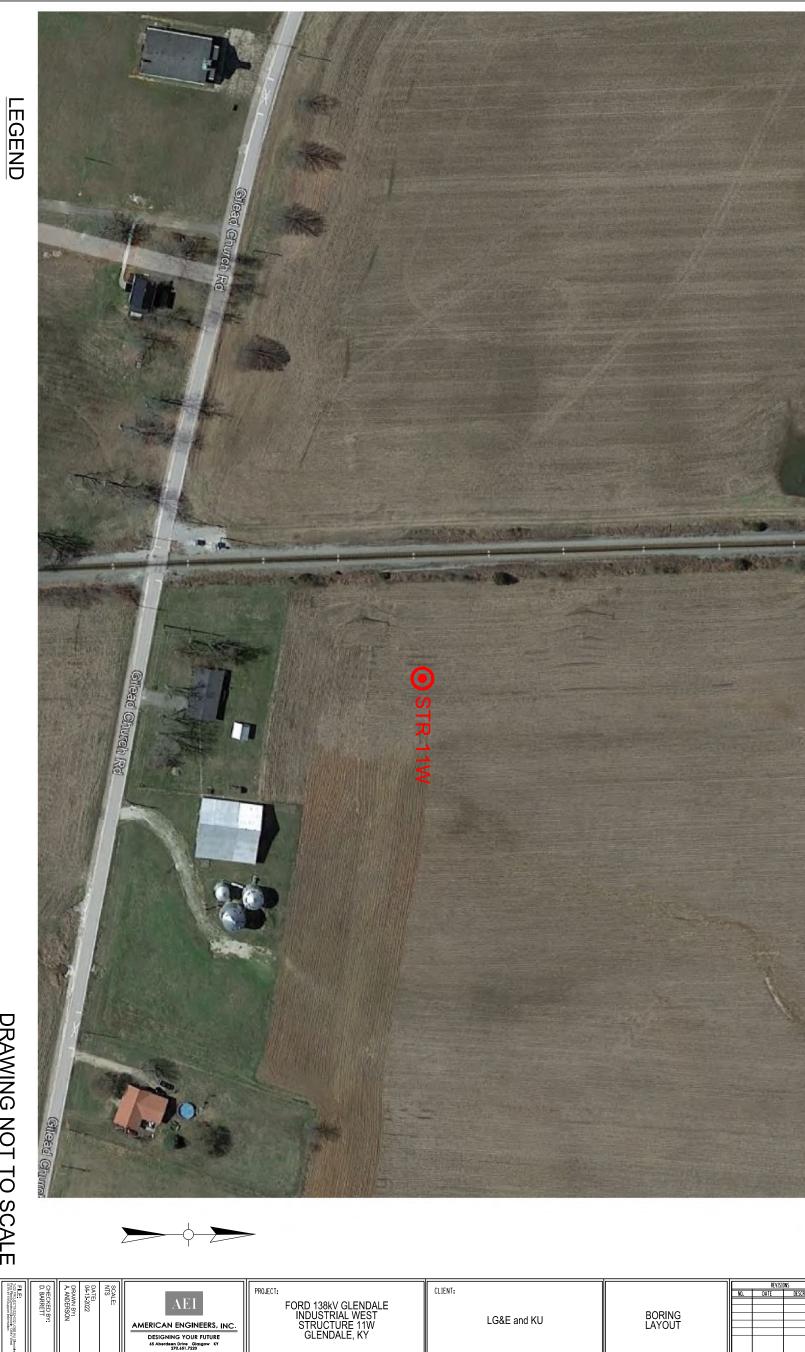
Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





DRAWING NOT TO SCALE ALL BORING LOCATIONS ARE APPROXIMATE

SOIL TEST BORING WITH ROCK CORE

AMERICAN ENGINEERS, INC.

DESIGNING YOUR FUTURE
65 Aberdeen Drive Glasgow KY
270.651.7220

APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLASTICITY					
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity				
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)				
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7				
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22				
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22				
Hard	30 blows/ft or more	> 4.00						

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	<u>ORTIONS</u>		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

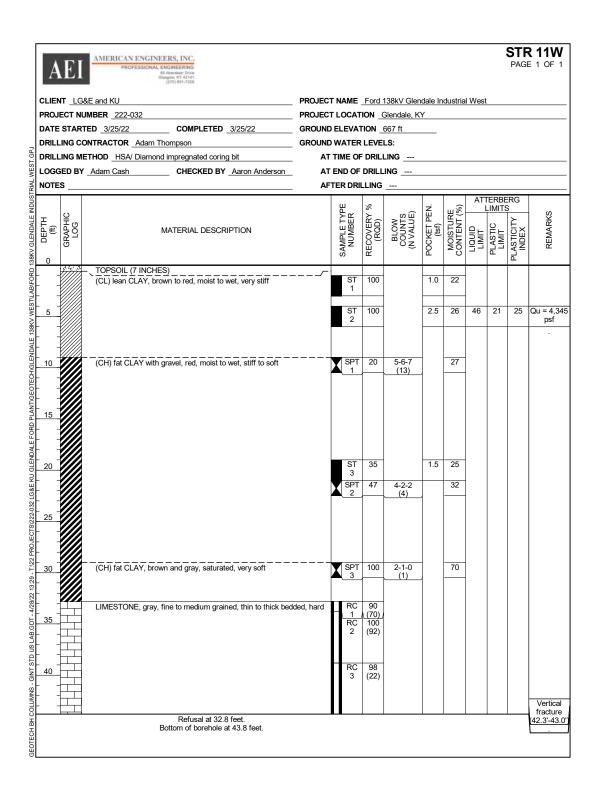
Soil Property Symbols

 Qu:
 Unconfined Compressive Strength
 N:
 Standard Penetration Value (see above)

 Qp:
 Unconfined Comp. Strength (pocket pent.)
 omc:
 Optimum Moisture content

 LL:
 Liquid Limit, % (Atterberg Limit)
 PL:
 Plastic Limit, % (Atterberg Limit)

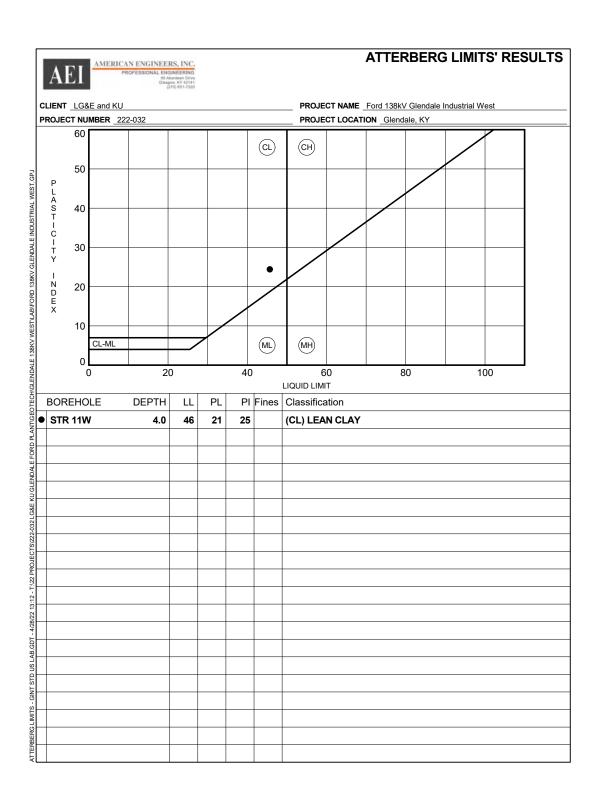
 PI:
 Plasticity Index
 mdd:
 Maximum Dry Density



APPENDIX C

Laboratory Testing Results

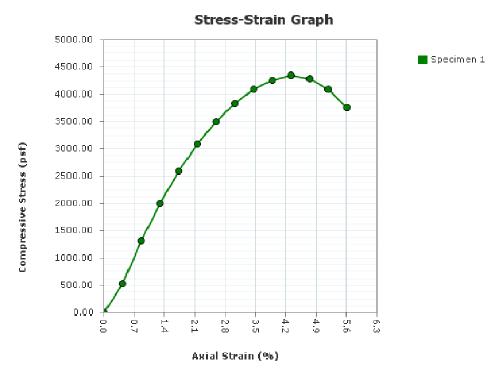




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/12/2022
Sampling Date: 4/12/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR 11W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/12/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Report Created: 4/28/2022

Unconfined Compression Test

ASTM D2166								
			$\mathbf{S}_{]}$	pecimer	Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	i							
Wet Density (pcf)	i							
Dry Density (pcf)	i							
Saturation (%):	i							
Void Ratio:								
Height (in)	i							
Diameter (in)	i							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	i							
Strain Rate (in/min)	i							
Strain Rate (%/min):	:							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	4.31							
Specific Gravity: 2.72	Pla	stic Limit:	: 21			Liquid Limi	it: 46	
Type: UD		ssification	i			1	:	
Type. : OD	Jon Cia.	Joille Cation.						
Project: Ford 138kV Glendale Ind								
Project: Ford 138kV Glendale Inc Project Number: 222-032								
Project: Ford 138kV Glendale Inc Project Number: 222-032 Sampling Date: 4/12/2022								
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2								
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft								
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: STR 11W								
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: STR 11W Location: Glendale, KY			:-					
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: STR 11W			:-					
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: STR 11W Location: Glendale, KY Client Name: LG&E and KU								
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: Location: Glendale, KY Client Name: Remarks: LG&E and KU Specimen 1 Specimen 2 Specimen 3	ustrial Wes	en 4	Specimen 5		imen 6	Specime		Specimen 8
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: Location: Glendale, KY Client Name: Remarks: LG&E and KU	ustrial Wes	en 4			imen 6 e Sketch	Specime Failure Sk		Specimen 8 ilure Sketch
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: Location: Glendale, KY Client Name: Remarks: LG&E and KU Specimen 1 Specimen 2 Specimen 3	ustrial Wes	en 4	Specimen 5					
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: Location: Glendale, KY Client Name: Remarks: LG&E and KU Specimen 1 Specimen 2 Specimen 3	ustrial Wes	en 4	Specimen 5					
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: Location: Glendale, KY Client Name: Remarks: LG&E and KU Specimen 1 Specimen 2 Specimen 3	ustrial Wes	en 4	Specimen 5					
Project: Ford 138kV Glendale Ind Project Number: 222-032 Sampling Date: 4/12/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: Location: Glendale, KY Client Name: Remarks: LG&E and KU Specimen 1 Specimen 2 Specimen 3	ustrial Wes	en 4	Specimen 5					

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 Checked By: ___ _ Date: _

Test Date: 4/12/2022 2

Report Created: 4/28/2022

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



April 14, 2022



One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 14W Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 14W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure		Churchina	Hainba	Centerline	Structure 0	Coordinates	Trans.	Long.	
	Number	Structure Description	Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)	
	14W	Double Circuit	100	100 671.1 37°34′49.41″N 85°5		85°53′49.42″W	8,477	4,945	

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 43 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of six inches. Beneath the surface material, lean clay was encountered to a depth of 19 feet. Fat clay was encountered from 19 feet to the auger refusal depth. The lean clay was typically

Ford 138kV Glendale Industrial West Structure 14W

April 14, 2022 Page **2** of **4**

described as brown to red in color, containing varying amounts of gravel, moist and medium stiff in soil strength consistency. The fat clay was typically described as red to brown in color, containing varying amounts of gravel, saturated and very soft in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 14W - Summary of Boring

			Surface	Auge	r Refusal	
			Elevation	Depth Elevation		
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL	
STR 14W	37°34′49.41″N	85°53′49.42″W	670.5	31.3	639.2	

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 14W	CL	5.0-19.0	0.7	0.4
STR 14W	СН	19.0-32.0	0.6	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial West Structure 14W

April 14, 2022 Page **3** of **4**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
STR 14W	CL	5.0-19.0	0.02	-
STR 14W CH 19.0-32.0		19.0-32.0	0.02	-

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

			-		
Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 14W	CL	5.0-19.0	125.0	0.7	0.7
STR 14W	CH	19.0-32.0	120.0	0.6	0.7

^{*}Effective Unit Weight accounts for Buoyancy

Ford 138kV Glendale Industrial West Structure 14W

April 14, 2022 Page **4** of **4**

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





Attachment 3 to Response to PSC-4 Question No. 1
Page 390 of 592
McFarland

APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling</u>: Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
2 blows/ft or less	0 - 0.25	Degree of	Plasticity
2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
15 to 30 blows/ft	2.00 - 4.00	High	over 22
30 blows/ft or more	> 4.00	_	
	2 blows/ft or less 2 to 4 blows/ft 4 to 8 blows/ft 8 to 15 blows/ft 15 to 30 blows/ft	2 blows/ft or less 0 - 0.25 2 to 4 blows/ft 0.25 - 0.49 4 to 8 blows/ft 0.50 - 0.99 8 to 15 blows/ft 1.00 - 2.00 15 to 30 blows/ft 2.00 - 4.00	2 blows/ft or less 0 - 0.25 Degree of 2 to 4 blows/ft 0.25 - 0.49 Plasticity 4 to 8 blows/ft 0.50 - 0.99 Low 8 to 15 blows/ft 1.00 - 2.00 Medium 15 to 30 blows/ft 2.00 - 4.00 High

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
4 blows/ft or less	Boulders	12 inch diameter or more
4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
30 to 50 blows/ft		Medium – 1/2 to 1 inch
50 blows/ft or more		Fine – ¼ to ½ inch
	Sand	Coarse – 0.6mm to 1/4 inch
RTIONS		Medium – 0.2mm to 0.6mm
<u>Percent</u>		
1 - 10		Fine -0.05 mm to 0.2 mm
11 - 20		
21 – 35	Silt	0.05mm to 0.005mm
36 - 50		
	Clay	0.005mm
	4 blows/ft or less 4 to 10 blows/ft 10 to 30 blows/ft 30 to 50 blows/ft 50 blows/ft or more RTIONS Percent 1 - 10 11 - 20 21 - 35	4 blows/ft or less 4 to 10 blows/ft 10 to 30 blows/ft 30 to 50 blows/ft 50 blows/ft or more Sand RTIONS Percent 1 - 10 11 - 20 21 - 35 36 - 50

NOTES

 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted.}$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

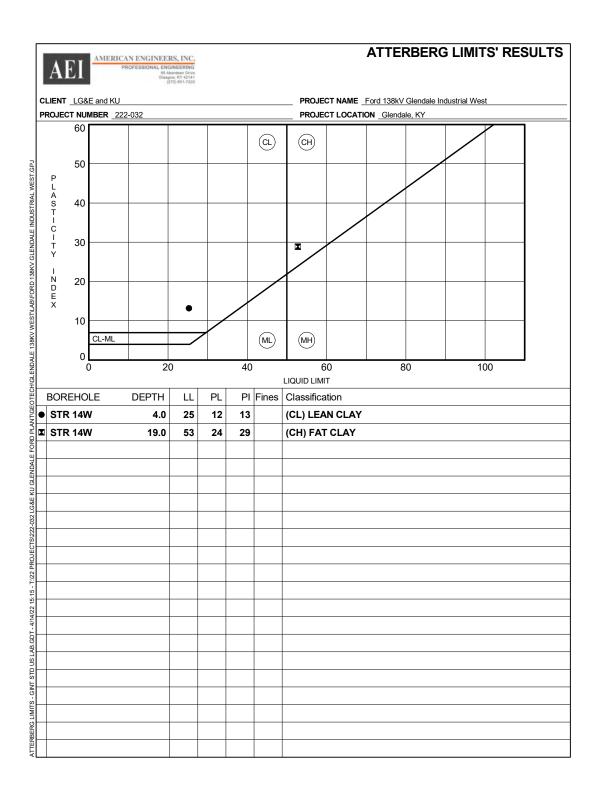
Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

	A	E	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING Observation of the Control of t								;		R 14W E 1 OF 1
	CLIEN	NT LC	&E and KU	PROJECT	NAME .	Ford '	138kV Glen	dale In	dustria	l West			
- 1	PROJECT NUMBER 222-032						Slendale, K	Y					
- 1			TED 3/23/22 COMPLETED 3/24/22										
∵.			ONTRACTOR Adam Thompson										
nΙ			ETHOD HSA/ Diamond impregnated coring bit				ING						
٦.			/ Adam Cash CHECKED BY Aaron Anderson		END OF TER DRII		ING						
2		- <u> </u>								AT	ERBE	RG	
38KV GLENDALE IND	O DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
WEST LABITORD I	-				ST 1	100		1.25	19				Qu = 1,700 psf
WES IN	5				ST 2	100		1.0	15	25	12	13	Qu = 1,160 psf
VDALE 138K	-												·
E FORD PLANT/GEOTECH/GLENDAL	10		(CL) lean CLAY, trace to some gravel, red and brown, moist,	stiff	SPT 1	60	6-5-6 (11)	1.5	18				
Z LG&E NO GLEINDALE	20		(CH) fat CLAY with gravel, red to brown, saturated, very soft		ST 3	75		1.0	33	53	24	29	Qu = 2,030 psf
I.ZZ PROJECI SIZZZ-US	25				V SPT	67	12-2-0	0.25	37				
- 07:01	-		LIMESTONE interbedded with shale, light gray to white, soft t	o hard,	2 RC	44	(2)						
414.	35		very thin to thick bedded		RC 2	(20) 46 (34)							
GEOLECH BH COLUMNS - GIN I SID US LAB.GI	40				RC 3	109 (96)							Void (37.8'-40.5')
GEOLECH BH COL	_	1	Refusal at 31.3 feet. Bottom of borehole at 43.3 feet.								ı	l	

APPENDIX C

Laboratory Testing Results

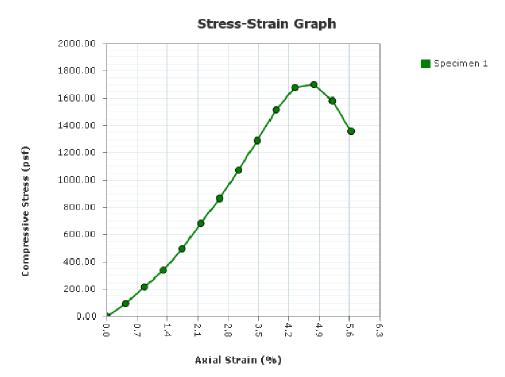




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 3/24/2022
Sampling Date: 3/24/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #14W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 3/24/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Report Created: 3/30/2022

Unconfined Compression Test

Test Date: 3/24/2022

ASTM D2166								
				pecimer	n Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)	i							
Saturation (%): Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio: Test Data	2.03	2	3	4	5	6	7	8
Failure Angle (°):				4	5			
Strain Rate (in/min)								
Strain Rate (III) Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):								
		:		:	:	:		:
Specific Gravity: 2.72		stic Limit:	i]	Liquid Lim	it: 0	
Type: UD	Soil Cla	ssification:	CL					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 3/24/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #14W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 Checked By: ___

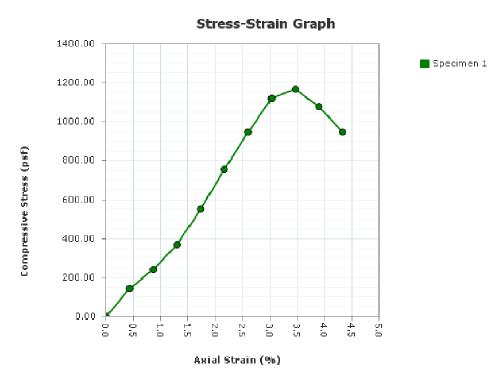
2 Report Created: 3/30/2022

_ Date: _

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 3/24/2022
Sampling Date: 3/24/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #14W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 3/24/2022 Checked By: _____ Date: _____

Report Created: 3/30/2022 1

Unconfined Compression Test

Test Date: 3/24/2022

ASTM D2166								
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Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)	ı							
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:	2.02							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	3.47							
Specific Gravity: 2.72	Pla	stic Limit:	12		I	iquid Lim	it: 25	
Type: UD		ssification:	i		-	orquie ziiii	: =0	
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 3/24/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #14W								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks:								
Kemarks.								
Specimen 1 Specimen 2 Specimen 3	Specim	en 4	Specimen 5	Spec	imen 6	Specime	n 7 Sr	pecimen 8
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 Checked By: ___

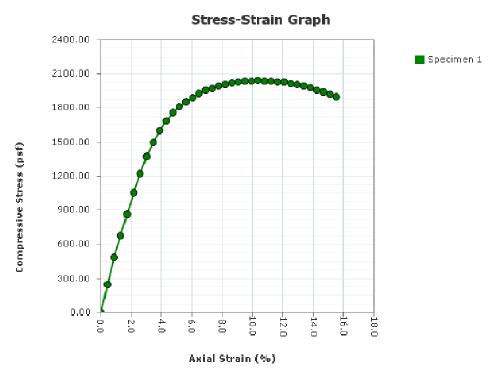
_ Date: _

2 Report Created: 3/30/2022

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 3/24/2022
Sampling Date: 3/24/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR #14W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 $\,$

Test Date: 3/24/2022 Checked By: _____ Date: _____

Report Created: 3/30/2022 1

Unconfined Compression Test

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	32.7							
Wet Density (pcf)	118.1							
Dry Density (pcf)	89.0							
Saturation (%):	98.0							
Void Ratio:	0.908							
Height (in)	5.8000							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	12.07						<u> </u>	
Specific Gravity: 2.72	Pla	stic Limit:	24		Ι	iquid Lim	it: 53	
Type: UD	Soil Clas	ssification:	СН				•	
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 3/24/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR #14W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure Sl		Specimen 5 ailure Sket		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 3/24/2022 Checked By: ___ ___ Date: __ 2

Report Created: 3/30/2022

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 5, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 18W Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 18W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure	Structure	Uniobt	Centerline	Structure (Coordinates	Trans.	Long.
Number		Flevation	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)	
18W	Double Circuit	110	678.7	37°35′9.19″N	85°53′41.63″W	10,410	5,214

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of 53 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of six inches. Beneath the surface material, lean clay was encountered to a depth of 29 feet. Fat clay was encountered from 29 feet to the auger refusal depth. The lean clay was typically

Ford 138kV Glendale Industrial West Structure 18W

May 5, 2022 Page **2** of **3**

described as brown and gray to red with black mottle in color, containing trace to some gravel, moist and very stiff to medium stiff in soil strength consistency. The fat clay was typically described as brown in color, containing varying amounts of gravel, moist to saturated and medium stiff to soft in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 18W - Summary of Boring

			Surface	Auge	r Refusal
			Elevation	Depth	Elevation
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 18W	37°35′9.19″N	85°53′41.63″W	679.0	53.0	626.0

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength	Modulus of Deformation (ksi)
			(ksf)	
STR 18W	CL	5.0-29.0	1.6	0.8
STR 18W	СН	29.0-53.0	0.5	0.3

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial West Structure 18W

May 5, 2022 Page **3** of **3**

Table 4: L-Pile Soil	Parameters for	r Design of	Drilled Shafts
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			•	
Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
STR 18W	CL	5.0-29.0	0.017	200
STR 18W	СН	29.0-53.0	0.020	-

Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 18W	CL	5.0-29.0	125.0	1.6	1.0
STR 18W	СН	29.0-39.0	120.0	0.5	0.8
STR 18W	СН	29.0-53.0	57.6	0.5	0.8

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- · Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





Attachment 3 to Response to PSC-4 Question No. 1
Page 410 of 592
McFarland

APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples are considered to provide disturbed samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLASTICITY			
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity		
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)		
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7		
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22		
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22		
Hard	30 blows/ft or more	> 4.00				

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	<u>ORTIONS</u>		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

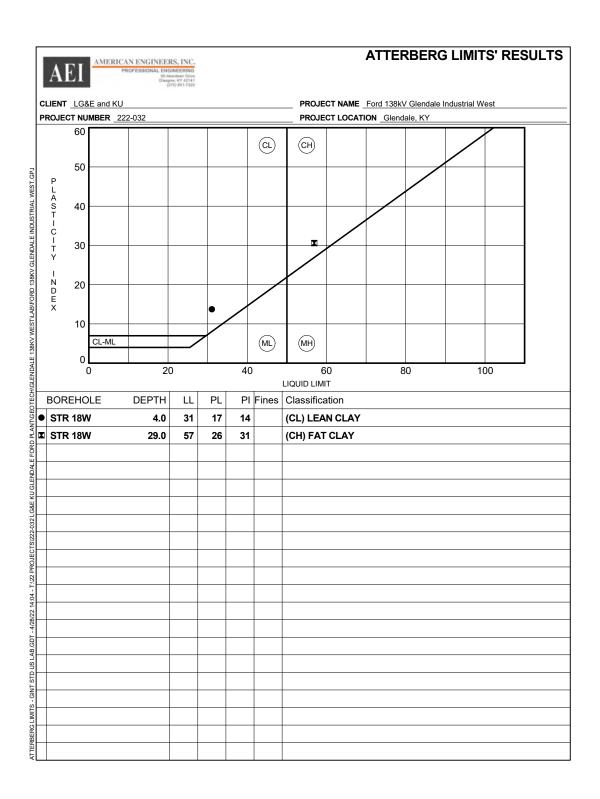
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A	ÆI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING Shareton Drive Glasgons KY 42141 (20) 815-1228								;		R 18W E 1 OF 1
PRO	JECT N	UMBER _222-032		T LOCAT	ION _	138kV Gle Glendale, I 679 ft		Indust	rial We	est		
_	LING M	ETHOD Hollow Stem Auger	GROUND $\overline{\mathcal{Y}}$ AT			L S : L ING 39.0	00 ft / E	Elev 64	40.00 f	t		
LOG NOT		Aaron Anderson CHECKED BY Aaron Anderson		END OF TER DRI		ING						
O DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	TIMIT LIMIT	PLASTIC LIMIT		REMARKS
STILABIFORD 138		TOPSOIL (6 INCHES) (CL) lean CLAY, brown and gray, moist, very stiff to stiff		ST 1	95		4.5+	19	31	17	14	Qu = 4,790 psf
				ST 2	90		1.0	20				Qu = 3,000 psf
D PLAN I GEOTECHIGE												·
-032 FG&E KU GLENDALE FOR		(CL) lean CLAY, trace to some gravel, red with black mottle moist, medium stiff		SPT 1	67	4-3-5 (8)	1.25	22				
22 16:03 - 1:022 PROJECT S/222		(CH) fat CLAY with gravel, brown, moist to saturated, med to soft	ium stiff	ST 3	100		1.0	29	57	26	31	Qu = 1,250 psf
GEOTICH BH COLUMNS - GIMT STD US LASS 25 PROSECUTIO		∑		SPT 2	100	1-2-1	0.0	49				
50 50 50 50 50 50 50 50 50 50 50 50 50 5		Refusal at 53.0 feet. Bottom of borehole at 53.0 feet.										

APPENDIX C

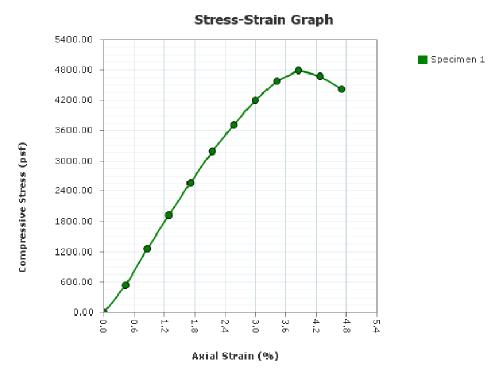
Laboratory Testing Results





Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/11/2022
Sampling Date: 4/11/2022
Sample Number: ST 1
Sample Depth: 4.0-6.0 ft
Boring Number: STR 18W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/11/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

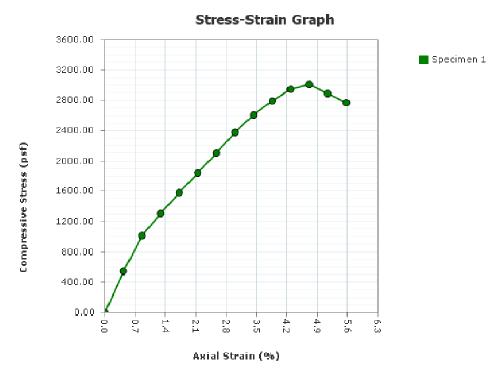
ASTM D2166								
	Specimen Number							
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	17.2							
Wet Density (pcf)	128.8							
Dry Density (pcf)	110.0							
Saturation (%):	85.8							
Void Ratio:								
Height (in)								
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	i							
Strain Rate (in/min)								
Strain Rate (%/min):	i							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	3.85							
Specific Gravity: 2.72	Pla	stic Limit:	17		I	iquid Limi	it: 31	
Type: UD	Soil Clas	ssification:	CL					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/11/2022								
Sample Number: ST 1								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR 18W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/11/2022 Checked By: ___ _ Date: _ 2

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/11/2022
Sampling Date: 4/11/2022
Sample Number: ST 2
Sample Depth: 9.0-11.0 ft
Boring Number: STR 18W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/11/2022 Checked By: _____ Date: _____

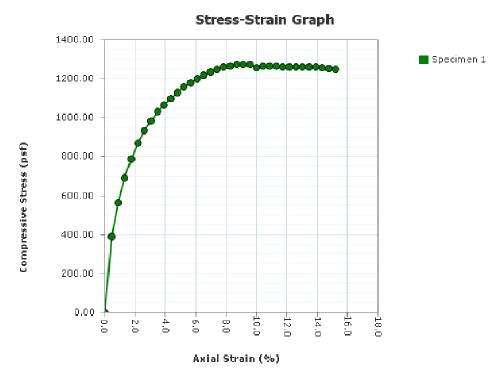
ASTM D2166								
			St	oecimer	Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	26.5							
Wet Density (pcf)								
Dry Density (pcf)	97.5							
Saturation (%):	i							
Void Ratio:	0.742							
Height (in)	5.8400							
Diameter (in)	2.8300							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.06							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.71							
Unconfined Compressive Strength (psf)	3006.15							
Undrained Shear Strength (psf)								
Strain at Failure (%):	4.71							
Specific Gravity: 2.72	Dl.	stic Limit:	0		1	Liquid Lim	it: 0	
Type: UD		ssification:	i			Elquia Ellii	11. 0	
			; CE					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/11/2022								
Sample Number: ST 2								
Sample Depth: 9.0-11.0 ft								
Boring Number: STR 18W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen 5	Spec	imen 6	Specime	en 7 - S	Specimen 8
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/11/2022 Checked By: ___

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 4/11/2022
Sampling Date: 4/11/2022
Sample Number: ST 3
Sample Depth: 29.0-31.0 ft
Boring Number: STR 18W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 4/11/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

ASTM D2166								
			$\mathbf{S}_{]}$	pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	. 8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	14.76							
Specific Gravity: 2.72	Pla	stic Limit:	26		I	iquid Limi	it: 57	
Type: UD		ssification:	i				;	
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 4/11/2022								
Sample Number: ST 3								
Sample Depth: 29.0-31.0 ft								
Boring Number: STR 18W Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
remarko.								
Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen 5	Spec	imen 6	Specime	n 7 S _I	pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		ailure Sketc		e Sketch	Failure Sk	etch Fai	lure Sketch
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 4/11/2022 Checked By: ___ _ Date: _ 2

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 5, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 21W

Glendale, KY

AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 21W, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

140.6 2. 1011.6. 2014.10										
Structure	Structure	Unight	Centerline	Structure (Trans.	Long.				
Number	Structure Description	Height (ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)			
21W	Double Circuit	100	703.9	37°35′3.583″N	85°53′17.327″W	8,918	4,818			

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 46 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered to a depth of about eight inches. Beneath the surface material, lean clay and fat clay were encountered to the auger refusal depth. The lean clay was typically described as light brown to reddish brown in color, containing trace

Ford 138kV Glendale Industrial West Structure 21W

May 5, 2022 Page **2** of **4**

amounts of gravel, wet and very stiff to stiff. The fat clay was typically described as reddish brown, containing varying amounts of gravel (gravel contents increased with depth), wet to saturated, and medium stiff.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 21W - Summary of Boring

			Surface	Auge	r Refusal
			Elevation	Depth	Elevation
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 21W	37°35′3.583″N	85°53′17.327″W	703.6	46.4	657.2

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 21W	CL	5.0-19.0	1.8	1.0
STR 21W	CH	19.0-28.0	1.5	0.8
STR 21W	CH	28.0-46.4	0.8	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial West Structure 21W

May 5, 2022 Page **3** of **4**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
STR 21W	CL	5.0-19.0	0.02	200
STR 21W	СН	19.0-28.0	0.015	200
STR 21W	СН	28.0-46.4	0.02	-

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

rable 517 Mar 5011 a ameter 5 101 Besign 61 Brinea Grants										
Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)					
STR 21W	CL	5.0-19.0	125.0	1.8	1.0					
STR 21W	СН	19.0-28.0	120.0	1.5	1.0					
STR 21W	СН	28.0-46.4	57.6	0.8	8.0					

^{*}Effective Unit Weight accounts for Buoyancy

Ford 138kV Glendale Industrial West Structure 21W

May 5, 2022 Page **4** of **4**

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – ½ to 1 inch
Very Dense	50 blows/ft or more		Fine − ¼ to ½ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

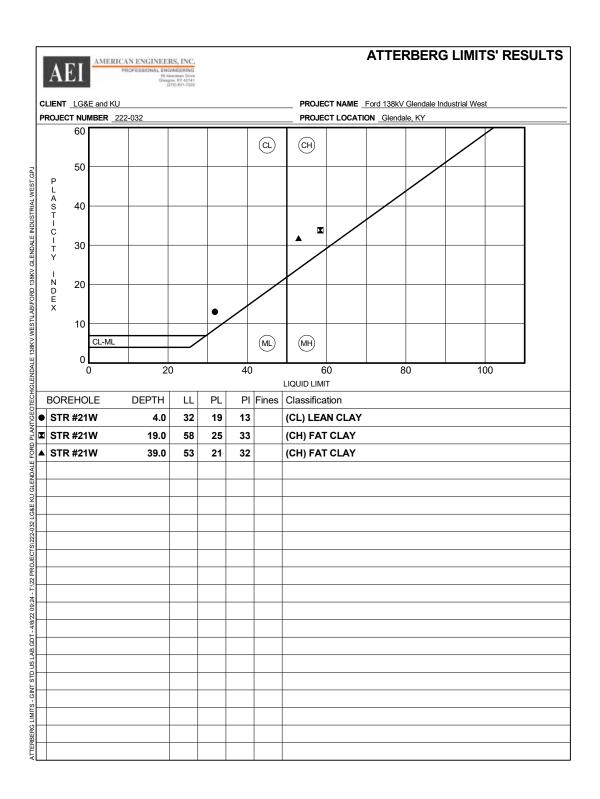
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F	PROJ	ECT N	UMBER _222-032	PROJECT LOCATION Glendale, KY									
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١٥			IETHOD Hollow Stem Augers Peyton Linder CHECKED BY Aaron Anderson				LING <u>27.6</u>		lev 67	′6.00 t	t		
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<u> </u>										ATT	ERBE		
GLENDALE INDUS		GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC IIMIT	PLASTICITY INDEX	REMARKS
	0	71 18. 15	TOPSOIL (8 INCHES)									ш	
OKOTION -	-		(CL) lean CLAY, trace gravel, light brown to reddish brown, very stiff to stiff	wet,	ST 1	90		4.5+	25				Qu = 2,920 psf
WESTILAB	5				ST 2	100		3.75	19	32	19	13	Qu = 5,430 psf
138KV	-												
GLENDAL	10				SPT 1	100	4-5-6 (11)	3.0	23				
- 15	-						(11)						
- GE	_												
- PLA	15 _												
- 12 - 12 - 12 - 12 - 12 - 12 - 12 - 12	-												
L GLEND	20		(CH) fat CLAY, trace to some gravel, reddish brown, wet, s	tiff	ST 3	100		3.25	36	58	25	33	3,080 psf
- K	-												
122 -	-												
3/22/2	<u> </u>												
2 2 1 1	-		(CH) fat CLAY with gravel, reddish brown, saturated to wet										
1	30 -		medium stiff		SPT	87	5-4-3	2.75	40				
-60:01	-						(7)						
77/0/	-												
<u>;</u> -	35												
186	-												
100	_					400		4.05	0.5		0.1	60	0 1.005
- S	40 -				ST 4	100		1.25	35	53	21	32	Qu = 1,620 psf
- SECOND	-												
SECTECH BH COLUMNS - GINT STOUS LAD	45												
			Refusal at 46.4 feet. Bottom of borehole at 46.4 feet.							<u> </u>			

APPENDIX C

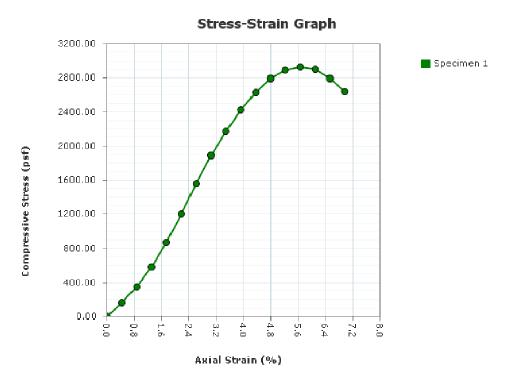
Laboratory Testing Results





Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 3/17/2022
Sampling Date: 3/17/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #21W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 3/17/2022 Checked By: _____ Date: _____

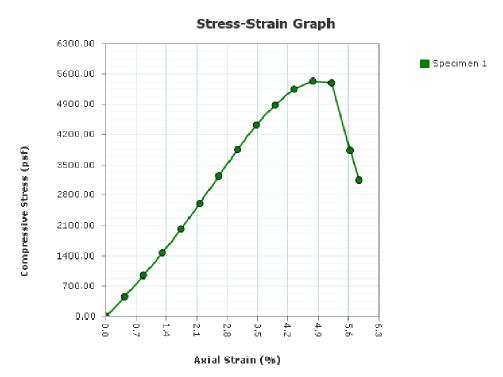
ASTM D2166								
			$\mathbf{S}_{\mathbf{I}}$	pecimen	Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	21.2							
Wet Density (pcf)	128.4							
Dry Density (pcf)	105.9							
Saturation (%):	95.6							
Void Ratio:	0.603							
Height (in)	5.7400							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	2928.07							
Undrained Shear Strength (psf)	1464.04							
Strain at Failure (%):	5.66							
Specific Gravity: 2.72	D1.	stic Limit:	0			Liquid Limi	F: 0	
Type: UD		ssification:	i			Elquia Ellili	L. U	
Type. OD	Jon Cia	ssification.	; CL					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 3/17/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #21W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 Checked By: ___

Test Date: 3/17/2022 ___ Date: _ 2

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 3/17/2022
Sampling Date: 3/17/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #21W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 $\,$

Test Date: 3/17/2022 Checked By: _____ Date: _____

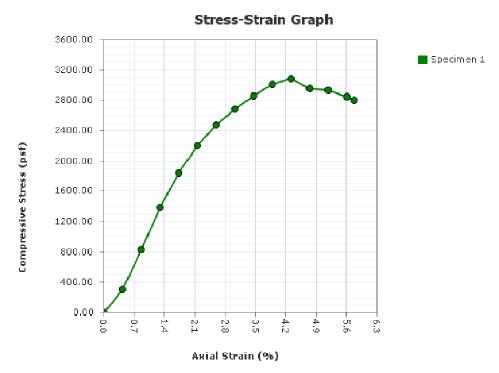
ASTM D2166								
	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)	109.3							
Saturation (%):	96.1							
Void Ratio:								
Height (in)								
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)	2717.39							
Strain at Failure (%):	4.77							
Specific Gravity: 2.72	Pl:	stic Limit:	19		1	Liquid Lim	it: 32	
Type: UD	Soil Classification: CL							
			: 02					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 3/17/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #21W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3	Specim	en 4	Specimen 5	5 Spec	rimen 6	Specime	n 7 Sr	pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		Failure Sket		e Sketch	Failure Sl		lure Sketch
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 3/17/2022 Checked By: ___ ___ Date: __ 2

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 3/17/2022
Sampling Date: 3/17/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR #21W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 3/17/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

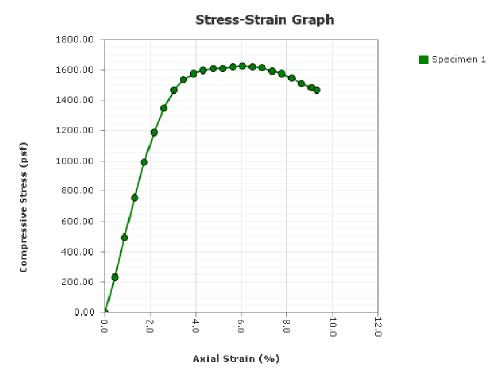
ASTM D2166								
				pecimer	Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	4.31						!	
Specific Gravity: 2.72	Pla	stic Limit:	25		I	iquid Lim	it: 58	
Type: UD	Soil Clas	ssification:	СН					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 3/17/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR #21W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 ailure Sket		imen 6 e Sketch	Specime Failure Sl		ecimen 8 ure Sketch
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 3/17/2022 Checked By: ___ ___ Date: __ 2

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 3/17/2022
Sampling Date: 3/17/2022
Sample Number: ST 4
Sample Depth: 39.0-41.0 ft
Boring Number: STR 21W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 3/17/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _

Test Date: 3/17/2022

ASTM D2166								
			$\mathbf{S}_{]}$	pecimei	n Numb	er		
Before Test		2	3	4	5	6	7	8
Moisture Content (%):	34.8							
Wet Density (pcf)	117.9							
Dry Density (pcf)	87.4							
Saturation (%):	100.6							
Void Ratio:	0.942							
Height (in)	5.7900							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1622.47							
Undrained Shear Strength (psf)	811.24							
Strain at Failure (%):	6.48							
Specific Gravity: 2.72	DI	stic Limit:	21			Liquid Limi	L E2	
Type: UD		ssification:				Liquia Limi	11: 33	
Type. ; OD	Jon Cia	SSIIICation.	i CI I					
Project: Ford 138kV Glendale Ind	ustrial We	st						
Project Number: 222-032								
Sampling Date: 3/17/2022								
Sample Number: ST 4								
Sample Depth: 39.0-41.0 ft								
Boring Number: STR 21W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3	Specim	en 4	Specimen 5	Spec	imen 6	Specime	n 7 C	pecimen 8
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 Checked By: _____ Date: ___

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



May 5, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford 138kV Glendale Industrial West Structure 24W Glendale, KY AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 24W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Churchina	C+	Haiaba	Centerline	Structure (Trans.	Long.	
Structure Number	Structure Description	Height (ft) Elevation (ft) Latitud		Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
24W	Double Circuit	110	691.7	37°34′42.58″N	85°53′21.88″W	10,578	5,178

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of 34 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of nine inches. Beneath the surface material, lean clay was encountered to the auger refusal depth. The lean clay

Ford 138kV Glendale Industrial West Structure 24W

May 5, 2022 Page **2** of **3**

was typically described as reddish brown in color, containing varying amounts of gravel, wet and soft to stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 24W - Summary of Boring

			Surface	Auger Refusal	
			Elevation	Depth	Elevation
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 24W	37°34′42.58″N	85°53′21.88″W	691.6	34.0	657.6

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 24W	CL	5.0-9.0	0.4	0.3
STR 24W	CL	9.0-34.0	1.2	0.7

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford 138kV Glendale Industrial West Structure 24W

May 5, 2022 Page **3** of **3**

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
STR 24W	CL	5.0-9.0	0.007	-
STR 24W	CL	9.0-34.0	0.021	200

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)								
STR 24W	CL	5.0-9.0	125.0	0.4	0.5								
STR 24W	CL	9.0-34.0	125.0	1.2	0.9								

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP Director of Geotechnical Services

Attachments:

- Boring Layout
- · Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





Attachment 3 to Response to PSC-4 Question No. 1
Page 453 of 592
McFarland

APPENDIX B

Boring Log



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY SPT N-VALUE		Qu/Qp (tsf)	PLASTICITY				
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity			
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)			
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7			
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22			
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22			
Hard	30 blows/ft or more	> 4.00					

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine − ¼ to ½ inch
·		Sand	Coarse – 0.6mm to ¼ inch
RELATIVE PROPO	<u>ORTIONS</u>		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted.}$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

 Qu:
 Unconfined Compressive Strength
 N:
 Standard Penetration Value (see above)

 Qp:
 Unconfined Comp. Strength (pocket pent.)
 omc:
 Optimum Moisture content

 LL:
 Liquid Limit, % (Atterberg Limit)
 PL:
 Plastic Limit, % (Atterberg Limit)

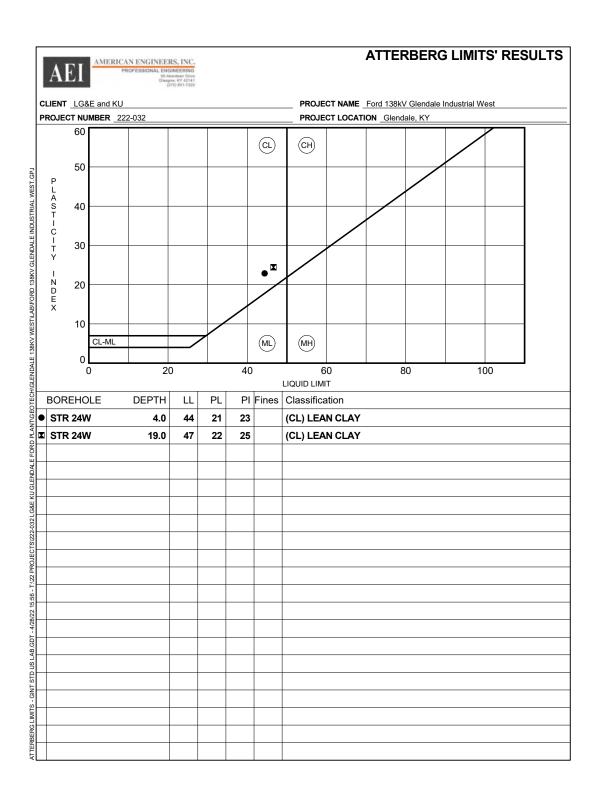
 PI:
 Plasticity Index
 mdd:
 Maximum Dry Density

	A	E	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING 65 Aberdelen Orses (USA) (275) (851-7229)								•	STF PAGE	R 24W E 1 OF 1
1	CLIEN	IT LC	&E and KU	PROJEC	T NAME	Ford	138kV Gle	ndale	ndust	rial We	st		
	PROJ	ECT N	UMBER 222-032 I	PROJECT LOCATION Glendale, KY									
	DATE	STAR	TED 3/18/22 COMPLETED 3/18/22	GROUND	ELEVA	TION _	691.6 ft						
	DRILL	ING C	ONTRACTOR Adam Thompson	GROUND	WATER	LEVE	LS:						
2	DRILL	ING N	IETHOD Hollow Stem Auger	AT	TIME OF	DRIL	LING						
2	LOGG	ED B	Peyton Linder CHECKED BY Aaron Anderson	AT	END OF	DRILL	ING						
	NOTE	s		AF	TER DRII	LLING							
F INDUS IN	Ε.	OH C			TYPE	ERY % D)	W VTS .UE)	PEN.	URE \T (%)	[ERBE	3	RKS
KV GLENDAL	o DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
PORU ISO	 		TOPSOIL (9 INCHES) (CL) lean CLAY, reddish brown, wet, soft to stiff		ST 1	100		2.75	23				Qu = 740 psf
WES IVED	5				ST 2	100		3.25	26	44	21	23	Qu = 840 psf
ALE 138KV V	 				2								
ECHIGLENDALE 138KV WESTILDABIFORD 138KV	10				SPT 1	100	5-5-6 (11)	3.75	26				
LG&E KU GLENDALE FORD PLANI GEOI	 15 												
GLENDALE	20		(CL) lean CLAY, trace to some gravel, reddish brown, wet,	stiff	ST 3	90		4.5+	29	47	22	25	Qu = 2,210 psf
32 LG&E KU													
JECI SIZZZ-L													
- 1.22 P.R.	30				SPT 2	20	4-7-5 (12)	<0.25	27				
21:01 22/6/0	 												
JS LAB.GDI - 5		<u> </u>	Refusal at 34.0 feet. Bottom of borehole at 34.0 feet.										
GEOLECH BH COLUMNS - GINT STD US LAB													
GEOLECT													

APPENDIX C

Laboratory Testing Results

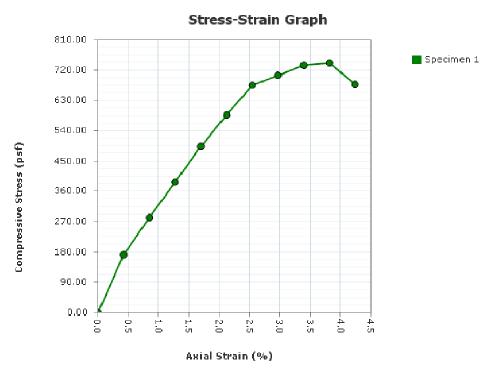




Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032 Received Date: 3/18/2022 Sampling Date: 3/18/2022 Sample Number: ST 1 Sample Depth: 1.0-3.0 ft Boring Number: STR #24W Location: Glendale, KY Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032 Checked By: ___ Date: _

Test Date: 3/18/2022 Report Created: 3/25/2022

Unconfined Compression Test

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	22.0							
Wet Density (pcf)	123.3							
Dry Density (pcf)	101.0							
Saturation (%):	87.9							
Void Ratio:	0.680							
Height (in)	5.9000							
Diameter (in)	2.8600							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.06							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.69							
Unconfined Compressive Strength (psf)	741.33							
Undrained Shear Strength (psf)	370.67							
Strain at Failure (%):	3.81							
Specific Gravity: 2.72	Pla	stic Limit:	0		I	iquid Limi	t: 0	
Type: UD	Soil Clas	ssification:	CL			_	•	
Project: Ford 138kV Glendale Indu	ıstrial Wes	st						
Project Number: 222-032								
Sampling Date: 3/18/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #24W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

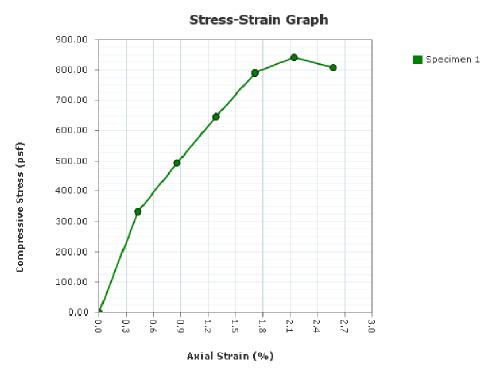
Test Date: 3/18/2022 Checked By: ___ _ Date: _

2 Report Created: 3/25/2022

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 3/18/2022
Sampling Date: 3/18/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #24W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 3/18/2022 Checked By: _____ Date: _____

Report Created: 3/25/2022

Unconfined Compression Test

ASTM D2166								
			$\mathbf{S}_{]}$	pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	2.14							
Specific Gravity: 2.72	Pla	stic Limit:	21		I	iquid Limi	t: 44	
Type: UD	Soil Cla	ssification:	CL			1	:	
Project: Ford 138kV Glendale Ind	netrial Was	o+						
Project Number: 222-032	ustriai vvc.	,,,						
Sampling Date: 3/18/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #24W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

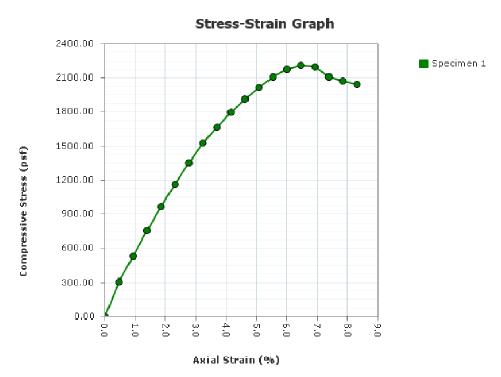
Test Date: 3/18/2022 Checked By: ___ _ Date: _

2 Report Created: 3/25/2022

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project: Ford 138kV Glendale Industrial West

Project Number: 222-032
Received Date: 3/21/2022
Sampling Date: 3/21/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR 24W
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 3/21/2022

Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Checked By: ______ Date: _____

Report Created: 4/28/2022

Unconfined Compression Test

Before Test			e	pecimer	Mission			
Before Test			3	pecimei	ınumid	er		
Deloie lest		2	3	4	5	6	7	8
Moisture Content (%):	29.3							
Wet Density (pcf)	118.1							
Dry Density (pcf)	91.4							
Saturation (%):	92.8							
Void Ratio:	0.858							
Height (in)	5.4200							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.8							
Height To Diameter Ratio:	1.90							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.85							
Unconfined Compressive Strength (psf)	2213.75							
Undrained Shear Strength (psf)	1106.87							
Strain at Failure (%):	6.46							
Specific Gravity: 2.72	D1°	stic Limit:	22			Liquid Limi	t· 17	
Type: UD		ssification:	i			Eiquia Eiiiii	. 17	
Type. : OD	Son Cia.	33IIICation.	i CL					
Project: Ford 138kV Glendale Ind	ustrial Wes	st						
Project Number: 222-032								
Sampling Date: 3/21/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR 24W								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen 5	Spec	imen 6	Specime	n 7 Sı	pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		Failure Sketo		e Sketch	Failure Sk		lure Sketch
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Project Name: Ford 138kV Glendale Industrial West Project Number: 222-032

Test Date: 3/21/2022 Checked By: ___ __ Date: _

Report Created: 4/28/2022 2

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



March 16, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration

Ford Property 345kV Glendale South – Brown North

Structure 1A Glendale, KY

AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford Property 345kV Glendale South — Brown North in Glendale, KY. This summary is provided for Structure 1A, a 3DS Tower.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Trans. Moment (ft-k)	Long. Moment (ft-k)
1A	3DS Tower	105	705.40	37°35′45.769″N	85°53′50.216″W	4,196	4,453
-	Leg 1	-	705.35	37°35′45.57″N	85°53′50.35″W	•	-
-	Leg 2	-	705.35	37°35′45.65″N	85°53'49.96"W	•	1
-	Leg 3	-	705.35	37°35′45.98″N	85°53′50.07″W	•	•
_	Leg 4	-	705.35	37°35′45.90″N	85°53′50.47″W	-	-

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of two soil test borings and two rockline soundings. The soil test borings were advanced to a depth of about 48 feet beneath the surface. The rockline soundings were advanced to a depth of about 42 feet to 54 feet beneath the surface. The boring locations were staked by KU personnel. A boring layout is included in Appendix A of this report.

Ford Property 345kV Glendale South – Brown North Structure 1A March 16, 2022 Page **2** of **4**

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring locations, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring logs in Appendix B.

Topsoil was encountered at the surface with thicknesses of approximately nine inches. Beneath the surface materials, lean clay was encountered to refusal depths in each of the borings. The lean clay was typically described as reddish-brown to red in color, moist to saturated and soft to very stiff.

Detailed laboratory results are included in Appendix C of this report.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring logs, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was encountered in the soil test borings at the depths shown in the table below.

Table 2: Structure 1A - Summary of Boring

			Surface	Aug	er Refusal
			Elevation (ft.)	Depth	Elevation
Hole No.	Latitude	Longitude	MSL	(ft.)	(ft.) MSL
STR 1A L1	37°35′45.57″N	85°53′50.35″W	703.5	48.8	654.7
STR 1A L2	37°35′45.65″N	85°53′49.96″W	702.7	42.3	660.4
STR 1A L3	37°35′45.98″N	85°53′50.07″W	703.0	54.1	648.9
STR 1A L4	37°35′45.90″N	85°53′50.47″W	703.9	48.7	655.2

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Ford Property 345kV Glendale South – Brown North Structure 1A March 16, 2022 Page **3** of **4**

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 1A	CL	5.0-12.0	2.3	0.7
STR 1A	CL	12.0-28.0	2.0	0.6
STR 1A	CL	28.0-48.8	0.5	0.2

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure		Donth	Estimated Strain	Initial Soil		
Number	Soil Type	Depth (feet)	at 50% Shear	Stiffness		
Number	er	(leet)	Strength (ε ₅₀)	(k _{py}) (pci)		
STR 1A	CL	5.0-12.0	0.03	400		
STR 1A	CL 12.0-28.0		0.03	200		
STR 1A			0.02	-		

5.2 Axial Design Parameters – Due to the karst conditions at the site, it is recommended to design the drilled shaft as soil bearing. Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Ford Property 345kV Glendale South – Brown North Structure 1A March 16, 2022 Page **4** of **4**

			-cc		
Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 1A	CL	5.0-12.0	125	2.3	1.0
STR 1A	CL	12.0-28.0	62.6	2.0	1.0
STR 1A	CL	28.0-48.8	62.6	0.5	0.7

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Logs
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Logs



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
2 blows/ft or less	0 - 0.25	Degree of	Plasticity
2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
15 to 30 blows/ft	2.00 - 4.00	High	over 22
30 blows/ft or more	> 4.00	_	
	2 blows/ft or less 2 to 4 blows/ft 4 to 8 blows/ft 8 to 15 blows/ft 15 to 30 blows/ft	2 blows/ft or less 0 - 0.25 2 to 4 blows/ft 0.25 - 0.49 4 to 8 blows/ft 0.50 - 0.99 8 to 15 blows/ft 1.00 - 2.00 15 to 30 blows/ft 2.00 - 4.00	2 blows/ft or less 0 - 0.25 Degree of 2 to 4 blows/ft 0.25 - 0.49 Plasticity 4 to 8 blows/ft 0.50 - 0.99 Low 8 to 15 blows/ft 1.00 - 2.00 Medium 15 to 30 blows/ft 2.00 - 4.00 High

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	<u>ORTIONS</u>		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted}.$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

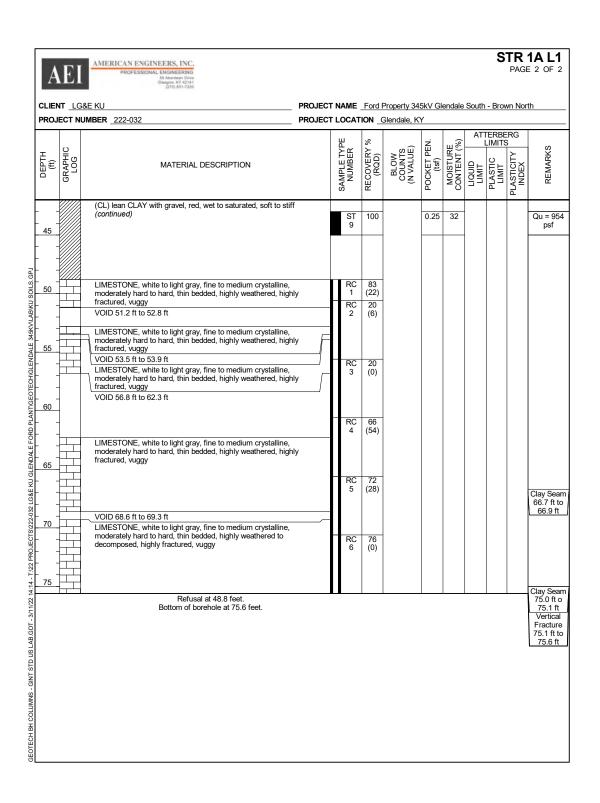
Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

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PROJ	ECT N	UMBER <u>222-032</u> PR	ROJECT I	LOCAT	ION _	Property 34 Glendale, K		endale	South	- Brov	vn Nor	th
			ROUND E ROUND V									
						LING <u>30.0</u>	0 ft / E	lev 67	3.50 ft			
		Clint Ervin CHECKED BY _Jacob Cowan				ING						
NOTE	S Lec	1	AFTE	ER DRII	LLING							
				ш	%		zi.	· (c)		ERBE		
O DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
		TOPSOIL (9 INCHES) (CL) lean CLAY, trace sand, light brown to reddish brown with bla mottle, moist to wet, stiff to very stiff	ack	ST 1	85		4.5+	22	30	19	11	Qu = 4,172 psf
5				ST	100		4.25	20				Qu = 4,039
 - 10				2			20					psf
				O.T.	95		2.5	21	42	15	0.7	Qu = 4,419
- 15 		(CL) lean CLAY, trace sand, red with gray mottle, moist to wet, ve stiff	ery	ST 3	95		2.5	21	42	15	27	psf
		(CL) lean CLAY with gravel, red, moist to wet, very stiff to mediur	m stiff	ST 4	100		3.5	27	-			Qu = 4,819 psf
 				ST	40		4.0					
25				5								
30		CL) lean CLAY with gravel, red, wet to saturated, soft to stiff		ST 6	80		0.5	37	46	23	23	Qu = 1,704 psf
- ·		(CE) CENT OF THE GRAPH, FOR MELLO SERVICES, SOIL TO STILL		ST	70		0.25					
35				7								
40				ST 8	100		1.25	50	38	16	22	Qu = 1,195 psf
	V ////											

(Continued Next Page)



A	E	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING Observation of the Control of t								S		1A L2 E 1 OF 1
CLIEN	NT LC	&E KU	PROJECT NAME Ford Property 345kV Glendale South - Brown North									
PROJ	ECT N		PROJECT LOCATION Glendale, KY									
DATE	STAF	TED 2/16/22 COMPLETED 2/16/22	GROUND	ELEVAT	ION _	702.7 ft						
DRILI	ING C	ONTRACTOR Aaron Anderson										
I		ETHOD Hollow Stem Auger		TIME OF	DRIL	LING 32.0	0 ft / E	lev 670	0.70 ft			
LOGG	SED B	CHECKED BY Jacob Cowan	_ AT	END OF	DRILL	ING						
NOTE	S Le	<u> </u>	AF	TER DRII	LING							
O DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	L	PLASTIC WEST		REMARKS
Ť		OVERBURDEN (42.3 FEET)										
	-											
30		⊋										
40												
		Refusal at 42.3 feet. Bottom of borehole at 42.3 feet.										

A	E	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING Sharden Drive Silveyer, NY 4141 Si								S		1A L3 E 1 OF 1
CLIEN	NT LG	&E KU	PROJECT	NAME	Ford I	Property 34	5kV GI	endale	South	- Brow	vn Nor	th
		UMBER 222-032	PROJECT				Y					
		TED <u>2/23/22</u> COMPLETED <u>2/23/22</u>					_					
		ONTRACTOR Aaron Anderson										
		ETHOD Hollow Stem Auger				LING 12.0	0 ft / E	lev 690	0.98 ft			
1	SED BY	/ Aaron Anderson CHECKED BY Jacob Cowan		END OF TER DRII		.ING						
NOIL	<u> </u>	10	. ~						АП	ERBE	RG	
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)		PLASTIC WILLIMIT	PLASTICITY INDEX	REMARKS
0		OVERBURDEN (54.1 FEET)										
-	1											
-	1											
	1											
10												
		Ā										
	1											
_ 20												
	1											
	1											
_ 30	1											
	-											
	1											
	1											
	1											
40	1											
	1											
	1											
	1											
	1											
50	1											
-	1											
		Refusal at 54.1 feet.										
		Bottom of borehole at 54.1 feet.										

CL sandy sand race gravel, brown with gray and black mottle, ST 65 2.5 40 33 18 15 Qu = 1.47	A	EI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING Glasgon, NY 42141 (27) 814-7221								S		1A L4 E 1 OF 2
DRILLING CONTRACTOR Aaron Anderson							-		endale	South	- Brov	vn Nor	th
DRILLING METHOD Hollow Stem Auger CHECKED BY Kely Bridges AT FIND OF DRILLING September CHECKED BY Kely Bridges AT FIND OF DRILLING September CHECKED BY Kely Bridges AT FIND OF DRILLING September CHECKED BY Kely Bridges AT FIND OF DRILLING September CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY Kely Bridges CHECKED BY CHECK													
Log Color Log A								06/5	07	20.6			
NOTES Leg 4 AFTER DRILLING Leg 4 AFTER DRILLING Leg 4 AFTER DRILLING Leg 4 AFTER BERGY LIMITIS Limitis								υπ/Ε	iev 67	3./3 π			
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A C										AT			
TOPSOIL (9 INCHES) (CL) sandy lean CLAY, trace gravel, brown with gray and black mottle, wet to saturated (CL) lean CLAY with sand, red with tan mottle, moist to wet, stiff (CL) lean CLAY with sand, red with tan mottle, moist to wet, stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to address advantated, soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated, soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated, soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated, soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated, soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated soft to medium stiff (CL) lean CLAY with sand, trace gravel, red with black mottle, wet to advantage of the mottle saturated soft to advantage of the mottle saturated soft to advantage of the mot		GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	MOISTURE CONTENT (%)	LIQUID			REMARKS
CL lean CLAY with sand, red with tan mottle, moist to wet, stiff SPT 100 3-4-6 1.5 24 (10)			(CL) sandy lean CLAY, trace gravel, brown with gray and black it	mottle,		65		2.5	40	33	18		Qu = 1,47
1 (10) Qu = 3,09	5					100		4.5+	21				Qu = 5,423
1 (10) Qu = 3,09					0.07	100							
Saturated, soft to medium stiff 3 SPT 100 2-2-2 0.5 39 (4) ST 75 0 50 41 20 21 Qu = 383			(OL) rean OLAT with sand, red with tan motite, moist to wet, stiff	'		100		1.3	24				
SPT 100 2-2-2 0.5 39 SPT 100 2-2-2 0.5 39 SPT 100 2-2-2 0.5 39 SPT 100 2-2-2 0.5 39 SPT 100 2-2-2 0.5 39 SPT 100 2-2-2 0.5 39 SPT 100 2-2-2 0.5 39				et to		100		1.25	35				Qu = 3,093
35 (4) (4) (2) (4) (4) (7) (8) (8) (8) (8) (8) (8) (8) (8) (8) (8	25		Ţ										
ST 75 0 50 41 20 21 Qu = 383	30			ļ		100		0.5	39				
ST 75 0 50 41 20 21 Qu = 383) 2		(4)						
	40				ST 4	75		0	50	41	20	21	Qu = 383

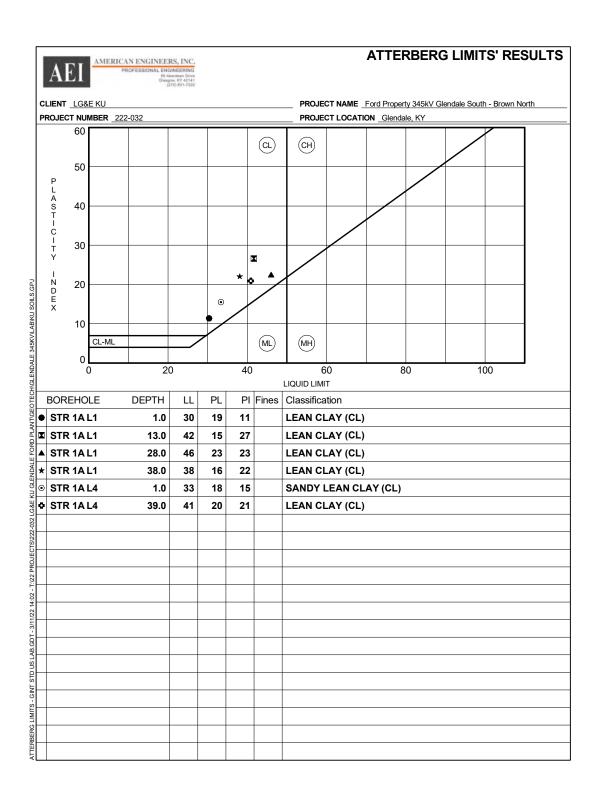
(Continued Next Page)

A	EI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING Shardson Fore (State State Control of								S	TR '	1A L4 2 OF 2
	NT LG		ROJECT NA					endale	South	- Brov	vn Nort	th
PROJ	ECT N	UMBER _222-032 P	ROJECT LO	CATI	ION _	Slendale, K\					-00	
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	M M M M M M M M M M M M M M M M M M M	NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)		PLASTIC LIMIT LIMIT	PLASTICITY N	REMARKS
45		(CL) lean CLAY with sand, trace gravel, red with black mottle, w saturated, soft to medium stiff (continued)	vet to									
		Refusal at 48.7 feet. Bottom of borehole at 48.7 feet.	<u>'</u>									

APPENDIX C

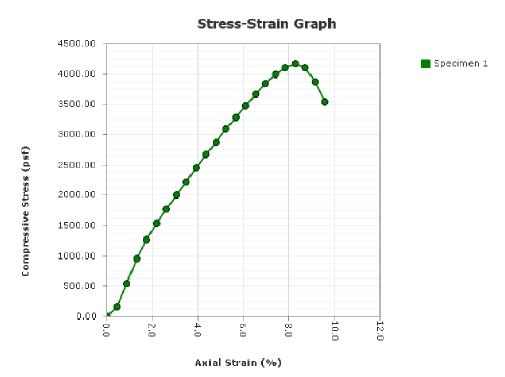
Laboratory Testing Results





Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 2/22/2022
Sampling Date: 2/22/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #1A L1
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

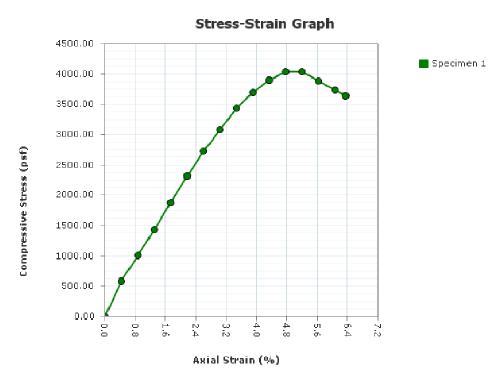
ASTM D2166								
				pecimen	Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	i							
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):	102.5							
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:				1	_			
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	i							
Strain Rate (in/min)								
Strain Rate (%/min): Unconfined Compressive Strength (psf)	i							
Undrained Shear Strength (psf)	i							
Strain at Failure (%):	i							
Strain at Failure (%):	0.27		-					
Specific Gravity: 2.72	Pla	stic Limit:	19			Liquid Limi	it: 30	
Type: Undisturbed	Soil Clas	ssification:	CL					
Project: Ford Property 345kV Gle	ndale Sout	h - Brown	North					
Project Number: 222-032								
Sampling Date: 2/22/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #1A L1								
Location: Glendale, KY								
Client Name: LG&E KU								
Remarks: Leg 1								
Specimen 1 Specimen 2 Specimen 3	Specime	1	Specimen 5	Conne	men 6	Specime	7 C	pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		Failure Sketc		Sketch	Failure Sk		lure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 2/22/2022
Sampling Date: 2/22/2022
Sample Number: ST 2
Sample Depth: 6.0-8.0 ft
Boring Number: STR #1A L1
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

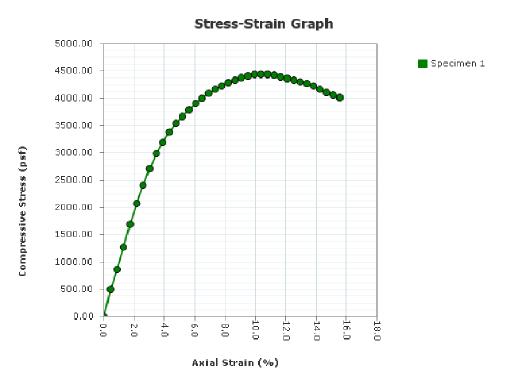
ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	. 7	8
Failure Angle (°):								
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	5.20							
Specific Gravity: 2.72	Pla	stic Limit:	0		Ι	iquid Lim	it: 0	
Type: UD	Soil Clas	ssification:	CL					
Project: Ford Property 345kV Gler	ndale Sout	h - Brown N	North					
Project Number: 222-032								
Sampling Date: 2/22/2022								
Sample Number: ST 2								
Sample Depth: 6.0-8.0 ft								
Boring Number: STR #1A L1								
Location: Glendale, KY								
Client Name: LG&E KU								
Remarks: Leg 1								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 ailure Sket		imen 6 e Sketch	Specime Failure Sl		ecimen 8 ure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 2/22/2022
Sampling Date: 2/22/2022
Sample Number: ST 3
Sample Depth: 13.0-15.0 ft
Boring Number: STR #1A L1
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

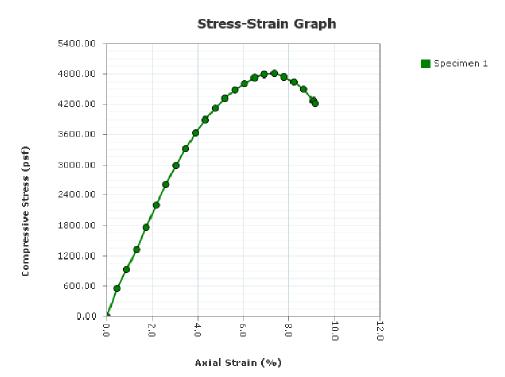
ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	11.21							
Specific Gravity: 2.72	Pla	stic Limit:	15		I	iquid Limi	it: 42	
Type: UD	Soil Clas	ssification:	CL					
Project: Ford Property 345kV Gle	ndale Sout	n - Brown N	North					
Project Number: 222-032								
Sampling Date: 2/22/2022								
Sample Number: ST 3								
Sample Depth: 13.0-15.0 ft								
Boring Number: STR #1A L1								
Location: Glendale, KY								
Client Name: LG&E KU								
Remarks: Leg 1								
	C	4	C	- C		C :		
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 ailure Sket		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: ___ _____ Date: __ 2

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 2/22/2022
Sampling Date: 2/22/2022
Sample Number: ST 4
Sample Depth: 18.0-20.0 ft
Boring Number: STR #1A L1
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

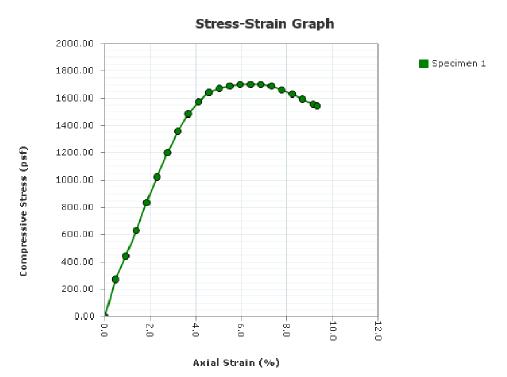
ASTM D2166								
			Sp	ecimer	Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	37.5							
Wet Density (pcf)								
Dry Density (pcf)	83.0							
Saturation (%):	97.5							
Void Ratio:	1.046							
Height (in)	5.7860							
Diameter (in)	2.8450							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4819.01							
Undrained Shear Strength (psf)	2409.50							
Strain at Failure (%):	7.35							
Specific Gravity: 2.72	Pla	stic Limi	t 0			Liquid Limi	it: 0	
Type: UD		ssification	i			Elquiu Ellin	11. 10	
Project: Ford Property 345kV Gle	ndale Soutl	h - Brown	n North					
Project Number: 222-032								
Sampling Date: 2/22/2022								
Sample Number: ST 4								
Sample Depth: 18.0-20.0 ft								
Boring Number: STR #1A L1								
Location: Glendale, KY								
Client Name: LG&E KU								
Remarks: Leg 1								
Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen 5	Spec	imen 6	Specime	n 7	Specimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		Failure Sketch		e Sketch	Failure Sk		ailure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: ___ _ Date: _

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 2/22/2022
Sampling Date: 2/22/2022
Sample Number: ST 6
Sample Depth: 28.0-30.0 ft
Boring Number: STR #1A L1
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

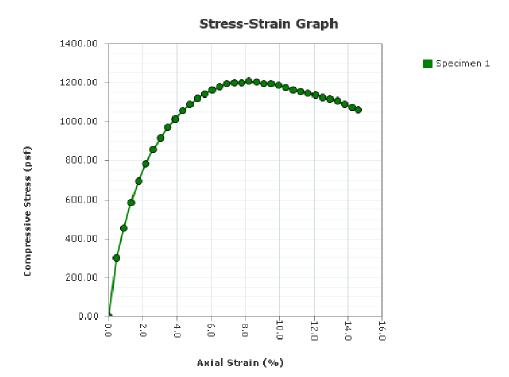
ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)	1							
Strain Limit @ 15% (in)	i							
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	6.85							
Specific Gravity: 2.72	Pla	stic Limit:	23		I	Liquid Lim	it: 46	
Type: UD	Soil Clas	ssification:	CL				:	
Project: Ford Property 345kV Gle	ndala Cauti	h Buorum N	Touth					
Project Number: 222-032	iluaie 30uti	ii - Diowii i	NOTHI					
Sampling Date: 2/22/2022								
Sample Number: ST 6								
Sample Depth: 28.0-30.0 ft								
Boring Number: STR #1A L1								
Location: Glendale, KY								
Client Name: LG&E KU								
Remarks: Leg 1								
Specimen 1 Specimen 2 Specimen 3	Specime		Specimen 5		imen 6	Specime		pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S	ketch F	ailure Sketc	h Failur	e Sketch	Failure Sk	etch Fai	lure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: ___ __ Date: _

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 2/22/2022
Sampling Date: 2/22/2022
Sample Number: ST 8
Sample Depth: 38.0-40.0 ft
Boring Number: STR #1A L1
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

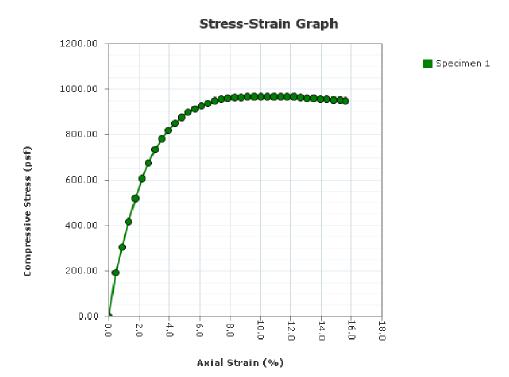
ASTM D2166								
			S	pecimer	n Numbe	er		
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	29.2							
Wet Density (pcf)	123.5							
Dry Density (pcf)	95.6							
Saturation (%):	102.2							
Void Ratio:								
Height (in)								
Diameter (in)	2.8170							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.06							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)	597.61							
Strain at Failure (%):	9.50							
Specific Gravity: 2.72	Pla	stic Limit:	16		I	Liquid Limi	it: 38	
Type: UD		ssification:			-	orquia Diri	100	
Project: Ford Property 345kV Gle	ndale Sout	h - Brown I	North					
Project Number: 222-032								
Sampling Date: 2/22/2022								
Sample Number: ST 8								
Sample Depth: 38.0-40.0 ft								
Boring Number: STR #1A L1								
Location: Glendale, KY								
Client Name: LG&E KU Remarks: Leg 1								
Terraine. Leg 1								
Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen	5 Spec	imen 6	Specime	n 7 Sp	ecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S	ketch F	ailure Sket	ch Failur	e Sketch	Failure Sk	etch Fail	ure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 2/22/2022
Sampling Date: 2/22/2022
Sample Number: ST 9
Sample Depth: 43.0-45.0 ft
Boring Number: STR #1A L1
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

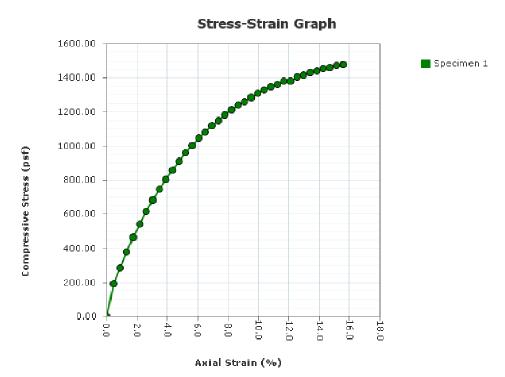
ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:	0.809							
Height (in)								
Diameter (in)	2.8010							
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	14.80							
Specific Gravity: 2.72	Pla	stic Limit:	0		I	iquid Limi	it: 0	
Type: UD	Soil Clas	ssification:	CL				•	
Project: Ford Property 345kV Gle	ndale Sout	h - Brown N	North					
Project Number: 222-032								
Sampling Date: 2/22/2022								
Sample Number: ST 9								
Sample Depth: 43.0-45.0 ft								
Boring Number: STR #1A L1								
Location: Glendale, KY								
Client Name: LG&E KU								
Remarks: Leg 1								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 ailure Sket		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
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				ii				
	<u> </u>	!		!!				

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 2/22/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/2/2022
Sampling Date: 3/2/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #1A L4
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 4

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/2/2022 Checked By: _____ Date: _____

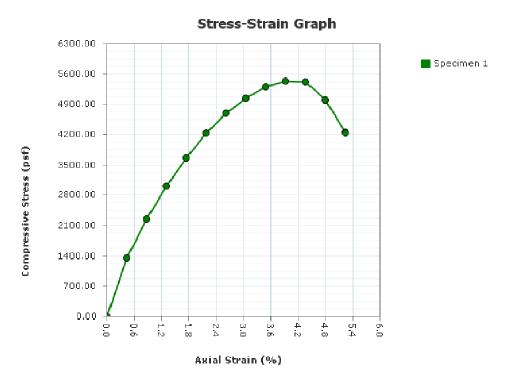
ASTM D2166								
			$\mathbf{S}_{]}$	pecimer	ı Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	56.2							
Wet Density (pcf)								
Dry Density (pcf)	81.0							
Saturation (%):	139.4							
Void Ratio:	1.096							
Height (in)	5.7870							
Diameter (in)	2.8750							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.01							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	15.12							
Specific Gravity: 2.72	Pl:	astic Limit:	18		T	Liquid Limi	t· 33	
Type: UD		ssification:	i		1	nquia Emi	1. 1. 3.3	
			•					
Project: Ford Property 345kV Gle	ndale Sout	h - Brown I	Vorth					
Project Number: 222-032								
Sampling Date: 3/2/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #1A L4								
Location: Glendale, KY								
Client Name: LG&E KU								
Remarks: Leg 4								
Specimen 1 Specimen 2 Specimen 3	Specim	en 4	Specimen 5	Spec	imen 6	Specime	n 7 Sr	ecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		ailure Sketc		e Sketch	Failure Sk		ure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/2/2022 Checked By: ___ __ Date: _ 2

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/2/2022
Sampling Date: 3/2/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #1A L4
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 4

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/2/2022 Checked By: _____ Date: _____

ASTM D2166								
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Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	4.36						<u> </u>	
Specific Gravity: 2.72	Pla	stic Limit	: 0			Liquid Lim	it: 0	
Type: UD	Soil Clas	ssification	: CL					
Project: Ford Property 345kV Gle	ndale Sout	h - Brown	North					
Project Number: 222-032								
Sampling Date: 3/2/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #1A L4								
Location: Glendale, KY								
Client Name: LG&E KU								
Remarks: Leg 4								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 Failure Sketc		imen 6 e Sketch	Specime Failure Sl		pecimen 8 ilure Sketch
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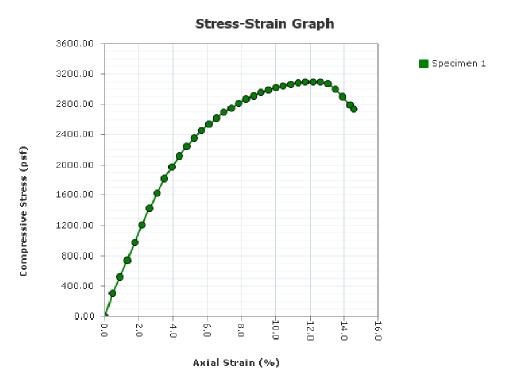
Test Date: 3/2/2022 Checked By: _____ Date: _____

Report Created: 3/11/2022 2

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/2/2022
Sampling Date: 3/2/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR #1A L4
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 4

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/2/2022 Checked By: _____ Date: _____

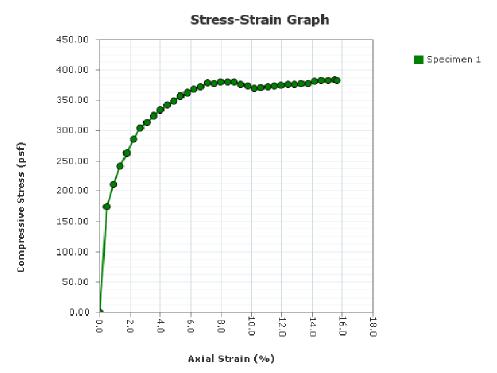
ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	12.62							
Specific Gravity: 2.72	Pla	stic Limit:	0		Ι	iquid Lim	it: 0	
Type: UD	Soil Clas	ssification:	CL					
Project: Ford Property 345kV Gler	ndale Sout	h - Brown N	North					
Project Number: 222-032								
Sampling Date: 3/2/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR #1A L4								
Location: Glendale, KY								
Client Name: LG&E KU								
Remarks: Leg 4								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 ailure Sket		imen 6 e Sketch	Specime Failure Sl		ecimen 8 ure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/2/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/2/2022
Sampling Date: 3/2/2022
Sample Number: ST 4
Sample Depth: 39.0-41.0 ft
Boring Number: STR #1A L4
Location: Glendale, KY
Client Name: LG&E KU
Remarks: Leg 4

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/2/2022 Checked By: _____ Date: _____

ASTM D2166								
	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	30.3							
Wet Density (pcf)								
Dry Density (pcf)	96.3							
Saturation (%):	107.9							
Void Ratio:	0.763							
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	0.8							
Height To Diameter Ratio:	2.00							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.77							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	15.03							
Specific Gravity: 2.72	Pla	stic Limit:	0		1	Liquid Lim	it· 0	
Type: UD		ssification:	i		•	orquia ziii.		
Project: Ford Property 345kV Gler	ndale Sout	h - Brown I	North					
Project Number: 222-032								
Sampling Date: 3/2/2022								
Sample Number: ST 4								
Sample Depth: 39.0-41.0 ft								
Boring Number: STR #1A L4								
Location: Glendale, KY								
Client Name: LG&E KU								
Remarks: Leg 4								
Specimen 1 Specimen 2 Specimen 3	Specime	en 4	Specimen 5	5 Spec	cimen 6	Specime	en 7 Sr	pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		ailure Sket		e Sketch	Failure Sl		lure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/2/2022 Checked By: ___ _____ Date: __

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



March 21, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration

Ford Property 345kV Glendale South – Brown North

Structure 2A Glendale, KY

AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford Property 345kV Glendale South – Brown North in Glendale, KY. This summary is provided for Structure 2A, a 3CS Tower.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Trans. Moment (ft-k)	Long. Moment (ft-k)
2A	3CS Tower	90	729.4	37°35′50.552″N	85°53′39.827″W	2,817	15
-	Leg 1	-	729.4	37°35′50.38″N	85°53′39.91″W	-	-
-	Leg 2	-	729.4	37°35′50.51″N	85°53′39.62″W	-	-
-	Leg 3	-	729.4	37°35′50.71″N	85°53′39.74″W	-	-
-	Leg 4	-	729.4	37°35′50.62″N	85°53′40.02″W	-	-

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of two soil test borings and two rockline soundings. The soil test borings were advanced to a depth of about 55 to 67 feet beneath the surface. The rockline soundings were advanced to a depth of about 58 feet to 59 feet beneath the surface. The boring locations were staked by KU personnel. A boring layout is included in Appendix A of this report.

Ford Property 345kV Glendale South – Brown North Structure 2A March 21, 2022 Page **2** of **4**

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring locations, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring logs in Appendix B.

Topsoil was encountered at the surface with thicknesses of approximately eight to nine inches. Beneath the surface materials, lean clay was encountered to refusal depths in each of the borings. The lean clay was typically described as reddish-brown to red in color, containing varying amounts of gravel, moist to saturated and soft to very stiff.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring logs, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal depths are provided in the table below.

Table 2: Structure 1A - Summary of Boring

			Surface	Auger Refusal	
			Elevation	Depth Elevation	
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 2A L1	37°35′50.38″N	85°53′39.91″W	726.4	46.9	679.5
STR 2A L2	37°35′50.51″N	85°53′39.62″W	727.2	59.3	667.9
STR 2A L3	37°35′50.71″N	85°53′39.74″W	727.3	55.1	672.2
STR 2A L4	37°35′50.62″N	85°53′40.02″W	726.7	58.2	668.5

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Ford Property 345kV Glendale South – Brown North Structure 2A March 21, 2022 Page **3** of **4**

Table 3: MFAD Geotechnical Design Parameters

- 1					
		Lithology		Soil	
۵.	61		Depth (feet)	Undrained	Modulus of
	Structure Number			Shear	Deformation
				Strength	(ksi)
				(ksf)	` ,
	STR 2A	CL	5.0-37.0	1.4	0.4
	STR 2A	CL	37.0-60.0	0.5	0.2

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Shear Strength (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
STR 2A	CL	5.0-37.0	0.03	200
STR 2A	CL	37.0-60.0	0.03	-

5.2 Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
STR 2A	CL	5.0-37.0	125.0	1.4	1.0
STR 2A	CL	37.0-60.0	62.6	0.5	0.7

^{*}Effective Unit Weight accounts for Buoyancy

Ford Property 345kV Glendale South – Brown North Structure 2A March 21, 2022 Page **4** of **4**

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Logs
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Logs



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – $\frac{1}{2}$ to 1 inch
Very Dense	50 blows/ft or more		Fine $-\frac{1}{4}$ to $\frac{1}{2}$ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

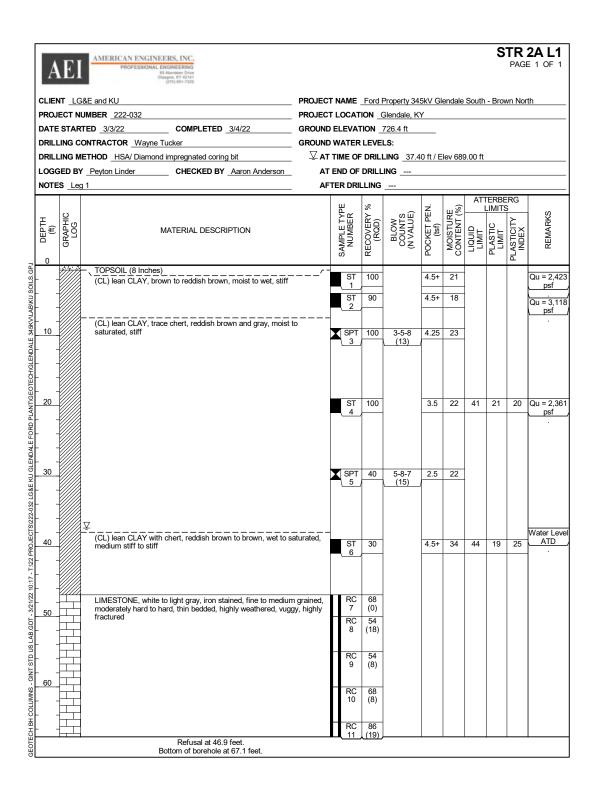
 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted.}$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density

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CLIENT LG&E and KU PROJECT NAME Ford Property 345kV Glendale South - Brown North PROJECT NUMBER 222-032 PROJECT LOCATION Glendale, KY DATE STARTED 3/9/22 COMPLETED 3/9/22 GROUND ELEVATION 727.2 ft DRILLING CONTRACTOR Adam Thompson GROUND WATER LEVELS: DRILLING METHOD Hollow Stem Auger AT TIME OF DRILLING LOGGED BY Adam Cash CHECKED BY Aaron Anderson NOTES Leg 2 AFTER DRILLING NOTES Leg 2 ATTERBERG LIMITS ATTERBERG LIMITS	
DATE STARTED 3/9/22 COMPLETED 3/9/22 GROUND ELEVATION 727.2 ft	
DRILLING CONTRACTOR Adam Thompson GROUND WATER LEVELS: DRILLING METHOD Hollow Stem Auger AT TIME OF DRILLING LOGGED BY Adam Cash CHECKED BY Aaron Anderson NOTES Leg 2 ATTERBERG LIMITS	
DRILLING METHOD Hollow Stem Auger LOGGED BY Adam Cash CHECKED BY Aaron Anderson NOTES Leg 2 ATTERBERG LIMITS AT TIME OF DRILLING AT END OF DRILLING AFTER DRILLING AFTER DRILLING LIMITS	
LOGGED BY Adam Cash CHECKED BY Aaron Anderson AFTER DRILLING NOTES Leg 2 ATTERBERG LIMITS AT END OF DRILLING AFTER DRILLING ATTERBERG LIMITS	
NOTES Leg 2 AFTER DRILLING U	
W % Z W W ATTERBERG LIMITS	
SAMPLE TYPE NUMBER RECOVERY % (RQD) ROWSTURE CONTENT (%) LIMIT PLASTICITY SABBLE TYPE CONTENT (%) LIMIT PLASTICITY NUMBER NOCKET PEN. (ST) LIMIT PLASTICITY NUMBER NOCKET PEN. (ST) LIMIT PLASTICITY NUMBER NOCKET PEN. (ST) NOCKET	REMARKS
OVERBURDEN (59.3 FEET)	
40	
50	
Refusal at 59.3 feet. Bottom of borehole at 59.3 feet.	

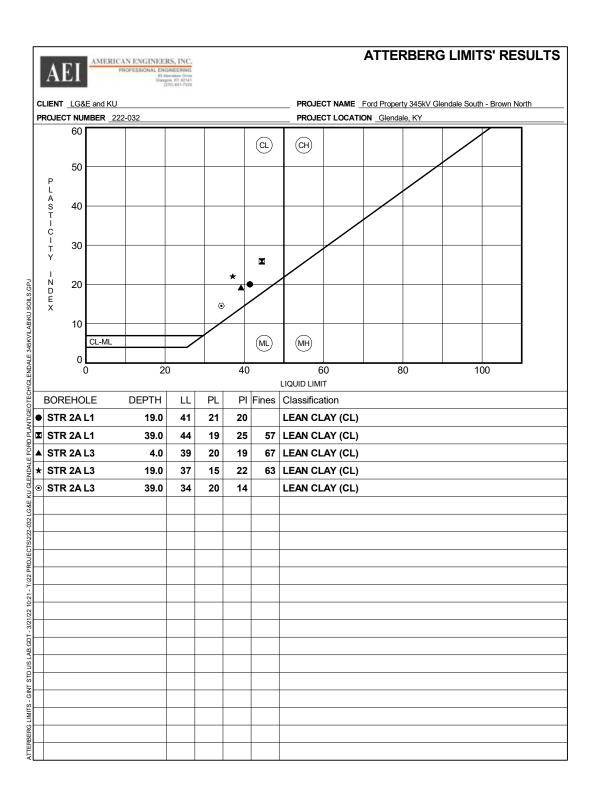
A	A EI	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERS OF Advantages Drive Glasgow, NY, 47454 (20) 651-7229								S		2A L3 E 1 OF 1
CLIE	ENT LO	&E and KU	PROJEC	ГИАМЕ	Ford F	Property 34	5kV GI	endale	South	- Brov	vn Nor	th
		UMBER 222-032				Glendale, K						
DAT	E STAR	TED 3/4/22 COMPLETED 3/4/22	GROUND	ELEVA1	ION _	727.3 ft						
DRIL	LING C	ONTRACTOR Aaron Anderson	GROUND	WATER	LEVE	LS:						
DRIL	LING N	ETHOD Hollow Stem Auger	AT	TIME OF	DRILI	LING						
LOG	GED B	Katy Bridges CHECKED BY Aaron Anderson	AT	END OF	DRILL	ING						
NOT	ES Le	13	AF	TER DRII	LLING							
_ 0	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC HIMIT LIMIT		REMARKS
<u>5</u>	7////			ST	95		4.25	20				Qu = 4,269
BIKU SU		(CL) sandy lean CLAY, red with tan and gray mottle, moist to	wet, very	ST	100		3.5	18	39	20	19	psf
15KV/LA		stiff		2								
10	-\			SPT 3	100	4-7-9 (16)	3.75	22				
GD1 - 32/102 1017 - 1/32 PROJECTS 2222032 LOKE KU GLENDALE FORD PLANTGEOTECHGLENDALE SIGN/LABKU SOLISS GP. 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0		(CL) lean CLAY with chert, red, moist to wet		ST 4	60		4.25	26	37	15	22	
	-											
30		(CL) lean CLAY with sand, red, moist to wet, medium stiff to	soft	SPT 5	73	0-2-3 (5)	1.0	30				
7 - LYZ PROJECIS												
40	<i>\\\\\\</i>			ST	100		4.25	31	34	20	14	Qu = 1,669
08 LAB.GDI - 3/21/2				6								psf ·
				SPT 7	93	0-1-2 (3)	0.5	37	-			
5 E	<u> </u>	Refusal at 55.1 feet.						<u> </u>				
SEOIECE		Bottom of borehole at 55.1 feet.										

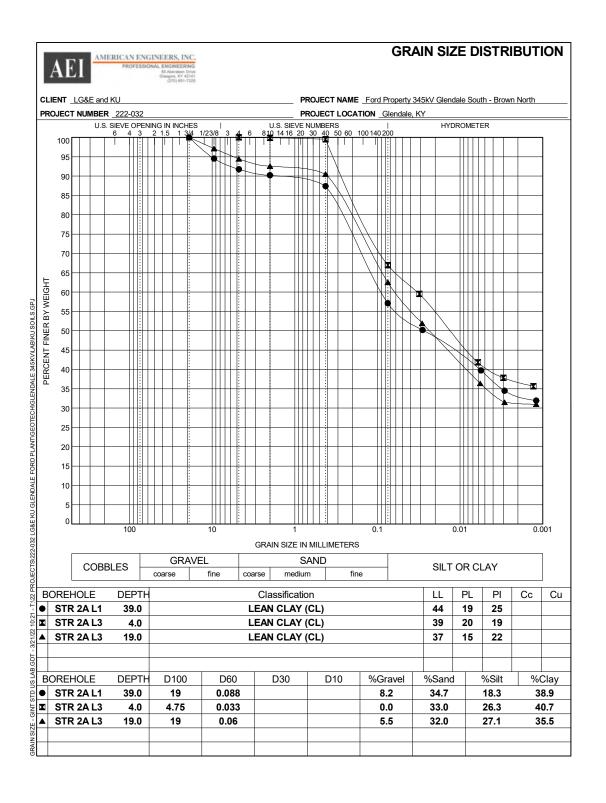
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	CLIEN	T LG	&E and KU	PROJECT	NAME	Ford I	Property 34	5kV GI	endale	South	- Brov	vn Nor	th
			UMBER 222-032				Glendale, K	Y					
- 1			TED _3/8/22					_					
- 1			ETHOD Hollow Stem Auger				ING						
- 1			Peyton Linder CHECKED BY Aaron Anderson				ING						
ŀ	NOTE	S <u>Le</u> ç	14	AF	TER DRII					ΔΤΊ	ERBE	RG	
	O DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	I	IMITS		REMARKS
S.GP.	U		OVERBURDEN (58.2 FEET)										
GEOLECH BH COLUMNS - GINT STD US LABGOLT - 3/2/1/27 10/17 - 1/2/2 PROJECT SYZZJOZ LG&E NO GLENDALE FORD PLANTIGEOTECHIGLENDALE 3498/NLABIRO SOILS, GF,	-												
NOALE 3	10												
SH GE	-												
9 0 1 0 1 1	-												
E P	20												
7													
LENDA	-												
SE NO	-												
-032 LG	30												
013/22	-												
L ROSE	-												
7 /.	40												
1/22 10:	_												
- 3/2	-												
S LAB.C	-												
S C	50												
2	-												
SMIN	-												
3	-												
ECH.			Refusal at 58.2 feet. Bottom of borehole at 58.2 feet.										

APPENDIX C

Laboratory Testing Results

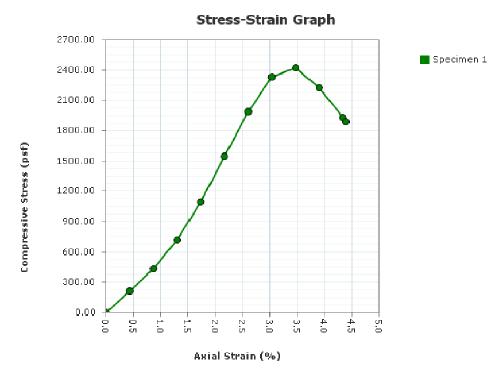






Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/7/2022
Sampling Date: 3/7/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #2A L1
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/7/2022 Checked By: _____ Date: _____

Unconfined Compression Test

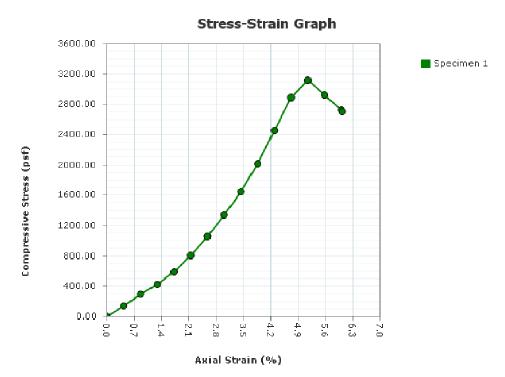
ASTM D2166								
				pecimen	Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf) Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):		_		-	5		,	
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):								
Sand Co. Co. 11 12 72	DI.	-(1-T-11)				T 1 1 J T 1 1		
Specific Gravity: 2.72 Type: UD		stic Limit: ssification:	1			Liquid Limi	T: U	
туре. : ОБ	Jon Cias	ssirication.	<u> </u>					
Project: Ford Property 345kV Gle	ndale Sout	h - Brown l	North					
Project Number: 222-032								
Sampling Date: 3/7/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #2A L1								
Location: Glendale, KY								
Client Name: LG&E and KU Remarks: Leg 1								
Kentarks. Leg 1								
Specimen 1 Specimen 2 Specimen 3	Specime		Specimen 5		men 6	Specime		pecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S	ketch I	ailure Sketc	h Failure	Sketch	Failure Sk	etch Fai	lure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/7/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032 Received Date: 3/7/2022 Sampling Date: 3/7/2022 Sample Number: ST 2 Sample Depth: 4.0-6.0 ft Boring Number: STR #2A L1 Location: Glendale, KY Client Name: LG&E and KU Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/7/2022 Checked By: ___

Date: _

Unconfined Compression Test

STM D2166								
			S	pecimer	n Numbe	er		
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	18.2							
Wet Density (pcf)	130.3							
Dry Density (pcf)	110.3							
Saturation (%):	91.5							
Void Ratio:	0.540							
Height (in)	5.8260							
Diameter (in)	2.8450							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.05							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	3118.48							
Undrained Shear Strength (psf)	1559.24							
Strain at Failure (%):	5.15							
Specific Gravity: 2.72	Pla	astic Limit:	0		I	iquid Limi	t: 0	
Type: UD	Soil Cla	ssification:				•	:	
Project: Ford Property 345kV Gle	ndale Sout	h - Brown 1	North					
Project Number: 222-032								
Sampling Date: 3/7/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #2A L1								
Location: Glendale, KY								
Client Name: LG&E and KU								

L								
	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5	Specimen 6	Specimen 7	Specimen 8
	Failure Sketch	Failure Sketch	Failure Sketch	Failure Sketch	Failure Sketch	Failure Sketch	Failure Sketch	Failure Sketch
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

2

Checked By: ___

Date:

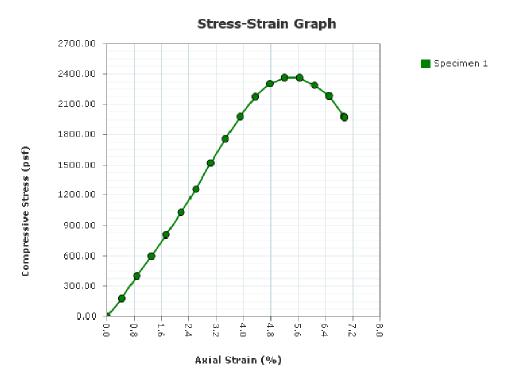
Report Created: 3/16/2022

Test Date: 3/7/2022

Remarks: Leg 1

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/7/2022
Sampling Date: 3/7/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR #2A L1
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/7/2022 Checked By: _____ Date: _____

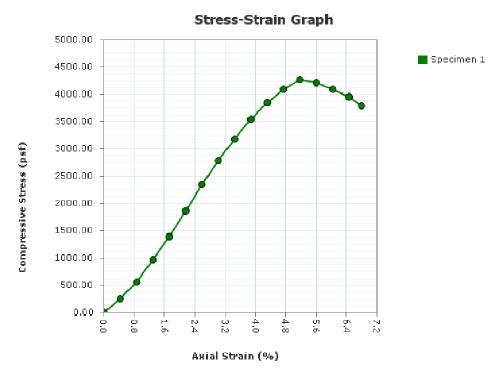
Test Date: 3/7/2022

Unconfined Compression Test

ASTM D2166								
			S	pecimer	Numbe	er		
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	19.5							
Wet Density (pcf)	129.4							
Dry Density (pcf)								
Saturation (%):	93.4							
Void Ratio:	:							
Height (in)	5.7630							
Diameter (in)	i							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	i							
Strain Rate (in/min)	i							
Strain Rate (%/min):	:							
Unconfined Compressive Strength (psf)	i							
Undrained Shear Strength (psf)								
Strain at Failure (%):	5.64							
Specific Gravity: 2.72	Pla	stic Limit:	21		I	iquid Lim	it: 41	
Type: UD	Soil Cla	ssification:	CL			_		
Project: Ford Property 345kV Gle	ndale Sout	h - Brown N	North					
Project Number: 222-032								
Sampling Date: 3/7/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR #2A L1								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 1								
Specimen 1 Specimen 2 Specimen 3	Specim	en 4	Specimen 5	Spec	imen 6	Specime	n 7 Cr	ecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		ailure Sket		e Sketch	Failure Sk		ure Sketch
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Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/8/2022
Sampling Date: 3/8/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #2A L3
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 3

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/8/2022 Checked By: _____ Date: _____

Unconfined Compression Test

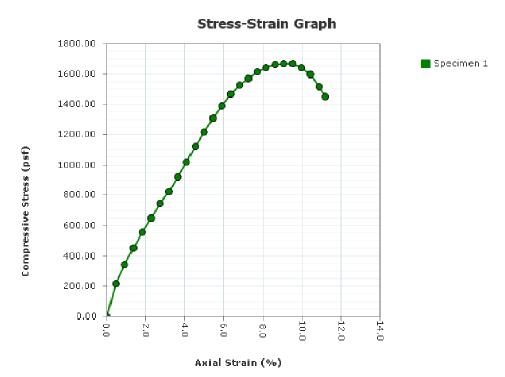
Test Date: 3/8/2022

ASTM D2166								
				pecime	n Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	i							
Wet Density (pcf)	i							
Dry Density (pcf)								
Saturation (%):	i							
Void Ratio:	i							
Height (in)								
Diameter (in)	2.8410							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)								
Strain Rate (%/min):	i							
Unconfined Compressive Strength (psf)	i							
Undrained Shear Strength (psf)	2134.91							
Strain at Failure (%):	5.17							
Specific Gravity: 2.72	Pl:	stic Limit:	0		1	Liquid Limi	it: 0	
Type: UD		ssification:				siquia Eirin		
72			:					
Project: Ford Property 345kV Gle	ndale Sout	h - Brown l	North					
Project Number: 222-032								
Sampling Date: 3/8/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #2A L3								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 3								
Specimen 1 Specimen 2 Specimen 3	Specim	en 4	Specimen 5	Spec	eimen 6	Specime	n 7 Sr	ecimen 8
Failure Sketch Failure Sketch Failure Sketch	Failure S		Failure Sketo		e Sketch	Failure Sk		ure Sketcl
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032 Checked By: ___ Date: _

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/8/2022
Sampling Date: 3/8/2022
Sample Number: ST 4
Sample Depth: 39'-41' ft
Boring Number: STR #2A L3
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 3

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/8/2022 Checked By: _____ Date: _____

Unconfined Compression Test

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)	2.8560							
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	9.52							
Specific Gravity: 2.72	Pla	stic Limit:	20		I	iquid Limi	t: 34	
Type: UD	Soil Clas	ssification:	CL				•	
Project: Ford Property 345kV Gle	ndale Soutl	n - Brown N	North					
Project Number: 222-032								
Sampling Date: 3/8/2022								
Sample Number: ST 4								
Sample Depth: 39'-41' ft								
Boring Number: STR #2A L3								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 3								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure Sl		Specimen 5 ailure Sketo		imen 6 e Sketch	Specime Failure Sk		ecimen 8 ure Sketch
	[1 [11			11	i
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/8/2022 Checked By: _____ Date: _____

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



March 22, 2022



LG&E and KU One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration Ford Property 345kV Glendale South – Brown North Structure 5A Glendale, KY

AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford Property 345kV Glendale South – Brown North in Glendale, KY. This summary is provided for Structure 5A, a 3DS Tower.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Trans. Moment (ft-k)	Long. Moment (ft-k)
5A	3DS Tower	110	720.40	37°35′57.32″N	85°53′12.08″W	8,206	3,254
-	Leg 1	-	720.32	37°35′57.16″N	85°53′12.33″W	-	-
-	Leg 2	-	720.32	37°35′57.13″N	85°53′11.88″W	-	-
-	Leg 3	-	720.32	37°35′57.47″N	85°53′11.82″W	-	-
-	Leg 4	-	720.32	37°35′57.52″N	85°53′12.27″W	-	-

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of two soil test borings and two rockline soundings. The soil test borings were advanced to a depth of about 43 feet to 61 feet beneath the surface. The rockline soundings were advanced to a depth of about 41 feet to 45 feet beneath the surface. The boring locations were staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Ford Property 345kV Glendale South – Brown North Structure 5A March 22, 2022 Page **2** of **3**

Topsoil was encountered at the surface with a thickness of approximately eight to nine inches. Beneath the surface material, lean clay and fat clay were encountered to refusal depth in the boring. The lean clay was typically described as brown to red in color, moist to wet and stiff. The fat clay was described as reddish brown to brown in color, containing varying amounts of gravel, moist to wet and medium stiff to very stiff.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 5A – Summary of Boring

				Aug	er Refusal			
			Surface Elevation	Depth	Elevation (ft.)			
Hole No.	Latitude	Longitude	(ft.) MSL	(ft.)	MSL			
STR 5A L1	37°35′57.16″N	85°53′12.33″W	720.8	N/A	N/A			
STR 5A L2	37°35′57.13″N	85°53′11.88″W	720.4	41.3	679.1			
STR 5A L3	37°35′57.47″N	85°53′11.82″W	718.5	43.2	675.3			
STR 5A L4	37°35′57.52″N	85°53′12.27″W	718.2	45.3	672.9			

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 5A	CL	5.0-40.0	1.5	0.8
STR 5A	СН	40.0-61.0	0.5	0.3

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford Property 345kV Glendale South – Brown North Structure 5A March 22, 2022 Page **3** of **3**

	Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
	STR 5A CL		5.0-40.0	0.02	200
STR 5A		СН	40.0-61.0	0.03	-

5.2 <u>Axial Design Parameters</u> – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q₅) (ksf)		
STR 5A	CL	5.0-40.0	125.0	1.5	1.0		
STR 5A	СН	40.0-61.0	120.0	0.5	0.7		

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS. INC.

Aaron Anderson, EIT Geotechnical Engineer

Dusty Barrett, PE, PMP

Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Logs
- Laboratory Data

APPENDIX A

Boring Layout





APPENDIX B

Boring Logs



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling</u>: Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00	-	

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – ½ to 1 inch
Very Dense	50 blows/ft or more		Fine – ¼ to ½ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

NOTES

 $\underline{\textbf{Classification}} - \text{The Unified Soil Classification System is used to identify soil unless otherwise noted.}$

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

 Qu:
 Unconfined Compressive Strength
 N:
 Standard Penetration Value (see above)

 Qp:
 Unconfined Comp. Strength (pocket pent.)
 omc:
 Optimum Moisture content

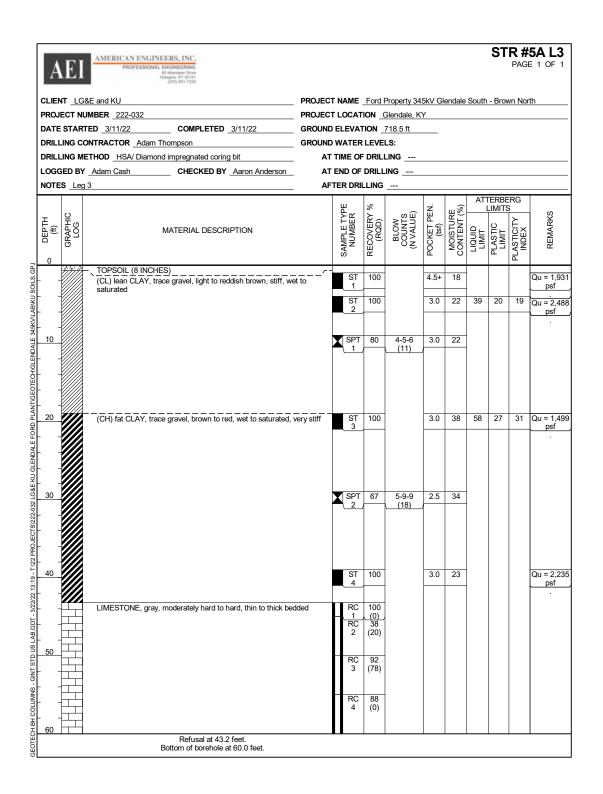
 LL:
 Liquid Limit, % (Atterberg Limit)
 PL:
 Plastic Limit, % (Atterberg Limit)

 PI:
 Plasticity Index
 mdd:
 Maximum Dry Density

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CLIE	NT LG	&E and KU	PROJEC	T NAME	Ford I	Property 34	5kV GI	endale	South	- Brov	vn Nor	th
		UMBER 222-032	PROJECT LOCATION Glendale, KY									
		TED 3/9/22 COMPLETED 3/10/22 ONTRACTOR Adam Thompson	GROUNE				_					
		IETHOD Hollow Stem Auger				LING						
LOG	GED BY	Peyton Linder CHECKED BY Aaron Anderson	AT	END OF	DRILL	ING						
NOTI	ES Lec	<u> </u>	AF	TER DRII	LLING							
O DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)		PLASTIC ELIMIT LIMIT		REMARKS
25.6		(CL) lean CLAY, light brown to reddish brown, gray mottle, mo		ST	100		4.5+	18				Qu = 1,786
-	- 4///	medium stiff to stiff	,	1 ST	100		1.5	19	33	13	20	psf
345KV/LAB/K	-{////			2	-50			"	35			Qu = 4,536 psf
		(CL) lean CLAY, trace gravel, red to brown, wet to saturated,	stiff to	▼ SPT	100	4-4-5	2.75	22				
O I E CHI (GLENDALE		very soft		1	100	(9)	2.70					
20 20				ST 3	95		2.0	24	38	20	18	Qu = 3,952 psf
KU GLENDALE FORD												
30				SPT	100	3-2-3	0.75	27				
00EC18/22-032						(5)						
- 10	-											
40				ST 4	100		0.0	44				Qu = 653 psf
1 - 3/2/2/2 13												
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50 50 50 50 50 50 50 50				SPT 3	60	1-1-0 (1)	0.0	36				
- LOMING	¥////											
S -				ST	75		0.0	41	40	15	25	
	<u> </u>	Bottom of borehole at 61.0 feet.							1	I	I	I.

A	E	AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING Olivery A (24) (1) (20) (51) (20) (20) (20) (20) (20) (20) (20) (20								ST		5A L2 E 1 OF 1
CLIEN	NT LG	&E and KU	PROJECT NAME Ford Property 345kV Glendale South - Brown North							th		
		UMBER _222-032	PROJECT LOCATION Glendale, KY									
		TED _3/11/22 COMPLETED _3/11/22 ONTRACTOR _Adam Thompson										
		ETHOD Hollow Stem Auger				ING						
LOGG	GED BY	Adam Cash CHECKED BY Aaron Anderson				ING						
NOTE	S Le	12	AF	TER DRII	LLING				٨Τ٦	ERBE	DC.	
O DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	I	IMITS		REMARKS
3		OVERBURDEN (41.3 FEET)										
5	-											
10	-											
5 5												
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	-											
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) - - -												
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40												
		Refusal at 41.3 feet.										
30 30 35 35 35 35 35 35 35 35 35 35 35 35 35		Bottom of borehole at 41.3 feet.										

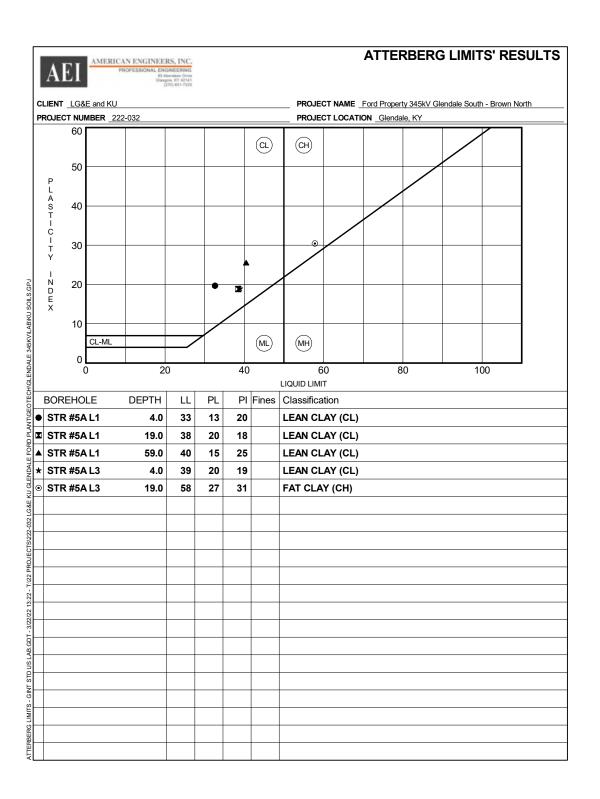


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			&E and KU UMBER 222-032	PROJECT NAME Ford Property 345kV Glendale South - Brown North PROJECT LOCATION Glendale, KY								th	
			TED <u>3/10/22</u> COMPLETED <u>3/10/22</u>										
			ONTRACTOR Adam Thompson										
			ETHOD Hollow Stem Auger				LING						
L	ogg	ED BY	Peyton Linder CHECKED BY Aaron Anderson				.ING						
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		GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)		PLASTIC LIMIT LIMIT		REMARKS
; —	0		OVERBURDEN (45.3 FEET)									_	
-	4												
5	1												
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-			Refusal at 45.3 feet.										
5			Bottom of borehole at 45.3 feet.										
2													

APPENDIX C

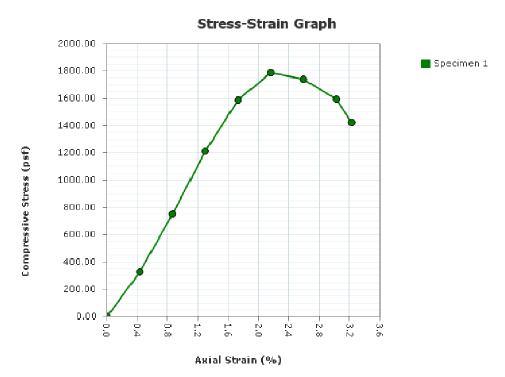
Laboratory Testing Results





Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/11/2022
Sampling Date: 3/11/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #5A L1
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/11/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022

Test Date: 3/11/2022

Unconfined Compression Test

ASTM D2166								
				pecimer	ı Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	2.16							
Specific Gravity: 2.72	Pla	stic Limit	: 0			Liquid Lim	it: 0	
Type: UD	Soil Clas	ssification	: CL					
Project: Ford Property 345kV Gle	ndale Sout	h - Brown	North					
Project Number: 222-032								
Sampling Date: 3/11/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #5A L1								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 1								
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Report Created: 3/18/2022 2

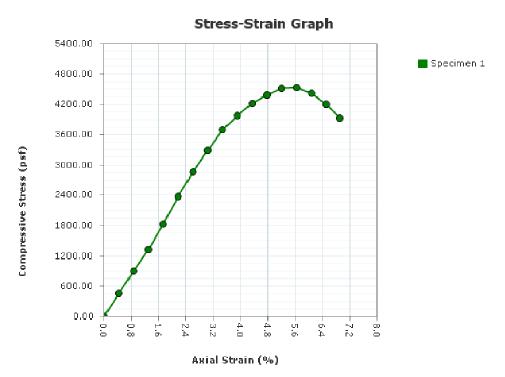
Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Checked By: ___

_____ Date: __

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/11/2022
Sampling Date: 3/11/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #5A L1
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/11/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022

ASTM D2166								
				pecimer	ı Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	5.64							
Specific Gravity: 2.72	Pla	stic Limit:	: 13			Liquid Lim	it: 33	
Type: UD	Soil Clas	ssification	CL					
Project: Ford Property 345kV Gle	ndale Sout	h - Brown	North					
Project Number: 222-032								
Sampling Date: 3/11/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #5A L1								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 1								
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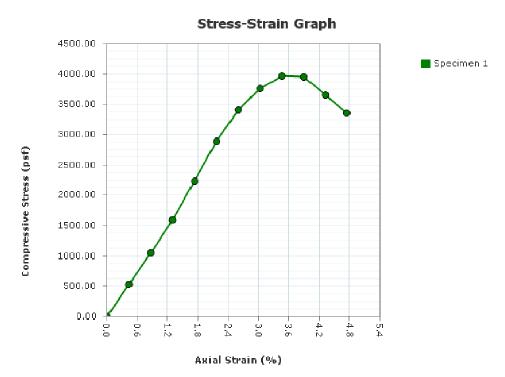
Test Date: 3/11/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022 2

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/11/2022
Sampling Date: 3/11/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR #5A L1
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/11/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022

Report Created: 3/18/2022

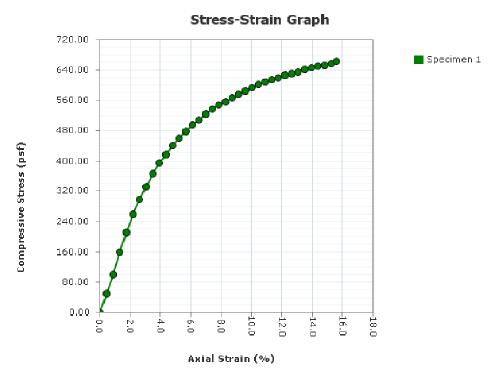
Unconfined Compression Test

ASTM D2166								
				pecimer	ı Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)	i							
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	i							
Strain Rate (in/min)								
Strain Rate (%/min):	i							
Unconfined Compressive Strength (psf)	i							
Undrained Shear Strength (psf)								
Strain at Failure (%):	3.89							
Specific Gravity: 2.72	Pla	stic Limit:	20			Liquid Lim	it: 38	
Type: UD	Soil Clas	ssification	CL					
Project: Ford Property 345kV Gle	ndale Sout	h - Brown	North					
Project Number: 222-032								
Sampling Date: 3/11/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR #5A L1								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 1								
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Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032 Test Date: 3/11/2022 Checked By: ___ _____ Date: __ 2

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/11/2022
Sampling Date: 3/11/2022
Sample Number: ST 4
Sample Depth: 39.0-41.0 ft
Boring Number: STR #5A L1
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 1

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/11/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):	107.3							
Void Ratio:	1.111							
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)	326.66							
Strain at Failure (%):	14.81							
Specific Gravity: 2.72	Pla	stic Limit:	0		Ι	iquid Lim	it: 0	
Type: UD	Soil Clas	ssification:	CL				•	
Project: Ford Property 345kV Gler	ndale Sout	h - Brown N	North					
Project Number: 222-032								
Sampling Date: 3/11/2022								
Sample Number: ST 4								
Sample Depth: 39.0-41.0 ft								
Boring Number: STR #5A L1								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 1								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen Sket		imen 6 e Sketch	Specime Failure Sl		becimen 8 lure Sketch
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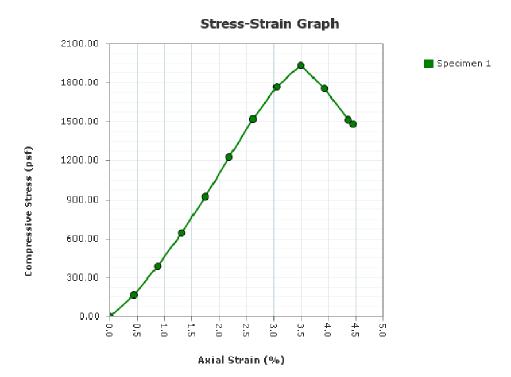
Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/11/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022 2

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 220-032
Received Date: 3/14/2022
Sampling Date: 3/14/2022
Sample Number: ST 1
Sample Depth: 1.0-3.0 ft
Boring Number: STR #5A L3
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 3

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 220-032

Test Date: 3/14/2022 Checked By: _____ Date: _____

Report Created: 3/17/2022

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)	133.1							
Dry Density (pcf)								
Saturation (%):	96.4							
Void Ratio:	0.504							
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	3.49			<u> </u>			1	
Specific Gravity: 2.72	Pla	stic Limit:	0		I	iquid Lim	it: 0	
Type: UD	Soil Clas	ssification:	CL					
Project: Ford Property 345kV Gle	ndale Sout	n - Brown N	Vorth					
Project Number: 220-032								
Sampling Date: 3/14/2022								
Sample Number: ST 1								
Sample Depth: 1.0-3.0 ft								
Boring Number: STR #5A L3								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 3								
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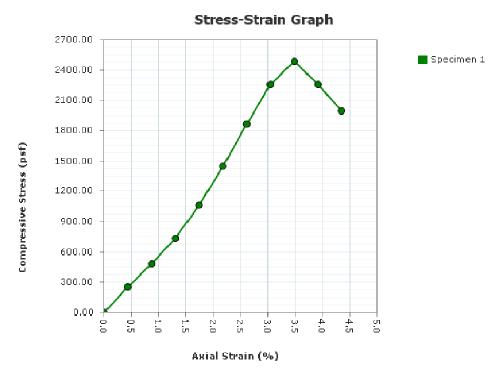
Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 220-032

Test Date: 3/14/2022 Checked By: _____ Date: _____

Report Created: 3/17/2022 2

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/14/2022
Sampling Date: 3/14/2022
Sample Number: ST 2
Sample Depth: 4.0-6.0 ft
Boring Number: STR #5A L3
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 3

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/14/2022 Checked By: _____ Date: _____

Report Created: 3/17/2022

ASTM D2166								
				pecimer	n Numbe			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)	125.9							
Dry Density (pcf)								
Saturation (%):	92.8							
Void Ratio:	0.645							
Height (in)								
Diameter (in)	2.8700							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	3.48							
Specific Gravity: 2.72	Pla	stic Limit:	20		I	iquid Limi	it: 39	
Type: UD	Soil Clas	ssification:	CL				•	
Project: Ford Property 345kV Gler	ndale Soutl	n - Brown N	North					
Project Number: 222-032								
Sampling Date: 3/14/2022								
Sample Number: ST 2								
Sample Depth: 4.0-6.0 ft								
Boring Number: STR #5A L3								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 3								
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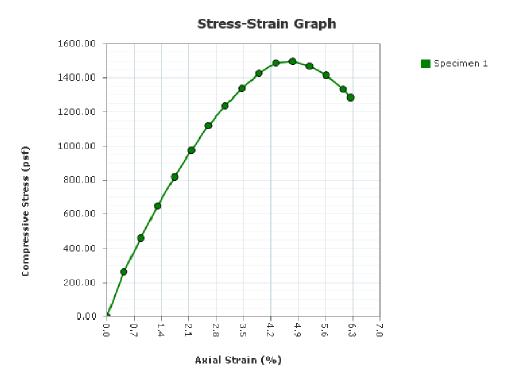
Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/14/2022 Checked By: _____ Date: _____

Report Created: 3/17/2022 2

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/14/2022
Sampling Date: 3/14/2022
Sample Number: ST 3
Sample Depth: 19.0-21.0 ft
Boring Number: STR #5A L3
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 3

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/14/2022 Checked By: _____ Date: _____

Report Created: 3/17/2022

Test Date: 3/14/2022

Unconfined Compression Test

ASTM D2166								
				pecimer	Numb			
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):	97.4							
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:		2		1	_	(0
Test Data Failure Angle (°):	0	2	3	4	5	6	7	8
Strain Rate (in/min)								
Strain Rate (III/ IIIII) Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):								
Strum at Fundic (70).	1.70							
Specific Gravity: 2.72	Pla	stic Limit:	27			Liquid Limi	it: 58	
Type: UD	Soil Clas	ssification:	CH					
Project: Ford Property 345kV Gle	ndale Sout	h - Brown 1	North					
Project Number: 222-032								
Sampling Date: 3/14/2022								
Sample Number: ST 3								
Sample Depth: 19.0-21.0 ft								
Boring Number: STR #5A L3								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 3								
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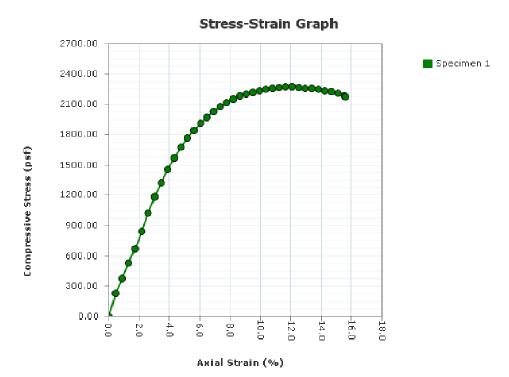
Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Checked By: _____ Date: ____

Report Created: 3/17/2022 2

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/14/2022
Sampling Date: 3/14/2022
Sample Number: ST 4
Sample Depth: 39.0-41.0 ft
Boring Number: STR #5A L3
Location: Glendale, KY
Client Name: LG&E and KU
Remarks: Leg 3

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/14/2022 Checked By: _____ Date: _____

Report Created: 3/17/2022

ASTM D2166								
				pecimei	n Numb		_	
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	23.1							
Wet Density (pcf)								
Dry Density (pcf)	104.3							
Saturation (%):								
Void Ratio:	0.628							
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	0.1							
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	14.22							
Specific Gravity: 2.72	Pla	stic Limit:	0			Liquid Limi	it: 0	
Type: UD	Soil Clas	sification:	СН			•	•	
Project: Ford Property 345kV Gler	adala Sauti	a Broun	North					
Project Number: 222-032	idale 30dti	II - DIOWII	NOTH					
Sampling Date: 3/14/2022								
Sample Number: ST 4								
Sample Depth: 39.0-41.0 ft								
Boring Number: STR #5A L3								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks: Leg 3								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure Sl		Specimen 5 Failure Sketc		rimen 6 re Sketch	Specime Failure Sk		pecimen 8 Ilure Sketch

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/14/2022 Checked By: ___ _____ Date: __

2 Report Created: 3/17/2022

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220



April 6, 2022



One Quality Street Lexington, KY 40507

RE: Report of Geotechnical Exploration

Ford Property 345kV Glendale South – Brown North

Structure /A Glendale, KY

AEI Project No. 222-032

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford Property 345kV Glendale South – Brown North in Glendale, KY. This summary is provided for Structure 7A, a single circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure	Structure	ture Height Centerline Structure Coordin		Coordinates	Trans.	Long.	
Number	Description	(ft)	Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Moment (ft-k)	Moment (ft-k)
7A	Single Circuit	120	721.2	37°35′51.225″N	85°52′58.831″W	10,622	2,528

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 58 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of approximately nine inches. Beneath the surface material, lean and fat clays were encountered to refusal depth in the boring. The lean clay was typically described as brown to gray in color, containing varying amounts of sand, moist to saturated and very stiff to soft. The fat

Ford Property 345kV Glendale South – Brown North Structure 2A April 6, 2022 Page **2** of **3**

clay was described as reddish brown to brown in color, containing varying amounts of gravel and sand, wet to saturated and medium stiff to very stiff.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 7A - Summary of Boring

			Surface	Auge	r Refusal
Hole			Elevation	Depth	Elevation
No.	Latitude	Longitude	(ft.) MSL	(ft.)	(ft.) MSL
STR 7A	37°35′51.225″N	85°52′58.831″W	719.8	58.5	661.3

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>Lateral Design Parameters</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 7A	CL	5.0-24.5	1.5	0.8
STR 7A	CH	24.5-58.5	0.75	0.3

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Ford Property 345kV Glendale South – Brown North Structure 2A April 6, 2022 Page **3** of **3**

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Shear Strength (ε ₅₀)	Initial Soil Stiffness (k _{py}) (pci)
STR 7A	CL	5.0-24.5	0.02	200
STR 7A	СН	24.5-58.5	0.02	-

Axial Design Parameters – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

				Effective	I I a dunda a d	Name in al Ciala
	Structure Number	Soil Type	Depth (feet)	Unit Weight* (pcf)	Undrained Shear Strength (S _u) (ksf)	Nominal Side Resistance (q _s) (ksf)
l	STR 7A	CL	5.0-24.5	125.0	1.5	1.0
	STR 7A	CH	24.5-58.5	57.6	0.75	0.7

^{*}Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT Geotechnical Engineer Dusty Barrett, PE, PMP Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout





Attachment 3 to Response to PSC-4 Question No. 1
Page 577 of 592
McFarland

APPENDIX B

Boring Logs



FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide disturbed samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide undisturbed samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

<u>Undisturbed Sampling:</u> Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS

(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)	PLAST	<u>ICITY</u>
Very Soft	2 blows/ft or less	0 - 0.25	Degree of	Plasticity
Soft	2 to 4 blows/ft	0.25 - 0.49	Plasticity	Index (PI)
Medium Stiff	4 to 8 blows/ft	0.50 - 0.99	Low	0 - 7
Stiff	8 to 15 blows/ft	1.00 - 2.00	Medium	8 - 22
Very Stiff	15 to 30 blows/ft	2.00 - 4.00	High	over 22
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS

(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE	PARTICLE	SIZE IDENTIFICATION
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – ½ to 1 inch
Very Dense	50 blows/ft or more		Fine – ¼ to ½ inch
•		Sand	Coarse – 0.6mm to 1/4 inch
RELATIVE PROPO	ORTIONS		Medium – 0.2mm to 0.6mm
Descriptive Term	Percent		
Trace	1 - 10		Fine -0.05 mm to 0.2 mm
Trace to Some	11 - 20		
Some	21 - 35	Silt	0.05mm to 0.005mm
And	36 - 50		
		Clay	0.005mm

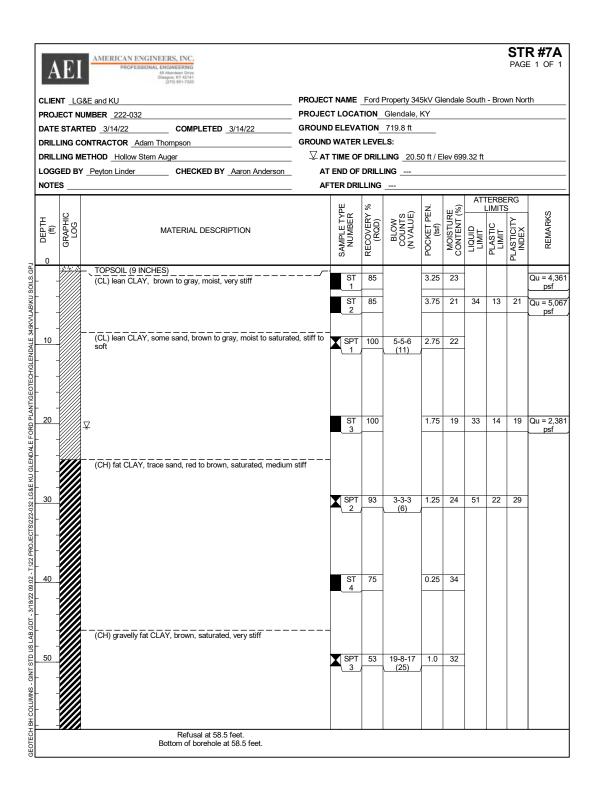
NOTES

<u>Classification</u> – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2^{nd} and 3^{rd} penetration counts (i.e., N=8+7=15 blows/ft.)

Soil Property Symbols

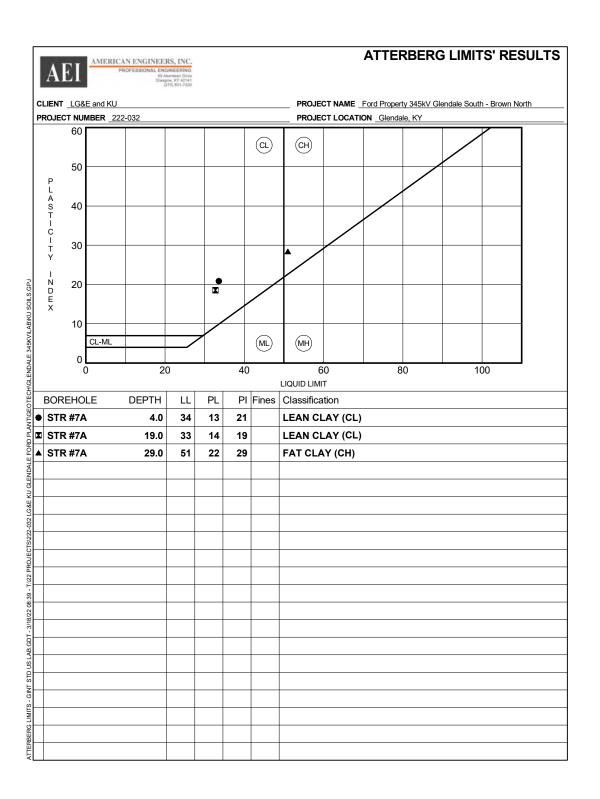
Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index		mdd: Maximum Dry Density



APPENDIX C

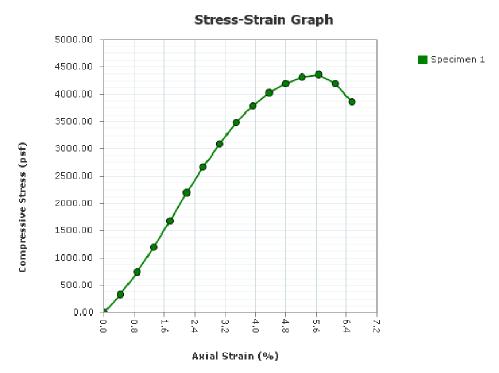
Laboratory Testing Results





Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/15/2022
Sampling Date: 3/15/2022
Sample Number: ST 1
Sample Depth: 1-3 ft
Boring Number: STR #7A
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/15/2022 Checked By: _____ Date: _____

Report Created: 3/16/2022

ASTM D2166								
Specimen Number						_		
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	5.66						<u> </u>	
Specific Gravity: 2.72	Pla	stic Limit:	0			Liquid Limi	it: 0	
Type: UD	Soil Clas	ssification:	CL				·	
Project: Ford Property 345kV Gler	ndale Soutl	h - Brown	North					
Project Number: 222-032								
Sampling Date: 3/15/2022								
I ·								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure Sl		Specimen 5 Failure Sketc		imen 6 e Sketch	Specime Failure Sk		Specimen 8 ilure Sketch
	[[
					į			
					İ			
	<u> </u>					<u> </u>		
Client Name: LG&E and KU Remarks: Specimen 1 Specimen 2 Specimen 3								

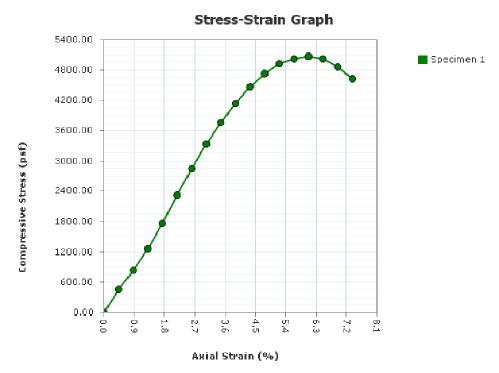
Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/15/2022 Checked By: ___ _____ Date: __

2 Report Created: 3/16/2022

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/15/2022
Sampling Date: 3/15/2022
Sample Number: ST 2
Sample Depth: 4-6 ft
Boring Number: STR #7A
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Test Date: 3/15/2022

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Checked By: ______ Date: _____

Report Created: 3/18/2022

ASTM D2166								
Specimen Number								
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)	0.1							
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	6.07							
Specific Gravity: 2.72	Pla	stic Limit:	13		I	Liquid Lim	it: 34	
Type: UD	Soil Clas	ssification:	CL			1	:	
	110 (L D .	т и					
Project: Ford Property 345kV Gler	naaie Souti	n - Brown I	North					
Project Number: 222-032								
Sampling Date: 3/15/2022 Sample Number: ST 2								
Sample Depth: 4-6 ft								
Boring Number: STR #7A								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1Specimen 2Specimen 3Failure SketchFailure SketchFailure Sketch	Specime Failure S		Specimen ailure Sket		eimen 6 e Sketch	Specime Failure Sl		ecimen 8 ure Sketch

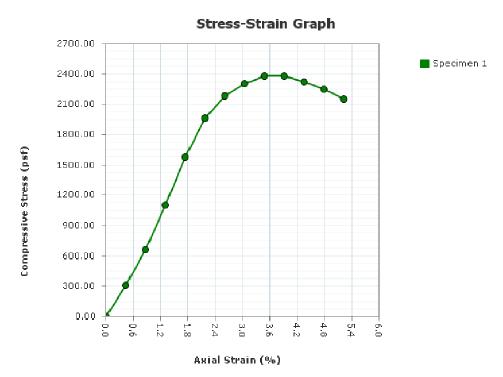
Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/15/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022 2

Unconfined Compression Test

ASTM D2166



Project: Ford Property 345kV Glendale South - Brown North

Project Number: 222-032
Received Date: 3/15/2022
Sampling Date: 3/15/2022
Sample Number: ST 3
Sample Depth: 19-21 ft
Boring Number: STR #7A
Location: Glendale, KY
Client Name: LG&E and KU

Remarks:

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Test Date: 3/15/2022 Checked By: _____ Date: _____

Report Created: 3/18/2022

Test Date: 3/15/2022

Unconfined Compression Test

ASTM D2166								
Specimen Number								
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):								
Wet Density (pcf)								
Dry Density (pcf)								
Saturation (%):								
Void Ratio:								
Height (in)								
Diameter (in)								
Strain Limit @ 15% (in)								
Height To Diameter Ratio:								
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):								
Strain Rate (in/min)								
Strain Rate (%/min):								
Unconfined Compressive Strength (psf)								
Undrained Shear Strength (psf)								
Strain at Failure (%):	3.92							
Specific Gravity: 2.72	Pla	stic Limit	: 14			Liquid Lim	it: 33	
Type: UD	Soil Clas	ssification	: CL			_		
Project: Ford Property 345kV Gle	ndale Sout	h - Brown	North					
Project Number: 222-032	ridare sout	ii Diowii	rvorur					
Sampling Date: 3/15/2022								
Sample Number: ST 3								
Sample Depth: 19-21 ft								
Boring Number: STR #7A								
Location: Glendale, KY								
Client Name: LG&E and KU								
Remarks:								
Specimen 1 Specimen 2 Specimen 3 Failure Sketch Failure Sketch Failure Sketch	Specime Failure S		Specimen 5 Failure Sketc		imen 6 e Sketch	Specime Failure Sl		pecimen 8 Ilure Sketch
	[T						
	<u> </u>			!!	i	<u> </u>		

Report Created: 3/18/2022 2

Project Name: Ford Property 345kV Glendale South - Brown North Project Number: 222-032

Checked By: ___

_____ Date: __

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or

responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations

within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid

development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



65 Aberdeen Drive Glasgow, KY 42141 270-651-7220





Wetland Delineation Report for the Glendale 345kV Transmission Lines Project

LG&E-KU Energy Services Company

Glendale 345kV Transmission Lines Project No. 144025

5/4/2022

Wetland Delineation Report for the Glendale 345kV Transmission Lines Project

prepared for

LG&E-KU Energy Services Company Glendale 345kV Transmission Lines Project Lexington, KY

Project No. 144025

5/4/2022

prepared by

Burns & McDonnell Engineering Company, Inc. Chicago, Illinois

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LIST OF ABBREVIATIONS

Abbreviation <u>Term/Phrase/Name</u>

APT Antecedent Precipitation Tool

Burns & McDonnell Engineering Company, Inc.

CWA Clean Water Act

E Ephemeral

EPA Environmental Protection Agency

FAC Facultative plants

FACU Facultative upland plants

FACW Facultative wetland plants

FEMA Federal Emergency Management Agency

FIRM Flood Insurance Rate Map

GPS Global Positioning System

I Intermittent

kV Kilovolt

LRR Land Resource Regions

LG&E-KU Energy Services Company

NFHL National Flood Hazard Layer

NHD National Hydrography Dataset

NRCS Natural Resources Conservation Service

NRPW Non-Relatively Permanent Water

NTCHS National Technical Committee for Hydric Soils

NWI National Wetlands Inventory

Wetland Delineation Report

List of Abbreviations

Abbreviation Term/Phrase/Name

OBL Obligate wetland plants

OHWM Ordinary High Water Mark

P Perennial

PEM Palustrine Emergent wetland

PFO Palustrine Forested wetland

Project Area Glendale 345kV transmission lines (LI-167000 and LI-167444) right-of-

way and proposed access routes

Project Glendale 345kV Transmission Lines Project

PUB Palustrine Unconsolidated Bottom wetland

Regional Supplement Regional supplements to the 1987 Wetlands Delineation Manual

RPW Relatively Permanent Water

S Stream

SDA Soil Data Access

SP Sample Plot

SSURGO Soil Survey Geographic

SWANCC Solid Waste Agency of Northern Cook County

Survey Area 216 acres including transmission lines right-of-way and proposed access

routes

TNW Traditional Navigable Waterway

UPL Upland plants

USACE U.S. Army Corps of Engineers

USDA U.S. Department of Agriculture

USFWS U.S. Fish and Wildlife Service

USGS U.S. Geological Survey

Wetland Delineation Report

List of Abbreviations

Abbreviation Term/Phrase/Name

WOTUS Waters of the U.S.

1.0 INTRODUCTION

Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) was retained by LG&E-KU Energy Services Company (LG&E-KU) to provide wetland delineation and permitting services for the proposed Glendale 345kV Transmission Lines Project (Project) that is located in Hardin County, Kentucky (Figure 1, Appendix A). The Project consists of two new 345kV transmission lines (LI-167000 and LI-167444) totaling approximately 8.2 miles as well as the use of access routes totaling approximately 12 miles. LI-167000 is approximately 4.8 miles totaling 35 structures. LI-167444 is approximately 3.4 miles totaling 27 structures. The Project will be located with a new 200-foot right-of-way (ROW). The Project Area encompasses a total of 216 acres, which includes the 200-foot ROW, 5-foot-wide access roads and potential pull pad locations that extend outside of the ROW, and approximately 0.5 acre access and work area for stringing new OPGW wires from the existing Hardin County Substation to Structure 4 of LI-167000. The Survey Area for the wetland delineation consists of the entire 216 acre Project Area, with approximately 26 acres of the Survey Area being previously delineated by Third Rock Consultants LLC in November and December 2021. The results of the delineation conducted by Third Rock Consultants LLC is not included in this Wetland Delineation Report.

The purpose of this assessment was to identify wetlands and surface waters present within the Survey Area that may be considered "Waters of the United States" (WOTUS, 40 CFR 230.3[s]) and subject to regulation under the federal Clean Water Act (CWA) by the U.S. Army Corps of Engineers (USACE). The USACE and the U.S. Environmental Protection Agency (EPA) jointly define wetlands as: "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (42 Fed. Reg. 37128-29). According to 40 CFR 230.3(s), WOTUS include all waters that may be used for interstate or foreign commerce, all interstate wetlands and waterways, intrastate wetlands and waterways of which the use, degradation, or destruction could affect interstate or foreign commerce, impoundments of waters, territorial seas, and wetlands adjacent to waters not including waste treatment systems, including their treatment ponds or lagoons designed to meet the requirements of the CWA.

LG&E-KU 1-1 Burns & McDonnell

Introduction

Burns & McDonnell conducted a wetland and surface water delineation on March 8 through 10, 2022 to identify the location and extent of wetlands and surface waters present within the Survey Area. This report documents the methods and results of the desktop and field investigations conducted to identify wetlands and surface waters for the Project.

LG&E-KU 1-2 Burns & McDonnell

2.0 METHODS

The following sections summarize the methods used to complete the desktop review of existing data and to conduct the field investigations within the Project Area.

2.1 Existing Data Review

Burns & McDonnell reviewed available background information for the Survey Area prior to conducting the site visit. Available background information included the following:

- U.S. Geological Survey (USGS) 7.5-minute topographic map (Elizabethtown 2019, Cecilia 2019, Sonora 2019, Tonieville 2019 quadrangles);
- U.S. Fish & Wildlife Service (USFWS) National Wetlands Inventory (NWI) map (USFWS 2022);
- USGS National Hydrography Dataset (NHD);
- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM),
 National Flood Hazard Layer (NFHL 2007); and
- U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO 2021) digital data for Hardin County.

Background data helps in identifying locations of potential wetland and surface waters. However, as these features may not have been field verified or modified since the data was published, the field analyses supersedes the mapped data.

2.2 Wetland Delineation

Identification of wetlands is based on a three-factor approach involving indicators of hydrophytic vegetation, hydric soil, and wetland hydrology, originally set forth by the USACE in the 1987 Environmental Laboratory publication entitled "Corps of Engineers Wetlands Delineation Manual: Technical Report Y-87-1", commonly referred to as the 1987 Wetlands Delineation Manual (Environmental Laboratory 1987).

The USACE released regional supplements to the 1987 Wetlands Delineation Manual outlining updated technical guidance and procedures for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the CWA or Section 10 of the Rivers and

LG&E-KU 2-1 Burns & McDonnell

Harbors Act. The Survey Area is located within the following regional supplement(s) (Regional Supplements):

• 2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0)

This wetland delineation used the hydrophytic vegetation, hydric soil, and wetland hydrology indicators as outlined in the applicable Regional Supplement for each sample point. A general overview of hydrophytic vegetation, hydric soil, and wetland hydrology indicators are provided below. Detailed information for each indicator can be found in the applicable Regional Supplement. In addition, methodology for determining wetland quality (where applicable), surface water boundaries, and farmed wetland determinations are provided below.

2.2.1 Hydrophytic Vegetation

To evaluate the presence of hydrophytic vegetation, data are gathered using a graduated series of plots, one for each vegetation stratum. Plot shape and size are dictated by vegetation type, as well as the shape and size of the plant community being evaluated.

The indicator status and percent absolute cover for plants within plots for all vegetation strata are recorded. The indicator status for plant species are based on an estimated probability of occurring in wetlands. This rating system, published by the USACE in 2020 under the title "The National Wetland Plant List, version 3.5" (USACE 2020), consists of obligate wetland plants (OBL), facultative-wet plants (FACW), facultative plants (FAC), facultative upland plants (FACU), and upland plants (UPL). Obligate plant species generally grow in water. Facultative plant species can exist in saturated or dry soil conditions, and upland plants typically require dry soil conditions to exist.

2.2.2 Hydric Soil

A description of the soil profile is used to evaluate the presence of hydric soil. The USDA recognizes 28 Land Resource Regions (LRRs) based on soil, climate, and land use. Hydric soil indicators for LRRs presented in the Regional Supplements are a subset of the National Technical Committee for Hydric Soils (NTCHS) Field Indicators of Hydric Soils in the United States and are regularly modified. The most recent version of Field Indicators of Hydric Soils is Version 8.2 (USDA NRCS 2018) and was used for this delineation.

LG&E-KU 2-2 Burns & McDonnell

2.2.3 Wetland Hydrology

Wetland hydrology indicators are separated into four groups and divided into a primary or secondary category based on their estimated reliability in the applicable region. Primary indicators provide stand-alone evidence of a current or recent hydrological event. Secondary indicators provide evidence of recent inundation or saturation when supported by one or more other primary indicators or secondary wetland hydrology indicators but should not be used alone.

2.2.4 Surface Water Assessment

Surface waters may only have one or two of the wetland criteria listed above. The USACE defines the ordinary high water mark (OHWM) as the boundary of surface waters (33 CFR 328.3[F]). The USACE issued an OHWM Identification regulatory guidance letter (USACE, 2005) which defines "the OHWM [as] the line on the shore established by fluctuations of water and is indicated by physical characteristics such as:

- A clear, natural line impressed on the bank;
- Shelving;
- Changes in the character of soil;
- Destruction of terrestrial vegetation;
- The presence of litter and debris; or
- Other appropriate means that consider the characteristics of the surrounding areas."

During low streamflow or drought conditions, the OHWM is used to determine the boundary of a surface water. During extremely high streamflow conditions or flood conditions the boundaries of surface waters cannot accurately be determined. Therefore, surface water boundaries should be delineated when normal streamflow conditions are present.

To differentiate boundaries between surface waters and adjacent wetlands, evidence of the OHWM is utilized. Changes in vegetation can also be evaluated to determine where true hydrophytic (FAC and FACW) plant species are present versus aquatic or OBL species; however, it should be noted that in many cases vegetation is not present within the channels of surface waters. Vegetation adjacent to surface waters may be limited to species overhanging the banks and channel.

If the presence of a surface water is questionable, the USACE will typically conduct a review of historic aerial photographs and historic USGS topographic maps to confirm the current or

LG&E-KU 2-3 Burns & McDonnell

Wetland Delineation Report

Methods

historic presence of a surface water. This can include segments of streams that are entirely enclosed.

LG&E-KU 2-4 Burns & McDonnell

3.0 RESULTS

The following sections summarize the desktop evaluation and field investigations.

3.1 Existing Data Review

Burns & McDonnell reviewed available background information for the Survey Area prior to conducting the site visit. These sources provide an indication of areas where wetlands and surface waters potentially occur and certain characteristics. A summary of the available background information is presented below and mapped on Figures in Appendix A.

3.1.1 USGS 7.5-minute Topographic Maps

The USGS topographic map indicates the Survey Area crosses generally flat areas ($\leq 5\%$) consisting of agricultural and pastureland with some gently rolling hills of 15-20% slopes (Figure 2 in Appendix A).

3.1.2 FEMA FIRM

The FEMA FIRM (Figure 2 in Appendix A) depicts the Survey Area crossing six floodplains associated with Valley Creek, East Rhudes Creek, and Rose Run as well as multiple tributaries (Figure 2 in Appendix A).

3.1.3 USFWS NWI

The digital format NWI maps were developed by USFWS in collaboration with the USGS, Water Resource Division using data from 1987 and are periodically updated. The maps are prepared primarily by stereoscopic analysis of high-altitude aerial photographs to produce reconnaissance level information on the location, type and size of wetlands and deepwater habitats. All wetlands are identified based on vegetation, visible hydrology, and geography in accordance with the Cowardin System (Cowardin 1979). According to the USFWS, the aerial photographs reflect conditions during the year and season they were taken; however, there is a margin of error inherent in the use of aerial photographs to delineate wetlands. Therefore, wetland boundaries established through interpretation of aerial photographs may be revised based upon detailed ground survey and historical analysis of an individual site.

The NWI map (Figure 3 in Appendix A) indicates two palustrine forested broad-leaved deciduous temporary flooded (PFO1A) wetlands, three palustrine unconsolidated bottom

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permanently flooded (PUBH) wetlands, one palustrine unconsolidated shore seasonally flooded (PUSC) wetland, one riverine lower perennial unconsolidated bottom permanently flooded (R2UBH) wetland, 14 riverine intermittent streambed seasonally flooded (R4SBC) wetlands, and three riverine unknown perennial unconsolidated bottom permanently flooded (R5UBH) wetlands are located within the Survey Area.

3.1.4 USGS NHD

The NHD represents the water drainage network of the United States with features such as rivers, streams, canals, lakes, ponds, coastline, dams, and streamgages. NHD is updated and maintained through partnerships with states and other collaborative bodies. The NHD dataset (Figure 3 in Appendix A) shows that fifteen unnamed streams and three named streams cross the Survey Area. Named waterbodies include East Rhudes Creek, Valley Creek, and Rose Run.

3.1.5 USDA NRCS SSURGO

The NRCS Web Soil Survey (USDA NRCS 2022a) is generated from the USDA-NRCS certified data (Figure 4 in Appendix A). The NRCS Soil Data Access (SDA) Hydric Soils List (USDA NRCS 2022b) contains a compilation of all map units with either a major or minor component that is at least in part hydric. As the list includes both major and minor (small) percentages for map units, in some cases most of the map unit may not be hydric. The list is useful in identifying map units that may contain hydric soils.

The NRCS SSURGO digital data indicates that portions of 22 soil map units are located in the Survey Area. One soil map unit, Melvin silt loam (Mv), is included on local and national hydric soil lists.

3.2 Site Investigation Results

A total of eight wetlands and 26 surface waters were delineated. The Antecedent Precipitation Tool (APT) results indicated the Survey Area was experiencing wetter than normal conditions at the time of the survey (Appendix B). The wetlands and surface waters are summarized in Tables 1 and 3, respectively, and are mapped on Figure 5 in Appendix A. Wetland Determination Data Forms from the applicable Regional Supplement were completed for each wetland and are included in Appendix B. Natural color photographs of sample plots, wetland and surface waters, and other identified features are included in Appendix C. Locations of sample plots, wetland and

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surface water boundaries, and other identified features were surveyed using a sub-meter accurate Global Positioning System (GPS) unit.

Approximately 0.5 acre of the approximate 216 acre Survey Area was added after the site investigations were completed. A desktop determination was conducted to identify wetlands and other water bodies within this area. Both the information gathered in the existing data review and knowledge from the previous site investigations were utilized to identify potential wetlands and waterbodies. These features were not field verified.

3.2.1 Wetlands

A total of eight wetlands were delineated within the Survey Area. Refer to Table 1 below for details for each wetland.

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Table 1: Summary of Wetlands within the Survey Area

Wetland Number	Wetland Type ^a	Dominant Vegetation ^b Hydric Soil Indicator(s) ^c Wetland Hydrology Indicator(s) ^d Delini in Su		Area of Wetland Delineated in Survey Area (acre)	Figure 5 Page Number	WOTUS (Y/N) ^e	
W-1	PEMf	Wing-pod purslane, common panic grass, Kentucky blue grass	F3	A1, A2, A3, C9, D1, D2	0.25	21	N
W-2	PFO	Green ash, American elm, river birch, black elder	F6	A2, A3, B3, B9, B10, D2, D5	0.18	46	Y
W-3	PEM	Deer-tongue rosette grass, lamp rush	F3	A2, A3, B10, D2, D5	1.10	44	Y
W-4	PEM	Silver maple, Dudley's rush, sedge species	F3	A2, A3, B9, C3, D2, D5	0.11	43	Y
W-5	PEM	Creeping buttercup, lamp rush	F3	A2, A3, D2, D5	0.25	42	N
W-6	PEMf	Common panic grass, Kentucky blue grass	F3	A3, C9, D2	0.44	39	Y
W-7	PUB					36	N
W-8	PEM	Sedge species, wand panic grass, dark- green bulrush	F3	A2, A3, C3, C9, D2, D5	0.72	35	Y
	Total						

- (a) Symbols for wetland type: PEMf = farmed wetland, PEM = palustrine emergent, PFO = palustrine forested, PUB = palustrine unconsolidated bottom
- (b) Winged-pod purslane (Portulaca umbraticola), common panic grass (Panicum capillare), Kentucky blue grass (Poa pratensis), green ash (Fraxinus pennsylvanica), American elm (Ulmus americana), river birch (Betula nigra), black elder (Sambucus nigra), deer-tongues rosette grass (Dichanthelium clandestinum), lamp rush (Juncus effusus), Silver maple (Acer saccharinum), Dudley's rush (Juncus dudleyi), sedge species (Carex sp.), creeping buttercup (Ranunculus repens), wand panic grass (Panicum virgatum), and dark-green bulrush (Scirpus atrovirens).
- (c) Indicator code for hydric soil: F3 = Depleted Matrix, F6 = Redox Dark Surface
- (d) Indicator code for wetland hydrology: A1 = Surface Water, A2 = High Water Table, A3 = Saturation, B3 = Drift Deposits, B9 = Water-Stained Leaves, B10 = Drainage Patterns, C3 = Oxidized Rhizospheres on Living Roots, C9 = Saturation Visible on Aerial Imagery, D1 = Stunted or Stressed Plants, D2 = Geomorphic Position, D5 = FAC-Neutral Test
- (e) Jurisdiction is based on professional judgement using the using the definition of WOTUS under Solid Waste Agency of Northern Cook County (SWANNCC) v. U.S. Army Corps of Engineers, and Rapanos v. United States. The USACE makes the final determination of jurisdictional status.

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Areas Determined to not Meet Wetland Criteria

Table 2: Sample Plots Not Determined to Meet Wetland Criteria

Sample Plot (SP)	Dominant Vegetation ^a	Hydric Soil Indicator(s)	Wetland Hydrology Indicator(s) ^b	Figure 5 Page Number	
SP-1	Kentucky blue grass	None	A1, C9	9	
SP-2	Common panic grass, Kentucky blue grass	None	A2, A3	25	
SP-5	Sycamore, black cherry, giant cane	None	D5	18	
SP-16	Common panic grass, Kentucky blue grass	None	None	38	

⁽a) Kentucky blue grass (*Poa pratensis*), common panic grass (*Panicum capillare*), sycamore (*Platanus occidentalis*), black cherry (*Prunus serotina*) giant cane (*Arundinaria gigantea*)

3.2.2 Streams

A total of 26 surface waters were delineated within the Survey Area. Refer to Table 3 below for details for each stream.

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⁽b) Indicator code for wetland hydrology: A1 = Surface Water, A2 = High Water Table, A3 = Saturation, C9 = Saturation Visible on Aerial Imagery, D5 = FAC-Neutral Test

Wetland Delineation Report Results

Table 3: Type and Length of Streams Delineated

Stream Number ^a	Flow Regime/ Stream Type ^b	WOTUS (Y/N)°	Stream Name ^d	Substrate	OHWM Width (feet)	OHWM Bank Height (feet)	Surface Water Depth (feet)	Length of Delineated Stream in Survey Area (feet)	Figure 5 Page
S-1	E/NRPW	Y	UNT to Valley Creek	Silt	3	4	0	73	3
S-2	P/RPW	Y	UNT to Valley Creek	Gravel, silt	8	8	1	498	3
S-3A	P/RPW	Y	Valley Creek	Cobble, gravel, silt	70	15	5	254	3
S-3B	P/RPW	Y	Valley Creek	Cobble, gravel, silt	70	20	8	218	15
S-4	I/RPW	Y	UNT to Valley Creek	Cobble, silt	5	6	0.5	350	3
S-5	I/RPW	Y	UNT to Valley Creek	Silt	8	1	0.5	205	5
S-6	P/RPW	Y	UNT to Valley Creek	Gravel, Silt	4	1	0.75	211	6
S-7	P/RPW	Y	UNT to Valley Creek	Silt, detritus	25	4	3	259	15
S-8	E/NRPW	Y	UNT to East Rhodes Creek	Silt	2.5	2	0.1	331	18
S-9	E/NRPW	Y	UNT to Rose Run	Silt	7	0.25	0.5	166	23
S-10	P/RPW	Y	Rose Run	Cobble, gravel, sand, silt	10	4	1	201	23
S-11	P/RPW	Y	UNT to Rose Run	Cobble, gravel, silt	8	0.25	0.5	884	24, 25
S-12	I/RPW	Y	UNT to Rose Run	Gravel, silt	2	1	0.2	421	24, 25
S-13	E/NRPW	Y	UNT to Rose Run	Gravel, silt	1	2.5	0.1	37	24
S-14A	P/RPW	Y	East Rhodes Creek	Cobble, gravel, sand, silt	35	6	5	215	18
S-14B	P/RPW	Y	East Rhodes Creek	Cobble, gravel, sand, silt	25	10	4	220	46
S-15	I/RPW	Y	UNT to East Rhodes Creek	Gravel, sand, detritus	4	4	2	578	19
S-16	I/RPW	Y	UNT to Nolin River	Silt	3	0.5	0.3	271	34
S-17	E/NRPW	Y	UNT to East Rhodes Creek	Silt, detritus	2.5	6	0.1	67	46
S-18	I/RPW	Y	UNT to East Rhodes Creek	Silt, detritus	3	4	0.4	296	44
S-19	E/NRPW	Y	UNT to East Rhodes Creek	Silt, detritus	4	0.25	0.1	87	43

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Stream Number ^a	Flow Regime/ Stream Type ^b	WOTUS (Y/N) ^c	Stream Name ^d	Substrate	OHWM Width (feet)	OHWM Bank Height (feet)	Surface Water Depth (feet)	Length of Delineated Stream in Survey Area (feet)	Figure 5 Page
S-20	I/RPW	Y	UNT to East Rhodes Creek	Gravel, sand, silt	3	7	0.75	239	42
S-21	E/NRPW	Y	UNT to Rose Run	Silt	2	0.5	0.2	71	39
S-22	E/NRPW	Y	UNT to Rose Run	Silt	1.5	1.5	0	50	39
S-23	I/RPW	Y	UNT to Nolin River	Detritus, silt	2	3	0.3	257	38
S-24	I/RPW	Y	UNT to Nolin River	Gravel, silt	1.5	0.5	0.2	37	35
S-25	I/RPW	Y	UNT to Nolin River	Silt	1.5	0.5	0.5	238	35
S-AA*	E/NRP	Y	UNT to Valley Creek	UNK	9**	UNK	UNK	15**	
S-AB*	E/NRP	Y	UNT to Valley Creek	UNK	9**	UNK	UNK	16**	
				·			Total:	6,765	

⁽a) Assigned by Burns & McDonnell staff during the site investigation; S = stream

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⁽b) Stream name follows USGS topographic map, NHD, or state/local data source; P = Perennial, I = Intermittent, E = Ephemeral; TNW = Traditional Navigable Waterway; RPW= Relatively Permanent Water, NRPW= Non-Relatively Permanent Water

⁽c) Jurisdiction is based on professional judgement using the using the definition of WOTUS under Solid Waste Agency of Northern Cook County (SWANNCC) v. U.S. Army Corps of Engineers, and Rapanos v. United States. The USACE makes the final determination of jurisdictional status.

⁽d) UNT = Unnamed Tributary

^{*} Stream identified based on desktop review and not verified with a field survey.

^{**} Value based on desktop review.

4.0 SUMMARY

Burns & McDonnell conducted a wetland delineation of the Survey Area to identify wetlands and other waterbodies. A total of eight wetlands and 26 surface waters were identified. Avoidance of wetlands and surface waters should be considered in Project planning. If avoidance is not possible, permits for impacts and alterations may be required. Permits for impacts to jurisdictional waterways and wetlands within Kentucky are regulated by the USACE in compliance with Section 404 of the CWA. Jurisdictional surface waters and wetlands are defined by the pre-2015 regulatory definition using guidance from Rapanos and SWANCC.

In addition, the Survey Area crossed floodplains associated with Valley Creek, East Rudes Creek, Rose Run, and several of their unnamed tributaries. Floodplains in Kentucky are regulated by Kentucky Department of Environmental Protection and the counties. The Project may be covered under the General Permit KY FPGP, but consultation with the state and counties is recommended.

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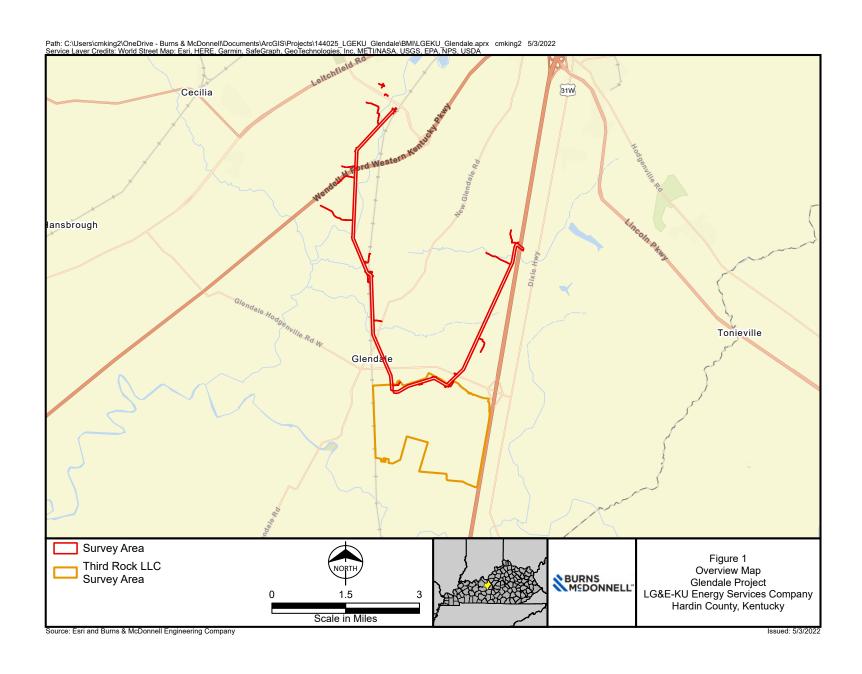
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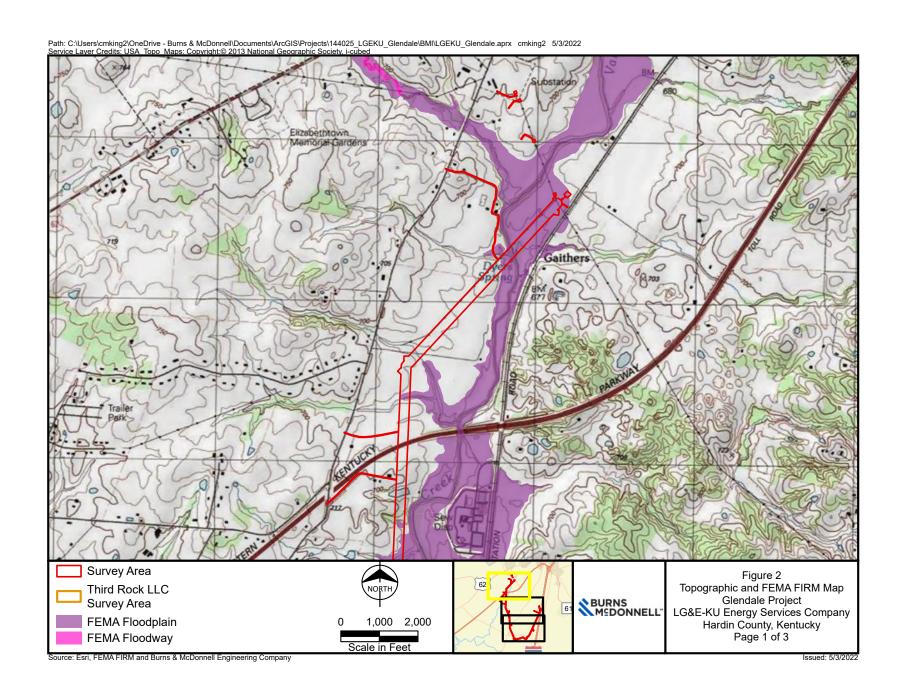
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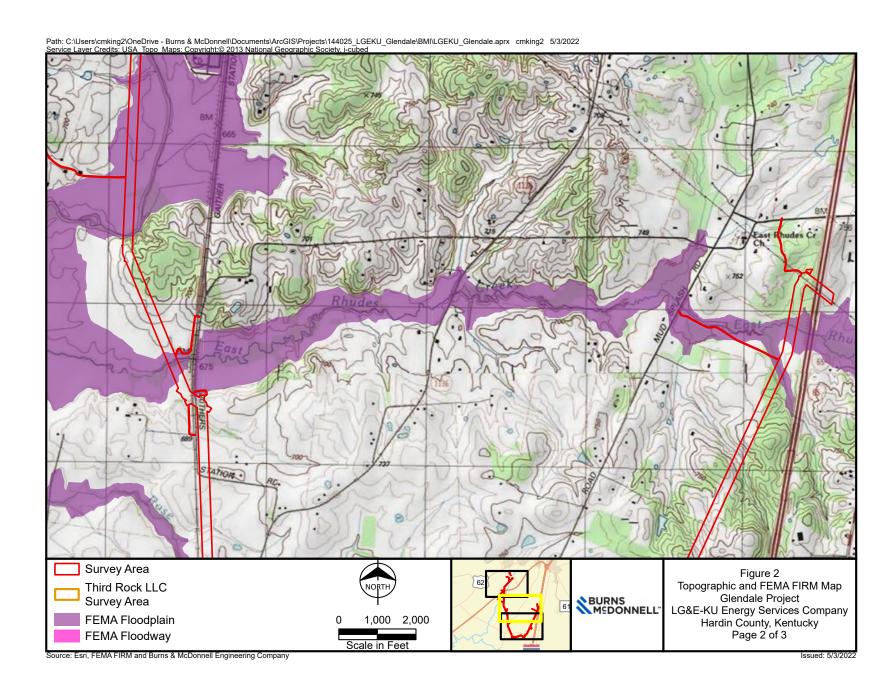
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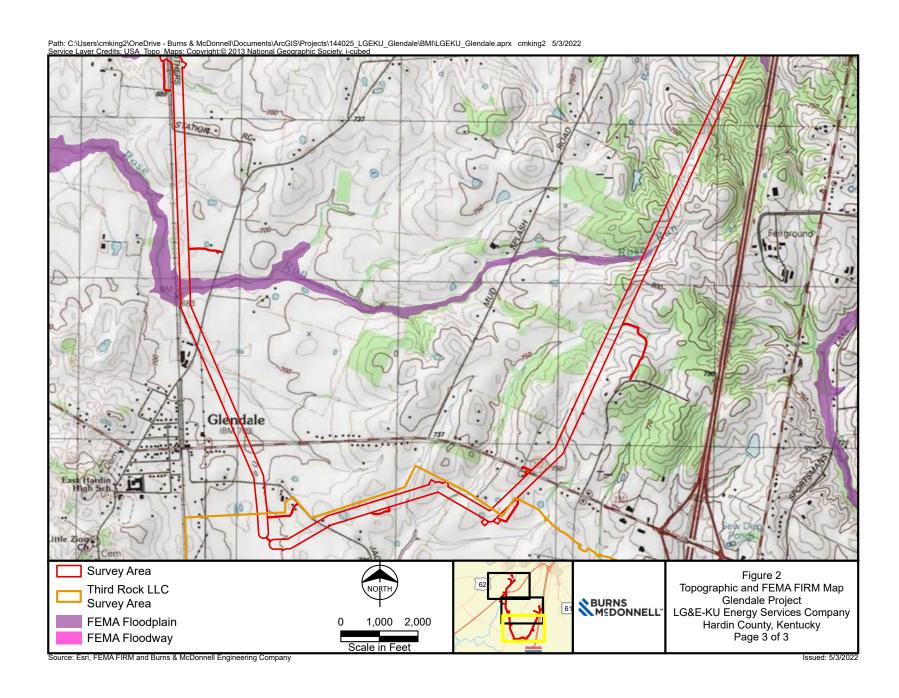
Attachment 4 to Response to PSC-4 Question No. 1
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McFarland

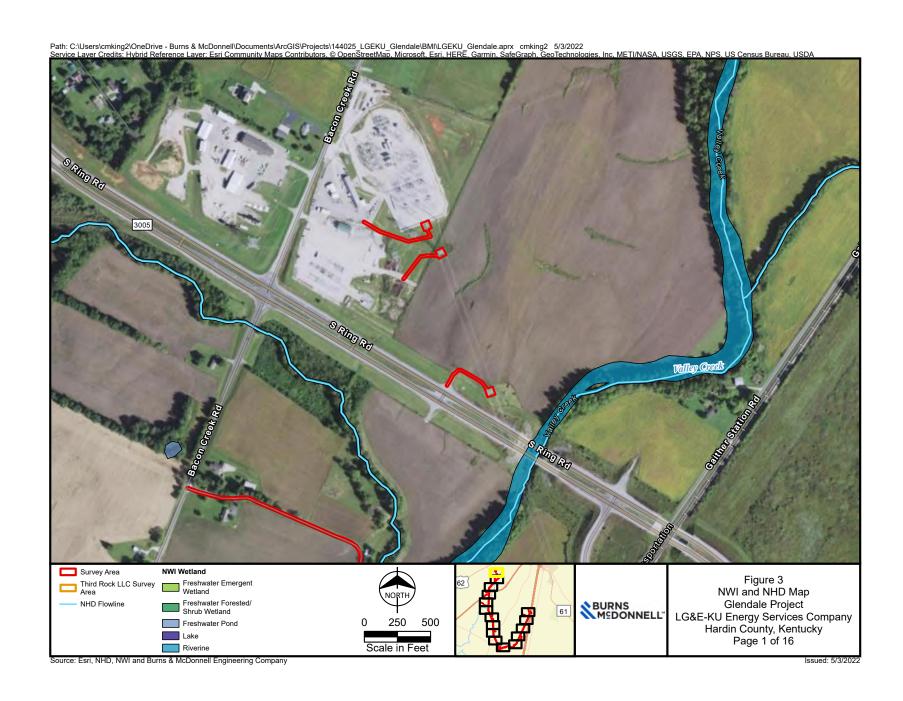
APPENDIX A – FIGURES

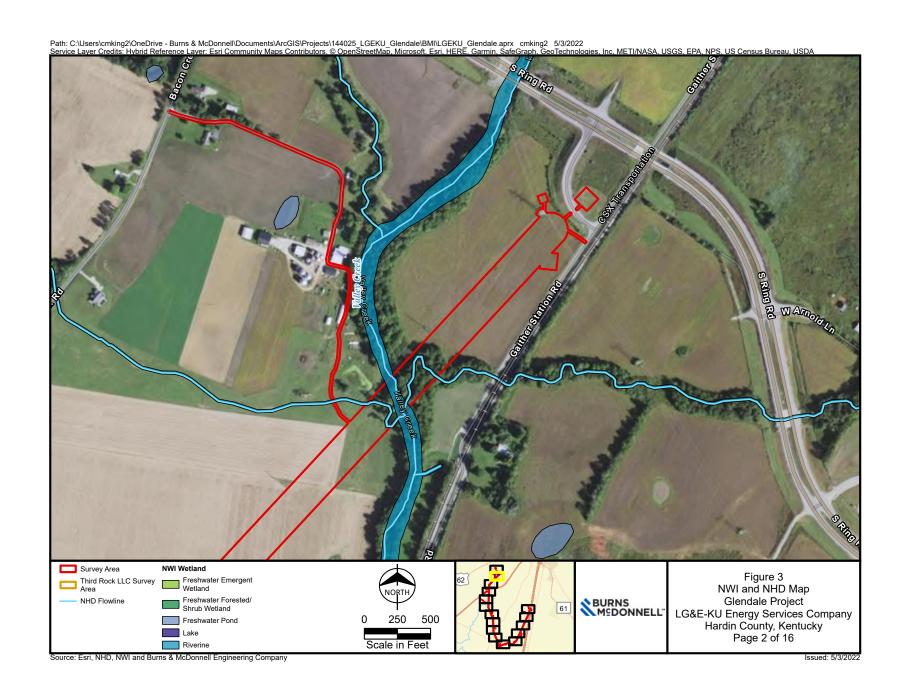


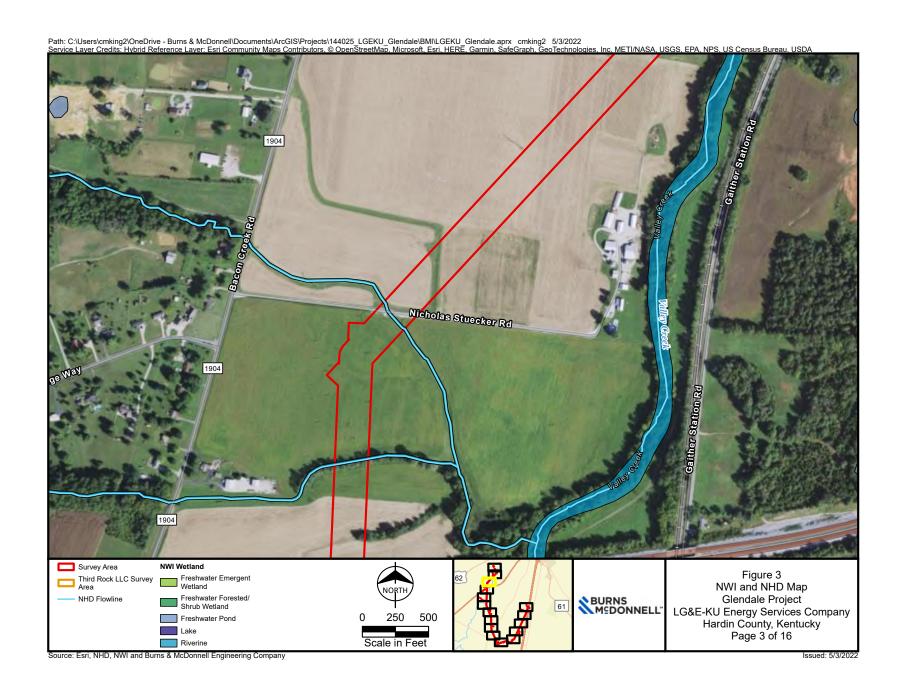


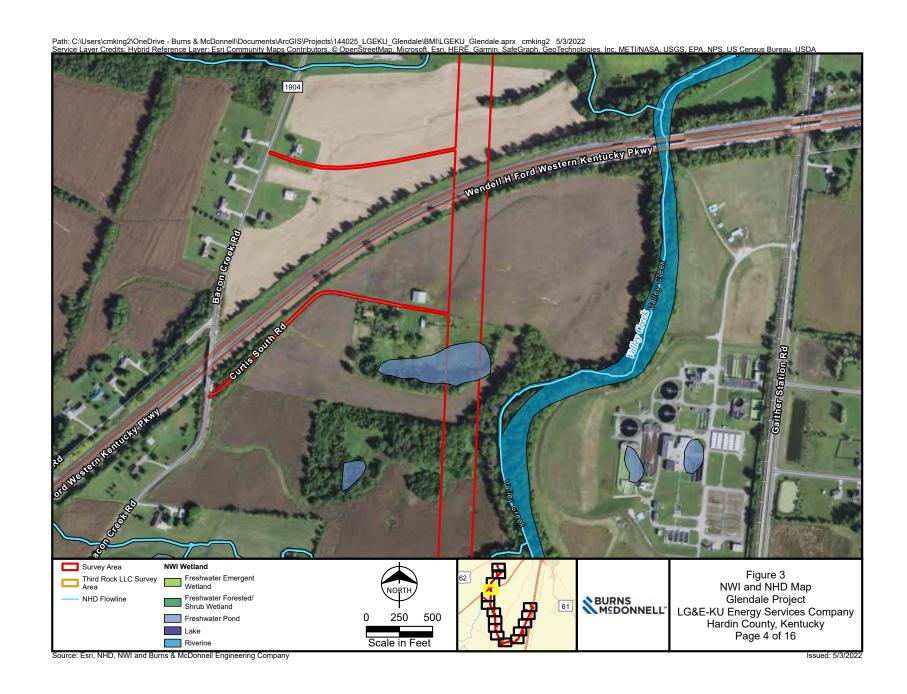


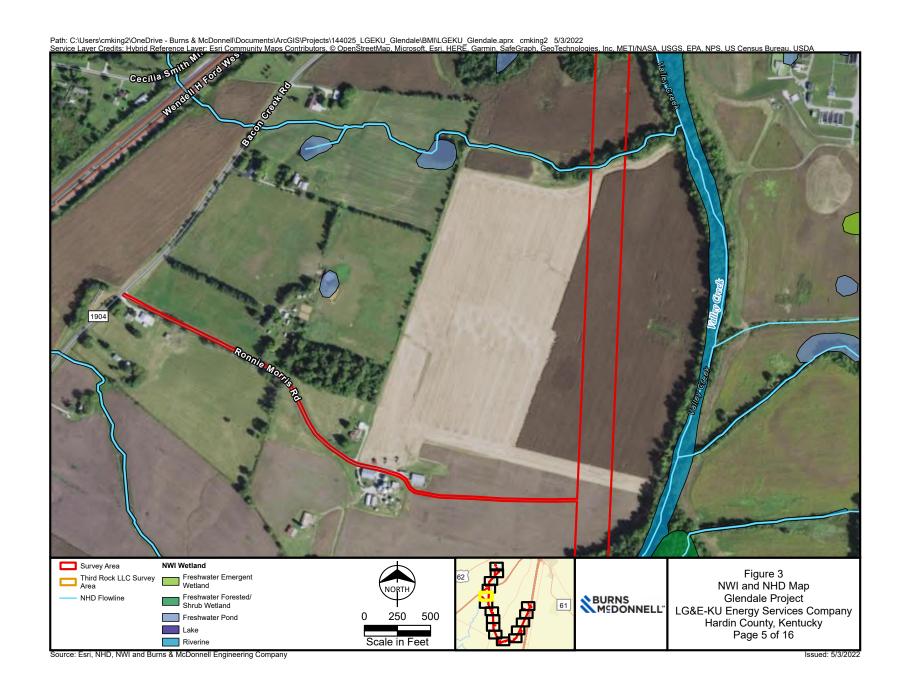


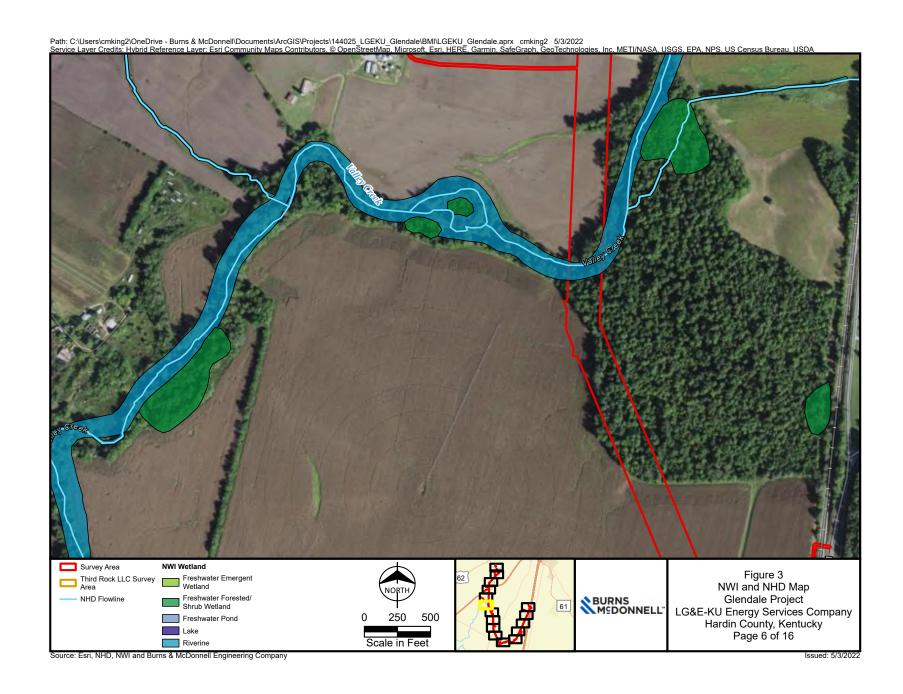


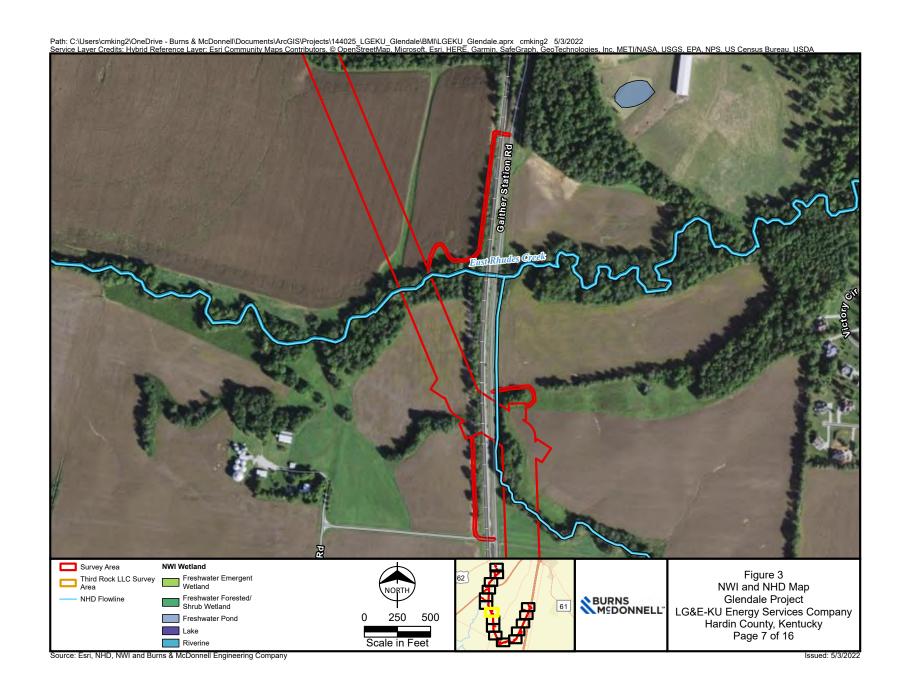


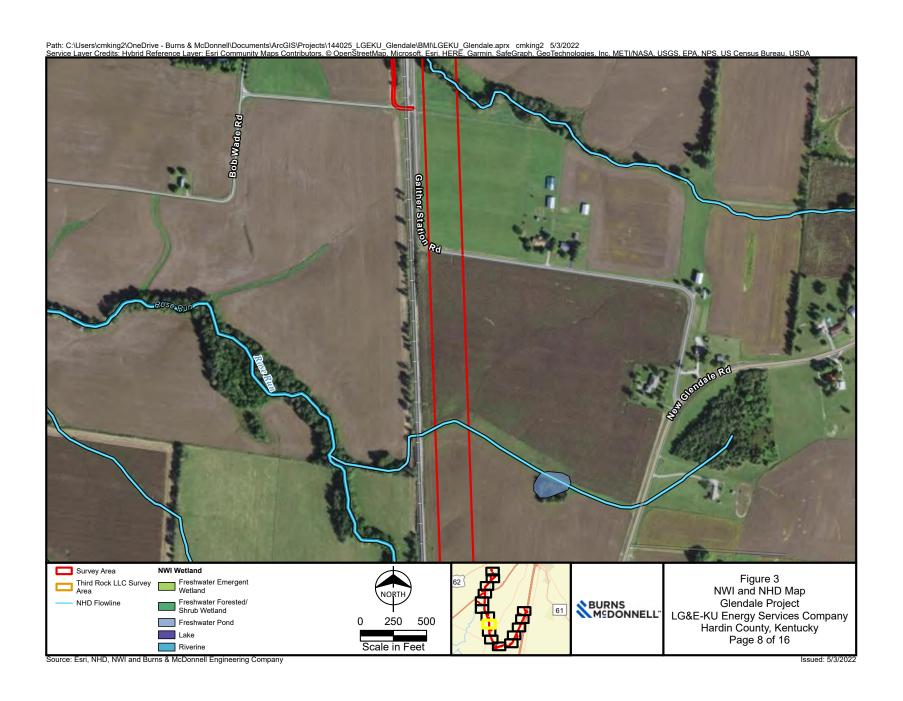


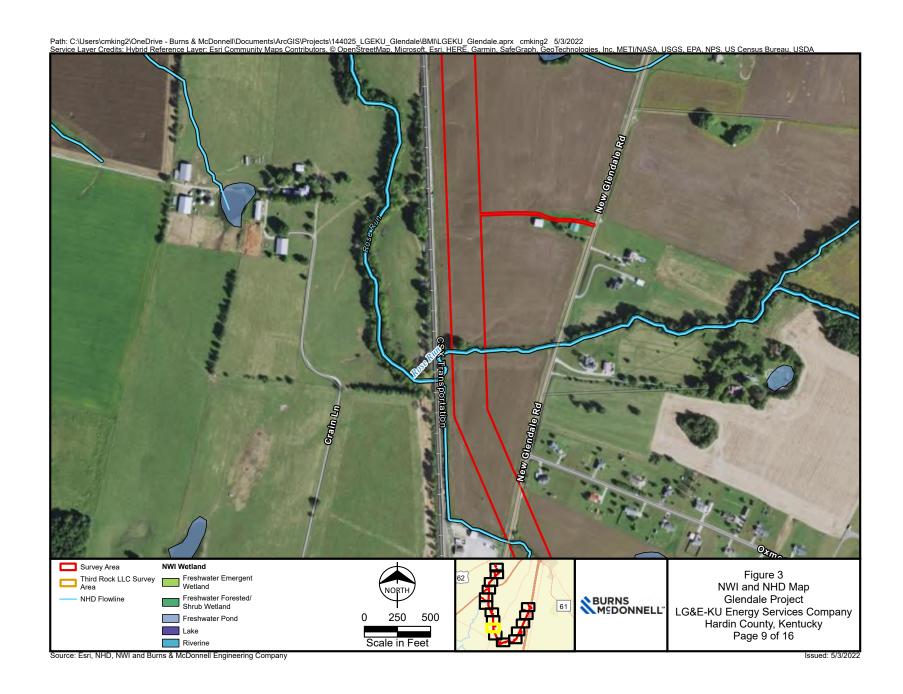


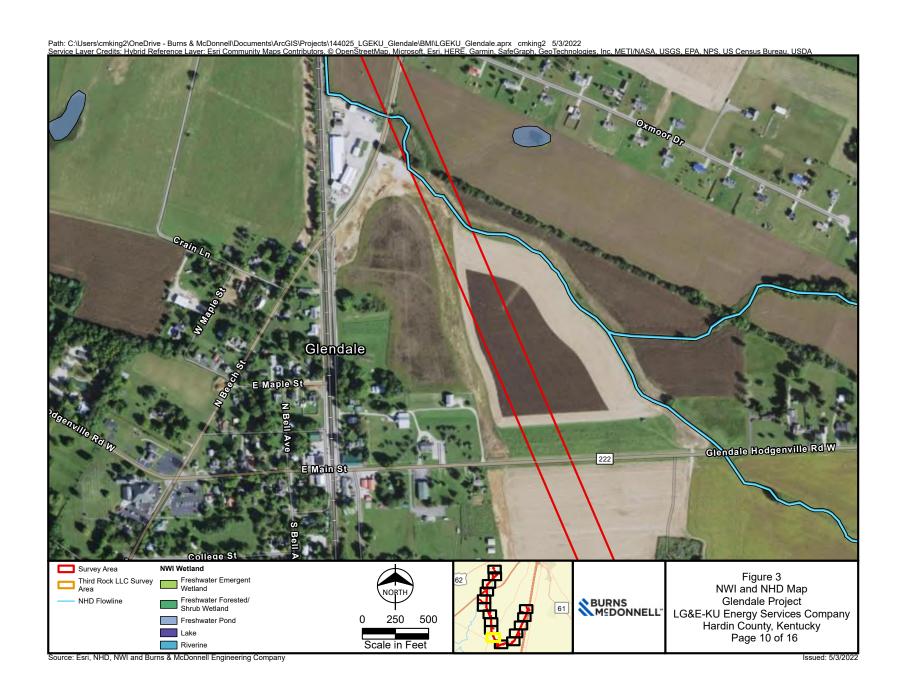


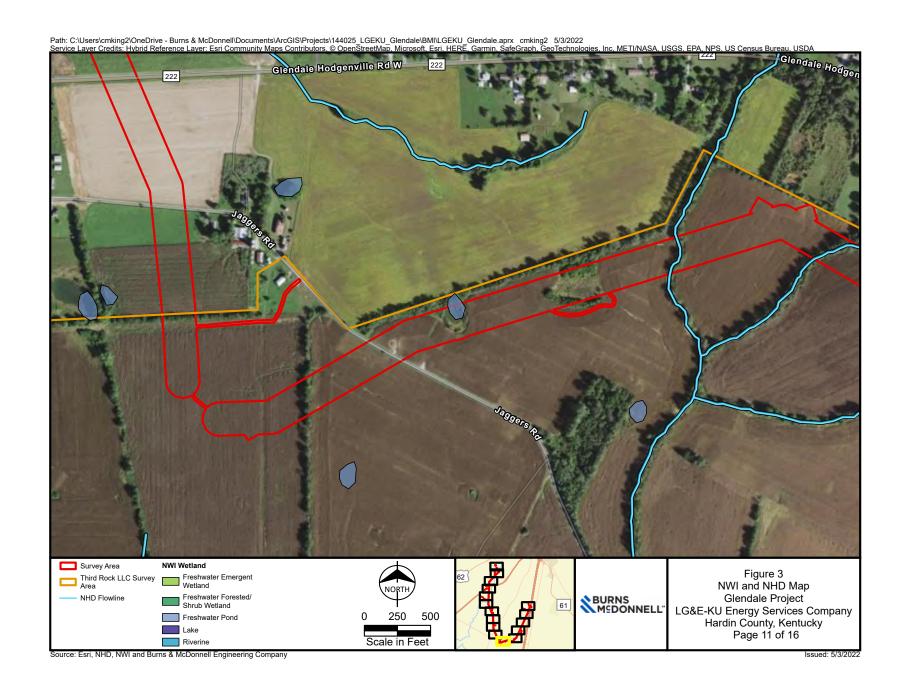


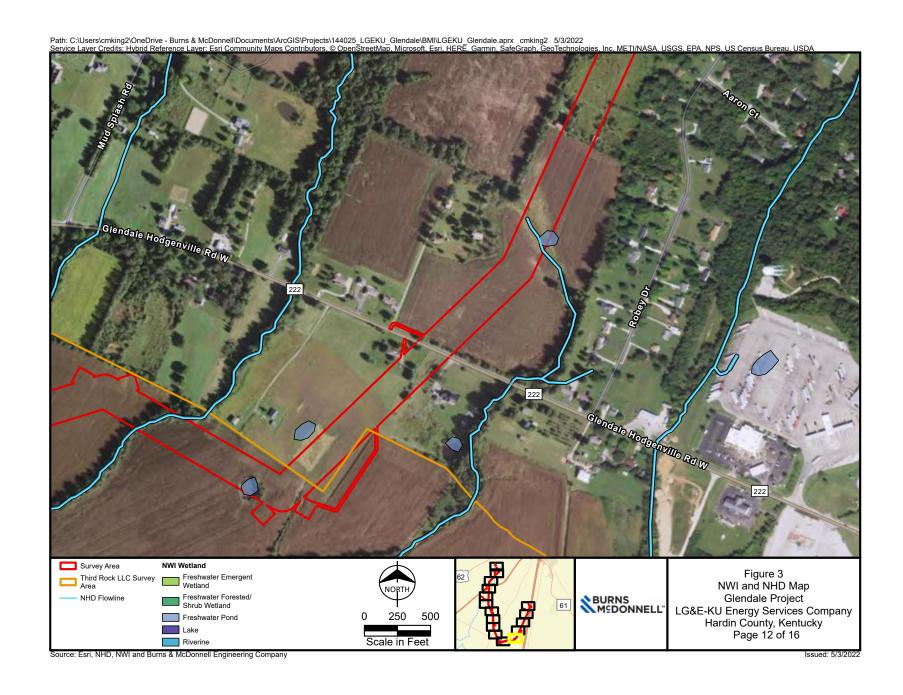


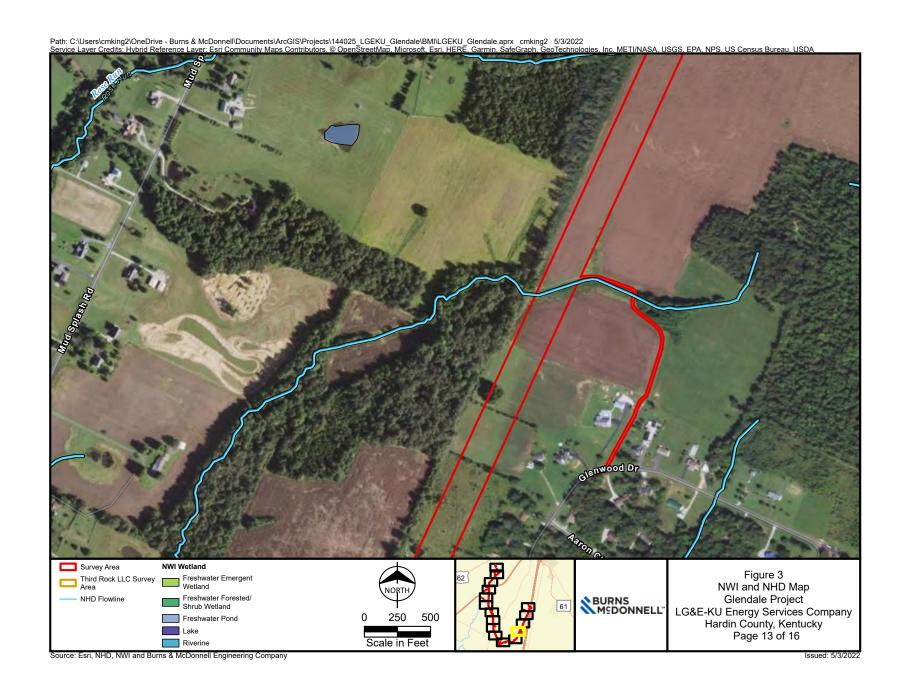


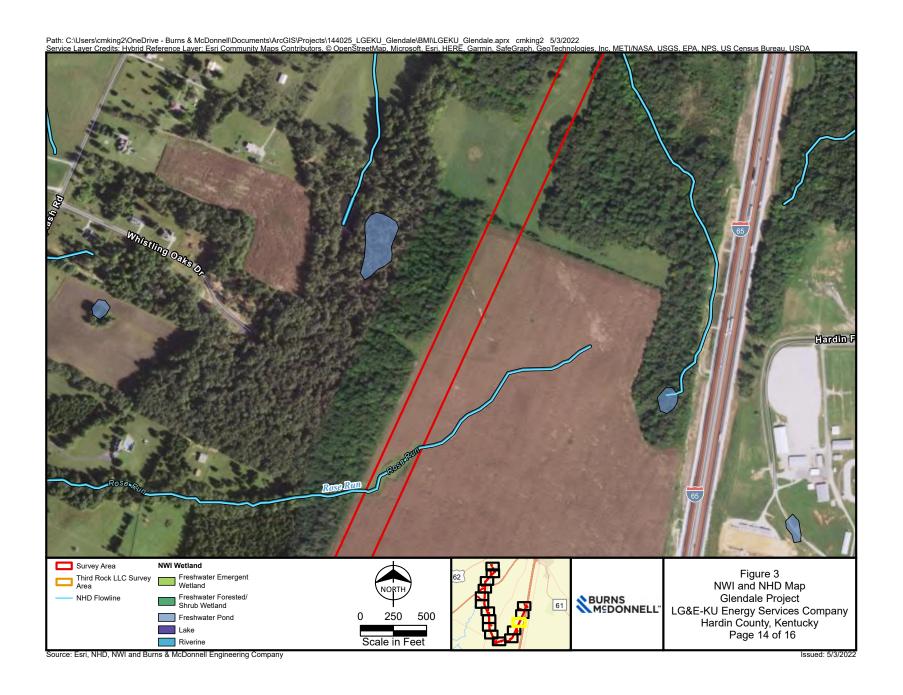


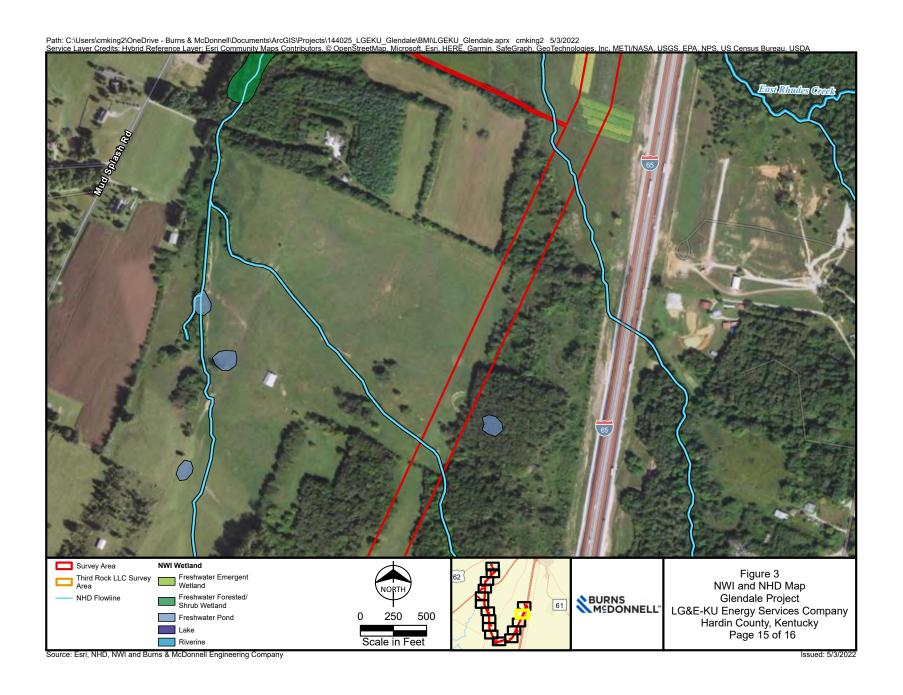


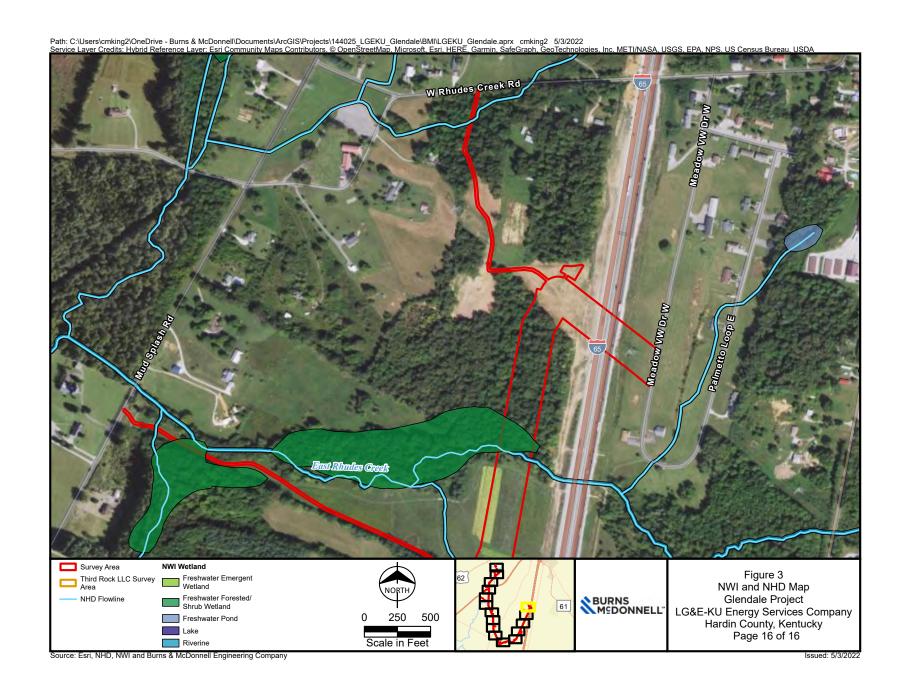


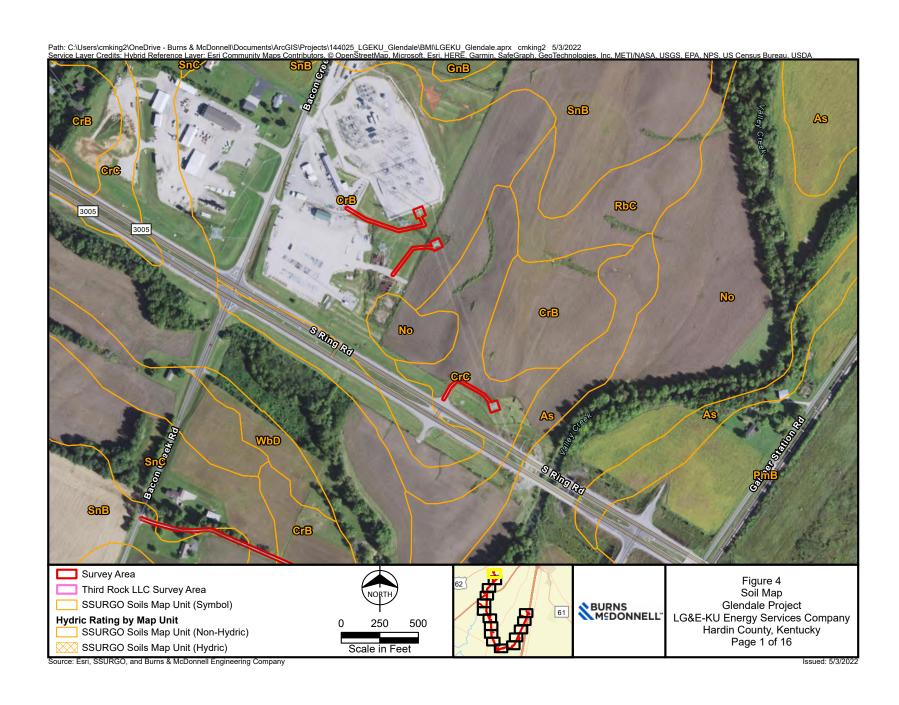


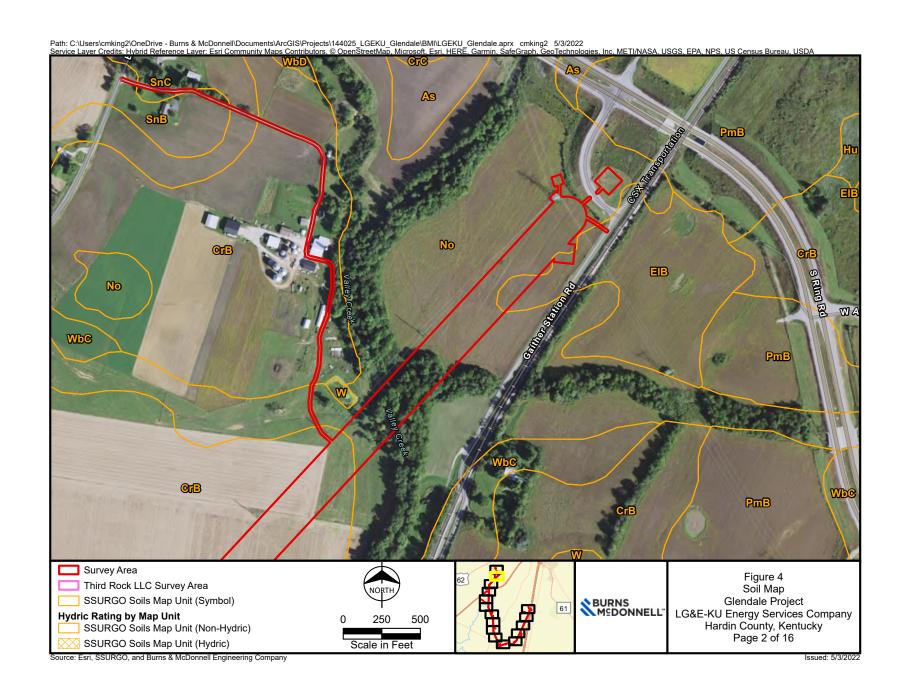


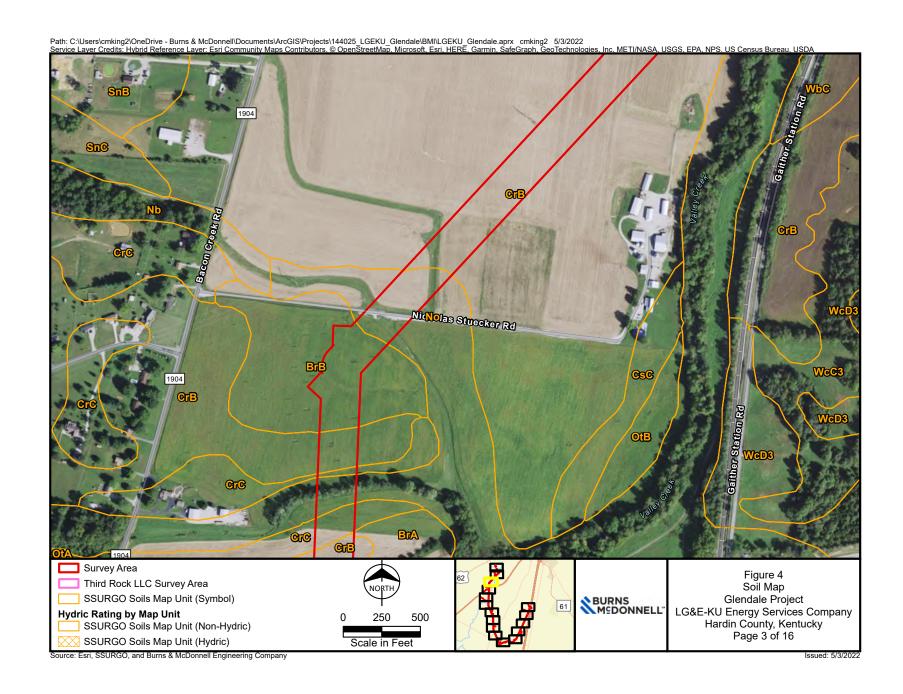


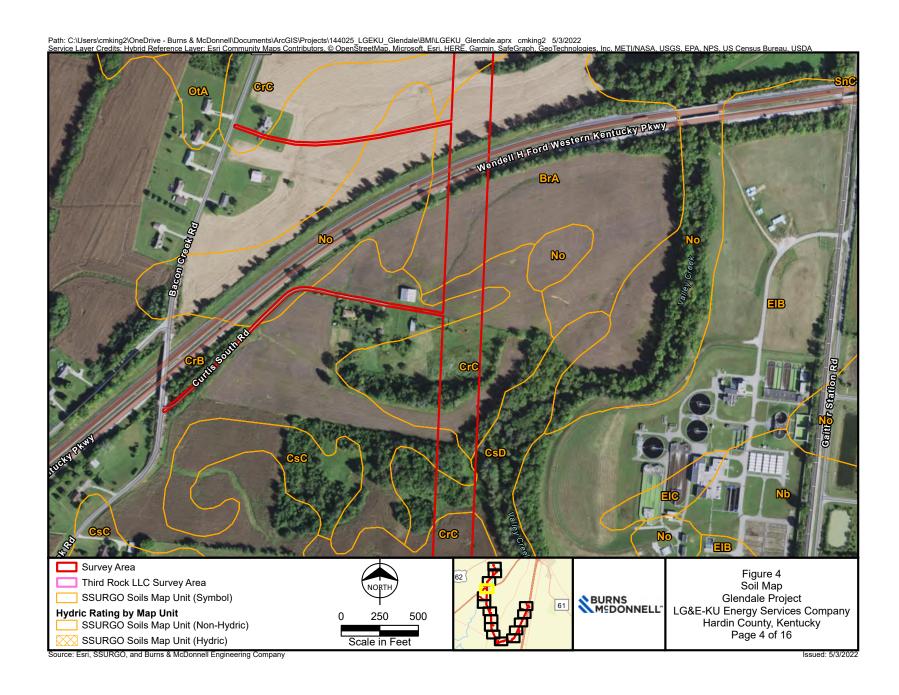


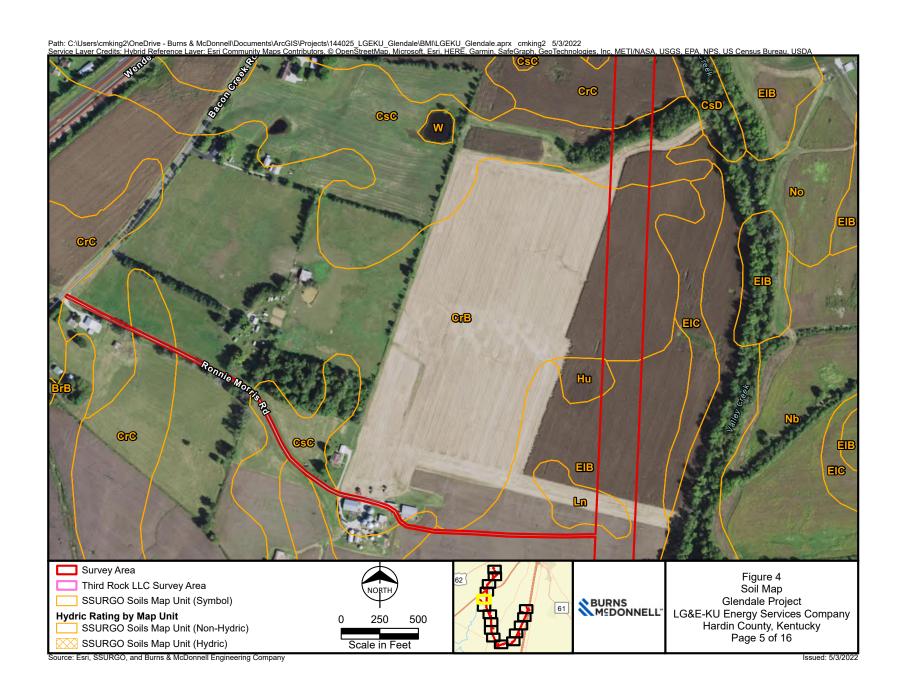


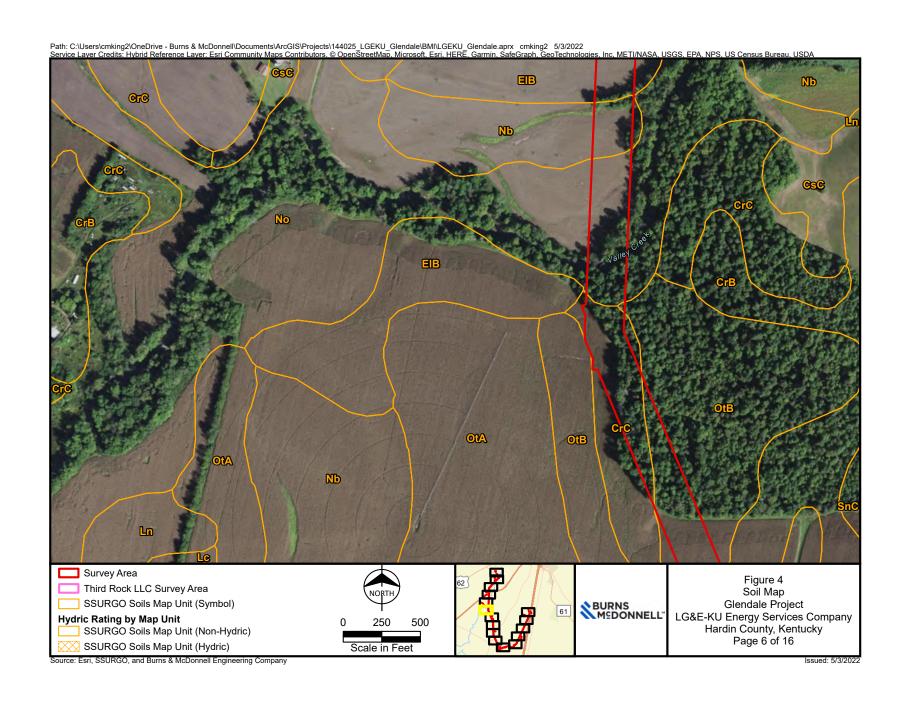


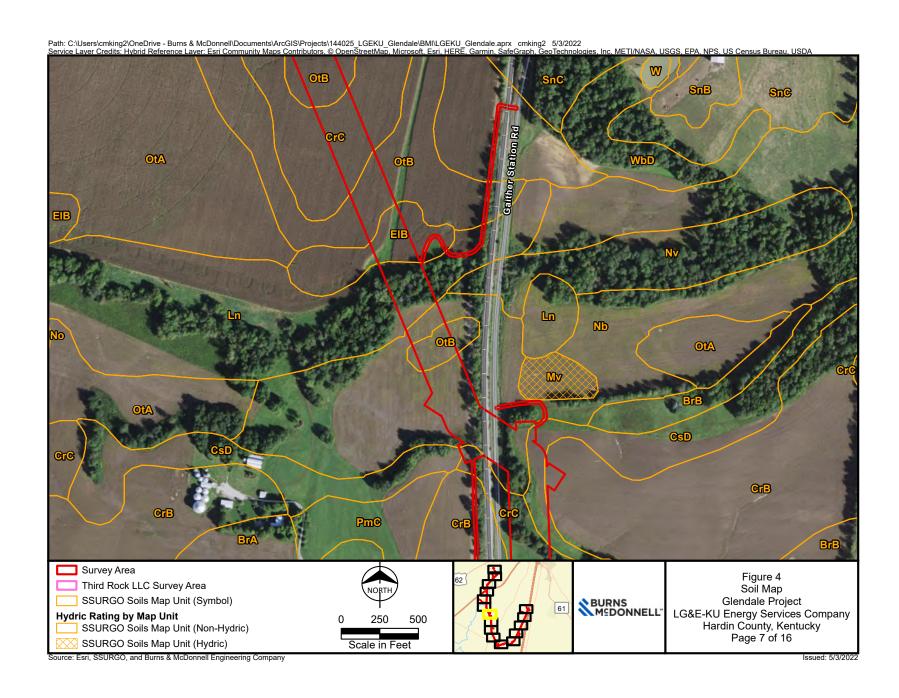


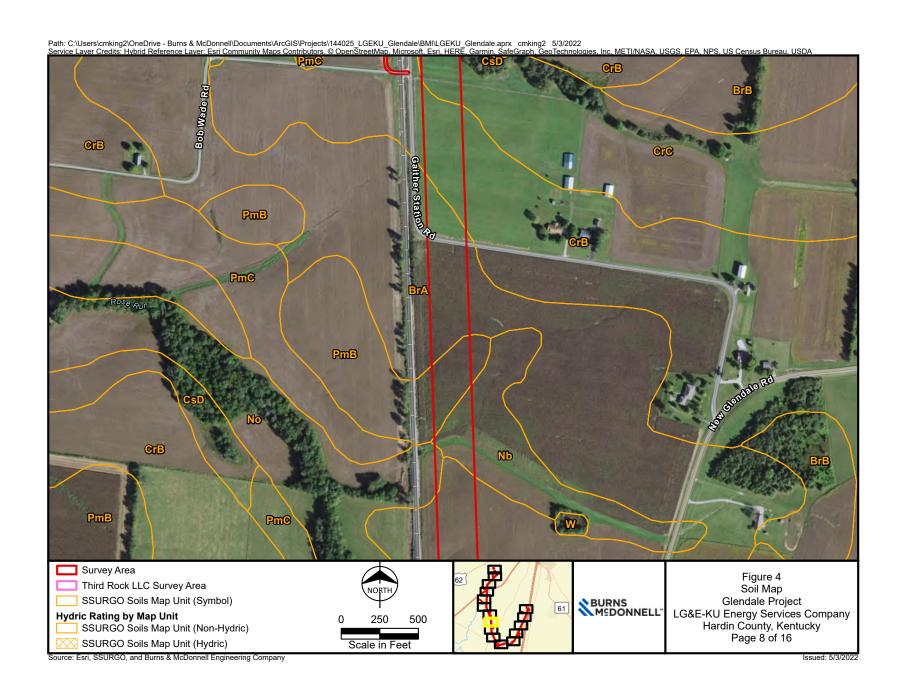


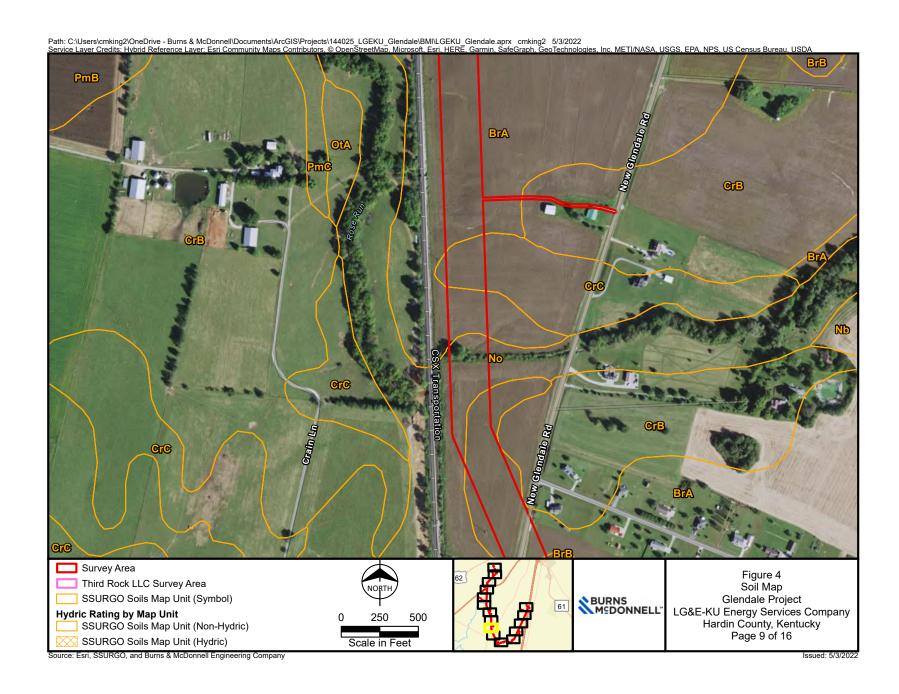


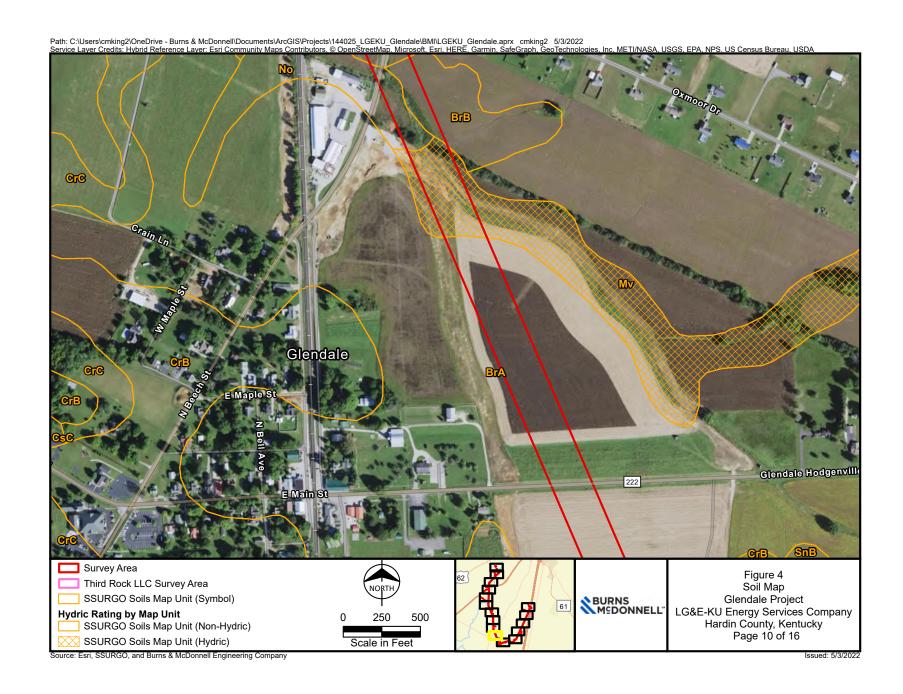


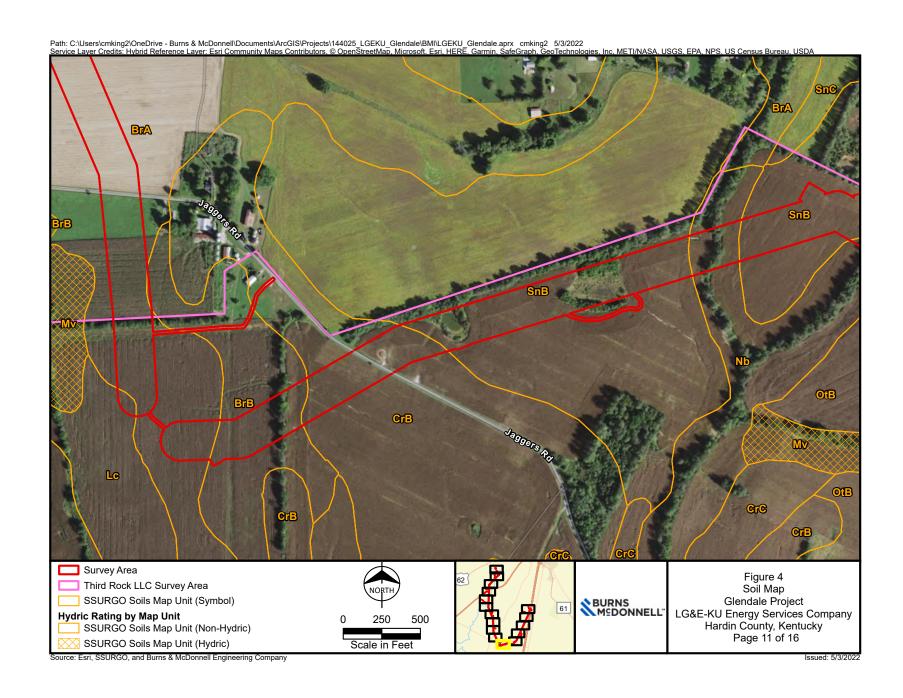


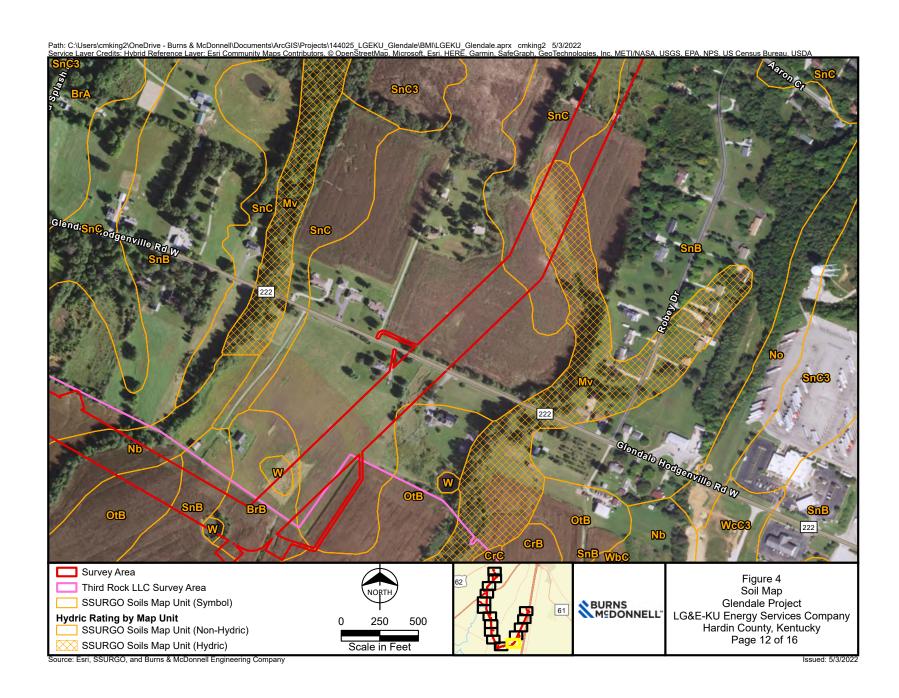


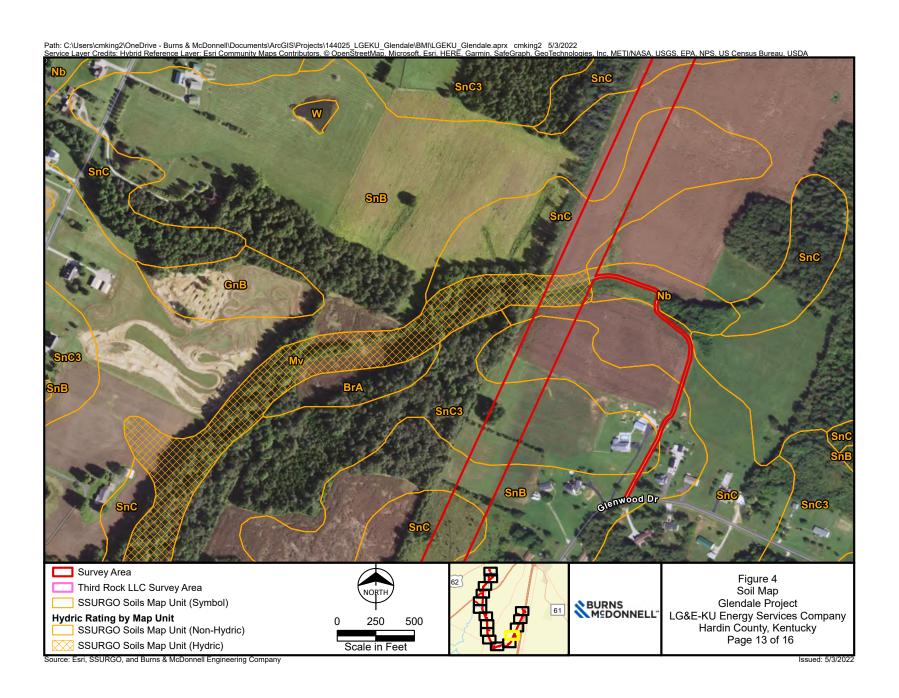


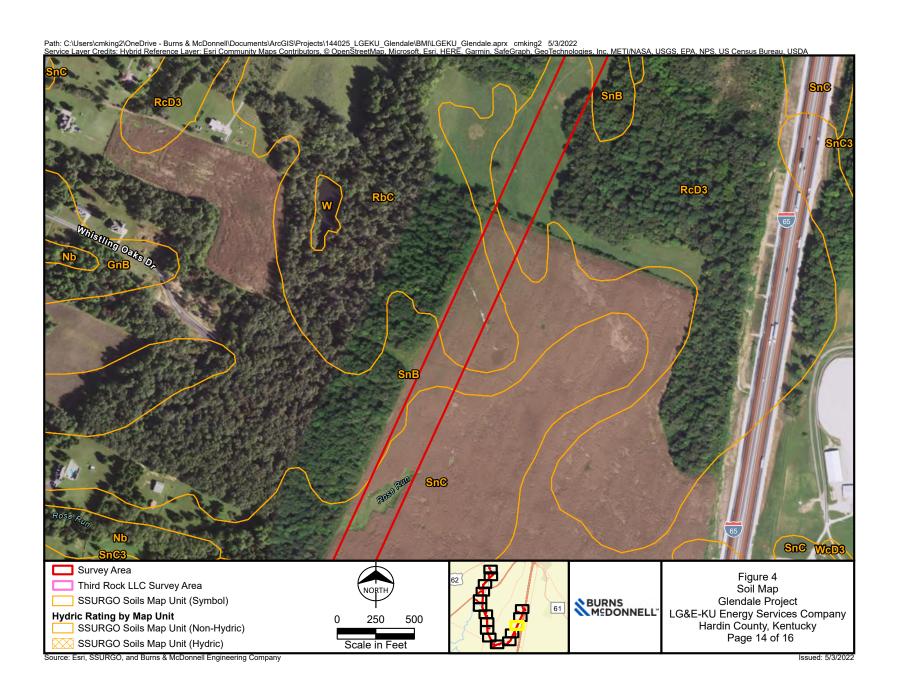


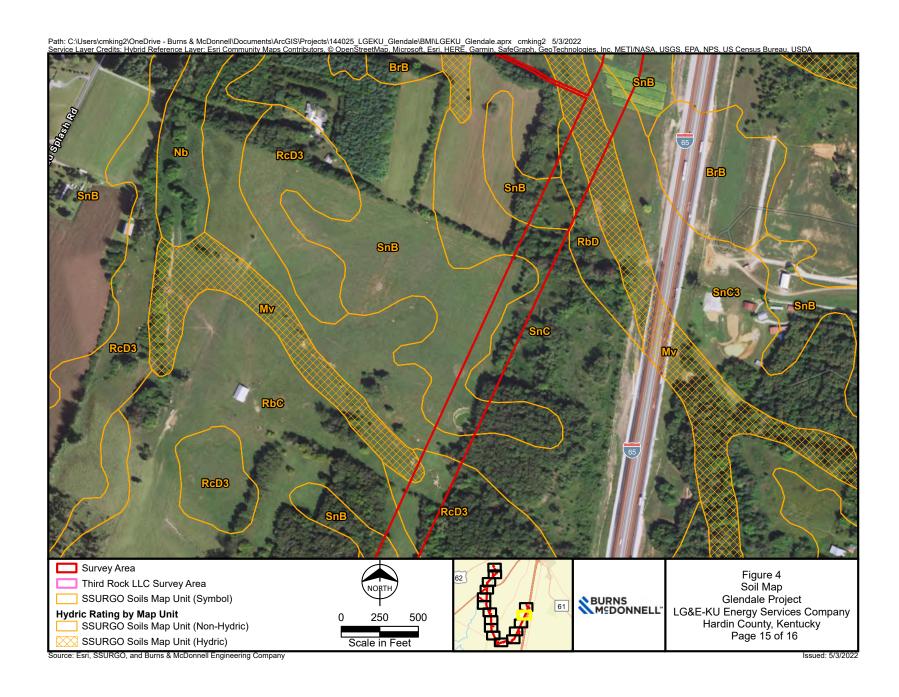


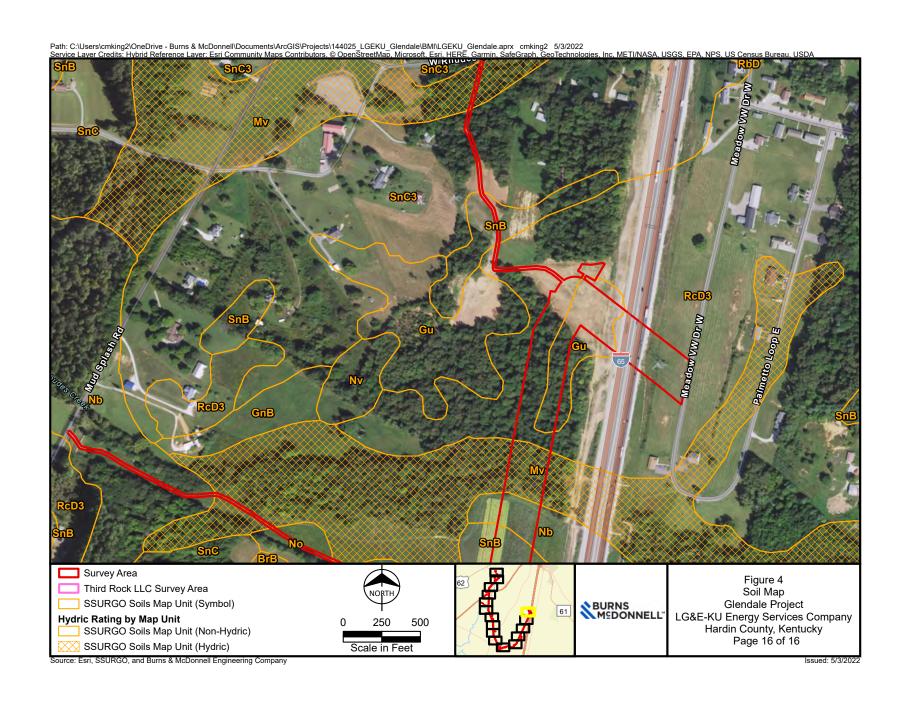


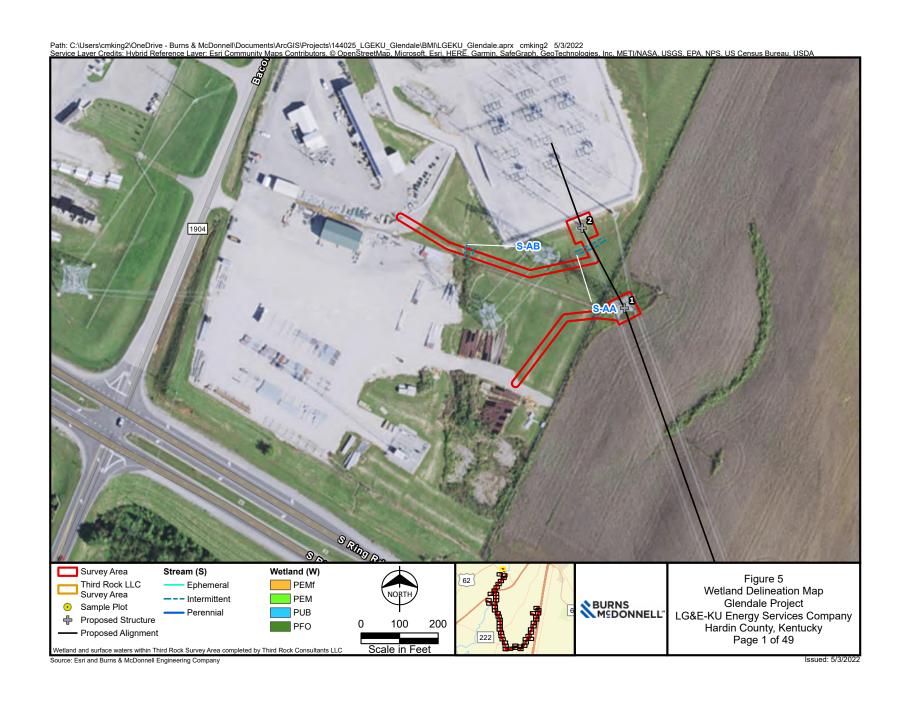


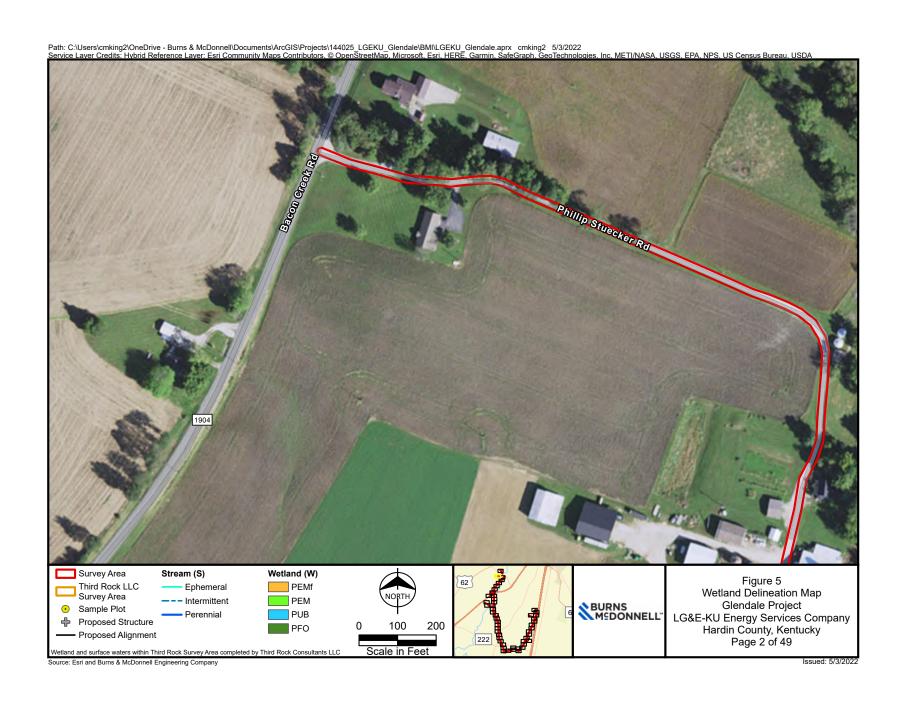


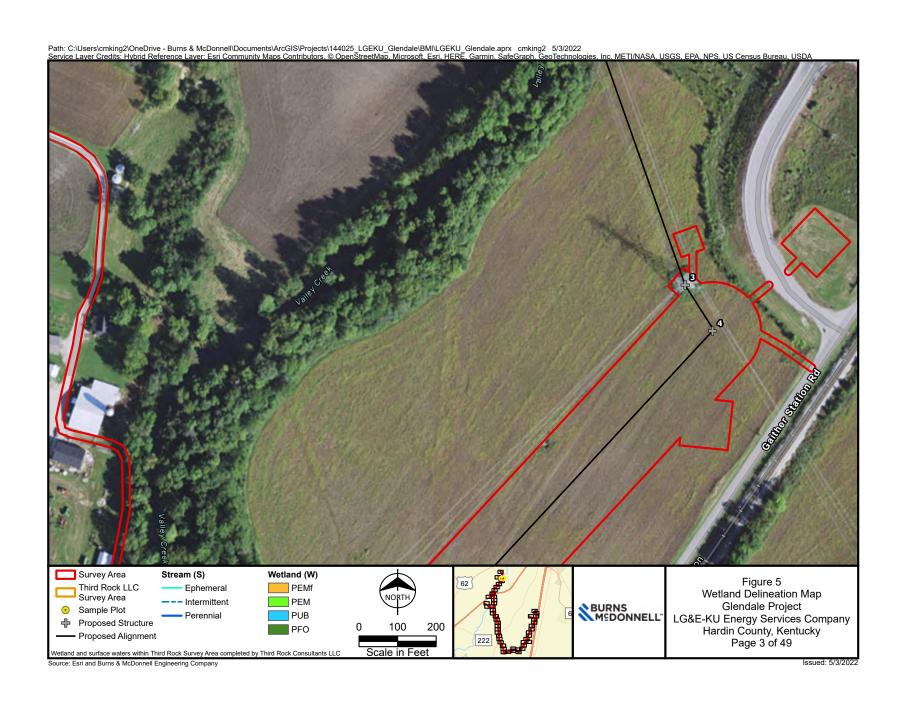


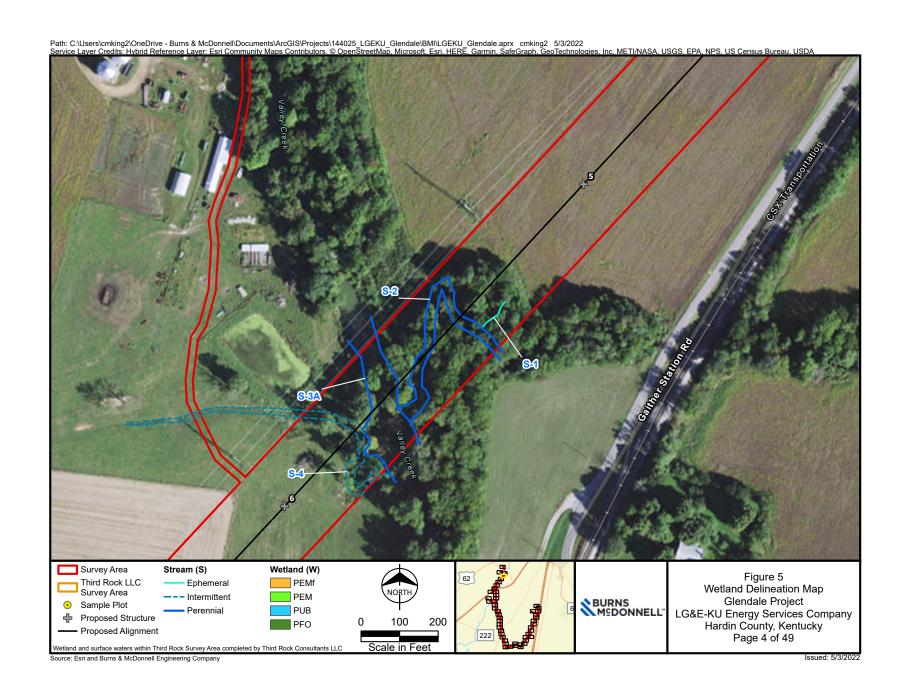


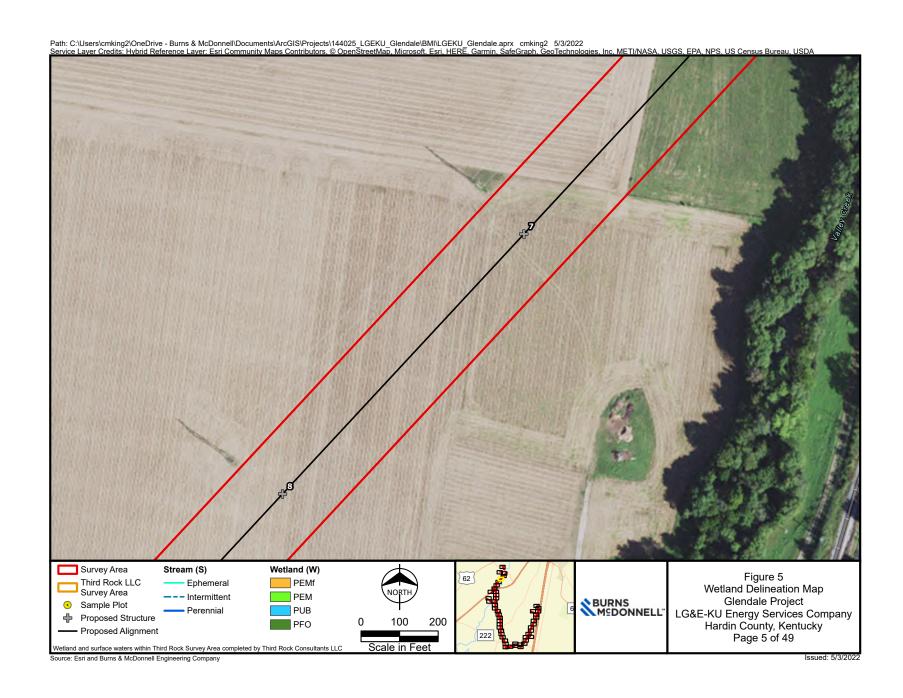


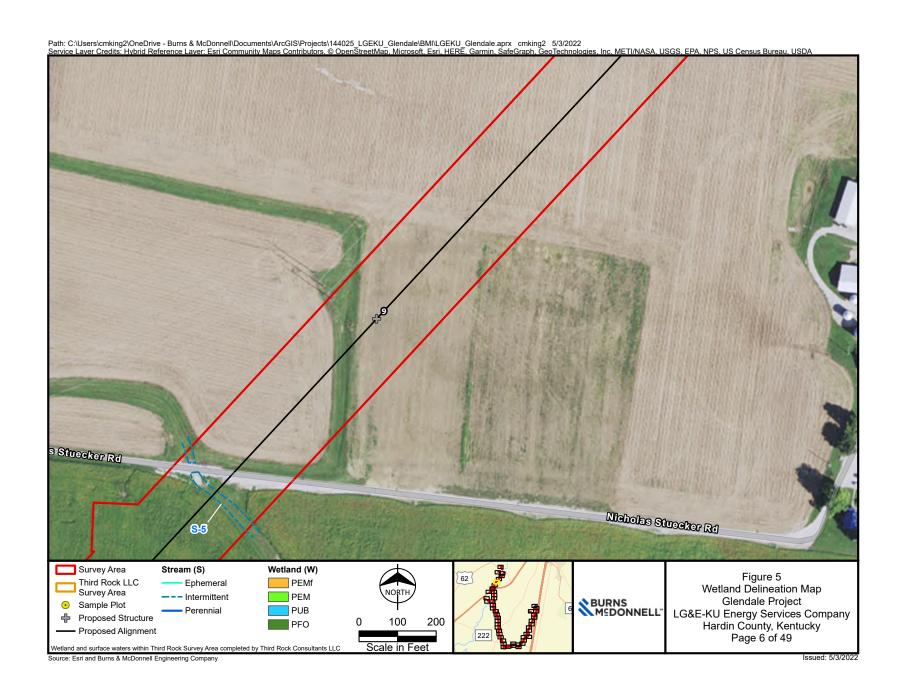


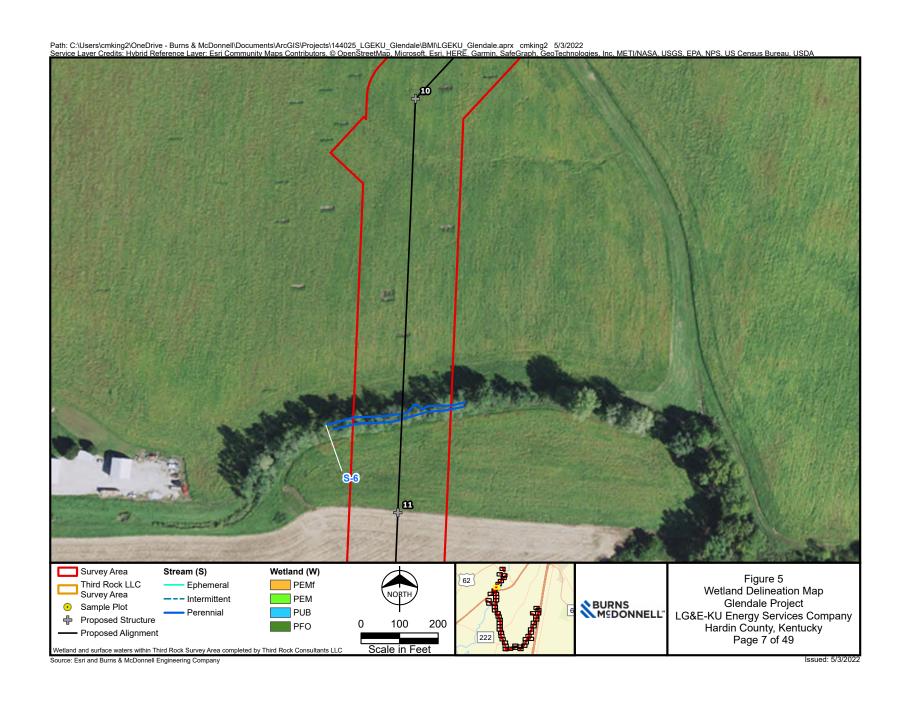


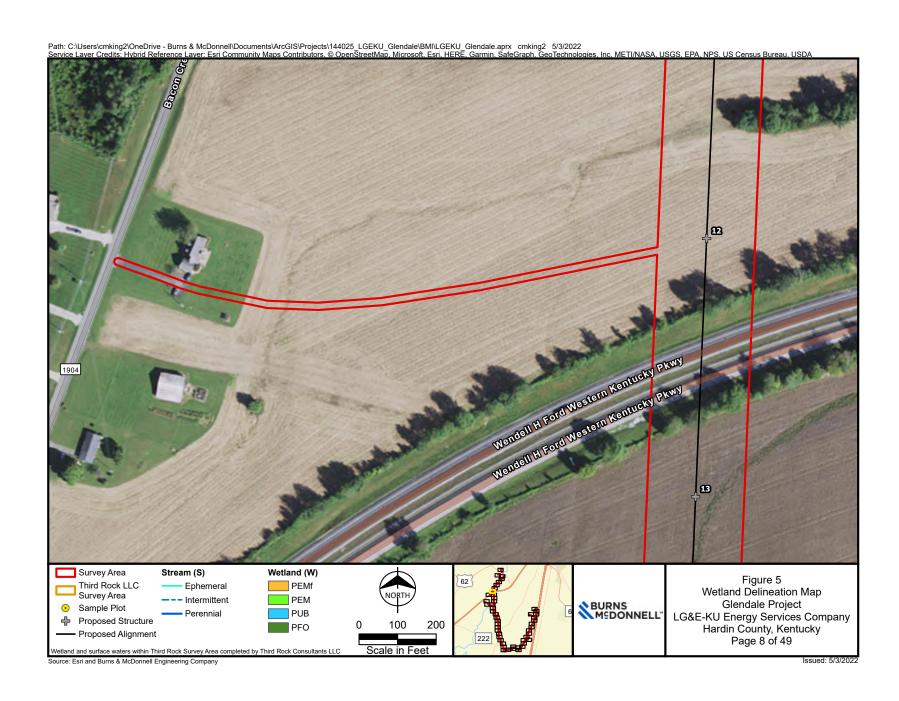


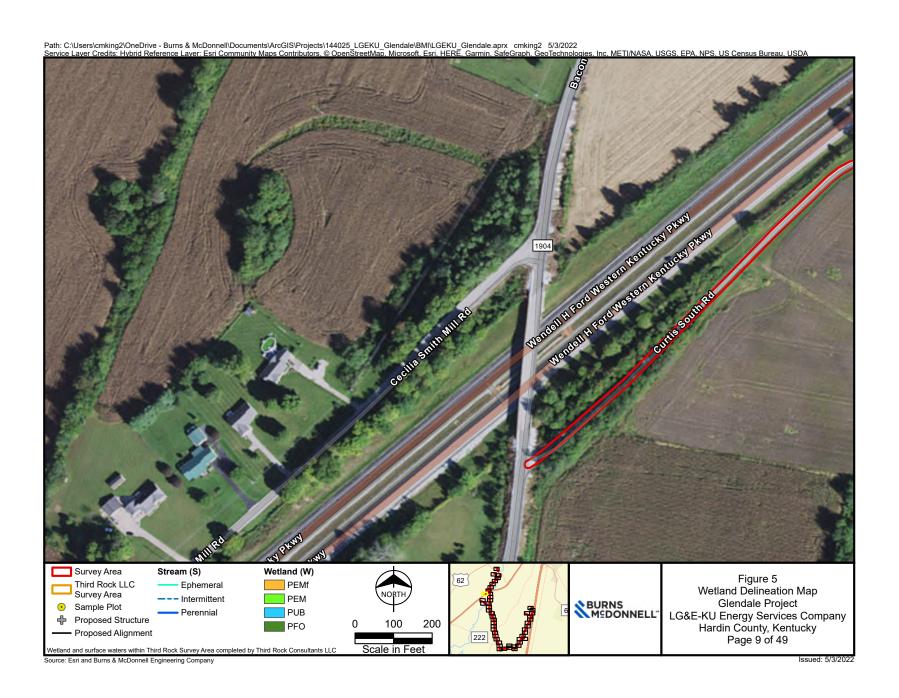


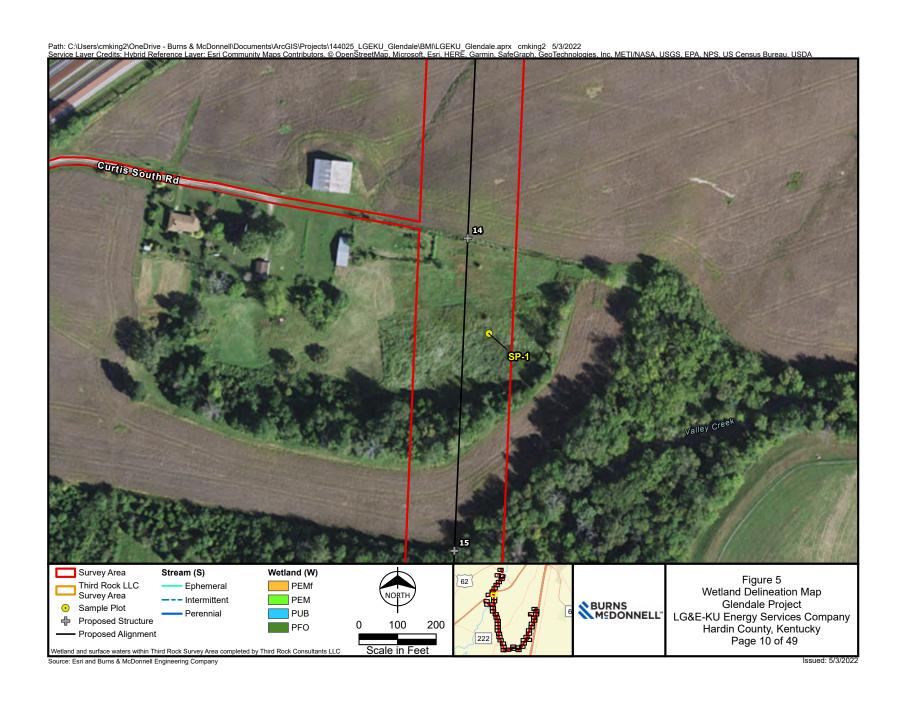


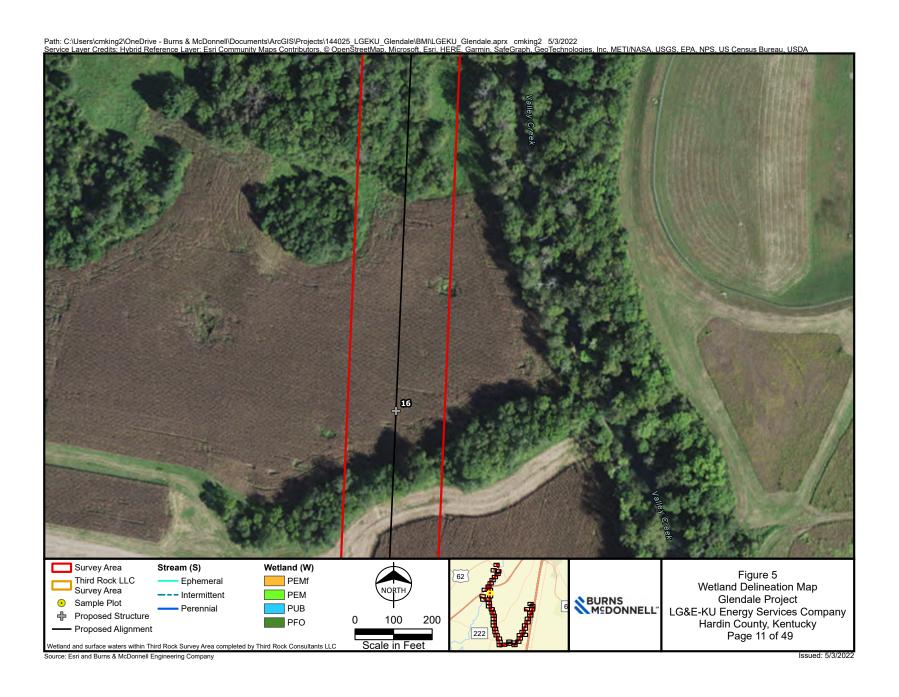


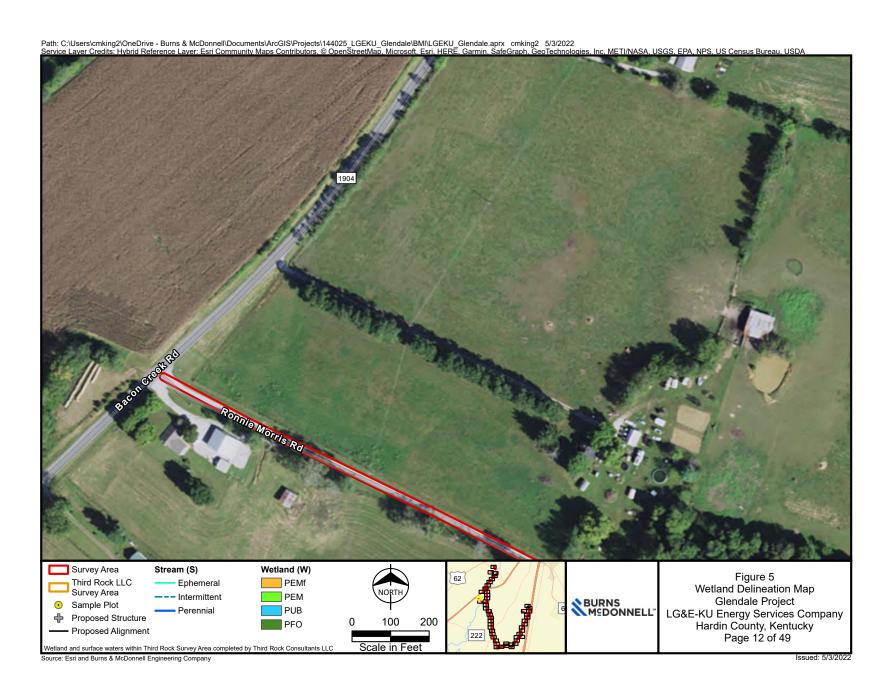


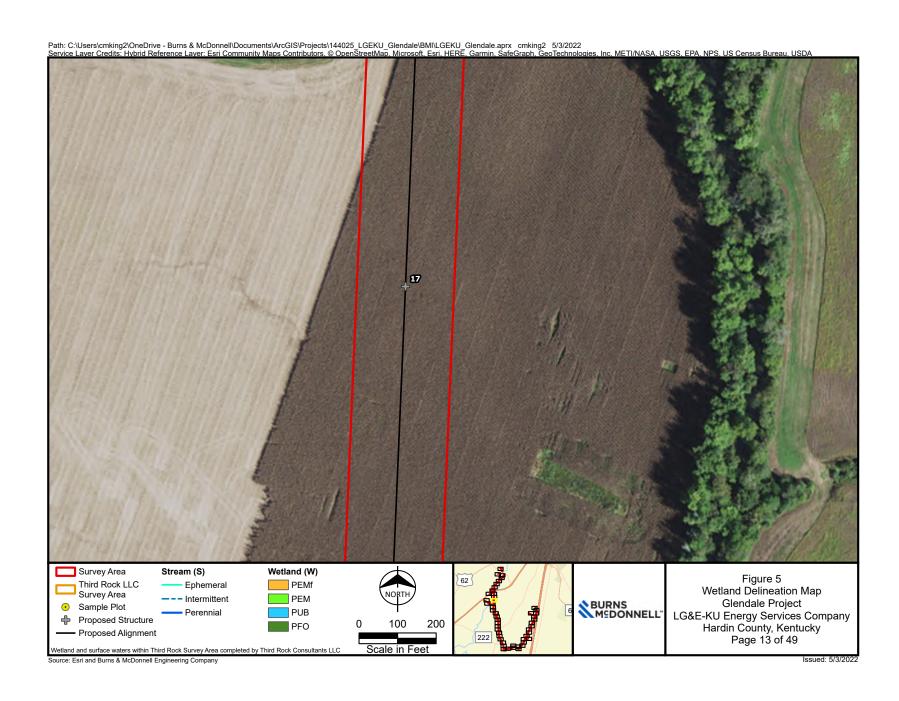


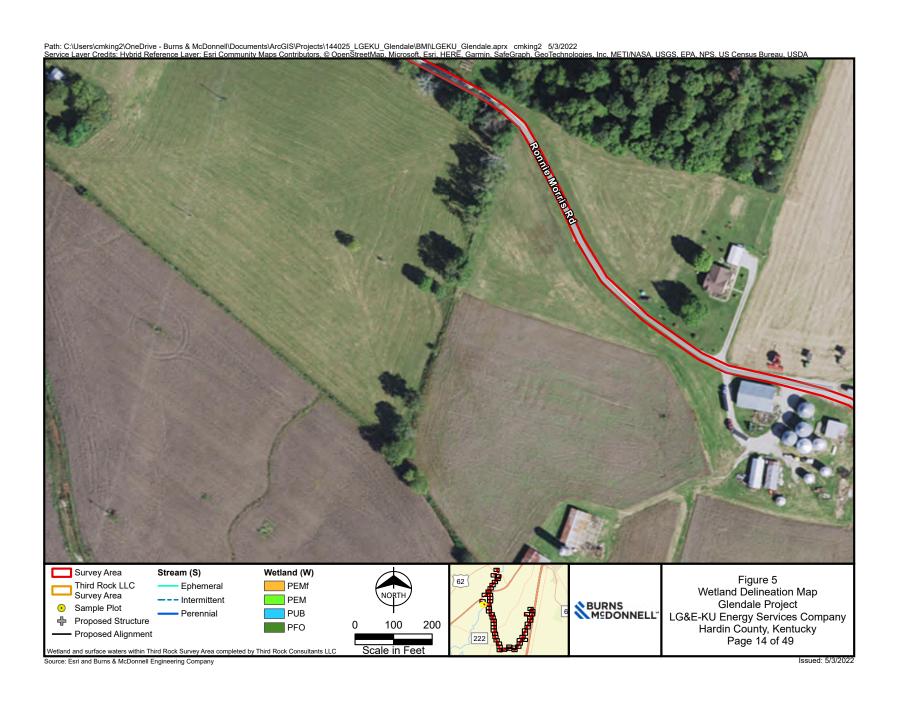


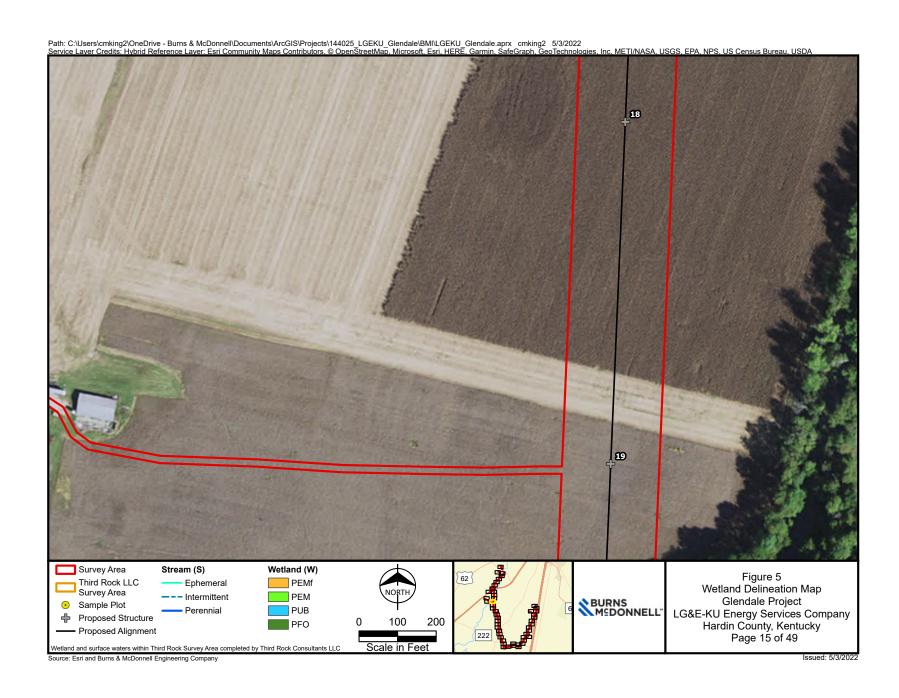


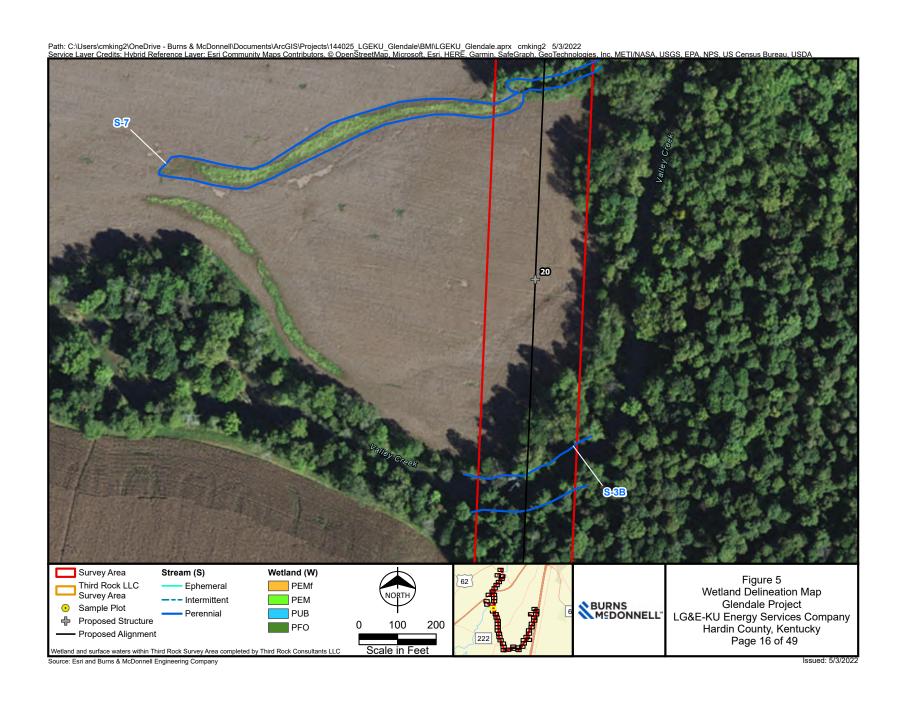


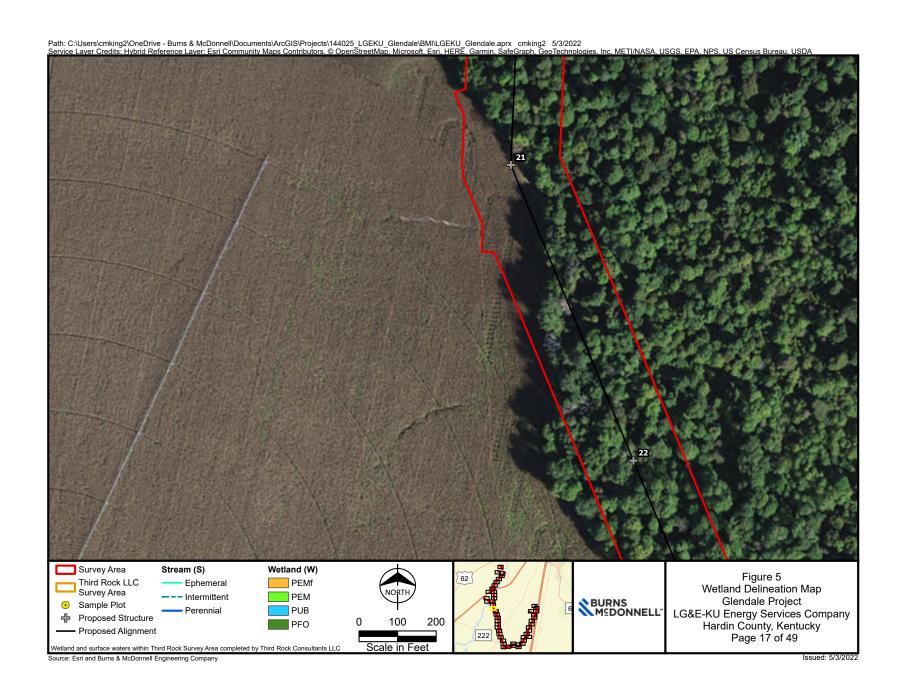


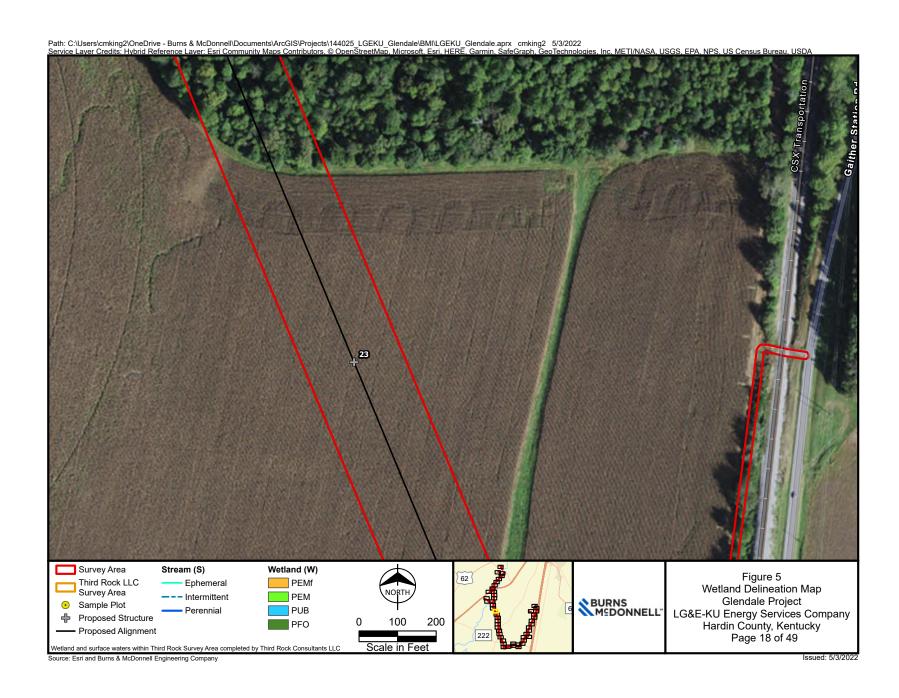


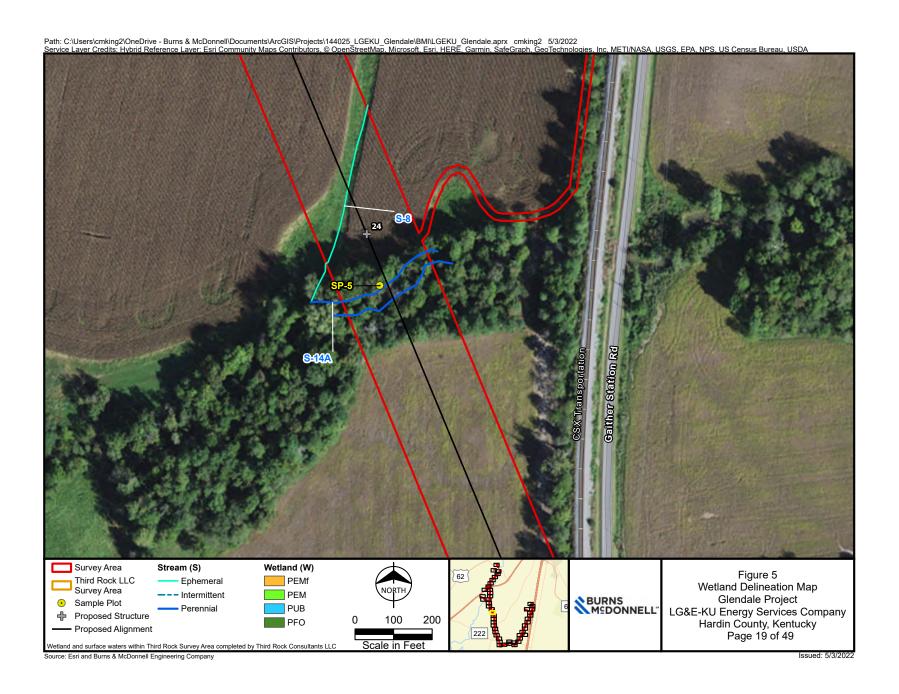


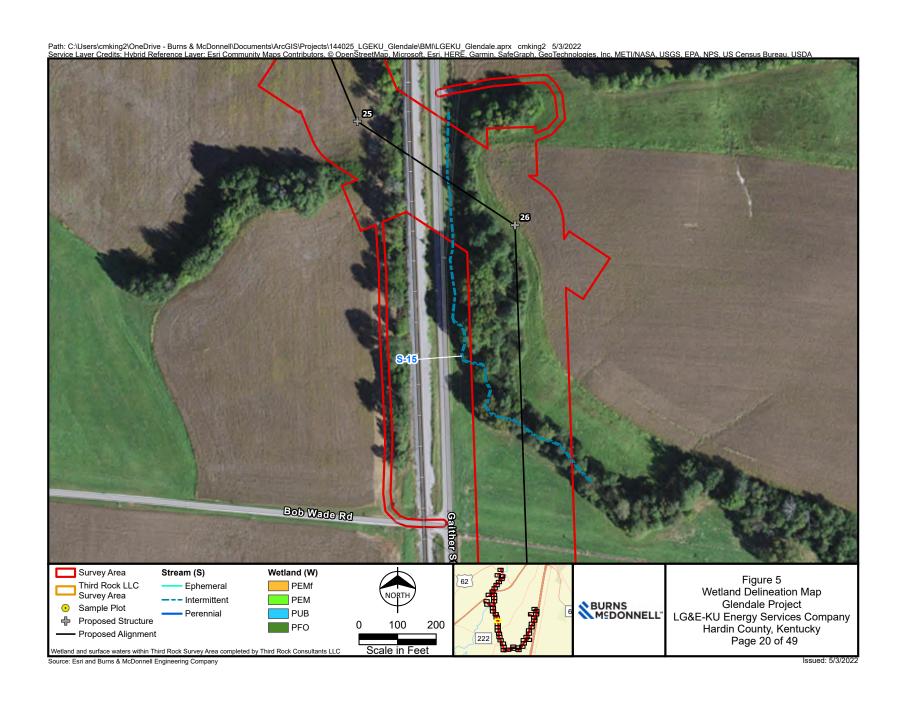


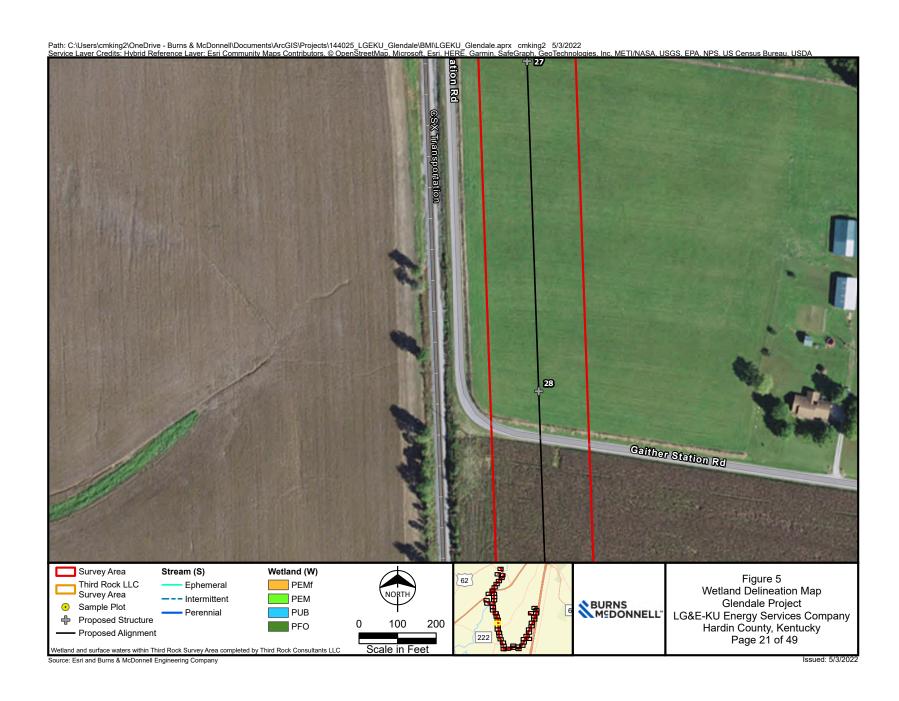


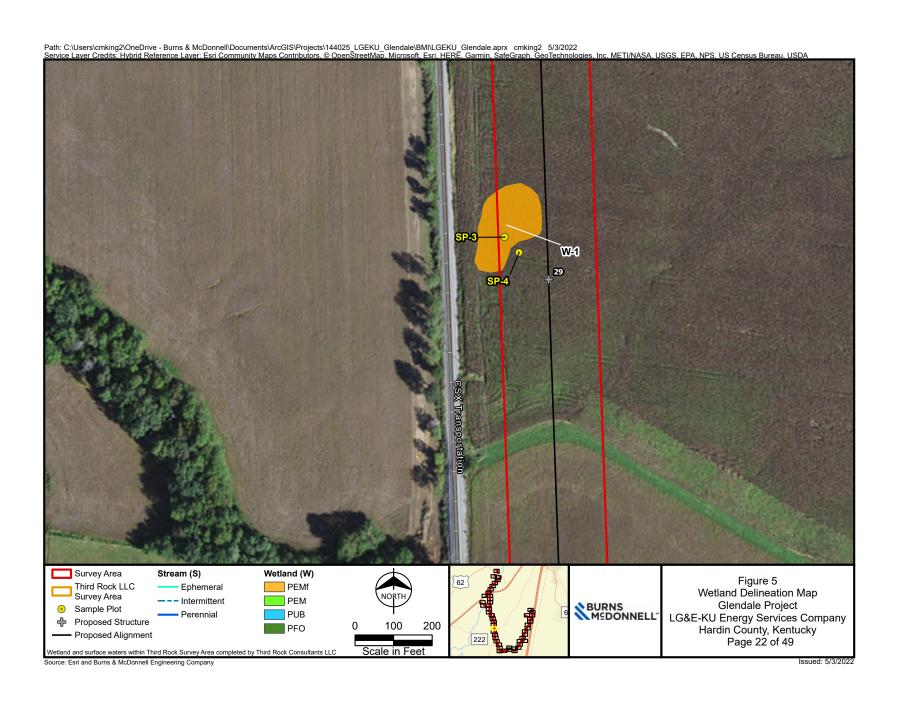


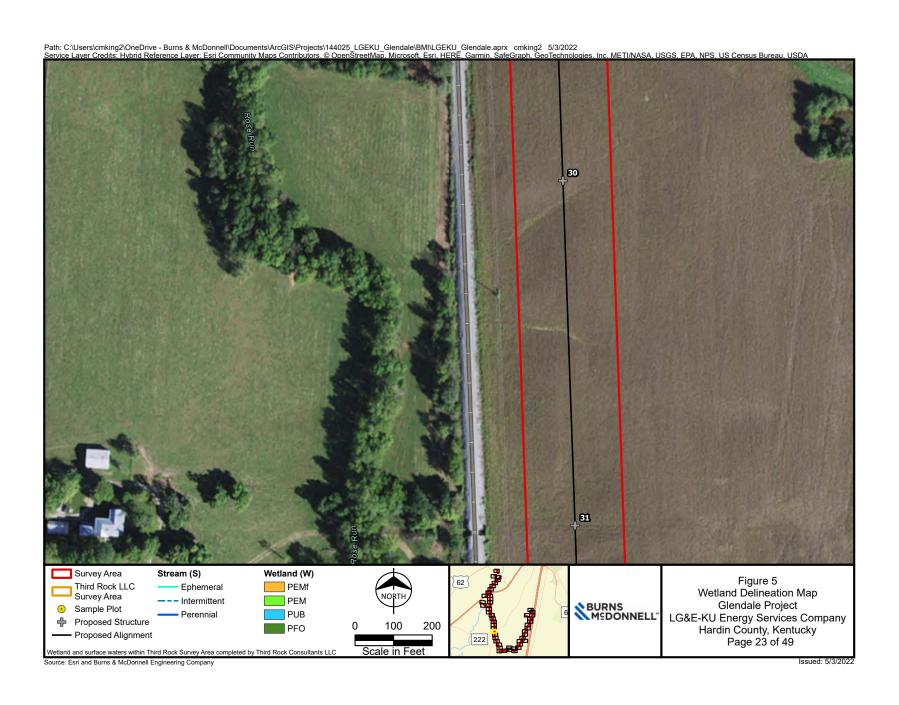


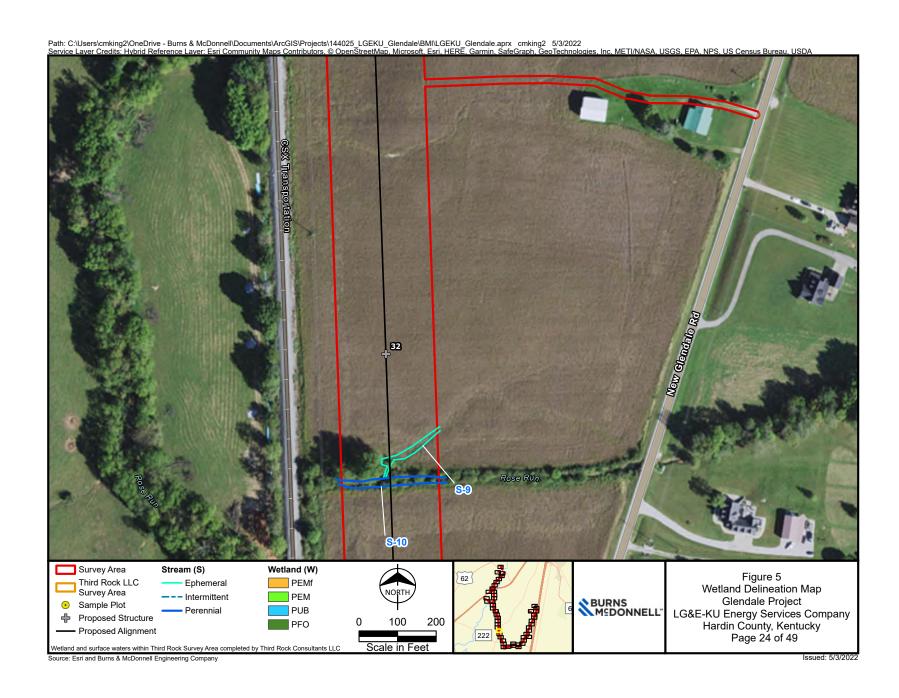


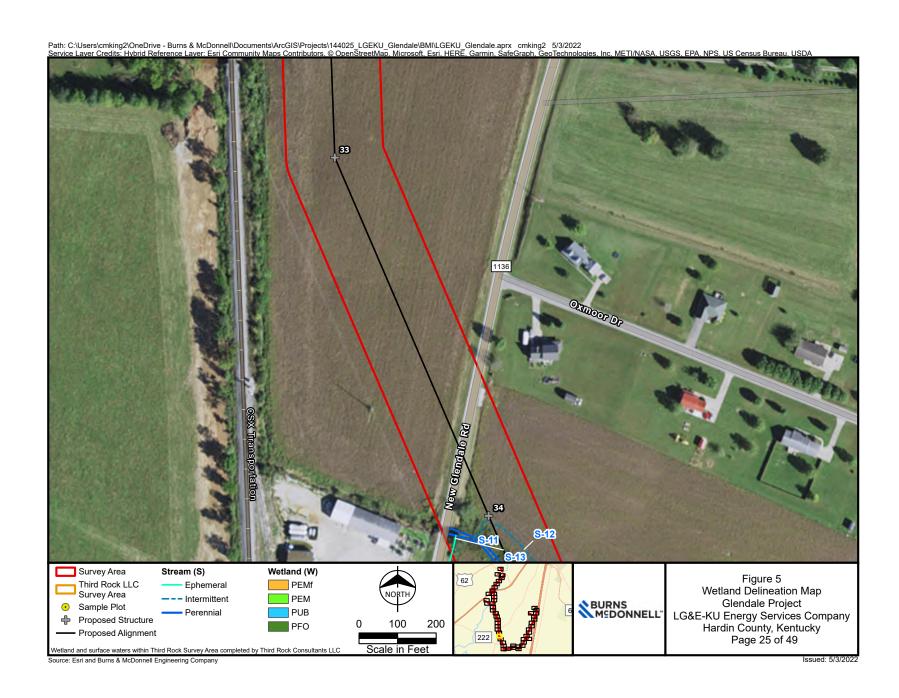


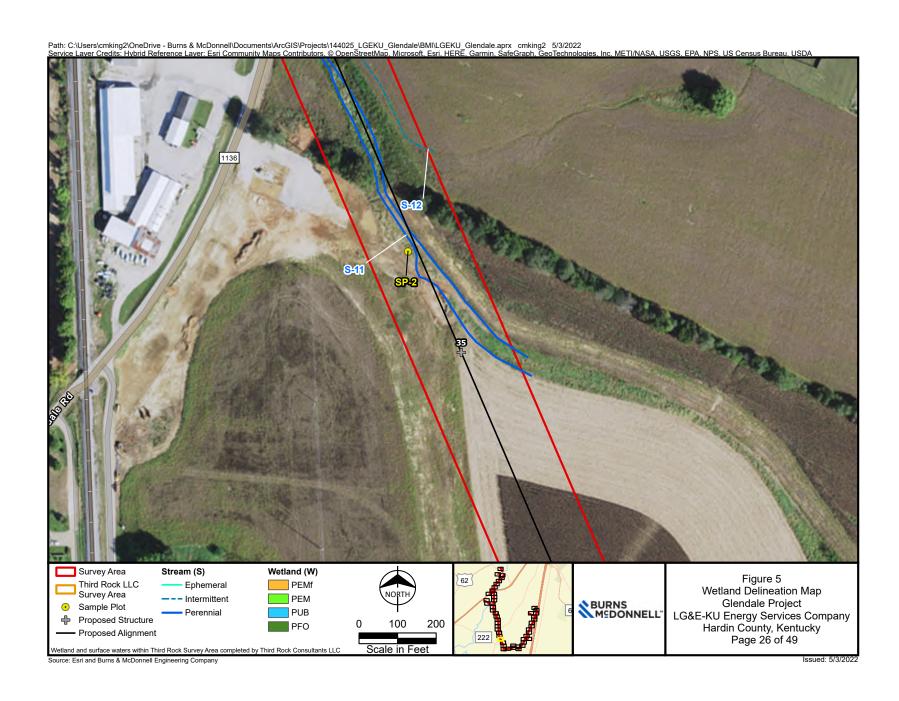


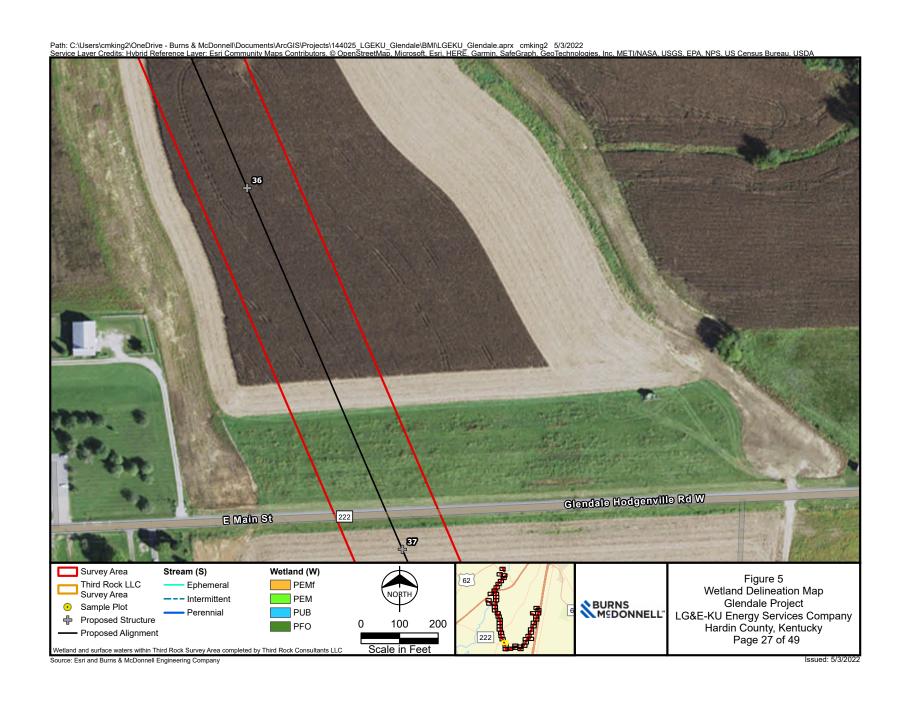


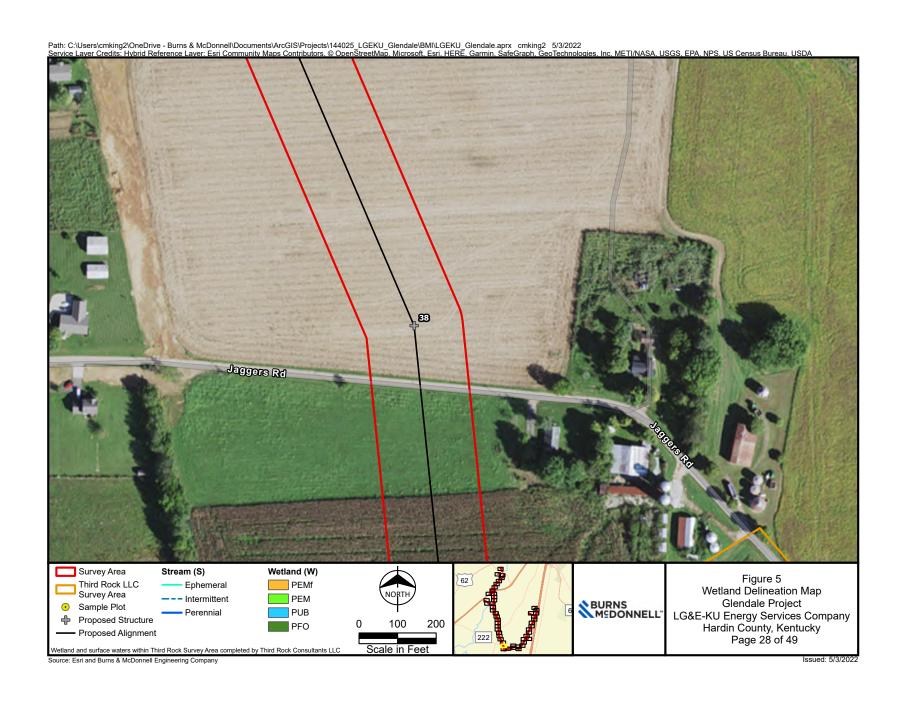


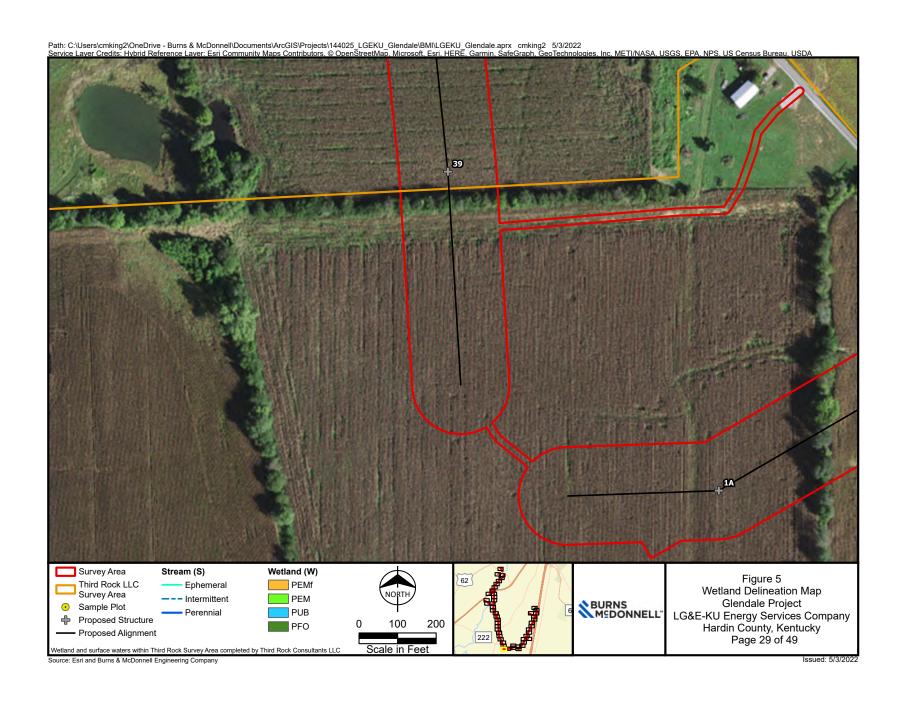


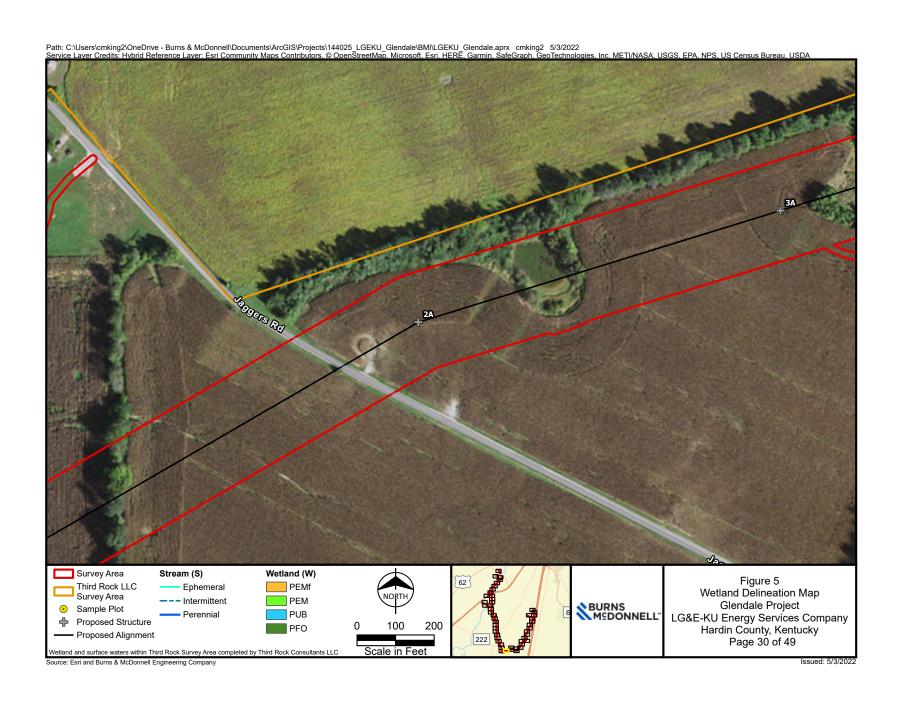


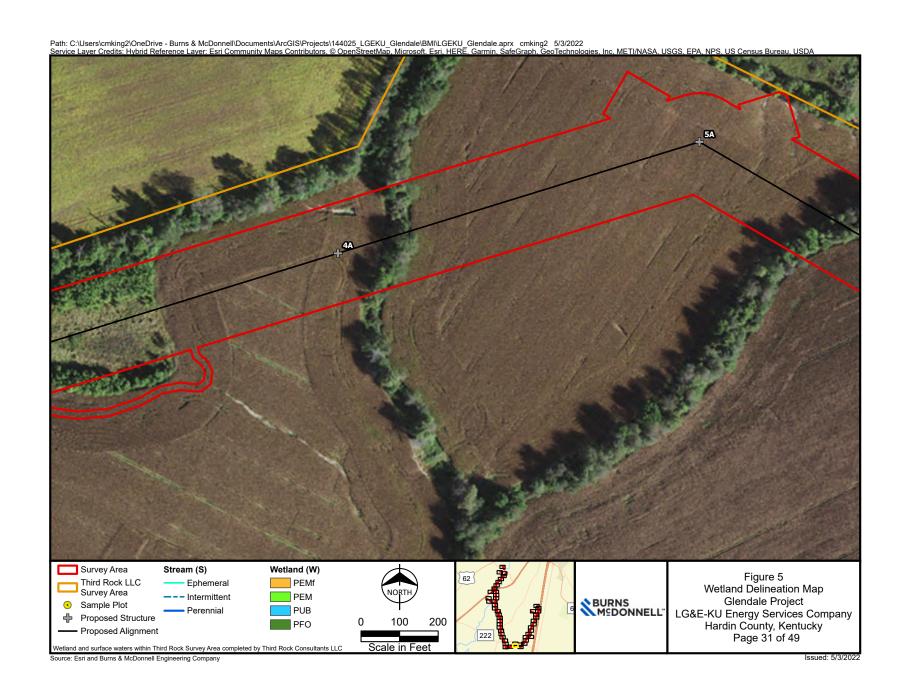


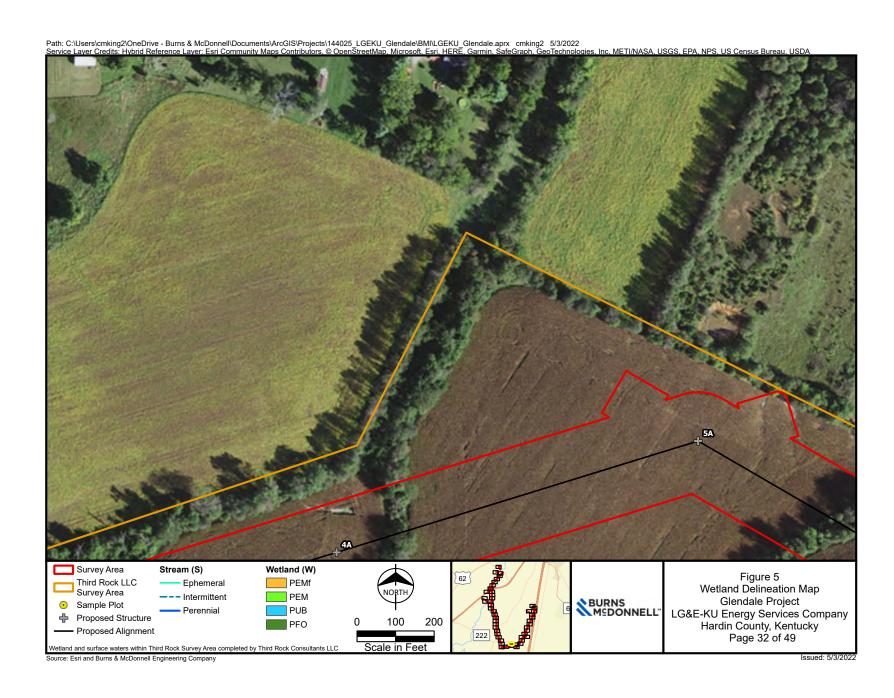


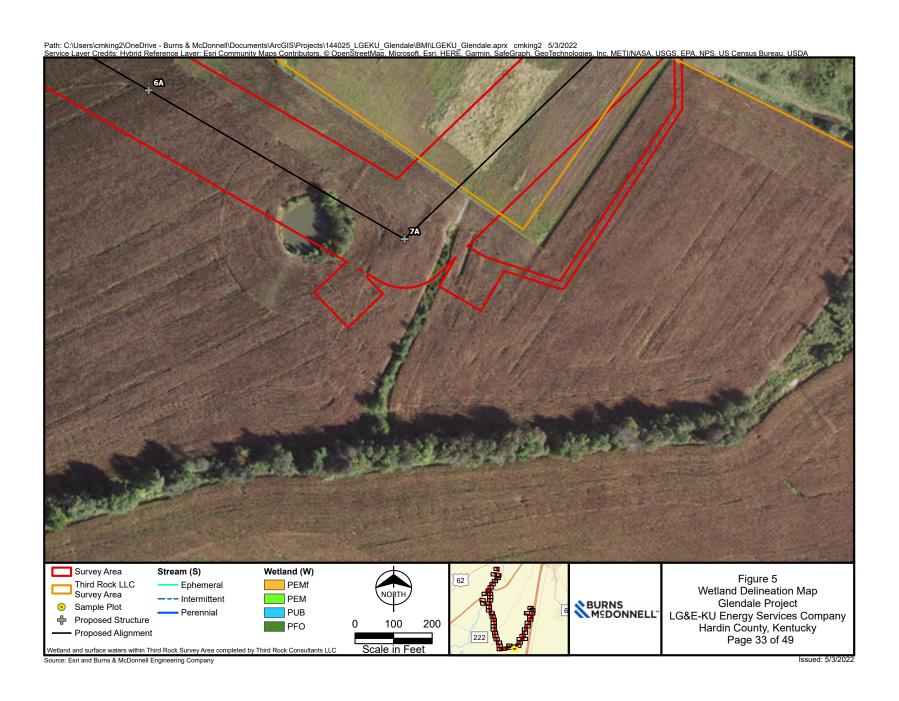


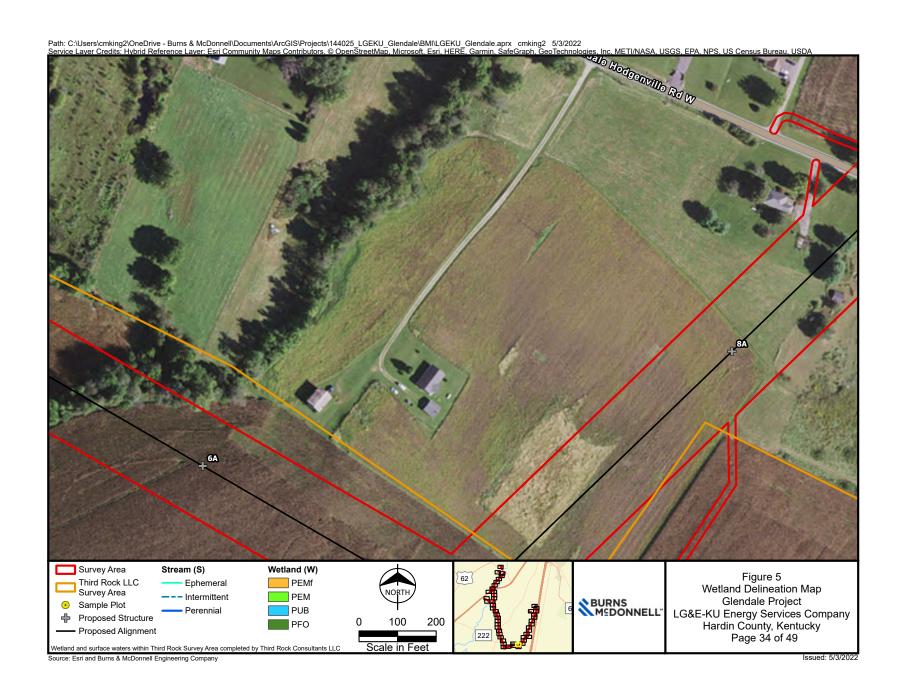


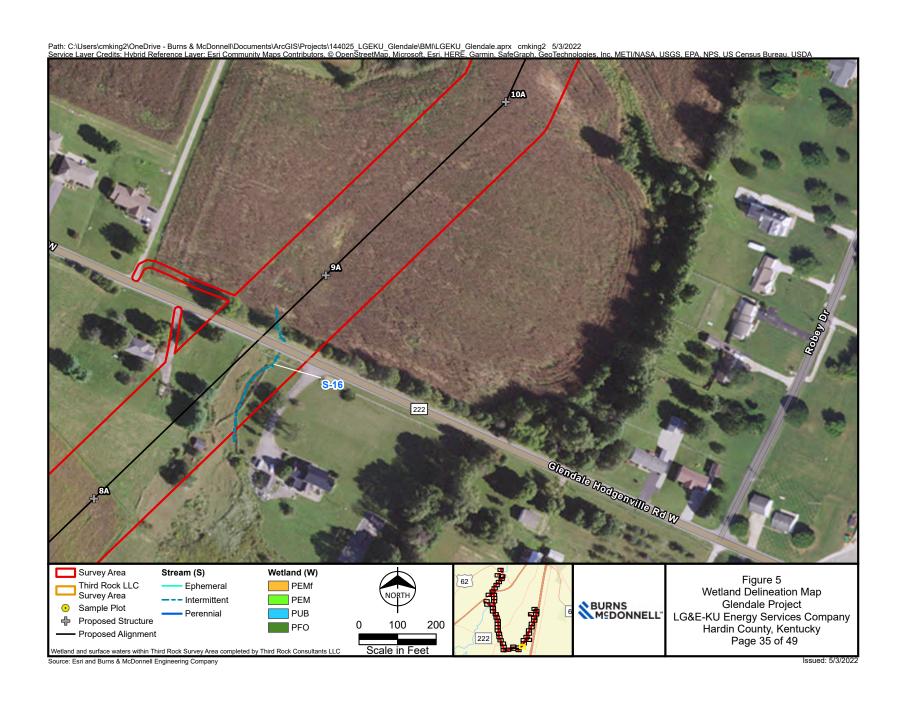


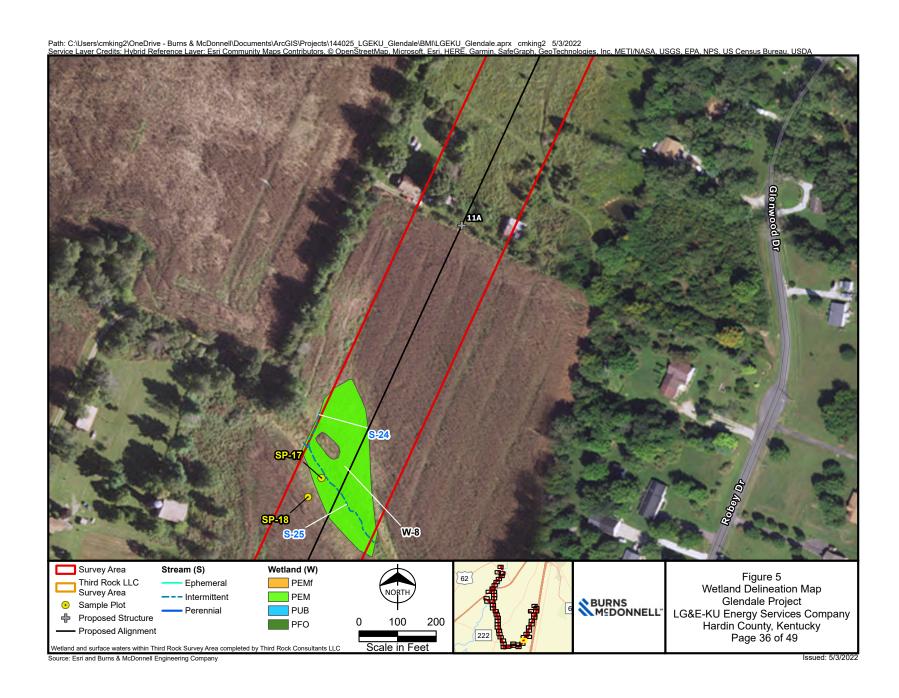


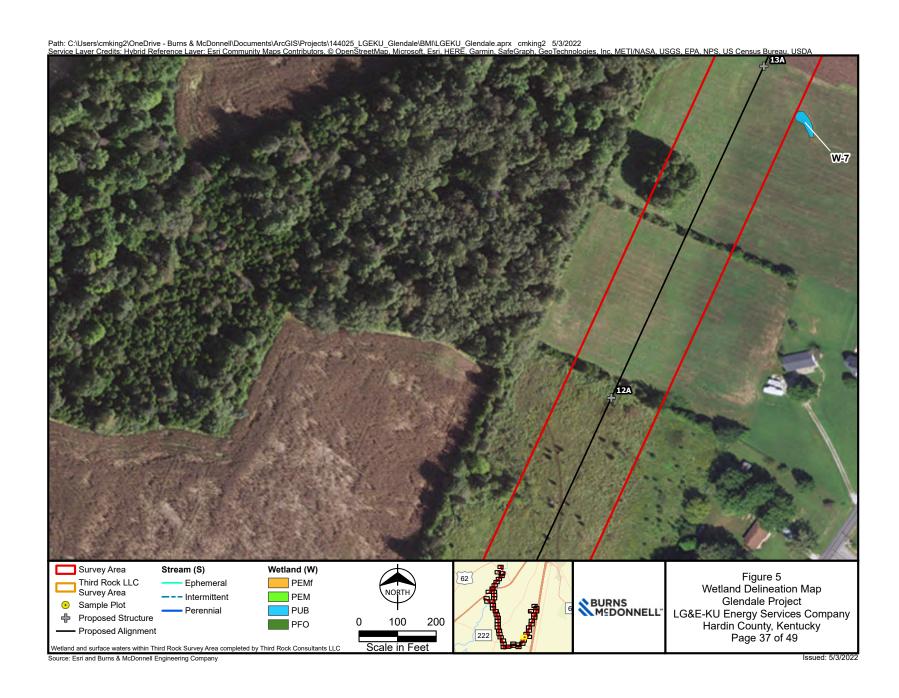


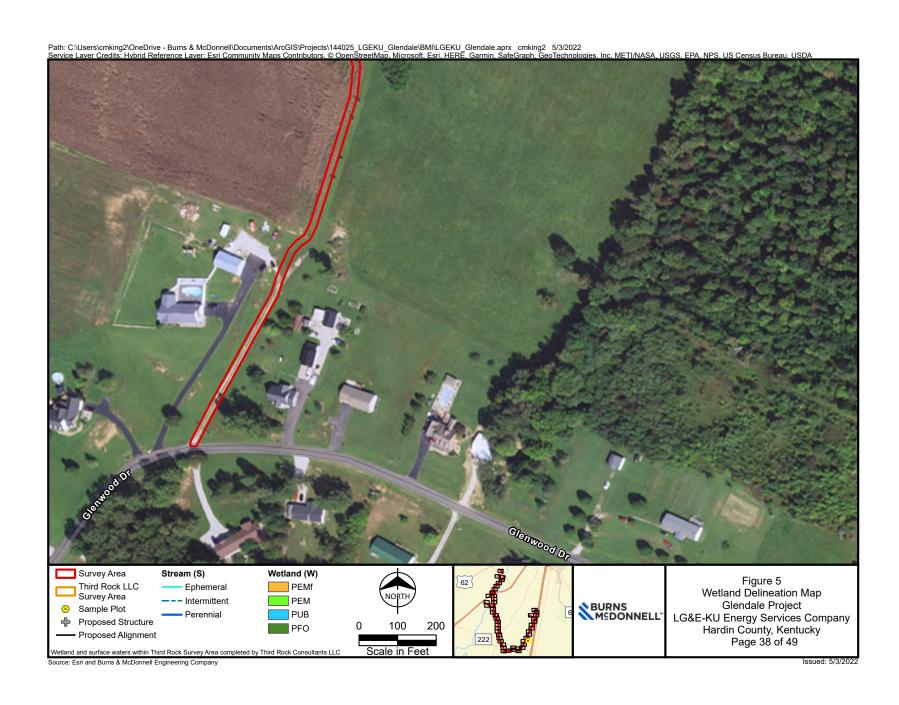


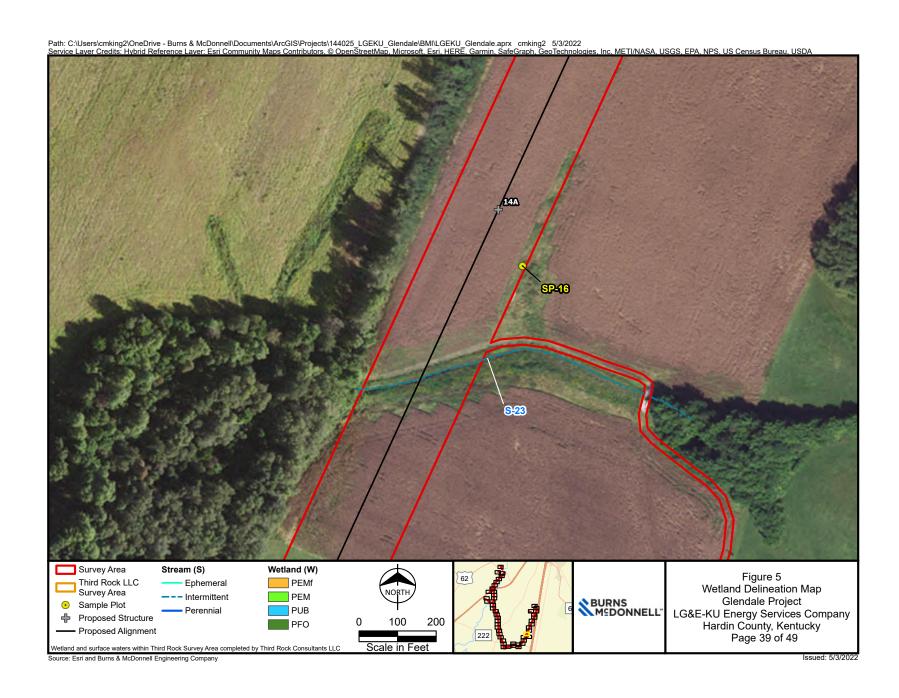


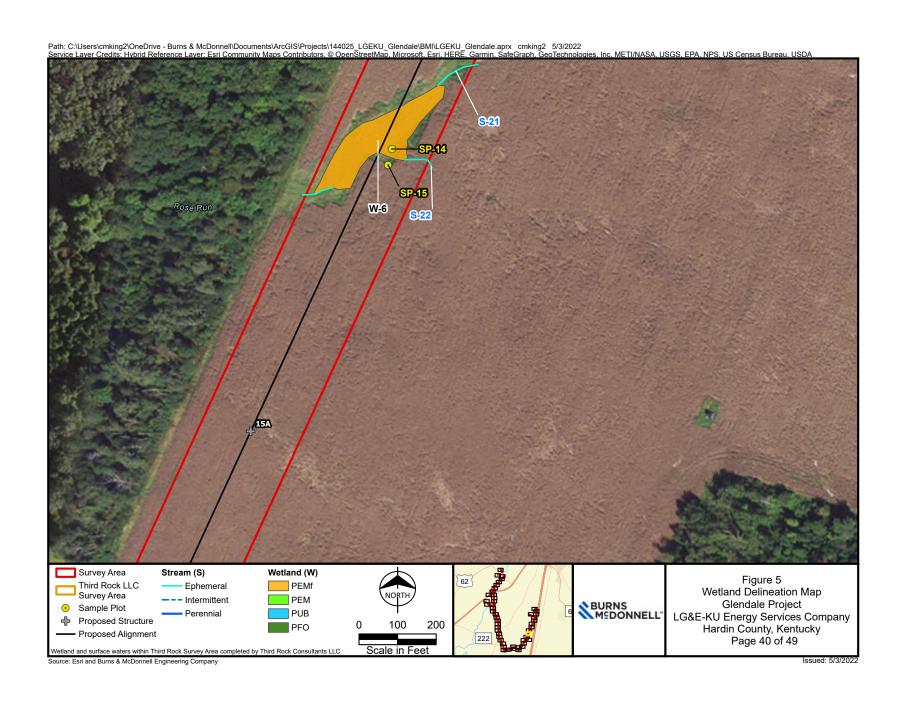


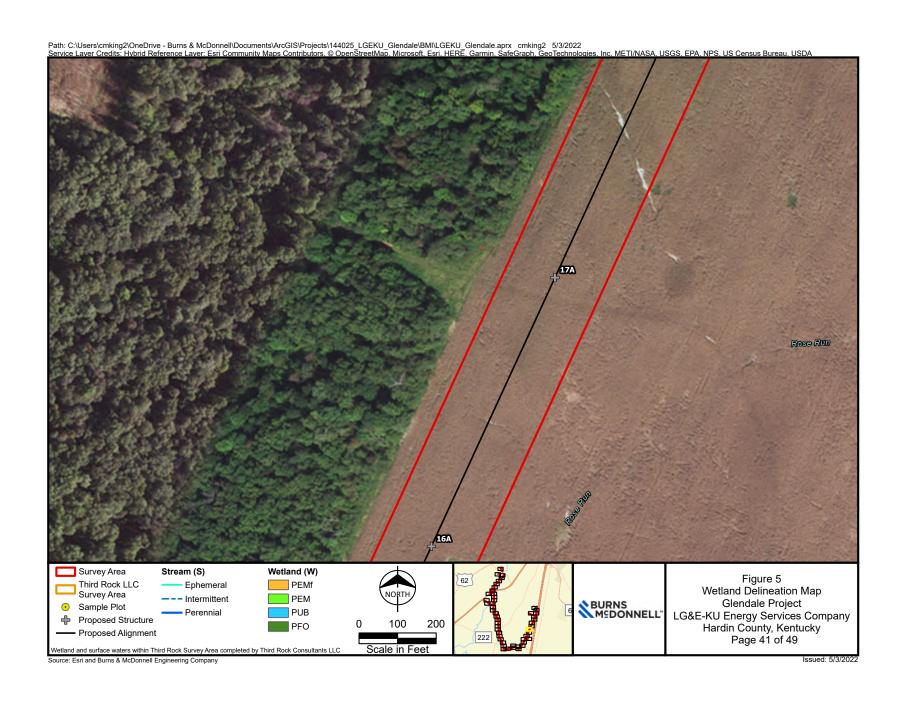


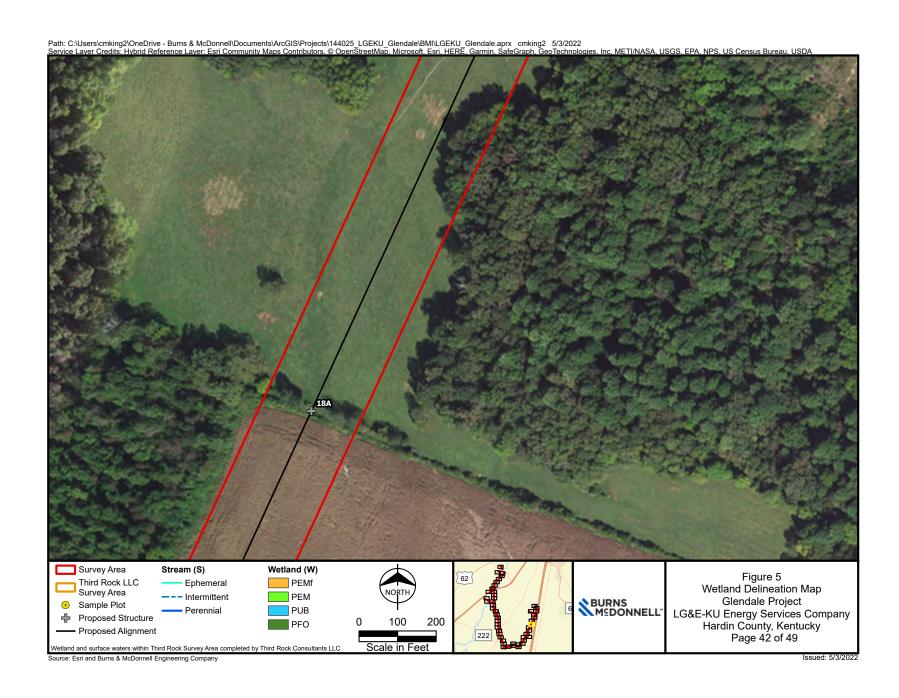


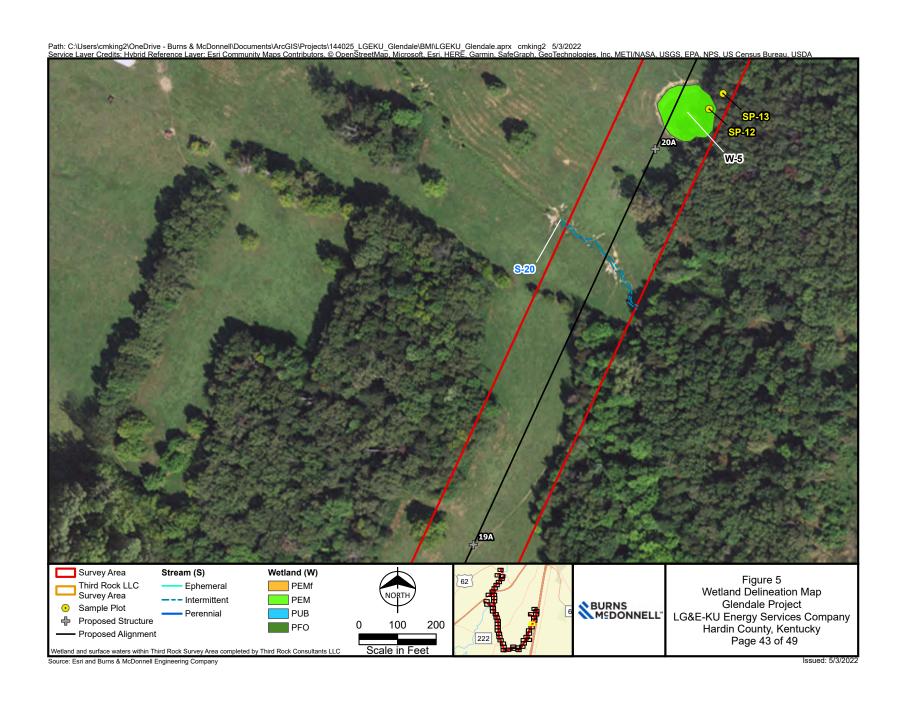


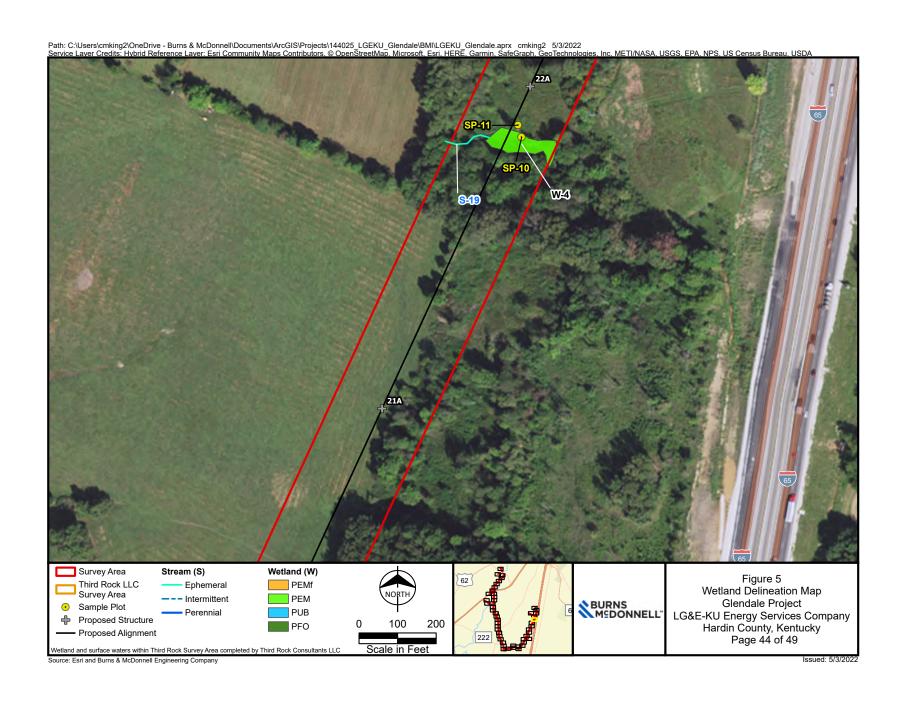


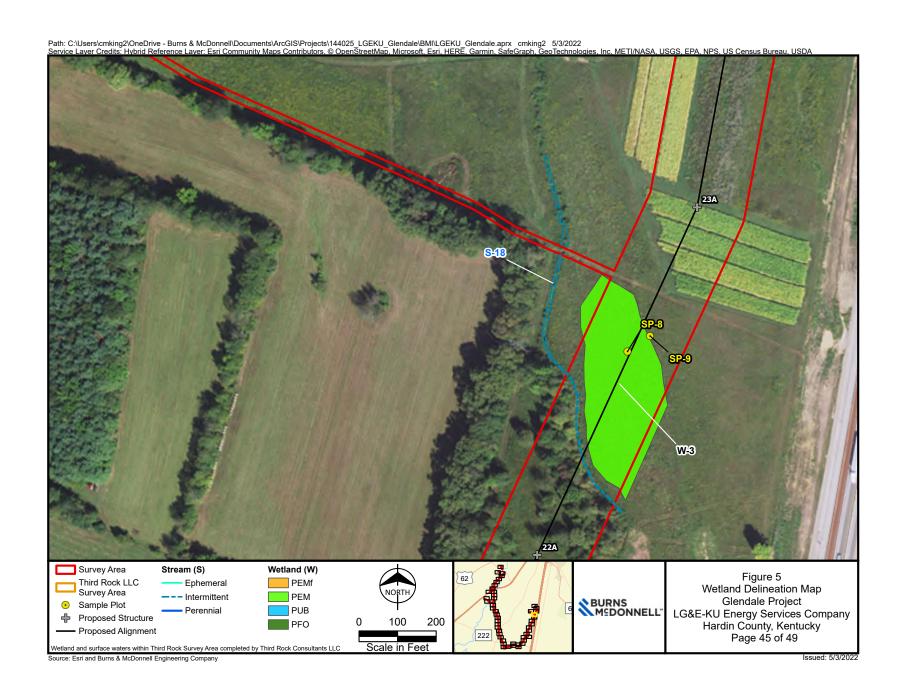


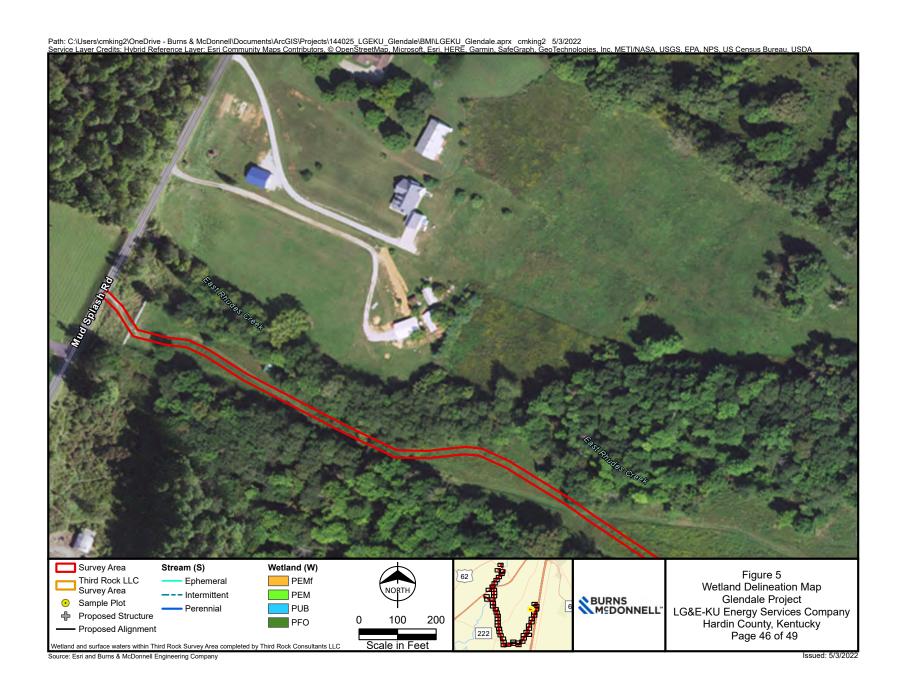


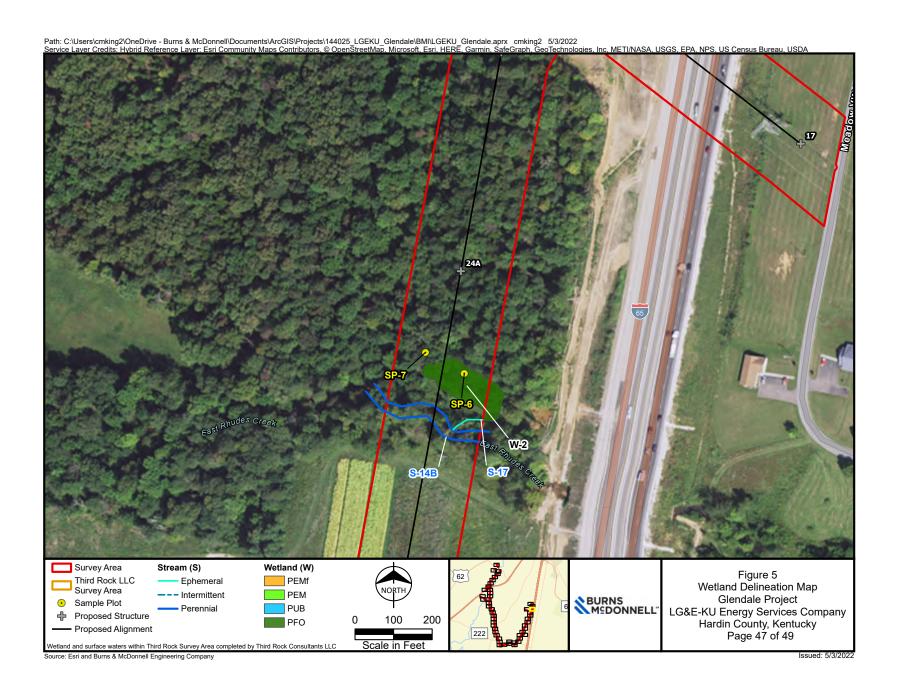


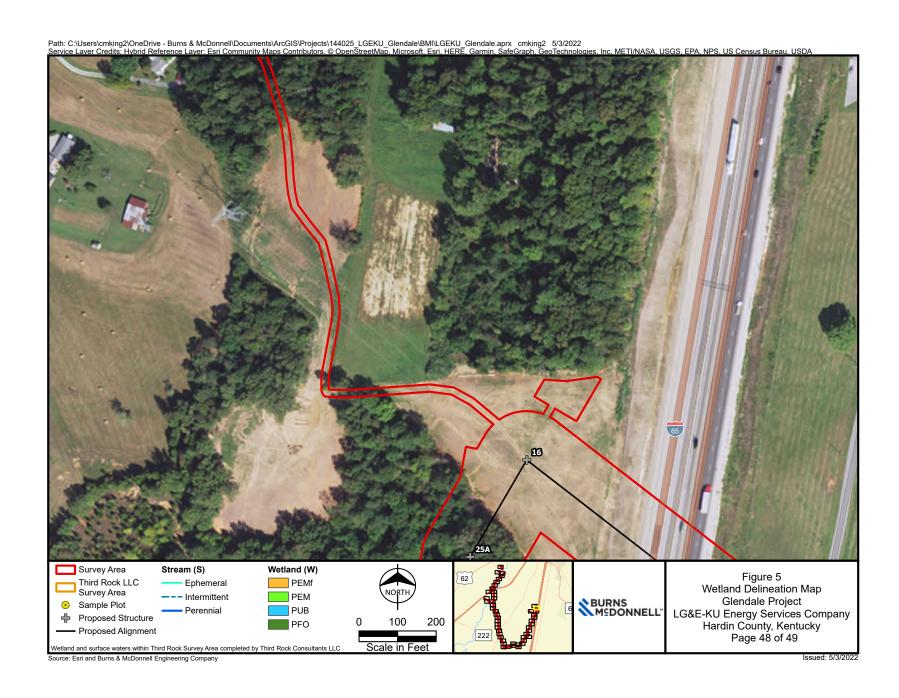


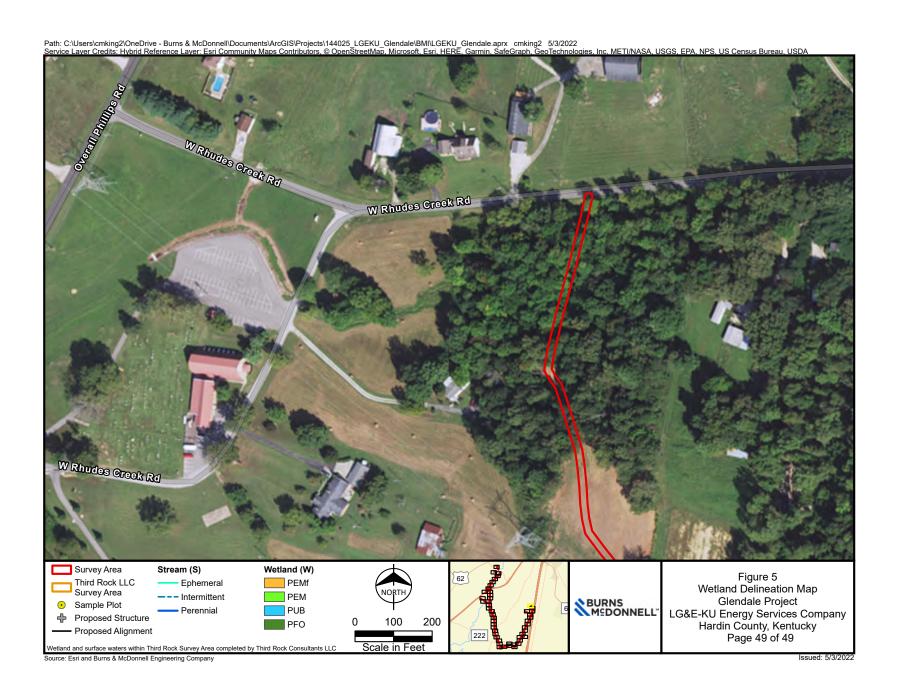












Attachment 4 to Response to PSC-4 Question No. 1 Page 110 of 191 McFarland APPENDIX B - WETLAND DETERMINATION DATA FORMS & ANTECEDENT **PRECIPITATION TOOL**

Project/Site: LGEKU Glendale City	//County: Glendale/Hardin Sampling Date: 2022-03-08
Applicant/Owner: LG&E-KU	State: Kentucky Sampling Point: SP-1
Investigator(s):Burns & McDonnell (SB & CK)	
Landform (hillslope, terrace, etc.): Depression Local r	· -
	Long: -85.9096418 Datum: WGS 84
Soil Map Unit Name: Crider silt loam, 6 to 12 percent slopes	NWI classification: PUBH
Are climatic / hydrologic conditions on the site typical for this time of year?	
Are Vegetation, Soil, or Hydrology significantly dist	
Are Vegetation, Soil, or Hydrology naturally proble	
SOMMARY OF FINDINGS - Attach site map showing sa	ampling point locations, transects, important features, etc.
Hydrophytic Vegetation Present? Yes No	Is the Sampled Area
Hydric Soil Present? Yes No	within a Wetland? Yes No 🗸
Wetland Hydrology Present? Yes No	
Remarks:	
Sample Plot (SP)-1 is a test pit within a PUBH NWI feature. Flooded	conditions were observed at the time of the site visit due to recent
rainfall.	
According to the Antecedent Precipitation Tool (APT), the area was	experiencing wet conditions at the time of the survey.
HYDROLOGY	
Wetland Hydrology Indicators:	Secondary Indicators (minimum of two required)
Primary Indicators (minimum of one is required; check all that apply)	Surface Soil Cracks (B6)
Surface Water (A1) True Aquatic Plant:	s (B14) Sparsely Vegetated Concave Surface (B8)
High Water Table (A2) Hydrogen Sulfide C	
	eres on Living Roots (C3) Moss Trim Lines (B16)
Water Marks (B1) Presence of Reduc	ced Iron (C4) Dry-Season Water Table (C2)
Sediment Deposits (B2) Recent Iron Reduc	tion in Tilled Soils (C6) Crayfish Burrows (C8)
Drift Deposits (B3) Thin Muck Surface	· ·
Algal Mat or Crust (B4) Other (Explain in R	temarks) Stunted or Stressed Plants (D1)
Iron Deposits (B5)	Geomorphic Position (D2)
Inundation Visible on Aerial Imagery (B7)	Shallow Aquitard (D3)
Water-Stained Leaves (B9)	Microtopographic Relief (D4)
Aquatic Fauna (B13)	FAC-Neutral Test (D5)
Field Observations: Surface Water Present? Yes _ V No Depth (inches): 6	
Water Table Present? Yes No Depth (inches):	
Saturation Present? Yes No Depth (inches):	
(includes capillary fringe)	
Describe Recorded Data (stream gauge, monitoring well, aerial photos, p	revious inspections), if available:
Remarks:	
One primary and one secondary indicator confirmed w	etland hydrology
The primary and one secondary maleuter committee w	chand hydrology.

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-1
	Absolute	Dominant	Indicator	Dominance Test worksheet:
Tree Stratum (Plot size: 30 ft r) 1)	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)
2				
3				Total Number of Dominant Species Across All Strata: 1 (B)
4				Opecies Across Air otrata.
				Percent of Dominant Species
6				That Are OBL, FACW, or FAC: 0 (A/B)
0				Prevalence Index worksheet:
·		= Total Cov		Total % Cover of: Multiply by:
50% of total cover:				OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)	20 70 01	total cover		FACW species x 2 =
1				FAC species x 3 =
2				FACU species x 4 =
				UPL species x 5 =
3				Column Totals: (A) (B)
4		-		()
5		-		Prevalence Index = B/A =
6		-		Hydrophytic Vegetation Indicators:
7		-		1 - Rapid Test for Hydrophytic Vegetation
B				2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
50% • 51 • 1 • 1 • • • • •		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
50% of total cover:	20% of	total cover		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r)	70	~	FACU	Problematic Hydrophytic Vegetation ¹ (Explain)
_{1.} Poa pratensis _{2.} Rosa multiflora	15		FACU	
3. Rumex crispus	2		FAC	¹ Indicators of hydric soil and wetland hydrology must
			1 40	be present, unless disturbed or problematic.
	· 			Definitions of Four Vegetation Strata:
5				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
6				more in diameter at breast height (DBH), regardless of
7				height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11				Herb – All herbaceous (non-woody) plants, regardless
		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover: <u>43.5</u>	20% of	total cover	17.4	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2				
3				
4				Hydrophytic
5				Vegetation
		= Total Cov		Present? Yes No
50% of total cover:	20% of	total cover		
Remarks: (Include photo numbers here or on a separate s	heet.)			
No indicators of hydrophytic vegetation we	a nracar	nt at the	time of t	the site visit
to indicators of flydropflytic vegetation wer	e preser	it at the	unie or t	tile site visit.

Profile Description: (Describe to the dept	th needed to document the indicator or confirm	the absence of indicators.)
Depth Matrix (inches) Color (moist) %	Redox Features Color (moist) % Type ¹ Loc ²	Texture Remarks
0 - 20 7.5YR 5/6 100	Color (moist) 76 Type Loc	Clay Loam
<u> </u>		Clay Loani
<u> </u>		
-		
_ 		
-		
-		
¹ Type: C=Concentration, D=Depletion, RM= Hydric Soil Indicators:	Reduced Matrix, MS=Masked Sand Grains.	² Location: PL=Pore Lining, M=Matrix. Indicators for Problematic Hydric Soils ³ :
•	Darly Confess (C7)	
Histosol (A1) Histic Epipedon (A2)	Dark Surface (S7)Polyvalue Below Surface (S8) (MLRA 147, 147)	2 cm Muck (A10) (MLRA 147) 148) Coast Prairie Redox (A16)
Black Histic (A3)	Polyvalue Below Surface (So) (MLRA 147, 148)	(MLRA 147, 148)
Hydrogen Sulfide (A4)	Loamy Gleyed Matrix (F2)	Piedmont Floodplain Soils (F19)
Stratified Layers (A5)	Depleted Matrix (F3)	(MLRA 136, 147)
2 cm Muck (A10) (LRR N)	Redox Dark Surface (F6)	Very Shallow Dark Surface (TF12)
Depleted Below Dark Surface (A11)	Depleted Dark Surface (F7)	Other (Explain in Remarks)
Thick Dark Surface (A12)	Redox Depressions (F8)	
Sandy Mucky Mineral (S1) (LRR N, MLRA 147, 148)	Iron-Manganese Masses (F12) (LRR N, MLRA 136)	
Sandy Gleyed Matrix (S4)	Umbric Surface (F13) (MLRA 136, 122)	³ Indicators of hydrophytic vegetation and
Sandy Redox (S5)	Piedmont Floodplain Soils (F19) (MLRA 148	
Stripped Matrix (S6)	Red Parent Material (F21) (MLRA 127, 147)	
Restrictive Layer (if observed):		
Туре:	<u></u>	
Depth (inches):		Hydric Soil Present? Yes No
Remarks:		
No indicators of hydric so	oil were present at the time of the site	visit.

Project/Site: LGEKU Glendale	City/County: Glendale/Hardin	Sampling Date: 2022-03-09
Applicant/Owner: LG&E-KU		ucky Sampling Point: SP-2
Investigator(s): Burns & McDonnell (SB & CK)	Section, Township, Range: N/A	
	cal relief (concave, convex, none): None	Slope (%); 0
Subregion (LRR or MLRA): N 122 Lat: 37.6060007		
Soil Map Unit Name: Melvin silt loam	NWI class	
Are climatic / hydrologic conditions on the site typical for this time of ye		
Are Vegetation, Soil, or Hydrologyv significantly		
Are Vegetation, Soil, or Hydrology naturally pro		
SUMMARY OF FINDINGS – Attach site map showing	sampling point locations, transe	cts, important features, etc.
Hydrophytic Vegetation Present? Yes No		
Hydric Soil Present? Yes No ✔	Is the Sampled Area within a Wetland? Yes	No 🗸
Wetland Hydrology Present? Yes 🗸 No	within a vocadia.	
Remarks:		
SP-2 is a test pit adjacent to a perennial stream with wetland hyd	drology present and located within a R4SE	BC NWI feature. Flooded
conditions were observed at the time of the site visit due to rece	nt rainfall.	
According to the Antecedent Precipitation Tool (APT), the area v	vas experiencing wet conditions at the tim	ne of the survey
	vas experiencing wer conditions at the till	ic of the survey.
HYDROLOGY Wetland Hydrology Indicators:	Sagandary In	dicators (minimum of two required)
, ,		
Primary Indicators (minimum of one is required; check all that apply)		Soil Cracks (B6) Vegetated Concave Surface (B8)
Surface Water (A1) True Aquatic Pl ✓ High Water Table (A2) Hydrogen Sulfic		= : :
l .	· ,	Patterns (B10) m Lines (B16)
Water Marks (B1) Presence of Re	· · · · · · —	on Water Table (C2)
		Burrows (C8)
Drift Deposits (B3) Thin Muck Surf	· · · · - · ·	n Visible on Aerial Imagery (C9)
Algal Mat or Crust (B4) Other (Explain	· ·	or Stressed Plants (D1)
Iron Deposits (B5)		hic Position (D2)
Inundation Visible on Aerial Imagery (B7)	-	Aquitard (D3)
Water-Stained Leaves (B9)	· · · · · · · · · · · · · · · · · · ·	ographic Relief (D4)
Aquatic Fauna (B13)	FAC-Neu	= :
Field Observations:		
Surface Water Present? Yes No Depth (inches)):	
Water Table Present? Yes No Depth (inches)) <u>: 1</u>	
Saturation Present? Yes No Depth (inches)	: 0 Wetland Hydrology Pre	sent? Yes No
(includes capillary fringe) Describe Recorded Data (stream gauge, monitoring well, aerial photo	os previous inspections) if available:	
2000 100 1000 2014 (0110411) gaage, memoring won, asita proce	re, premede inopedatione), il diffamiliario.	
Remarks:		
Two primary indicators confirmed wetland hydrolog	y. The water table was likely high	er due
to flooded conditions from recent rainfall.	,	

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-2
	Absolute	Dominant	Indicator	Dominance Test worksheet:
<u>Tree Stratum</u> (Plot size: 30 ft r) 1.	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)
2				
3				Total Number of Dominant Species Across All Strata: 2 (B)
4				(2)
5				Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)
6				That Are OBL, FACW, or FAC: 50 (A/B)
7.				Prevalence Index worksheet:
<u> </u>		= Total Cov		Total % Cover of: Multiply by:
50% of total cover:				OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)				FACW species x 2 =
1				FAC species x 3 =
2				FACU species x 4 =
3				UPL species x 5 =
4				Column Totals: (A) (B)
5		-		Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
50% of total cover:		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
F 41	20% 01	lolai covei.		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 Tt r) 1. Panicum capillare	40	~	FAC	Problematic Hydrophytic Vegetation ¹ (Explain)
2. Poa pratensis	30		FACU	
3. Rumex crispus	5		FAC	¹ Indicators of hydric soil and wetland hydrology must
4 Andropogon virginicus	1		FACU	be present, unless disturbed or problematic.
"	<u> </u>		1700	Definitions of Four Vegetation Strata:
				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
				more in diameter at breast height (DBH), regardless of
7				height.
8	-			Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10	-			m) tall.
11	700/			Herb – All herbaceous (non-woody) plants, regardless
20.0		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover: <u>38.0</u>	20% of	total cover:	15.2	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2				
3				
4				Hydrophytic
5				Vegetation
		= Total Cov		Present? Yes No
50% of total cover:		total cover:		
Remarks: (Include photo numbers here or on a separate s	sheet.)			
No indicators of hydrophytic vegetation wer	e nreser	nt at the t	ime of t	the site visit
no maleators of rigarophytic vegetation wer	c preser	it at the t		tile site visit.

Depth	Matrix	%		lox Featur	es Type ¹	Loc ²	Tavtura		Domorko	
(inches) 0 - 12	Color (moist) 2.5Y 5/3	<u>%</u> 97	Color (moist) 7.5YR 5/8	<u>%</u> 1	C Type	M	Texture Clay Loam		Remarks	
0 - 12	10YR 2/2	$-\frac{37}{2}$	7.01100	- <u> </u>	- —					
			7.EVD 4/6			- 	Clay Loam			
12 - 20	2.5Y 6/3	93	7.5YR 4/6	_ 5	<u> </u>	<u> M</u>	Clay Loam			
12 - 20	10YR 2/1	_ 2	-				Clay Loam	<u> </u>		
-			_		_			_		
-										
-			- '							
_								_		
								_		
	-									
							2			
		epletion, RI	M=Reduced Matrix, N	/IS=Maske	ed Sand G	Grains.	Location:	PL=Pore Lini	ing, M=Matrix roblematic H	udria Caila ³ .
•	Indicators:		Dorle Curfo	oo (C7)						
_ Histosol Histic Fr	(A1) pipedon (A2)		Dark Surfac Polyvalue E		ace (S8)	MLRA 147			A10) (MLRA 1 Redox (A16)	
Histic Li Black Hi			Tolyvalde E		. ,	•	,	(MLRA 14		•
Hydroge	en Sulfide (A4)		Loamy Gle			1			oodplain Soils	(F19)
	d Layers (A5)		Depleted M	atrix (F3)				(MLRA 13		
	ick (A10) (LRR N)		Redox Darl		. ,				v Dark Surfac	
	d Below Dark Surfa	ace (A11)	Depleted D				_	Other (Expla	in in Remarks	5)
	ark Surface (A12) ⁄lucky Mineral (S1)	(LRR N.	Redox Dep Iron-Manga			(LRR N.				
	A 147, 148)	(=,	MLRA 1		,	(=,				
Sandy C	Bleyed Matrix (S4)			•			3.		vdrophytic vo	notation and
Sanuy C	neyeu Mainx (34)		Umbric Sur	tace (F13)	(MLRA 1	36, 122)	٩lr	ndicators of h	yuropriyuc ve	getation and
Sandy F	Redox (S5)		Piedmont F	loodplain	Soils (F19) (MLRA 1	48) v		logy must be	-
Sandy R Stripped	Redox (S5) I Matrix (S6)			loodplain	Soils (F19) (MLRA 1	48) v	vetland hydro		present,
Sandy F Stripped Restrictive I	Redox (S5)	i):	Piedmont F	loodplain	Soils (F19) (MLRA 1	48) v	vetland hydro	logy must be	present,
Sandy R Stripped Restrictive I Type:	Redox (S5) I Matrix (S6) Layer (if observed	i):	Piedmont F	loodplain	Soils (F19) (MLRA 1	48) v 7) u	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped Restrictive I Type: Depth (inc	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro	ology must be ed or problem	present,
Sandy R Stripped Restrictive I Type: Depth (inc	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped estrictive I Type: Depth (independent)	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped Restrictive I Type: Depth (inc	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped estrictive I Type: Depth (independent)	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped Sestrictive I Type: Depth (inclemarks:	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped estrictive I Type: Depth (independent)	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped estrictive I Type: Depth (independent)	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped Restrictive I Type: Depth (inc	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped Restrictive I Type: Depth (inc	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped Restrictive I Type: Depth (inc	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped Restrictive I Type: Depth (inc	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped Sestrictive I Type: Depth (inclemarks:	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped estrictive I Type: Depth (independent)	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.
Sandy R Stripped estrictive I Type: Depth (incemarks:	Redox (S5) Matrix (S6) Layer (if observed)		Piedmont F Red Parent	loodplain Material (Soils (F19 F21) (ML	9) (MLRA 1 RA 127, 14	48) v 7) u Hydric So	vetland hydro Inless disturb	ology must be ed or problem	present, natic.

Project/Site: LGEKU Glendale	City/C	ounty: Glendale/Hardi	n	Sampling Date: 2022-03-09
Applicant/Owner: LG&E-KU		, -		y Sampling Point: SP-3
Investigator(s).Burns & McDonnell (SB & CK)	Section	on. Township. Range: N/A		<u> </u>
Landform (hillslope, terrace, etc.): Depression		· -		Slope (%); 1
Subregion (LRR or MLRA): N 122 Lat:				Datum: WGS 84
Soil Map Unit Name: Bedford silt loam, 0 to 2 pe				<u></u>
Are climatic / hydrologic conditions on the site typical fo				
Are Vegetation, Soil, or Hydrology				resent? Yes No _
Are Vegetation, Soil, or Hydrology SUMMARY OF FINDINGS – Attach site m				
SUMMART OF FINDINGS - Attach site in	ap snowing sam	iping point location	is, transects	, important reatures, etc.
Hydrophytic Vegetation Present? Yes	No	Is the Sampled Area		
Hydric Soil Present? Yes	No	within a Wetland?	Yes 🗸	No
Wetland Hydrology Present? Yes	No			
Remarks:				
Wetland (W)-1 is a farmed wetland. Flooded	conditions were o	bserved at the time o	f the site visit	due to recent rainfall.
According to the Antecedent Precipitation To	ool (APT), the area	a was experiencing w	et conditions a	at the time of the survey.
HYDROLOGY				
Wetland Hydrology Indicators:		3	Secondary Indica	tors (minimum of two required)
Primary Indicators (minimum of one is required; check	all that apply)		Surface Soil (Cracks (B6)
Surface Water (A1)	True Aquatic Plants (B14) _	Sparsely Veg	etated Concave Surface (B8)
<u>✓</u> High Water Table (A2)	Hydrogen Sulfide Odd	or (C1)	Drainage Pat	terns (B10)
✓ Saturation (A3)	Oxidized Rhizosphere	es on Living Roots (C3)	Moss Trim Li	nes (B16)
Water Marks (B1)	Presence of Reduced	I Iron (C4)	Dry-Season \	Water Table (C2)
Sediment Deposits (B2)	Recent Iron Reduction	· · · · -	Crayfish Burr	·
	Thin Muck Surface (C			sible on Aerial Imagery (C9)
	Other (Explain in Ren	narks) _		ressed Plants (D1)
Iron Deposits (B5)		-	Geomorphic	* *
Inundation Visible on Aerial Imagery (B7)		-	Shallow Aqui	
Water-Stained Leaves (B9)		-		phic Relief (D4)
Aquatic Fauna (B13) Field Observations:		<u>-</u>	FAC-Neutral	Test (D5)
Surface Water Present? Yes No	Depth (inches): 4			
Water Table Present? Yes V No				
Saturation Present? Yes V No		Wetland Hy	/drology Presen	t? Yes No
(includes capillary fringe) Describe Recorded Data (stream gauge, monitoring w	. , ,			
Describe Recorded Data (Stream gauge, monitoring w	reii, aeriai priotos, pre	vious irispections), ii avail	abic.	
Remarks:				
Three primary and three secondary indic	cators confirmed	wetland hydrology	y. The water	table
was likely higher due to flooded condition	ns from recent i	ain.		

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-3
		Dominant	Indicator	Dominance Test worksheet:
<u>Tree Stratum</u> (Plot size: 30 ft r) 1.	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)
2		-		(,
3				Total Number of Dominant Species Across All Strata: 3 (B)
4				Opedies Across Air Strata.
5.				Percent of Dominant Species
6				That Are OBL, FACW, or FAC: 66.7 (A/B)
7.				Prevalence Index worksheet:
		= Total Cov		Total % Cover of: Multiply by:
50% of total cover:				OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)		10101 00101		FACW species x 2 =
1				FAC species x 3 =
2				FACU species x 4 =
3				UPL species x 5 =
4				Column Totals: (A) (B)
5		•		Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7		-		1 - Rapid Test for Hydrophytic Vegetation
8		-		✓ 2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
EON/ of total agreem		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
50% of total cover: Herb Stratum (Plot size: 5 ft r)	20% 01	total cover		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 Tt r) 1. Portulaca umbraticola	10	V	FAC	Problematic Hydrophytic Vegetation ¹ (Explain)
2. Panicum capillare	5		FAC	
3. Poa pratensis	5		FACU	¹ Indicators of hydric soil and wetland hydrology must
4 Sonchus oleraceus	2		UPL	be present, unless disturbed or problematic.
··				Definitions of Four Vegetation Strata:
				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
6				more in diameter at breast height (DBH), regardless of
7				height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10	. ——	-		m) tall.
11	000/	-		Herb – All herbaceous (non-woody) plants, regardless
700 4		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover: 11.0	20% of	total cover	4.4	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2	. ——	-		
3				
4				Hydrophytic
5				Vegetation Present? Yes ✓ No
500 / 51.1.1		= Total Cov		Present? Yes V No No
50% of total cover:		total cover		
Remarks: (Include photo numbers here or on a separate s	sheet.)			
The Dominance Test confirmed hydrophytic	vegetat	ion. Sam	ple plot	location had standing
water present with minimal vegetation grow	_			
water present with minimal vegetation grow	mg. veg	Ctation 0	iispiayet	a sucescu growni.

Profile Desc	ription: (Describe	to the dep	th needed to docu	ment the	indicator	or confirr	n the absence	of indicators.)
Depth	Matrix		Redo	x Feature	:S			
(inches)	Color (moist)	%	Color (moist)	%	Type ¹	Loc ²	Texture	Remarks
0 - 4	2.5Y 5/2	100	. <u></u>				Clay Loam	
4 - 16	2.5Y 5/2	98	10YR 6/6	2	С	М	Clay Loam	
-								
				-	·	· ——		
	_							
-								
-								
	_					· ——		
		pletion, RM	=Reduced Matrix, M	S=Masked	d Sand Gr	ains.		=Pore Lining, M=Matrix.
Hydric Soil	Indicators:						Indica	tors for Problematic Hydric Soils ³ :
Histosol			Dark Surface					cm Muck (A10) (MLRA 147)
	oipedon (A2)		Polyvalue Be				, 148) Co	past Prairie Redox (A16)
Black H			Thin Dark Su			147, 148)		(MLRA 147, 148)
	en Sulfide (A4)		Loamy Gleye		(F2)			edmont Floodplain Soils (F19)
	d Layers (A5)		<u>✓</u> Depleted Ma					(MLRA 136, 147)
	ick (A10) (LRR N)	(4.4.4)	Redox Dark	•	•			ery Shallow Dark Surface (TF12)
	d Below Dark Surfac ark Surface (A12)	ce (A11)	Depleted Da				0	ther (Explain in Remarks)
	Aucky Mineral (S1)	IDDN	Redox Depre Iron-Mangan		,	IDDN		
	A 147, 148)	LKK N,	MLRA 13		65 (I IZ) (LKK N,		
	Gleyed Matrix (S4)		Umbric Surfa	,	(MIRA 1	86 122)	³ Indi	cators of hydrophytic vegetation and
Sandy F			Piedmont Flo					land hydrology must be present,
	Matrix (S6)		Red Parent I					ess disturbed or problematic.
	Layer (if observed)):		(-	, (,	1	
Type:	.,							
	ches):						Hydric Soil	Present? Yes V No No
	Cile3).						Tiyane Jon	rresent: resNo
Remarks:	anlated Matrix	(F2) oor	firmed budrie	انما				
D D	epieted Matrix	(F3) COI	nfirmed hydric s	oii.				

Project/Site: LGEKU Glendale Cit	ty/County: Glendale/Hardin Sampling Date: 2022-03-09
Applicant/Owner: LG&E-KU	State: Kentucky Sampling Point: SP-4
Investigator(s):Burns & McDonnell (SB & CK)	
	relief (concave, convex, none): None Slope (%): 0
	Long: -85.9051949 Datum: WGS 84
Soil Map Unit Name: Pembroke silt loam, 2 to 6 percent slope	NWI classification: No
Are climatic / hydrologic conditions on the site typical for this time of year'	
Are Vegetation, Soil, or Hydrology significantly dis	
Are Vegetation, Soil, or Hydrology naturally problem.	
SUMMARY OF FINDINGS – Attach site map showing s	ampling point locations, transects, important features, etc.
Hydrophytic Vegetation Present? Yes No 🔽	Is the Sampled Area
Hydric Soil Present? Yes No 🗸	within a Wetland? Yes No 🗸
Wetland Hydrology Present? Yes No	
Remarks:	
SP-4 is located adjacent to W-1. Flooded conditions were o	bserved at the time of the site visit due to recent rainfall.
According to the Antecedent Precipitation Tool (APT), the a	rea was experiencing wet conditions at the time of the survey.
HYDROLOGY	
Wetland Hydrology Indicators:	Secondary Indicators (minimum of two required)
Primary Indicators (minimum of one is required; check all that apply)	Surface Soil Cracks (B6)
Surface Water (A1) True Aquatic Plan	ts (B14) Sparsely Vegetated Concave Surface (B8)
<u>✓</u> High Water Table (A2) Hydrogen Sulfide	Odor (C1) Drainage Patterns (B10)
✓ Saturation (A3) Oxidized Rhizospl	heres on Living Roots (C3) Moss Trim Lines (B16)
Water Marks (B1) Presence of Redu	ced Iron (C4) Dry-Season Water Table (C2)
Sediment Deposits (B2) Recent Iron Redu	ction in Tilled Soils (C6) Crayfish Burrows (C8)
Drift Deposits (B3) Thin Muck Surface	e (C7) Saturation Visible on Aerial Imagery (C9)
Algal Mat or Crust (B4) Other (Explain in I	Remarks) Stunted or Stressed Plants (D1)
Iron Deposits (B5)	Geomorphic Position (D2)
Inundation Visible on Aerial Imagery (B7)	Shallow Aquitard (D3)
Water-Stained Leaves (B9)	Microtopographic Relief (D4)
Aquatic Fauna (B13)	FAC-Neutral Test (D5)
Field Observations: Surface Water Present? Yes No Depth (inches):	
Water Table Present? Yes No Depth (inches): 6	
Saturation Present? Yes Vo Depth (inches): 2	
(includes capillary fringe)	
Describe Recorded Data (stream gauge, monitoring well, aerial photos,	previous inspections), if available:
Remarks:	
Two primary indicators confirmed wetland hydrology.	The water table was likely higher due
to flooded conditions from recent rainfall.	,g
to nooded conditions from recent rainfail.	

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-4
		Dominant	Indicator	Dominance Test worksheet:
<u>Tree Stratum</u> (Plot size: 30 ft r) 1.	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)
2				
_				Total Number of Dominant Species Across All Strata: 1 (B)
				Species Across All Strata: 1 (B)
4				Percent of Dominant Species
				That Are OBL, FACW, or FAC: 0 (A/B)
6				Prevalence Index worksheet:
7				
		= Total Cov		Total % Cover of: Multiply by:
50% of total cover:	20% of	total cover:		OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)				FACW species x 2 =
1,				FAC species x 3 =
2				FACU species x 4 =
3				UPL species x 5 =
4				Column Totals: (A) (B)
5				
				Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
50% of total cover:	20% of	total cover:		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r)			LIBI	Problematic Hydrophytic Vegetation ¹ (Explain)
1. Lamium amplexicaule	80		UPL	Troblemation tytrophytic vegetation (Explain)
2. Lepidium campestre	5		FACU	Indicators of hydric call and watland hydrology must
3. Allium schoenoprasum	2		FACU	Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.
4				Definitions of Four Vegetation Strata:
5				Definitions of Four Vegetation Strata.
6.				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
7				more in diameter at breast height (DBH), regardless of height.
				neight.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.
10				iii) taii.
11	070/			Herb – All herbaceous (non-woody) plants, regardless
40.5		= Total Cov		of size, and woody plants less than 3.28 ft tall.
	20% of	total cover:	17.4	Woody vine – All woody vines greater than 3.28 ft in height.
1				
2				
3				
4				
5				Hydrophytic Vegetation
<u>. </u>		= Total Cov		Present? Yes No
50% of total cover:				
Remarks: (Include photo numbers here or on a separate s				
No indicators of hydrophytic vegetation wer	•	it at the t	ime of t	the site visit.

Profile Desc	ription: (Describe	to the depti	needed to docume	ent the indicator	or confirm	the absence	of indicato	rs.)	
Depth	Matrix		Redox	Features					
(inches)	Color (moist)	%	Color (moist)	% Type ¹	Loc ²	Texture		Remarks	
0 - 12	2.5Y 5/3	100				Clay Loam			
12 - 20	2.5Y 5/3	30				Clay Loam			
12 - 20	2.5Y 6/6	70				Clay Loam			
	-	_ ,							_
		 .							
	-	 .							_
		 .							
		 ·							_
	-								_
		pletion, RM=F	Reduced Matrix, MS=	Masked Sand G	rains.	² Location: P			
Hydric Soil I	ndicators:					Indica	ators for Pro	oblematic H	ydric Soils³:
Histosol			Dark Surface ((10) (MLRA 1	-
. —	pipedon (A2)		_ ′	w Surface (S8) (-	148) C		Redox (A16)	
Black His				ace (S9) (MLRA	147, 148)		(MLRA 147		
	n Sulfide (A4)		Loamy Gleyed	, ,		P		odplain Soils	(F19)
	Layers (A5)		Depleted Matri				(MLRA 136		
	ck (A10) (LRR N)	(* 4 4)	Redox Dark Su	, ,			-	Dark Surface	
-	d Below Dark Surfa	ce (A11)	Depleted Dark				itner (Explaii	n in Remarks)
	ark Surface (A12)	I DD N	Redox Depress	sions (Fo) se Masses (F12)	/I DD N				
	lucky Mineral (S1) (\ 147, 148)	LKK N,	MLRA 136)		(LKK N,				
	lleyed Matrix (S4)		•	e (F13) (MLRA 1	26 122\	3Ind	icators of hy	drophytic veg	retation and
Sandy G			Piedmont Floor				-	ogy must be	
	Matrix (S6)			iterial (F21) (ML I			-	ed or problem	
	_ayer (if observed)):		itoriai (i 2 i) (iii 2 i	01121,141	, un	iooo alotai be	od or problem	atio.
Type:									
Depth (inc	ches):		_			Hydric Soil	Present?	Yes	No 🖍
Remarks:									
No	o indicators of	hydric so	il were present	at the time o	f the site	visit.			
		•	•						

Project/Site: LGEKU Glendale	City/County: Glen	dale/Hardin	Sampling Date: 2022-03-09
Applicant/Owner: LG&E-KU			ucky Sampling Point: SP-5
Investigator(s):Burns & McDonnell (SB & CK)	Section, Township.		<u> </u>
Landform (hillslope, terrace, etc.): Hillslope	•	=	Slope (%): 2
Subregion (LRR or MLRA): N 122 Lat: 37.62			Datum: WGS 84
Soil Map Unit Name: Lindside silt loam, 0 to 2 percent		_	
Are climatic / hydrologic conditions on the site typical for this tin			•
Are Vegetation, Soil, or Hydrologyv signi			s" present? Yes No
Are Vegetation, Soil, or Hydrology natu			
SUMMARY OF FINDINGS – Attach site map sho	wing sampling poir	nt locations, transec	cts, important features, etc.
Hydrophytic Vegetation Present? Yes V		-ll A	
Hydric Soil Present? Yes No	Is the Samp		No 🗸
Wetland Hydrology Present? Yes No	<u>v</u>	-	
Remarks:			
SP-5 is a test pit adjacent to a perennial stream. Flooded	conditions were observed	d at the time of the site v	visit due to recent rainfall.
According to the Antecedent Precipitation Tool (APT), the	area was experiencing v	vet conditions at the tim	e of the survey.
HYDROLOGY			
Wetland Hydrology Indicators:		Secondary Inc	dicators (minimum of two required)
Primary Indicators (minimum of one is required; check all that	apply)		Soil Cracks (B6)
	uatic Plants (B14)		Vegetated Concave Surface (B8)
	en Sulfide Odor (C1)		Patterns (B10)
	d Rhizospheres on Living R		
<u> </u>	e of Reduced Iron (C4)	· · · —	on Water Table (C2)
Sediment Deposits (B2) Recent	ron Reduction in Tilled Soi	ils (C6) Crayfish F	Burrows (C8)
Drift Deposits (B3) Thin Mu	ck Surface (C7)	Saturation	n Visible on Aerial Imagery (C9)
Algal Mat or Crust (B4) Other (E	Explain in Remarks)	Stunted o	r Stressed Plants (D1)
Iron Deposits (B5)		Geomorpi	hic Position (D2)
Inundation Visible on Aerial Imagery (B7)		Shallow A	Aquitard (D3)
Water-Stained Leaves (B9)		The state of the s	ographic Relief (D4)
Aquatic Fauna (B13)		FAC-Neut	tral Test (D5)
Field Observations:	2 - de - A		
Surface Water Present? Yes No Depth			
Water Table Present? Yes No Depth			sant? Vas No V
Saturation Present? Yes No Depth (includes capillary fringe)	inches):	Wetland Hydrology Pres	sent? Yes No
Describe Recorded Data (stream gauge, monitoring well, aeria	al photos, previous inspecti	ions), if available:	
Remarks:			
One secondary indicator of wetland hydrology	was present at the	time of the site visi	t.

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-5
	Absolute	Dominant	Indicator	Dominance Test worksheet:
Tree Stratum (Plot size: 30 ft r)	% Cover	Species?	Status	Number of Dominant Species
1. Platanus occidentalis	30		FACW	That Are OBL, FACW, or FAC: 2 (A)
2. Prunus serotina	20		FACU	Total Number of Dominant
3. Celtis occidentalis	10		FACU	Species Across All Strata: 3 (B)
4. Fraxinus pennsylvanica	10		FACW	(,
5.				Percent of Dominant Species That Are OBL. FACW. or FAC: 66.7 (A/B)
6.				That Are OBL, FACW, or FAC: 66.7 (A/B)
7				Prevalence Index worksheet:
·	70%	= Total Cov		Total % Cover of: Multiply by:
50% of total cover: 35.0				OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)	20 /0 01	total cover.		FACW species x 2 =
				FAC species x 3 =
1				FACU species x 4 =
2				UPL species x 5 =
3				
4				Column Totals: (A) (B)
5				Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				✓ 2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0¹
		= Total Cov	er	
50% of total cover:	20% of	total cover:		4 - Morphological Adaptations ¹ (Provide supporting
Herb Stratum (Plot size: 5 ft r)				data in Remarks or on a separate sheet)
1. Arundinaria gigantea	50	~	FACW	Problematic Hydrophytic Vegetation ¹ (Explain)
2 Poa pratensis	5		FACU	
3. Alliaria petiolata	2		FACU	¹ Indicators of hydric soil and wetland hydrology must
4. Euonymus fortunei	2			be present, unless disturbed or problematic.
·· ·				Definitions of Four Vegetation Strata:
5				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
6				more in diameter at breast height (DBH), regardless of
7				height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11				Herb – All herbaceous (non-woody) plants, regardless
		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover: 29.5	20% of	total cover:	11.8	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2				
3				
4.				II. In all gr
5.				Hydrophytic Vegetation
		= Total Cov	er	Present? Yes No
50% of total cover:				
Remarks: (Include photo numbers here or on a separate s	heet.)			
	,	_		
The Dominance Test confirmed hydrophytic	vegetat	ion.		

Profile Desc	ription: (Describe	to the depth	needed to docur	nent the ir	ndicator	or confirm	n the abse	nce of indicat	ors.)	
Depth	Matrix		Redo	x Features	3					
(inches)	Color (moist)	%	Color (moist)	%	Type ¹	Loc ²	Texture	<u> </u>	Remark	(S
0 - 2	10YR 3/2	100					Sandy Lo	am		
2 20	10VD 4/4	100					Cond			
2 - 20	10YR 4/4	100					Sand			
-										
l ——										
							-			
-										
l ———	-									
-										
			,							
— <u> </u>										
l										
¹ Type: C=C	oncentration, D=Dep	oletion. RM=R	educed Matrix. M	S=Masked	Sand Gra	ains.	² Location	n: PL=Pore Lir	ning, M=Matr	ix.
Hydric Soil										Hydric Soils ³ :
-			Dark Surface	(97)						-
Histosol	oipedon (A2)		Dark Surface		o (SO) /N	II DA 447		_ 2 cm Muck		•
			Polyvalue Be				, 140) _	_ Coast Prairi	-	0)
Black Hi			Thin Dark Su			47, 148)		(MLRA 1		ilo (F10)
	en Sulfide (A4)		Loamy Gleye	•	-2)		_	_ Piedmont F	-	iis (F19)
	d Layers (A5)		Depleted Ma		۵)			(MLRA 1	-	(7540)
	ick (A10) (LRR N)	(4.4.1)	Redox Dark		•		_	_ Very Shallo		
· -	d Below Dark Surfac	œ (A11)	Depleted Da				_	_ Other (Expl	ain in Remar	KS)
	ark Surface (A12)		Redox Depre							
	Mucky Mineral (S1) (LRR N,	Iron-Mangan		es (F12) (I	LRR N,				
	A 147, 148)		MLRA 13	•				•		
	Bleyed Matrix (S4)		Umbric Surfa					³ Indicators of I		•
Sandy F	Redox (S5)		Piedmont Flo					wetland hydr	ology must b	e present,
										omotio
Stripped	Matrix (S6)		Red Parent I	Material (F2	21) (MLR	A 127, 147	7)	unless distur	bed or proble	emanc.
Stripped		:	Red Parent I	Material (F2	21) (MLR .	A 127, 147	7)	unless distur	bed or proble	emanc.
Stripped	Matrix (S6)	:	Red Parent I	Material (F2	21) (MLR	A 127, 147	7)	unless distur	bed or proble	emanc.
Stripped Restrictive	Matrix (S6) Layer (if observed)		_	Material (F2	21) (MLR .	A 127, 147			·	
Stripped Restrictive Type: Depth (in	l Matrix (S6) Layer (if observed)		_	Material (F2	21) (MLR	A 127, 147		unless distur	·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in Remarks:	Matrix (S6) Layer (if observed)		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in Remarks:	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in Remarks:	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	
Stripped Restrictive Type: Depth (in Remarks:	Matrix (S6) Layer (if observed) ches):		_ _				Hydric		·	

Project/Site: LGEKU Glendale	City/Co	ounty: Glendale/Hardin	Sampling Date: 2022-03-09
Applicant/Owner: LG&E-KU	•		ate: Kentucky Sampling Point: SP-6
Investigator(s):Burns & McDonnell (SB & CK)	Sectio		
Landform (hillslope, terrace, etc.): Depression		·	Concave Slope (%): 2
Subregion (LRR or MLRA): N 122			1266 Datum: WGS 84
Soil Map Unit Name: Melvin silt loam			NWI classification: PFO1A
Are climatic / hydrologic conditions on the site typi	cal for this time of year? Ye		
Are Vegetation, Soil, or Hydrology			umstances" present? Yes No
Are Vegetation, Soil, or Hydrology			
SUMMARY OF FINDINGS – Attach si			
		pinig point locations,	transects, important reatures, etc
Hydrophytic Vegetation Present? Yes	No _	Is the Sampled Area	
Hydric Soil Present? Wetland Hydrology Present? Yes Yes	No	within a Wetland?	Yes No
Trouding Try arology Trooping	<u> No</u>		
Remarks:			
Wetland (W)-2 is a palustrine forested (PFO)	wetland. Flooded condition	ons were observed at the t	me of the site visit due to recent rainfall.
According to the Antecedent Precipitation To	ol (ΔPT) the area was ev	neriencing wet conditions	at the time of the survey
According to the Antecedent's recipitation re	or (Ar 1), the area was ex	seriencing wer conditions	at the time of the survey.
HYDROLOGY			
Wetland Hydrology Indicators:		Sec	ondary Indicators (minimum of two required)
Primary Indicators (minimum of one is required;	check all that apply)		Surface Soil Cracks (B6)
Surface Water (A1)	True Aquatic Plants (E	<u> </u>	Sparsely Vegetated Concave Surface (B8)
✓ High Water Table (A2)	Hydrogen Sulfide Odo	r (C1) <u>~</u>	Drainage Patterns (B10)
✓ Saturation (A3)	Oxidized Rhizosphere	s on Living Roots (C3)	Moss Trim Lines (B16)
Water Marks (B1)	Presence of Reduced	Iron (C4)	Dry-Season Water Table (C2)
Sediment Deposits (B2)	Recent Iron Reduction	in Tilled Soils (C6)	Crayfish Burrows (C8)
✓ Drift Deposits (B3)	Thin Muck Surface (C		Saturation Visible on Aerial Imagery (C9)
Algal Mat or Crust (B4)	Other (Explain in Rem		Stunted or Stressed Plants (D1)
Iron Deposits (B5)		<u>v</u>	Geomorphic Position (D2)
Inundation Visible on Aerial Imagery (B7)		_	Shallow Aquitard (D3)
Water-Stained Leaves (B9)			Microtopographic Relief (D4) FAC-Neutral Test (D5)
Aquatic Fauna (B13)		<u> </u>	FAC-Neutral Test (D5)
Field Observations: Surface Water Present? Yes No	Depth (inches):		
	Depth (inches):		
	Depth (inches):		ology Present? Yes No
(includes capillary fringe)			
Describe Recorded Data (stream gauge, monito	ring well, aerial photos, prev	rious inspections), if available	2 :
Remarks:			
Four primary indicators and three se	condary indicators o	onfirmed wetland hy	drology
Tour primary indicators and three se	condary malcators c	ommined wetland my	diology.

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-6
	Absolute	Dominant	Indicator	Dominance Test worksheet:
Tree Stratum (Plot size: 30 ft r)	% Cover	Species?	Status	Number of Dominant Species
1. Fraxinus pennsylvanica	15		FACW	That Are OBL, FACW, or FAC: 5 (A)
2. Ulmus americana	15	~	FACW	Total North and Developed
3. Betula nigra	10	~	FACW	Total Number of Dominant Species Across All Strata: 5 (B)
4				Openies / toross / tir otrata.
				Percent of Dominant Species
· `				That Are OBL, FACW, or FAC: 100 (A/B)
6				Prevalence Index worksheet:
7	400/			Total % Cover of: Multiply by:
20.0		= Total Cov		OBL species x 1 =
50% of total cover: 20.0	20% of	total cover:	0.0	FACW species x 2 =
Sapling/Shrub Stratum (Plot size: 15 ft r	45	_	E 4 C) 4/	
1. Ulmus americana	15		FACW	FAC species x 3 =
2. Sambucus nigra	5		FAC	FACU species x 4 =
3. Rosa multiflora	2		FACU	UPL species x 5 =
4		. <u></u>		Column Totals: (A) (B)
5				Bu show late B/A
6				Prevalence Index = B/A =
7				Hydrophytic Vegetation Indicators:
				1 - Rapid Test for Hydrophytic Vegetation
8				✓ 2 - Dominance Test is >50%
9	22%			3 - Prevalence Index is ≤3.0 ¹
500/ official control 11.0		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
50% of total cover: 11.0	20% of	total cover:	4.4	data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r)				Problematic Hydrophytic Vegetation ¹ (Explain)
2				¹ Indicators of hydric soil and wetland hydrology must
3				be present, unless disturbed or problematic.
4		. <u></u>		Definitions of Four Vegetation Strata:
5				
6				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
7				more in diameter at breast height (DBH), regardless of height.
8				noight.
				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11				Herb – All herbaceous (non-woody) plants, regardless
		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover:	20% of	total cover:		Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2				
3				
4				
5				Hydrophytic Vegetation
<u> </u>		= Total Cov		Present? Yes No No
50% of total cover:				
Remarks: (Include photo numbers here or on a separate s		10101 001011		
remarks. (include prioto numbers here of on a separate s	neet.)			
The Dominance Test confirmed hydrophytic	vegetat	ion.		
· · ·	-			

Depth (inches)	Matrix Color (moist)	%		dox Feature	es Type ¹	Loc ²	Touture	Domorko	
(inches) 0 - 4	10YR 3/2	<u></u>	Color (moist) 5YR 4/6	<u>%</u> 5	C	M	Texture Clay Loam	Remarks	
0 - 4		20	31K 4/0			_ '''			
	10YR 6/8		EVD 4/6	10		- 	Sand		
4 - 20	10YR 6/8	70	5YR 4/6	10	<u>C</u>	_ <u>M</u>	Sandy Clay Lo		
4 - 20	10YR 3/2	20	_				Clay Loam		
	_		_						
-		_							
-					- '				
				_	_	_			
							2		
Type: C=Co l ydric Soil l		epletion, RI	M=Reduced Matrix,	MS=Maske	d Sand G	rains.		re Lining, M=Matrix. for Problematic Hy	rdria Caila ³ ı
•			Dork Surfa	00 (87)				fluck (A10) (MLRA 1	
Histosol Histic Er	(AT) ipedon (A2)		Dark Surfa Polyvalue		ace (S8)	MLRA 147		Prairie Redox (A16)	71)
Black Hi			Thin Dark					RA 147, 148)	
Hydroge	n Sulfide (A4)		Loamy Gle	yed Matrix		. ,		ont Floodplain Soils	(F19)
	Layers (A5)		Depleted N				•	RA 136, 147)	
	ck (A10) (LRR N)		Redox Dar	,	•			hallow Dark Surface	
-	l Below Dark Surfa irk Surface (A12)	ace (A11)	Depleted D				Other	Explain in Remarks)
	lucky Mineral (S1)	(LRR N.	Iron-Manga			(LRR N.			
	147, 148)	(=,	MLRA		(,	(=,			
Sandy G	leyed Matrix (S4)		Umbric Su	rface (F13)	(MLRA 1	36, 122)	³ Indicator	rs of hydrophytic veg	etation and
Sandy R			Piedmont F					hydrology must be p	
	Matrix (S6)		Red Paren	t Material (F21) (ML	RA 127, 14	7) unless o	listurbed or problem	atic.
	ayer (if observed	1):							
Type:							1	/	
Depth (inc Remarks:	ches):						Hydric Soil Pres	ent? Yes _*	No

Project/Site: LGEKU Glend	dale		City/C	county: Glendale/Hai	rdin	Sampling Date: 2022-03-09
Applicant/Owner: LG&E-KU						Sampling Point: SP-7
Investigator(s):Burns & McD	onnell (SB & Cl	()	Section	on, Township, Range: N		
Landform (hillslope, terrace, e				• •		Slope (%): 2
Subregion (LRR or MLRA): N		Lat: 37.62				Datum: WGS 84
Soil Map Unit Name: Melvin						ation: PFO1A
Are climatic / hydrologic condi		nical for this ti	mo of year?	Yos No V		<u> </u>
Are Vegetation, Soil						
						present? Yes No
Are Vegetation, Soil _		· -			explain any answer	
SUMMART OF FINDIN	GS – Attach s	site map sn	lowing San	ipling point locati	ons, transects	, important features, etc.
Hydrophytic Vegetation Pres				Is the Sampled Area		
Hydric Soil Present?	Yes	No		within a Wetland?	Yes	No 🗸
Wetland Hydrology Present?	Yes	No	<u> </u>			<u> </u>
Remarks:						
SP-7 is located adjacent	t to W-2. Flood	ed conditior	ns were obs	erved at the time of	the site visit du	e to recent rainfall.
According to the Antece	edent Precipita	tion Tool (Al	PT), the are	a was experiencing	wet conditions a	at the time of the survey.
HYDROLOGY						
Wetland Hydrology Indicat	ors:				Secondary Indica	tors (minimum of two required)
Primary Indicators (minimum	of one is required	; check all tha	t apply)		Surface Soil (Cracks (B6)
Surface Water (A1)		True A	quatic Plants (B14)	Sparsely Veg	getated Concave Surface (B8)
High Water Table (A2)			gen Sulfide Od		Drainage Pat	tterns (B10)
Saturation (A3)			-	es on Living Roots (C3)		
Water Marks (B1)		·	ice of Reduced	` '	=	Water Table (C2)
Sediment Deposits (B2)		·		on in Tilled Soils (C6)	Crayfish Burr	
Drift Deposits (B3) Algal Mat or Crust (B4)			uck Surface (0 Explain in Rer	·		sible on Aerial Imagery (C9) tressed Plants (D1)
Iron Deposits (B5)		Other (Lxpiaiii iii ixei	ilaiks)	Geomorphic	
Inundation Visible on Ae	erial Imagery (B7)				Shallow Aqui	
Water-Stained Leaves (aphic Relief (D4)
Aquatic Fauna (B13)	,				FAC-Neutral	
Field Observations:						
Surface Water Present?	Yes No	Depth	(inches):			
Water Table Present?	Yes No	Depth	(inches):			
Saturation Present?	Yes No	Depth	(inches):	Wetland	Hydrology Presen	it? Yes No
(includes capillary fringe) Describe Recorded Data (str	eam gauge, monit	oring well, aer	ial photos, pre	evious inspections), if av	ailable:	
Remarks:						
One secondary indica	itor of wetland	d hydrolog	y was pres	ent at the time of	the site visit.	

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-7
	Absolute	Dominant	Indicator	Dominance Test worksheet:
Tree Stratum (Plot size: 30 ft r)	% Cover	Species?	Status	Number of Dominant Species
1. Prunus serotina	40		FACU	That Are OBL, FACW, or FAC: 0 (A)
2. Acer saccharinum	10		FACW	Total North and Developed
3. Celtis occidentalis	5		FACU	Total Number of Dominant Species Across All Strata: 3 (B)
Λ				Opedies Across Air Strata.
T		· 		Percent of Dominant Species
		· 		That Are OBL, FACW, or FAC: 0 (A/B)
6	-	· 		Prevalence Index worksheet:
7		· 		Total % Cover of: Multiply by:
		= Total Cov		
50% of total cover: 27.5	20% of	total cover:	11.0	OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)				FACW species x 2 =
1. Celtis occidentalis	10		FACU	FAC species x 3 =
2. Fraxinus pennsylvanica	2		FACW	FACU species x 4 =
3				UPL species x 5 =
				Column Totals: (A) (B)
4				
5				Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				2 - Dominance Test is >50%
9				<u> </u>
	12%	= Total Cov	er	3 - Prevalence Index is ≤3.0¹
50% of total cover: 6.0				4 - Morphological Adaptations ¹ (Provide supporting
Herb Stratum (Plot size: 5 ft r				data in Remarks or on a separate sheet)
1. Lonicera maackii	5	~	UPL	Problematic Hydrophytic Vegetation ¹ (Explain)
1				
				¹ Indicators of hydric soil and wetland hydrology must
3				be present, unless disturbed or problematic.
4		. <u></u>		Definitions of Four Vegetation Strata:
5				To a Mark design of the Control of t
6				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of
7				height.
8				
9				Sapling/Shrub – Woody plants, excluding vines, less
				than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.
10	-			ini) tali.
11,	F0/			Herb – All herbaceous (non-woody) plants, regardless
0.5		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover: 2.5	20% of	total cover:	1.0	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r				height.
1				
2				
3				
4				
5				Hydrophytic
J				Vegetation Present? Yes No
50% of total cover:		= Total Cov		· · · · · · · · · · · · · · · · · · ·
		total cover.		
Remarks: (Include photo numbers here or on a separate s	ineet.)			
No indicators of hydrophytic vegetation wer	e preser	nt at the t	ime of t	he site visit.
, , , , , , , , , , , , , , , , , , ,				

O - 2	0 - 2	Depth	Matrix	0/	Redox Features	T. (D 1 .	
0 - 2	Syr Syr	(inches)	Color (moist)	<u>%</u>	Color (moist) % Type ¹ Loc ²	Texture		Remarks	
2 - 20 7.5YR 5/8 100 Sandy Clay Lox Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Type: C=Concentration, D=Depleted Matrix. Type: C=Concentration, D=Depleted Matrix. Type: C=Concentration, D=Depleted Matrix. Indicators for Problematic Hydric Soils Indicators for Problematic Hydric Soils (RA 147) (MRA 147) (MRA 147) (MRA 147) (MRA 147) (MRA 147) (MRA 147) (MRA 147) (MRA 147) (MRA 146) (MRA 14	2-20 7.5YR 5/8 100 Sandy Clay Lo		-						
Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Indicators for Problematic Hydric Soils Indicators: Histosol (A1)	ype: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.								
Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. PL=Pore Lining, M=Matrix. Indicators for Problematic Hydric Soils Indicators: Histosol (A1)	ype: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.	2 - 20	7.5YR 5/8	<u>100</u>		Sandy Clay Lo			
ydric Soil Indicators: Histosol (A1)	Histosol (A1) Dark Surface (S7) 2 cm Muck (A10) (MLRA 147) Histic Epipedon (A2) Polyvalue Below Surface (S8) (MLRA 147, 148) Coast Prairie Redox (A16) Black Histic (A3) Thin Dark Surface (S9) (MLRA 147, 148) Piedmont Floodplain Soils (F19) Stratified Layers (A5) Depleted Matrix (F2) Piedmont Floodplain Soils (F19) 2 cm Muck (A10) (LRR N) Redox Dark Surface (F6) Very Shallow Dark Surface (TF12) Depleted Below Dark Surface (A11) Depleted Dark Surface (F7) Other (Explain in Remarks) Sandy Mucky Mineral (S1) (LRR N, MLRA 136, 122) Sandy Gleyed Matrix (S4) Piedmont Floodplain Soils (F19) (MLRA 148)	-							
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Black Histic (A3)	Black Histic (A3)	_ Histosol	I (A1)		Dark Surface (S7)		2 cm Muck (A	10) (MLRA 14	7)
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Stratified Layers (A5)	Stratified Layers (A5)	_	` '						
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Thick Dark Surface (A12)	Thick Dark Surface (A12)			ιςο (Λ11)					TF12)
Sandy Mucky Mineral (S1) (LRR N, MLRA 147, 148)	Sandy Mucky Mineral (S1) (LRR N, MLRA 147, 148)			ice (ATT)		_	Other (Explain	i ili Nelliaiks)	
MLRA 147, 148) _ Sandy Gleyed Matrix (S4) _ Sandy Redox (S5) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Red Parent Material (F21) (MLRA 127, 147) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _ Stripped Matrix (S6) _	MLRA 147, 148) Sandy Gleyed Matrix (S4) Sandy Redox (S5) Piedmont Floodplain Soils (F19) (MLRA 148) Wetland hydrology must be present, unless disturbed or problematic. Setrictive Layer (if observed): Type: Depth (inches): Hydric Soil Present? Yes No France (F13) (MLRA 148) Hydric Soil Present? Yes No France (F13) (MLRA 148) Hydric Soil Present? Yes No France (F13) (MLRA 148) MLRA 136) Umbric Surface (F13) (MLRA 136, 122) Piedmont Floodplain Soils (F19) (MLRA 148) Wetland hydrology must be present, unless disturbed or problematic. Hydric Soil Present? Yes No France (F13) (MLRA 127, 147)			(LRR N,					
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Depth (inches): No	Depth (inches): No	Sandy R	Redox (S5) d Matrix (S6)		Piedmont Floodplain Soils (F19) (MLRA 14	-8) v	vetland hydrolo	gy must be pr	esent,
lemarks:	emarks:	Sandy R	Redox (S5) d Matrix (S6)	I):	Piedmont Floodplain Soils (F19) (MLRA 14	-8) v	vetland hydrolo	gy must be pr	esent,
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		Sandy R Stripped estrictive I Type: Depth (independent)	Redox (S5) d Matrix (S6) Layer (if observed		Piedmont Floodplain Soils (F19) (MLRA 14 Red Parent Material (F21) (MLRA 127, 147	8) v	vetland hydrolo unless disturbe	ogy must be pr d or problema	esent, tic.
		Sandy R Stripped estrictive I Type: Depth (indemarks:	Redox (S5) d Matrix (S6) Layer (if observed		Piedmont Floodplain Soils (F19) (MLRA 14 Red Parent Material (F21) (MLRA 127, 147	8) v	vetland hydrolo unless disturbe	ogy must be pr d or problema	esent, tic.
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		Sandy R Stripped estrictive I Type: Depth (incemarks:	Redox (S5) d Matrix (S6) Layer (if observed		Piedmont Floodplain Soils (F19) (MLRA 14 Red Parent Material (F21) (MLRA 127, 147	8) v	vetland hydrolo unless disturbe	ogy must be pr d or problema	esent, tic.
		Sandy R Stripped estrictive I Type: Depth (indemarks:	Redox (S5) d Matrix (S6) Layer (if observed		Piedmont Floodplain Soils (F19) (MLRA 14 Red Parent Material (F21) (MLRA 127, 147	8) v	vetland hydrolo unless disturbe	ogy must be pr d or problema	esent, tic.
		Sandy R Stripped estrictive I Type: Depth (indemarks:	Redox (S5) d Matrix (S6) Layer (if observed		Piedmont Floodplain Soils (F19) (MLRA 14 Red Parent Material (F21) (MLRA 127, 147	8) v	vetland hydrolo unless disturbe	ogy must be pr d or problema	esent, tic.
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		Sandy R Stripped estrictive I Type: Depth (indemarks:	Redox (S5) d Matrix (S6) Layer (if observed		Piedmont Floodplain Soils (F19) (MLRA 14 Red Parent Material (F21) (MLRA 127, 147	8) v	vetland hydrolo unless disturbe	ogy must be pr d or problema	esent, tic.
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		Sandy R Stripped estrictive I Type: Depth (incemarks:	Redox (S5) d Matrix (S6) Layer (if observed		Piedmont Floodplain Soils (F19) (MLRA 14 Red Parent Material (F21) (MLRA 127, 147	8) v	vetland hydrolo unless disturbe	ogy must be pr d or problema	esent, tic.

Project/Site: LGEKU Glendale	City/Co	ounty: Glendale/Hardir	n	Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU	•			y Sampling Point: SP-8
Investigator(s):Burns & McDonnell (SB & CK)	Section			<u></u>
Landform (hillslope, terrace, etc.): Depression				Slope (%): 5
Subregion (LRR or MLRA): N 122				Datum: WGS 84
Soil Map Unit Name: Melvin silt loam			NWI classifica	
Are climatic / hydrologic conditions on the site typi	cal for this time of year? V	es No 🗸 (If		
Are Vegetation, Soil, or Hydrology				resent? Yes No
Are Vegetation, Soil, or Hydrology SUMMARY OF FINDINGS – Attach sit				
		ipining point location	s, transects,	, important reatures, etc.
Hydrophytic Vegetation Present?	<u> </u>	Is the Sampled Area		
Hydric Soil Present?	No _	within a Wetland?	Yes 🗸	No
Wetland Hydrology Present? Yes	<u> No</u>			
Remarks:				
Wetland (W)-3 is a palustrine emergent (PEM) wetland. Flooded condit	tions were observed at t	he time of the s	ite visit due to recent rainfall.
According to the Antecedent Precipitation To	ol (ADT) the area was ev	porionaina wat candition	as at the time of	f the curvey
According to the Antecedent Frecipitation To	or (AFT), the area was ex	periencing wer condition	is at the time of	i tile survey.
HYDROLOGY				
Wetland Hydrology Indicators:		<u>S</u>	econdary Indicat	tors (minimum of two required)
Primary Indicators (minimum of one is required;	check all that apply)		Surface Soil (Cracks (B6)
Surface Water (A1)	True Aquatic Plants (E	B14)	Sparsely Veg	etated Concave Surface (B8)
✓ High Water Table (A2)	Hydrogen Sulfide Odd	or (C1)	Drainage Pat	terns (B10)
✓ Saturation (A3)	Oxidized Rhizosphere	es on Living Roots (C3)	Moss Trim Lii	nes (B16)
Water Marks (B1)	Presence of Reduced	I Iron (C4)	Dry-Season V	Vater Table (C2)
Sediment Deposits (B2)	Recent Iron Reduction	n in Tilled Soils (C6)	Crayfish Burn	ows (C8)
Drift Deposits (B3)	Thin Muck Surface (C			sible on Aerial Imagery (C9)
Algal Mat or Crust (B4)	Other (Explain in Rem			ressed Plants (D1)
Iron Deposits (B5)		<u>-</u> '	Geomorphic I	• ,
Inundation Visible on Aerial Imagery (B7)		_	Shallow Aquit	
Water-Stained Leaves (B9)		-		phic Relief (D4)
Aquatic Fauna (B13)			FAC-Neutral	Test (D5)
Field Observations: Surface Water Present? Yes No	Depth (inches):			
	Depth (inches): 8			
	Depth (inches): 0	Wetland Hv	drology Presen	t? Yes 🗸 No
(includes capillary fringe)				1: 165 110
Describe Recorded Data (stream gauge, monitor	ring well, aerial photos, prev	vious inspections), if availa	ıble:	
Remarks:				
Two primary indicators and three se	condary indicators c	confirmed wetland h	ydrology	
Two primary maleutors and three se	condary malcators c	John Mediana I	lydrology.	
1				

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-8
	Absolute	Dominant	Indicator	Dominance Test worksheet:
Tree Stratum (Plot size: 30 ft r	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)
1	. ——			That Are OBL, FACW, or FAC: 2 (A)
2				Total Number of Dominant
3				Species Across All Strata: 2 (B)
4				Percent of Dominant Species
5				That Are OBL, FACW, or FAC: 100 (A/B)
6				Prevalence Index worksheet:
7				Total % Cover of: Multiply by:
		= Total Cov		OBL species x 1 =
50% of total cover:	20% of	total cover:		FACW species x 2 =
Sapling/Shrub Stratum (Plot size: 15 ft r				-
1				FAC species x 3 =
2				FACU species x 4 =
3				UPL species x 5 =
4				Column Totals: (A) (B)
5				Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				✓ 2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
50% of total cover:	20% of	total cover:		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r)			EAC	Problematic Hydrophytic Vegetation ¹ (Explain)
1. Dichanthelium clandestinum	55		FAC	
2. Juncus effusus	30		FACW	¹ Indicators of hydric soil and wetland hydrology must
3. Carex sp.	10		UNK	be present, unless disturbed or problematic.
_{4.} Rumex crispus	5		FAC	Definitions of Four Vegetation Strata:
5				To a Month dark and discrete 2 to (70 cm) as
6				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of
7				height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11				Herb – All herbaceous (non-woody) plants, regardless
	100%	= Total Cov	er	of size, and woody plants less than 3.28 ft tall.
50% of total cover: <u>50.0</u>	20% of	total cover:	20.0	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2	<u></u>			
3				
4				Undrankida
5				Hydrophytic Vegetation
		= Total Cov	er	Present? Yes V No No
50% of total cover:	20% of	total cover:		
Remarks: (Include photo numbers here or on a separate s	sheet.)			
	•			
The Dominance Test confirmed hydrophytic	: vegetat	ion. Care	ex sp. cc	ould not be identified to
he species level during the site investigatio	n. Veget	ation wa	s distur	bed from mowing. Due
· · · · · · · · · · · · · · · · · · ·	_			-
o the presence of hydric soil, wetland hydro			-	
assumed to be FACW. The wetland indicato	r status o	of this sp	ecies d	oes not change outcome
or hydrophytic vegetation.				

Depth	Matrix		Rede	x Feature	s		n the absence	
(inches)	Color (moist)		Color (moist)	%	Type ¹	Loc ²	Texture	Remarks
0-3	2.5Y 4/2	100					Silty Clay Loan	-
3 - 10	2.5Y 5/2	88	5YR 4/6	2	С	M	Sandy Clay Loa	
3 - 10	10YR 7/8	10					Sandy Clay Loa	
10 - 20	2.5Y 6/4	70	5YR 5/6	30	С	<u>M</u>	Sandy Clay	
-								
_				<u> </u>				
			-					
¹Type: C=C	oncentration D=D	enletion RN	/=Reduced Matrix, M	S=Masked	Sand G	rains	² Location: P	L=Pore Lining, M=Matrix.
Hydric Soil		opiotion, ren	Troduced Water, W	<u> </u>	a cana c	i dii i o.	Indic	ators for Problematic Hydric Soils ³ :
Histosol	(A1)		Dark Surfac	e (S7)				cm Muck (A10) (MLRA 147)
	pipedon (A2)		Polyvalue B	elow Surfa				Coast Prairie Redox (A16)
	istic (A3)		Thin Dark S			147, 148)		(MLRA 147, 148)
	en Sulfide (A4)		Loamy Gley		(F2)		F	Piedmont Floodplain Soils (F19)
	d Layers (A5) uck (A10) (LRR N)		✓ Depleted Ma — Redox Dark		-6\			(MLRA 136, 147) /ery Shallow Dark Surface (TF12)
	d Below Dark Surf		Redox Dark		•			Other (Explain in Remarks)
-	ark Surface (A12)	uoo (/ 1. 1.)	Redox Depr				_ `	valor (Explain in Formanio)
	Mucky Mineral (S1) (LRR N,	Iron-Mangar	nese Mass	es (F12)	(LRR N,		
	A 147, 148)		MLRA 13	•			2.	
	Gleyed Matrix (S4)		Umbric Surf		-	-		licators of hydrophytic vegetation and
Sandy F	Redox (S5) I Matrix (S6)		Piedmont FI Red Parent					etland hydrology must be present, lless disturbed or problematic.
	Layer (if observe	d):	ited i aleiti	iviateriai (i	21) (IVILI	XA 121, 141		ness disturbed of problematic.
	• •	•						
Type:								
Type: Depth (in	ches):						Hydric Soil	Present? Yes V No
	ches):						Hydric Soil	Present? Yes V No No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No No
Depth (in Remarks:		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No
Depth (in Remarks:		x (F3) co	nfirmed hydric s	soil.			Hydric Soil	Present? Yes V No

Project/Site: LGEKU Glendale	City/County: Glen	dale/Hardin	Sampling Date: 2022-03-10					
Applicant/Owner: LG&E-KU			ky Sampling Point: SP-9					
Investigator(s):Burns & McDonnell (SB & CK)	Section, Township		<u> </u>					
Landform (hillslope, terrace, etc.): Hillslope	-	=	Slope (%): 3					
Subregion (LRR or MLRA): N 122 Lat:			Datum: WGS 84					
Soil Map Unit Name: Melvin silt loam		NWI classific						
Are climatic / hydrologic conditions on the site typical for	or this time of year? Ves N							
Are Vegetation, Soil, or Hydrology			oresent? Yes No					
Are Vegetation, Soil, or Hydrology		If needed, explain any answe	·					
SUMMARY OF FINDINGS – Attach site m	nap snowing sampling poli	nt locations, transects	s, important features, etc.					
Hydrophytic Vegetation Present? Yes V	No Is the Sam	aled Area						
Hydric Soil Present? Yes	No within a We							
Wetland Hydrology Present? Yes	No 🔽		-					
Remarks:								
SP-9 is located adjacent to W-3. Flooded co	nditions were observed at th	e time of the site visit du	ue to recent rainfall.					
According to the Antecedent Precipitation T	ool (APT), the area was expe	riencing wet conditions	at the time of the survey.					
HYDROLOGY								
Wetland Hydrology Indicators:		Secondary Indica	ators (minimum of two required)					
Primary Indicators (minimum of one is required; check	k all that apply)	Surface Soil	Cracks (B6)					
Surface Water (A1) True Aquatic Plants (B14) Sparsely Vegetated Concave Surface (B8								
High Water Table (A2)	Hydrogen Sulfide Odor (C1) Drainage Patterns (B10)							
Saturation (A3)								
Water Marks (B1)	Presence of Reduced Iron (C4)	Dry-Season	Water Table (C2)					
Sediment Deposits (B2)								
	Thin Muck Surface (C7)	Saturation V	isible on Aerial Imagery (C9)					
1	Other (Explain in Remarks)		tressed Plants (D1)					
Iron Deposits (B5)		•	Position (D2)					
Inundation Visible on Aerial Imagery (B7)		Shallow Aqu						
Water-Stained Leaves (B9)		· -	aphic Relief (D4)					
Aquatic Fauna (B13) Field Observations:		FAC-Neutral	Test (D5)					
	Depth (inches):							
	Depth (inches):							
	Depth (inches):	Wetland Hydrology Preser	nt? Yes No					
(includes capillary fringe)			100 <u></u>					
Describe Recorded Data (stream gauge, monitoring v	veii, aeriai pnotos, previous inspect	ions), if available:						
Remarks:								
No indicators of wetland hydrology were	e present at the time of the	e site visit						
The manager of menand my arenegy men	о регосоте се ино инто се ин							

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-9
	Absolute	Dominant	Indicator	Dominance Test worksheet:
<u>Tree Stratum</u> (Plot size: 30 ft r) 1.	% Cover	Species?	<u>Status</u>	Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)
2				
3				Total Number of Dominant Species Across All Strata: 1 (B)
4				Opecies Across Air otrata.
5.				Percent of Dominant Species
				That Are OBL, FACW, or FAC: 100 (A/B)
6				Prevalence Index worksheet:
7		T-1-1-0-		Total % Cover of:Multiply by:
50% of total cover:		= Total Co		OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)	20 /0 01	total cover	·	FACW species x 2 =
				FAC species x 3 =
1				FACU species x 4 =
2				UPL species x 5 =
3				Column Totals: (A) (B)
4		-		Column rotals (A) (B)
5				Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				✓ 2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
		= Total Co	ver	4 - Morphological Adaptations¹ (Provide supporting
50% of total cover:	20% of	total cover	r:	data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r)				Problematic Hydrophytic Vegetation ¹ (Explain)
1. Dichanthelium clandestinum	60		FAC	Problematic Trydrophytic Vegetation (Explain)
_{2.} Poa pratensis	15		FACU	Indicators of hodic call and contact hodes are secret
_{3.} Rosa multiflora	10		FACU	¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.
_{4.} Allium schoenoprasum	5		FACU	Definitions of Four Vegetation Strata:
_{5.} Solidago canadensis	2		FACU	Johnson G. Four Pogotation Chata.
6.				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
7				more in diameter at breast height (DBH), regardless of height.
8				
9				Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11.				He de All he de conservations and National Conservations
· ··-	92%	= Total Co		Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.
50% of total cover: 46.0				o. o.zo, and moody planto loos than o.zo it tall
Woody Vine Stratum (Plot size: 30 ft r	_			Woody vine – All woody vines greater than 3.28 ft in
1.				height.
2				
3				
4				
				Hydrophytic
o		= Total Co	vor	Vegetation Present? Yes V No
50% of total cover:				
Remarks: (Include photo numbers here or on a separate s			· 	
	•			
Γhe Dominance Test confirmed hydrophytic	vegetat	ion. Veg	etation v	was disturbed from
mowing.				
··-···································				

4 - 10 0 - 20	dicators: A1)	98 98 epletion, RM	7.5YR 5/6	2	Type ¹ C		Texture Silty Clay Loan Silty Clay Loan Silty Clay Loan	Rei	marks
4 - 10 0 - 20	10YR 5/4 2.5Y 5/4 accentration, D=D dicators: A1)	98	7.5YR 5/6	2	<u>c</u>	M	Silty Clay Loan		
0 - 20	2.5Y 5/4 ncentration, D=D dicators: A1)	98	7.5YR 5/6	2	<u>c</u>	<u>M</u>			
pe: C=Con dric Soil Ind Histosol (A Histic Epip Black Histi Hydrogen	ncentration, D=D dicators:		7.518 5/6	<u>Z</u>	<u></u>		Slity Clay Loan		
pe: C=Condric Soil Inc Histosol (A Histic Epip Black Histi Hydrogen	dicators: A1)	epletion, RN							
dric Soil Ind Histosol (A Histic Epip Black Histi Hydrogen	dicators: A1)	epletion, RN							
dric Soil Ind Histosol (A Histic Epip Black Histi Hydrogen	dicators: A1)	epletion, RN							
dric Soil Ind Histosol (A Histic Epip Black Histi Hydrogen	dicators: A1)	epletion, RN							
dric Soil Ind Histosol (A Histic Epip Black Histi Hydrogen	dicators: A1)	epletion, RN							
dric Soil Ind Histosol (A Histic Epip Black Histi Hydrogen	dicators: A1)	epletion, RN	<u> </u>						
dric Soil Ind Histosol (A Histic Epip Black Histi Hydrogen	dicators: A1)	epletion, RN					·	-	
Histosol (A Histic Epip Black Histi Hydrogen	dicators: A1)	epletion, RN							
dric Soil Ind Histosol (A Histic Epip Black Histi Hydrogen	dicators: A1)	epletion, RN							
Histosol (A Histic Epip Black Histi Hydrogen	A1)		M=Reduced Matrix, M	IS=Masked	d Sand G	rains.	² Location: Pl	L=Pore Lining, M=	Matrix.
Histic Epip Black Histi Hydrogen							Indica	ators for Problem	atic Hydric Soils ³ :
Black Histi Hydrogen	andan (AO)		Dark Surfac					cm Muck (A10) (N	•
Hydrogen			Polyvalue B		. , .		148) C	oast Prairie Redox	
	. ,		Thin Dark S			147, 148)		(MLRA 147, 148)	
Stratified L	Sulfide (A4)		Loamy Gley		(F2)		P	iedmont Floodplair	, ,
			Depleted Ma		-6)		.,	(MLRA 136, 147)	
	k (A10) (LRR N) Below Dark Surf		Redox Dark Depleted Da	•	,			ery Shallow Dark S other (Explain in Re	
	k Surface (A12)	ace (ATT)	Redox Depr				_ 0	tilei (Explaiii iii ite	illaiks)
	icky Mineral (S1)	(LRR N,	Iron-Mangai			(LRR N,			
-	147, 148)	,	MLRA 1:		, ,	,			
Sandy Gle	eyed Matrix (S4)		Umbric Surf	ace (F13)	(MLRA 1	36, 122)	³ Ind	icators of hydrophy	ytic vegetation and
Sandy Red	dox (S5)		Piedmont FI	loodplain S	oils (F19) (MLRA 14	18) we	tland hydrology mi	ust be present,
Stripped M			Red Parent	Material (F	21) (ML I	RA 127, 14	7) unl	less disturbed or p	roblematic.
strictive La	ayer (if observe	d):							
Туре:									
Depth (inch	nes):						Hydric Soil	Present? Yes	No <u> </u>
narks: No	indicators o	f hvdric s	soil were preser	nt at the	time o	f the site	e visit.		
	maioatoro o	,	on word proces				710111		

Project/Site: LGEKU Glendale	City/Cour	_{nty:} Glendale/Hardi	<u>n</u>	Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU	•			Sampling Point: SP-10
Investigator(s).Burns & McDonnell (SB & CK)	Section.			
Landform (hillslope, terrace, etc.): Depression				Slope (%): 5
Subregion (LRR or MLRA): N 122 Lat:		Long:85.8		Datum: WGS 84
Soil Map Unit Name: Sonora silt loam, 6 to 12 per		_		
Are climatic / hydrologic conditions on the site typical for	r this time of year? Yes	No (If	f no, explain in Rei	marks.)
Are Vegetation, Soil, or Hydrology	significantly disturbed	l? Are "Normal (Circumstances" pre	esent? Yes No
Are Vegetation, Soil, or Hydrology			plain any answers	
SUMMARY OF FINDINGS – Attach site ma			· ·	·
Hydrophytic Vegetation Present? Hydric Soil Present? Wetland Hydrology Present? Yes Ves V	No I	the Sampled Area ithin a Wetland?	Yes	No <u>′</u>
Remarks:				
Wetland (W)-4 is a palustrine emergent (PEM) wet According to the Antecedent Precipitation Tool (AF				
HYDROLOGY				
Wetland Hydrology Indicators:		<u> </u>	Secondary Indicato	ors (minimum of two required)
✓ High Water Table (A2) ✓ Saturation (A3) ✓ € ✓ Water Marks (B1) — □ — Sediment Deposits (B2) — □ — Drift Deposits (B3) — □	True Aquatic Plants (B14 Hydrogen Sulfide Odor (I Oxidized Rhizospheres of Presence of Reduced Iro Recent Iron Reduction in Thin Muck Surface (C7) Other (Explain in Remark	C1) on Living Roots (C3) on (C4) 1 Tilled Soils (C6) ks)	Drainage Patte Moss Trim Line Dry-Season W Crayfish Burro Saturation Visi	tated Concave Surface (B8) ems (B10) es (B16) ater Table (C2) ws (C8) ble on Aerial Imagery (C9) essed Plants (D1) osition (D2) and (D3) hic Relief (D4)
	Depth (inches):			
Water Table Present? Saturation Present? (includes capillary fringe)	Depth (inches): 8		drology Present	? Yes No
Describe Recorded Data (stream gauge, monitoring w	ell, aerial photos, previou	us inspections), if availa	able:	
Remarks:				
Four primary indicators and two seconda	ary indicators conf	irmed wetland hy	drology. The	
water table was likely higher due to flood	ded conditions from	m recent rainfall.		

VEGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-10
<u> </u>		Dominant	Indicator	Dominance Test worksheet:
Tree Stratum (Plot size: 30 ft r)	% Cover	Species?	Status	Number of Dominant Species
1. Acer saccharinum	15		FACW	That Are OBL, FACW, or FAC: 3 (A)
2				T
2				Total Number of Dominant Species Across All Strata: 3 (B)
4				Species Across Air Strata.
T				Percent of Dominant Species
5				That Are OBL, FACW, or FAC: 100 (A/B)
6				Prevalence Index worksheet:
7	450/			Total % Cover of: Multiply by:
		= Total Cov		OBL species x 1 =
50% of total cover: 7.5	20% of	total cover:	3.0	
Sapling/Shrub Stratum (Plot size: 15 ft r				FACW species x 2 =
1				FAC species x 3 =
2				FACU species x 4 =
3				UPL species x 5 =
4				Column Totals: (A) (B)
5				5 50
6				Prevalence Index = B/A =
7				Hydrophytic Vegetation Indicators:
				✓ 1 - Rapid Test for Hydrophytic Vegetation
8				2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
500 / 51 1 1		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
50% of total cover:	20% of	total cover:		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r)	20		E A C\A/	Problematic Hydrophytic Vegetation ¹ (Explain)
1. Juncus dudleyi	30		FACW	: resignate : i alle : i
2. Carex sp.	25		FACW	¹ Indicators of hydric soil and wetland hydrology must
3. Dichanthelium clandestinum	15		FAC	be present, unless disturbed or problematic.
4. Juncus effusus	15		FACW	Definitions of Four Vegetation Strata:
_{5.} Ludwigia alternifolia	10		FACW	Deminions of Four Vegetation offata.
6. Panicum capillare	5		FAC	Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
7				more in diameter at breast height (DBH), regardless of height.
8				noight.
				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.
10				ini) tali.
11	100%			Herb – All herbaceous (non-woody) plants, regardless
50.0		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover: 50.0	20% of	total cover:	20.0	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2				
3				
4				Hydrophytic
5				Vegetation
		= Total Cov	er	Present? Yes No
50% of total cover:	20% of	total cover:		
Remarks: (Include photo numbers here or on a separate s	heet.)			I.
	,			
The Rapid Test for Hydrophytic Vegetation of	confirme	d hydrop	hytic ve	egetation. Carex sp.
could not be identified to the species level d	urina the	e site inv	estigation	on. Due to the presence
·	•		•	•
of hydric soil, wetland hydrology, and other	nyaropn	yuc vege	tation,	it is assumed to be
FACW.				

Depth Matrix Redox Features Matrix Sit Color (moist) % Color (moist) % Type Loc Texture Remarks	Profile Desc	ription: (Describe	to the de	pth needed to docur	nent the	indicator	or confirm	the absence	of indicate	ors.)	
0 - 4	Depth				x Feature						
1-	(inches)	Color (moist)	%	Color (moist)	%	Type ¹	Loc ²	Texture		Remarks	
	0 - 4	2.5Y 6/2	95	5YR 4/6	5	<u>C</u>	PL / M	Silty Clay Loan			_
	4 - 20	2.5Y 6/2	80	5YR 4/6	20	С	PL / M				
Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. PL=Pore Lining, M=Matrix. Pydric Soil Indicators: Histosol (A1) Black Histic Epipedon (A2) Black Histic (A3) Thin Dark Surface (S9) (MLRA 147, 148) Hydrogen Sulfide (A4) Stratified Layers (A5) Depleted Matrix (F3) Pepleted Below Dark Surface (A11) Depleted Dark Surface (F6) Sandy Mucky Mineral (S1) (LRR N, MLRA 147, 148) MLRA 147, 148) Sandy Gleyed Matrix (S4) Sandy Redox (S5) Piedmont Floodplain Soils (F19) (MLRA 147, 148) Iron-Manganese Masses (F12) (LRR N, MLRA 147, 148) Sandy Redox (S5) Piedmont Floodplain Soils (F19) (MLRA 148, Nemarks) Pindicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic. Restrictive Layer (if observed): Type: Depth (inches): Remarks:	-										
Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. PL=Pore Lining, M=Matrix. Pydric Soil Indicators: Histosol (A1) Black Histic Epipedon (A2) Black Histic (A3) Thin Dark Surface (S9) (MLRA 147, 148) Hydrogen Sulfide (A4) Stratified Layers (A5) Depleted Matrix (F3) Pepleted Below Dark Surface (A11) Depleted Dark Surface (F6) Sandy Mucky Mineral (S1) (LRR N, MLRA 147, 148) MLRA 147, 148) Sandy Gleyed Matrix (S4) Sandy Redox (S5) Piedmont Floodplain Soils (F19) (MLRA 147, 148) Iron-Manganese Masses (F12) (LRR N, MLRA 147, 148) Sandy Redox (S5) Piedmont Floodplain Soils (F19) (MLRA 148, Nemarks) Pindicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic. Restrictive Layer (if observed): Type: Depth (inches): Remarks:	-										
Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. 1 Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. 1 Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. 2 Location: PL=Pore Lining, M=Matrix. 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 2 cm Muck (A10) (MLRA 147) 3 Location: PL=Pore Lining, M=Matrix. 4 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 2 cm Muck (A10) (MLRA 147) 4 Location: PL=Pore Lining, M=Matrix. 5 Location: PL=Pore Lining, M=Matrix. 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 2 cm Muck (A10) (MLRA 147) 4 Location: PL=Pore Lining, M=Matrix. 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 1 Location: PL=Pore Lining, M=Matrix. 1 Indicators for Problematic Hydric Soils¹: 1 Location: PL=Pore Lining, M=Matrix. 2 Location: PL=Pore Lining, M=Matrix. 1 Indicators for Problematic Hydric Soils¹: 1 Location: PL=Pore Lining, M=Matrix. 2 cm Muck (A10) (MLRA 147) 2 cm Muck (A10) (MLRA 136) 2 pledmont Floodplain Soils (F12) (LRR N, MLRA 136) 3 Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic. 2 cm Muck (A10) (MLRA 127, 147) 3 Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic. 3 Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic. 4 Popleted Both Dark Surface (F12) (MLRA 127, 147) 5 Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic. 4 Popleted Both Dark Surface (F12) (MLRA 127, 147) 5 Indicators of hydrophytic vegetation and we	-					_			-		
Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. 1 Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. 1 Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. 2 Location: PL=Pore Lining, M=Matrix. 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 2 cm Muck (A10) (MLRA 147) 3 Location: PL=Pore Lining, M=Matrix. 4 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 2 cm Muck (A10) (MLRA 147) 4 Location: PL=Pore Lining, M=Matrix. 5 Location: PL=Pore Lining, M=Matrix. 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 2 cm Muck (A10) (MLRA 147) 4 Location: PL=Pore Lining, M=Matrix. 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 1 Indicators for Problematic Hydric Soils¹: 1 Location: PL=Pore Lining, M=Matrix. 1 Indicators for Problematic Hydric Soils¹: 1 Location: PL=Pore Lining, M=Matrix. 2 Location: PL=Pore Lining, M=Matrix. 1 Indicators for Problematic Hydric Soils¹: 1 Location: PL=Pore Lining, M=Matrix. 2 cm Muck (A10) (MLRA 147) 2 cm Muck (A10) (MLRA 136) 2 pledmont Floodplain Soils (F12) (LRR N, MLRA 136) 3 Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic. 2 cm Muck (A10) (MLRA 127, 147) 3 Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic. 3 Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic. 4 Popleted Both Dark Surface (F12) (MLRA 127, 147) 5 Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic. 4 Popleted Both Dark Surface (F12) (MLRA 127, 147) 5 Indicators of hydrophytic vegetation and we				-					-		_
*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. *Location: PL=Pore Lining, M=Matrix. *Hydric Soil Indicators:					-				-		
Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Hydric Soil Indicators: Histosol (A1)		-			-						
Hydric Soil Indicators: Histosol (A1)		-									
Hydric Soil Indicators: Histosol (A1)				·							
Hydric Soil Indicators: Histosol (A1)						_					
Histosol (A1)			pletion, RN	M=Reduced Matrix, MS	S=Maske	ed Sand G	rains.				
Histic Epipedon (A2) Black Histic (A3) Thin Dark Surface (S9) (MLRA 147, 148) Hydrogen Sulfide (A4) Stratified Layers (A5) Zem Muck (A10) (LRR N) Depleted Below Dark Surface (A11) Thick Dark Surface (A12) Sandy Mucky Mineral (S1) (LRR N, MLRA 147, 148) Sandy Gleyed Matrix (S4) Sandy Redox (S5) Stratified Layers (A5) MLRA 136, 147) Wery Shallow Dark Surface (TF12) Depleted Dark Surface (F7) Thick Dark Surface (A12) Sandy Mucky Mineral (S1) (LRR N, MLRA 136) Sandy Gleyed Matrix (S4) Stripped Matrix (S6) Red Parent Material (F21) (MLRA 127, 147) Restrictive Layer (if observed): Type: Depth (inches): Hydric Soil Present? Yes No MLRA 17, 148) Coast Prairie Redox (A16) (MLRA 147, 148) (MLRA 147, 148) Piedmont Floodplain Soils (F19) (MLRA 147, 148) Hydric Soil Present? Yes No Incomparison of Mydrophytic Vegetation and Wetland hydrology must be present, unless disturbed or problematic.	Hydric Soil	Indicators:						Indica	ators for Pi	roblematic H	ydric Soils³:
Black Histic (A3)						()					-
Hydrogen Sulfide (A4)								148) C)
Stratified Layers (A5) 2 cm Muck (A10) (LRR N) Depleted Below Dark Surface (A11) Thick Dark Surface (A12) Sandy Mucky Mineral (S1) (LRR N, MLRA 147, 148) Sandy Gleyed Matrix (S4) Sandy Redox (S5) Stripped Matrix (S6) Red Parent Material (F21) (MLRA 127, 147) Remarks: Mura 136, 147) Very Shallow Dark Surface (TF12) Other (Explain in Remarks) Other (Explain in Remarks) Oth							147, 148)	Б			· (F10)
2 cm Muck (A10) (LRR N)						(FZ)		<u> </u>		•	(F19)
Depleted Below Dark Surface (A11) Thick Dark Surface (A12) Sandy Mucky Mineral (S1) (LRR N, MLRA 147, 148) Sandy Gleyed Matrix (S4) Sandy Redox (S5) Stripped Matrix (S6) Pethodorus Layer (if observed): Type: Depth (inches): Depleted Dark Surface (F7) Depleted Dark Surface (F12) (LRR N, Dark Bases (F12) (LRR						'E6\		V	-	-	o (TE12)
Thick Dark Surface (A12)			ce (Δ11)			,					
Sandy Mucky Mineral (S1) (LRR N, MLRA 147, 148) Sandy Gleyed Matrix (S4) Sandy Redox (S5) Stripped Matrix (S6) Restrictive Layer (if observed): Type: Depth (inches): Sandy Mucky Mineral (S1) (LRR N, MLRA 136) Umbric Surface (F12) (MLRA 136, 122) Piedmont Floodplain Soils (F19) (MLRA 148) Wetland hydrology must be present, unless disturbed or problematic. Hydric Soil Present? Yes No Hydric Soil Present? Yes No No No No No No No No No No			00 (/111)	•				_ ~	Allici (Expla	iii iii recinane	,
MLRA 147, 148) Sandy Gleyed Matrix (S4) Sandy Redox (S5) Stripped Matrix (S6) Stripped Matrix (S6) Red Parent Material (F21) (MLRA 127, 147) Type: Depth (inches): Remarks: MLRA 136) Umbric Surface (F13) (MLRA 136, 122) Pledmont Floodplain Soils (F19) (MLRA 148) wetland hydrology must be present, unless disturbed or problematic. Hydric Soil Present? Yes No			(LRR N.				(LRR N.				
Sandy Gleyed Matrix (S4)			(=,				(,				
Sandy Redox (S5)					•	(MLRA 1	36. 122)	³ Ind	icators of h	vdrophytic ve	getation and
Stripped Matrix (S6) Red Parent Material (F21) (MLRA 127, 147) unless disturbed or problematic. Restrictive Layer (if observed): Type: Depth (inches): Hydric Soil Present? Yes No											_
Restrictive Layer (if observed): Type: Depth (inches): Remarks: Hydric Soil Present? Yes V No									-		-
Depth (inches): No Remarks:):								
Remarks:	Type:										
	Depth (in	ches):						Hydric Soil	Present?	Yes 🔽	No
Depleted Matrix (F3) confirmed hydric soil.	Remarks:							<u> </u>			
	D	epleted Matrix	(F3) co	nfirmed hydric s	oil.						
		•		-							

Project/Site: LGEKU Glendale City/	County: Glendale/Hardin Sampling Date: 2022-03-10						
Applicant/Owner: LG&E-KU	State: Kentucky Sampling Point: SP-11						
Investigator(s):Burns & McDonnell (SB & CK) Sect							
Landform (hillslope, terrace, etc.): Hillslope Local re	· -						
	Long: -85.8649404 Datum: WGS 84						
Soil Map Unit Name: Sonora silt loam, 2 to 6 percent slopes							
Are climatic / hydrologic conditions on the site typical for this time of year?							
Are Vegetation, Soil, or Hydrology significantly distu							
Are Vegetation, Soil, or Hydrology naturally problem							
SUMMARY OF FINDINGS – Attach site map showing sai	mpling point locations, transects, important features, etc.						
Hydrophytic Vegetation Present? Yes _v No	Is the Sampled Area						
Hydric Soil Present? Yes No	within a Wetland? Yes No 🗸						
Wetland Hydrology Present? Yes No							
Remarks:							
SP-11 is located adjacent to W-4. Flooded conditions were ob	oserved at the time of the site visit due to recent rainfall.						
According to the Antecedent Precipitation Tool (APT), the are	ea was experiencing wet conditions at the time of the survey.						
HYDROLOGY							
Wetland Hydrology Indicators:	Secondary Indicators (minimum of two required)						
Primary Indicators (minimum of one is required; check all that apply)	Surface Soil Cracks (B6)						
Surface Water (A1) True Aquatic Plants (B14) Sparsely Vegetated Concave Surface (B8)							
High Water Table (A2) Hydrogen Sulfide O							
	eres on Living Roots (C3) Moss Trim Lines (B16)						
Water Marks (B1) Presence of Reduce	ed Iron (C4) Dry-Season Water Table (C2)						
Sediment Deposits (B2) Recent Iron Reducti	ion in Tilled Soils (C6) Crayfish Burrows (C8)						
Drift Deposits (B3) Thin Muck Surface ((C7) Saturation Visible on Aerial Imagery (C9)						
Algal Mat or Crust (B4) Other (Explain in Re	emarks) Stunted or Stressed Plants (D1)						
Iron Deposits (B5)	Geomorphic Position (D2)						
Inundation Visible on Aerial Imagery (B7)	Shallow Aquitard (D3)						
Water-Stained Leaves (B9)	Microtopographic Relief (D4)						
Aquatic Fauna (B13)	FAC-Neutral Test (D5)						
Field Observations: Surface Water Present? Yes No Depth (inches):							
Water Table Present? Yes No Depth (inches):							
Saturation Present? Yes No Depth (inches):							
(includes capillary fringe)							
Describe Recorded Data (stream gauge, monitoring well, aerial photos, pr	revious inspections), if available:						
Remarks:							
 No indicators of wetland hydrology were present at the	e time of the site visit						
The indicators of westand flydrology were present at the	, time of the site visit.						

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-11
	Absolute	Dominant	Indicator	Dominance Test worksheet:
Tree Stratum (Plot size: 30 ft r)	% Cover	Species?	Status	Number of Dominant Species
1. Acer saccharinum	15	~	FACW	That Are OBL, FACW, or FAC: 2 (A)
2. Prunus serotina	2		FACU	T
3.				Total Number of Dominant Species Across All Strata: 3 (B)
4				opeoles / toross / tir otrata.
5				Percent of Dominant Species
5				That Are OBL, FACW, or FAC: 66.7 (A/B)
6				Prevalence Index worksheet:
1	17%			Total % Cover of: Multiply by:
F00/ - 51-1-1 9 F		= Total Cov		OBL species x 1 =
50% of total cover: <u>8.5</u>	20% 01	total cover:	0.4	FACW species x 2 =
Sapling/Shrub Stratum (Plot size: 15 ft r				FAC species x 3 =
1				•
2				FACU species x 4 =
3				UPL species x 5 =
4				Column Totals: (A) (B)
5				Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				_ , , , , ,
9				✓ 2 - Dominance Test is >50%
<u> </u>		= Total Cov		3 - Prevalence Index is ≤3.0 ¹
50% of total cover:				4 - Morphological Adaptations ¹ (Provide supporting
Herb Stratum (Plot size: 5 ft r)				data in Remarks or on a separate sheet)
1. Dichanthelium clandestinum	50	~	FAC	Problematic Hydrophytic Vegetation ¹ (Explain)
2 Poa pratensis	20		FACU	
3. Panicum capillare	10		FAC	¹ Indicators of hydric soil and wetland hydrology must
4. Geum canadense	5		FACU	be present, unless disturbed or problematic.
5. Juncus effusus	5		FACW	Definitions of Four Vegetation Strata:
	5		FAC	Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
6. Rumex crispus			FAC	more in diameter at breast height (DBH), regardless of
7				height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11				Herb – All herbaceous (non-woody) plants, regardless
	95%	= Total Cov	er	of size, and woody plants less than 3.28 ft tall.
50% of total cover: 47.5	20% of	total cover:	19.0	March 1 and
Woody Vine Stratum (Plot size: 30 ft r)				Woody vine – All woody vines greater than 3.28 ft in height.
1.				noight.
2				
3				
4.				
5.				Hydrophytic
J		Tatal Car		Vegetation Present? Yes _ V No
50% of total cover:		= Total Cov		
		total cover.		
Remarks: (Include photo numbers here or on a separate s	sneet.)			
The Dominance Test confirmed hydrophytic	vegetat	ion.		
, , ,	-			

Profile Desc	ription: (Describe	to the depth r	eeded to docume	nt the indicator	or confirm	the absence	e of indicato	rs.)	
Depth	Matrix		Redox F	eatures					
(inches)	Color (moist)	%	Color (moist)	% Type ¹	Loc ²	Texture		Remarks	_
0 - 4	10YR 3/2	90				Silty Clay Loan			
0 - 4	10YR 6/6	10				Silty Clay Loan	<u> </u>		
4 - 20	2.5Y 5/4	100				Silty Clay Loan			
					·	-			
									_
-							-		
					· <u></u>				
¹Type: C=Ce	oncentration, D=De	pletion, RM=Re	duced Matrix, MS=	Masked Sand Gr	ains.	² Location: F	PL=Pore Linir	ıg, M=Matrix.	
Hydric Soil	Indicators:							oblematic Hy	dric Soils³:
Histosol	(A1)		Dark Surface (S	67)		:	2 cm Muck (A	.10) (MLRA 1 4	17)
	oipedon (A2)	·		w Surface (S8) (N	ILRA 147,		Coast Prairie		•
Black Hi		- -		ace (S9) (MLRA 1	-		(MLRA 147		
Hydroge	n Sulfide (A4)	<u>-</u>	Loamy Gleyed			!	Piedmont Flo	odplain Soils (F19)
Stratified	d Layers (A5)	<u>-</u>	Depleted Matrix	(F3)			(MLRA 136	6, 147)	
2 cm Mu	ick (A10) (LRR N)	_	Redox Dark Su	rface (F6)		`	Very Shallow	Dark Surface	(TF12)
Depleted	d Below Dark Surfa	ce (A11)	Depleted Dark	Surface (F7)		(Other (Explain	n in Remarks)	
Thick Da	ark Surface (A12)	-	Redox Depress	ions (F8)					
Sandy N	lucky Mineral (S1)	(LRR N,	Iron-Manganes	e Masses (F12) (LRR N,				
MLRA	A 147, 148)		MLRA 136)						
Sandy G	Bleyed Matrix (S4)	<u>-</u>	Umbric Surface	(F13) (MLRA 13	6, 122)	3In	dicators of hy	drophytic veg	etation and
Sandy R	Redox (S5)	_	Piedmont Floor	Iplain Soils (F19)	(MLRA 14	8) w	etland hydrol	ogy must be p	resent,
Stripped	Matrix (S6)	-	Red Parent Ma	terial (F21) (MLR	A 127, 147	') uı	nless disturbe	d or problema	ntic.
Restrictive	Layer (if observed):							
Type:			_						
Depth (in	ches):		=			Hydric Soi	il Present?	Yes	No <u>′</u>
Remarks:									
N-	o indicators of	hydric soil	were present a	at the time of	the site	visit.			

Project/Site: LGEKU Glendale	City/County: Glendale/Hardin Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU	State: Kentucky Sampling Point: SP-12
Investigator(s):Burns & McDonnell (SB & CK)	
	Local relief (concave, convex, none): Concave Slope (%): 6
Subregion (LRR or MLRA): N 122 Lat: 37.621	
	slopes NWI classification: No
	ne of year? Yes No (If no, explain in Remarks.)
Are Vegetation, Soil, or Hydrologyv signif	
	rally problematic? (If needed, explain any answers in Remarks.)
SUMMARY OF FINDINGS – Attach site map sho	owing sampling point locations, transects, important features, etc.
Hydrophytic Vegetation Present? Yes <u>V</u> No	
Hydric Soil Present? Yes ✓ No	Is the Sampled Area within a Wetland? Yes ✓ No
Wetland Hydrology Present? Yes ✓ No	within a Wetland? Yes V No No
Remarks:	
Wetland (W)-5 is a palustrine emergent (PEM) wetland. Flo	ooded conditions were observed at the time of the site visit due to recent rainfall.
According to the Antecedent Precipitation Tool (APT), the	area was experiencing wet conditions at the time of the survey.
HYDROLOGY	
Wetland Hydrology Indicators:	Secondary Indicators (minimum of two required)
Primary Indicators (minimum of one is required; check all that	apply) Surface Soil Cracks (B6)
Surface Water (A1) True Aq	uatic Plants (B14) Sparsely Vegetated Concave Surface (B8)
<u>✓</u> High Water Table (A2) Hydroge	en Sulfide Odor (C1) Drainage Patterns (B10)
✓ Saturation (A3) Oxidized	d Rhizospheres on Living Roots (C3) Moss Trim Lines (B16)
Water Marks (B1) Presenc	ee of Reduced Iron (C4) Dry-Season Water Table (C2)
Sediment Deposits (B2) Recent I	Iron Reduction in Tilled Soils (C6) Crayfish Burrows (C8)
Drift Deposits (B3) Thin Mu	ck Surface (C7) Saturation Visible on Aerial Imagery (C9)
Algal Mat or Crust (B4) Other (E	Explain in Remarks) Stunted or Stressed Plants (D1)
Iron Deposits (B5)	✓ Geomorphic Position (D2)
Inundation Visible on Aerial Imagery (B7)	Shallow Aquitard (D3)
Water-Stained Leaves (B9)	Microtopographic Relief (D4)
Aquatic Fauna (B13)	FAC-Neutral Test (D5)
Field Observations:	
Surface Water Present? Yes No Depth (
Water Table Present? Yes No Depth (
Saturation Present? Yes No Depth ((inches): 4 Wetland Hydrology Present? Yes No
(includes capillary fringe) Describe Recorded Data (stream gauge, monitoring well, aeria	al photos, previous inspections), if available:
Remarks:	
Two primary indicators and two secondary ind	licators confirmed wetland hydrology.

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-12
	Absolute	Dominant	Indicator	Dominance Test worksheet:
Tree Stratum (Plot size: 30 ft r) 1)	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)
2				· · · · · · · · · · · · · · · · · · ·
3				Total Number of Dominant Species Across All Strata: 2 (B)
4				Species Across Air Strata (B)
5.	-			Percent of Dominant Species
56				That Are OBL, FACW, or FAC: 100 (A/B)
0				Prevalence Index worksheet:
·		= Total Cov		Total % Cover of: Multiply by:
50% of total cover:				OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)	20 70 01	total cover.		FACW species x 2 =
1				FAC species x 3 =
1				FACU species x 4 =
				UPL species x 5 =
3				Column Totals: (A) (B)
4				()
5				Prevalence Index = B/A =
6			-	Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8. <u> </u>				✓ 2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
500 % of Latel and a		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
50% of total cover:	20% of	total cover:		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r)	30	V	FAC	Problematic Hydrophytic Vegetation ¹ (Explain)
1 _. Ranunculus repens 2 _. Juncus effusus	25		FACW	
2. Junicus enusus 3. Poa pratensis	10		FACU	¹ Indicators of hydric soil and wetland hydrology must
	10		UPL	be present, unless disturbed or problematic.
_{4.} Trifolium campestre	10		OF L	Definitions of Four Vegetation Strata:
				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
6				more in diameter at breast height (DBH), regardless of
7				height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11	. —			Herb – All herbaceous (non-woody) plants, regardless
		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover: <u>37.5</u>	20% of	total cover:	15.0	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2				
3				
4				Hydrophytic
5				Vegetation
		= Total Cov		Present? Yes No
50% of total cover:		total cover:		
Remarks: (Include photo numbers here or on a separate s	sheet.)			
The Dominance Test confirmed hydrophytic	vegetat	ion.		
, , , , , , , , , , , , , , , , , , , ,	3			

Soil Sampling Point: SP-12

Profile Desc	ription: (Describe	to the de	oth needed to docu	ment the	indicator	or confirm	n the absence	of indicators.)	
Depth	Matrix			x Feature					
(inches)	Color (moist)	%	Color (moist)	%	Type ¹	Loc ²	<u>Texture</u>	Remarks	
0 - 3	2.5Y 4/2	70	5YR 4/6	5	<u>C</u>	M	Sandy Clay Loa		
0 - 3	10YR 4/3	25					Sandy Clay Loa		
3 - 8	2.5Y 5/2	80	5YR 4/6	20	С	М	Sandy Clay Loa		
8 - 16	2.5Y 5/2	60	5YR 4/6	40	С	M	Sandy Clay Loa		
-									
-			-						
-									
-					-				
¹ Type: C=Ce	oncentration, D=De	pletion. RM	=Reduced Matrix, M	S=Maske	d Sand G	ains.	² Location: PL	=Pore Lining, M=Matrix.	
Hydric Soil		protion, ran	rioddod maan, m	<u> </u>	<u>u ounu o</u>			tors for Problematic Hydric	Soils ³ :
Histosol			Dark Surface	e (S7)				cm Muck (A10) (MLRA 147)	
	oipedon (A2)		Polyvalue Be		ace (S8) (I	MLRA 147,		oast Prairie Redox (A16)	
. —	stic (A3)		Thin Dark Su		. , .	-	, ., <u>—</u>	(MLRA 147, 148)	
	n Sulfide (A4)		Loamy Gleye				Pi	edmont Floodplain Soils (F19)
Stratified	d Layers (A5)		✓ Depleted Ma		, ,			(MLRA 136, 147)	,
2 cm Mu	ick (A10) (LRR N)		Redox Dark		F6)		Ve	ery Shallow Dark Surface (TF	12)
Depleted	d Below Dark Surfa	ce (A11)	Depleted Da	rk Surfac	e (F7)		Of	ther (Explain in Remarks)	
Thick Da	ark Surface (A12)		Redox Depre	essions (F	- 8)				
Sandy M	lucky Mineral (S1)	(LRR N,	Iron-Mangan	ese Mas	ses (F12)	(LRR N,			
	A 147, 148)		MLRA 13	•					
	Sleyed Matrix (S4)		Umbric Surfa			-		cators of hydrophytic vegetati	
	Redox (S5)		Piedmont Flo					tland hydrology must be prese	ent,
	Matrix (S6)		Red Parent I	Material (F21) (MLF	RA 127, 147	7) unle	ess disturbed or problematic.	
Restrictive I	Layer (if observed) edrock):							
, , , <u> </u>	ches): 16						Hydric Soil	Present? Yes V N	o
Remarks:							Tiyano oon		
	epleted Matrix (F3) confi	rmed hydric soil.						
	opiotou maant (. 0, 001111	inioa nyano com						

Project/Site: LGEKU Glendale	City/Cour	nty: Glendale/Hardin	Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU		•	ate: Kentucky Sampling Point: SP-13
Investigator(s):Burns & McDonnell (SB & CK)	Section		
Landform (hillslope, terrace, etc.): Hillslope		· -	Convex Slope (%): 8
Subregion (LRR or MLRA): N 122 Lat: 37.			
Soil Map Unit Name: Sonora silt loam, 2 to 6 perce		Long.	
· · · · · · · · · · · · · · · · · · ·			
Are climatic / hydrologic conditions on the site typical for this			
Are Vegetation, Soil, or Hydrology s			
Are Vegetation, Soil, or Hydrology r			
SUMMARY OF FINDINGS – Attach site map	showing sampl	ing point locations,	transects, important features, etc.
Hydrophytic Vegetation Present? Yes	No 🗸		
l	NO 🗸	the Sampled Area ithin a Wetland?	Yes No ✔
Wetland Hydrology Present? Yes	10 V	ulili a Welland!	
Remarks:			
SP-13 is located adjacent to W-5. Flooded condi	tions were obser	ved at the time of the	site visit due to recent rainfall.
•			
According to the Antecedent Precipitation Tool	(APT), the area w	as experiencing wet o	conditions at the time of the survey.
HYDROLOGY			
Wetland Hydrology Indicators:		Seco	ondary Indicators (minimum of two required)
Primary Indicators (minimum of one is required; check all to	hat apply)		Surface Soil Cracks (B6)
<u> </u>	Aquatic Plants (B14		Sparsely Vegetated Concave Surface (B8)
<u> </u>	rogen Sulfide Odor (· —	Drainage Patterns (B10)
			Moss Trim Lines (B16)
	sence of Reduced Iro		Dry-Season Water Table (C2)
<u> </u>	ent Iron Reduction in	· · · —	Crayfish Burrows (C8)
	Muck Surface (C7) er (Explain in Remarl		Saturation Visible on Aerial Imagery (C9) Stunted or Stressed Plants (D1)
Iron Deposits (B5)	or (Explain in Roman		Geomorphic Position (D2)
Inundation Visible on Aerial Imagery (B7)			Shallow Aquitard (D3)
Water-Stained Leaves (B9)		_	Microtopographic Relief (D4)
Aquatic Fauna (B13)		_	FAC-Neutral Test (D5)
Field Observations:			
Surface Water Present? Yes No De			
Water Table Present? Yes No De			
Saturation Present? Yes No Del (includes capillary fringe)	oth (inches):	Wetland Hydro	ology Present? Yes No
Describe Recorded Data (stream gauge, monitoring well, a	aerial photos, previou	us inspections), if available	x
Remarks:			
No indicators of wetland hydrology were pr	esent at the tim	ne of the site visit.	

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-13
	Absolute	Dominant	Indicator	Dominance Test worksheet:
Tree Stratum (Plot size: 30 ft r)	% Cover	Species?	Status	Number of Dominant Species
1. Juniperus virginiana	20		FACU	That Are OBL, FACW, or FAC: 1 (A)
2. Quercus falcata	5	~	FACU	Total Niverban of Descinant
3.				Total Number of Dominant Species Across All Strata: 5 (B)
4				Species / torocc / till ottata.
5				Percent of Dominant Species
0				That Are OBL, FACW, or FAC: 20 (A/B)
6				Prevalence Index worksheet:
1	25%			Total % Cover of: Multiply by:
F00% - 51-1-1-1		= Total Cov		OBL species x 1 =
50% of total cover: 12.5	20% of	total cover:	3.0	FACW species x 2 =
Sapling/Shrub Stratum (Plot size: 15 ft r)				·
1				FAC species x 3 =
2				FACU species x 4 =
3				UPL species x 5 =
4				Column Totals: (A) (B)
5				Prevalence Index = B/A =
6				
7.				Hydrophytic Vegetation Indicators:
8		·		1 - Rapid Test for Hydrophytic Vegetation
9.				2 - Dominance Test is >50%
э. <u></u>				3 - Prevalence Index is ≤3.0 ¹
50% of total cover:		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
	20% 01	total cover.		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r)	35	V	FAC	Problematic Hydrophytic Vegetation ¹ (Explain)
1. Ranunculus repens				
2. Trifolium campestre	30		UPL	¹ Indicators of hydric soil and wetland hydrology must
3. Poa pratensis	20		FACU	be present, unless disturbed or problematic.
4				Definitions of Four Vegetation Strata:
5				
6				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
7				more in diameter at breast height (DBH), regardless of height.
8				
9				Sapling/Shrub – Woody plants, excluding vines, less
				than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.
10				,
11	85%			Herb – All herbaceous (non-woody) plants, regardless
F00/ - 51-1-1 42 5		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover: 42.5	20% of	total cover:	17.0	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2				
3				
4				Hydrophytic
5				Vegetation
		= Total Cov	er	Present? Yes No
50% of total cover:	20% of	total cover:		
Remarks: (Include photo numbers here or on a separate s			·	
·	,			
No indicators of hydrophytic vegetation were pr	esent at t	he time o	f the site	visit.

	ription: (Describe	to the dept	h needed to document the indic	ator or confirm	n the absence	or indicators.)	
Depth	Matrix		Redox Features				
(inches)	Color (moist)	%	Color (moist) % Ty	pe ¹ Loc ²	Texture	Rema	rks
0 - 3	10YR 3/2	90			Silty Clay Loan		_
0 - 3	10YR 5/6	10			Silty Clay Loan		
3 - 8	10YR 5/4	100			Silty Clay Loan		
8 - 20	7.5YR 5/8	100			Clay Loam		
¹Type: C=Co	oncentration, D=De	pletion, RM=	Reduced Matrix, MS=Masked Sar	nd Grains.	² Location: P	L=Pore Lining, M=Ma	trix.
Hydric Soil						ators for Problemation	
Histosol	(A1)		Dark Surface (S7)		2	cm Muck (A10) (MLF	A 147)
	oipedon (A2)		Polyvalue Below Surface (S	88) (MLRA 147 ,		Coast Prairie Redox (A	-
Black Hi	stic (A3)		Thin Dark Surface (S9) (ML	RA 147, 148)		(MLRA 147, 148)	
Hydroge	n Sulfide (A4)		Loamy Gleyed Matrix (F2)		F	Piedmont Floodplain S	oils (F19)
Stratified	d Layers (A5)		Depleted Matrix (F3)			(MLRA 136, 147)	
2 cm Mu	ick (A10) (LRR N)		Redox Dark Surface (F6)		\	ery Shallow Dark Sur	face (TF12)
Depleted	d Below Dark Surfa	ce (A11)	Depleted Dark Surface (F7))	0	Other (Explain in Rema	arks)
Thick Da	ark Surface (A12)		Redox Depressions (F8)				
Sandy M	lucky Mineral (S1)	LRR N,	Iron-Manganese Masses (F	12) (LRR N,			
MLRA	A 147, 148)		MLRA 136)				
Sandy G	Bleyed Matrix (S4)		Umbric Surface (F13) (MLR	RA 136, 122)	³ Ind	licators of hydrophytic	vegetation and
Sandy R	Redox (S5)		Piedmont Floodplain Soils (F19) (MLRA 14	18) we	etland hydrology must	be present,
	Matrix (S6)		Red Parent Material (F21) (less disturbed or prob	lematic.
Restrictive I	Layer (if observed):					
Type:			<u> </u>				
					Hydric Soil	Present? Yes	No <u>'</u>
Depth (inc	ches):				,		
Remarks:					1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		
Remarks:		hydric so	il were present at the tim	e of the site	1 -		

Project/Site: LGEKU Glenda	ale			City/Co	ounty: Glend	dale/Harc	din	Sampling	Date: 202	2-03-10
Applicant/Owner: LG&E-KU				C, .			State: Kentu			
nvestigator(s):Burns & McDo	nnell (SB &	CK)		Section					<u> </u>	
Landform (hillslope, terrace, etc								!	Slope (9	ر». 20
Subregion (LRR or MLRA): <u>N</u> ´										
										10004
Soil Map Unit Name: Sonora							NWI class	ification: NO		
Are climatic / hydrologic condition										
Are Vegetation, Soil	, or Hydro	ology	significantly	disturb	bed? A	re "Normal	Circumstances	" present? Y	/es	No 🖊
Are Vegetation, Soil	, or Hydr	ology	naturally pro	oblema	atic? (It	f needed, e	explain any ans	wers in Rema	ırks.)	
SUMMARY OF FINDING										ıres, etc.
Hydrophytic Vegetation Prese	nt? Y	es 🗸	No							
Hydric Soil Present?		es 🗸	No —		Is the Samp		Yes	✓ No	ı	
Wetland Hydrology Present?	Y	es 🗸	No —		within a We	tianu?	-			
Remarks:				I						
Wetland (W)-6 is a farme										
HYDROLOGY										
Wetland Hydrology Indicato	rs:						Secondary Ind	icators (minim	num of two	required)
Primary Indicators (minimum o	of one is requ	ired; che	eck all that apply)				Surface S	oil Cracks (B6	3)	
Surface Water (A1)		_	_ True Aquatic P	lants (E	B14)		Sparsely \	egetated Cor	ncave Surfa	ace (B8)
High Water Table (A2)		_	_ Hydrogen Sulfi	de Odo	or (C1)		Drainage	Patterns (B10)	
Saturation (A3)		_	_ Oxidized Rhizo	sphere	es on Living R	oots (C3)	Moss Trim	Lines (B16)		
Water Marks (B1)		_	_ Presence of Re	educed	I Iron (C4)		Dry-Seaso	on Water Tabl	e (C2)	
Sediment Deposits (B2)		_	_ Recent Iron Re	eduction	n in Tilled Soil	ls (C6)		urrows (C8)		
Drift Deposits (B3)		_	_ Thin Muck Surf	face (C	7)		Saturation	Visible on Ae	erial Imager	y (C9)
Algal Mat or Crust (B4)		_	_ Other (Explain	in Rem	narks)			Stressed Pla		
Iron Deposits (B5)							Geomorph	nic Position (D	02)	
Inundation Visible on Aeri	al Imagery (B	7)					Shallow A	quitard (D3)		
Water-Stained Leaves (BS	€)						Microtopo	graphic Relief	f (D4)	
Aquatic Fauna (B13)							FAC-Neut	ral Test (D5)		
Field Observations:										
Surface Water Present?			Depth (inches							
Water Table Present?			Depth (inches							
Saturation Present?	Yes 🔽	No	Depth (inches): <u>10</u>		Wetland H	lydrology Pres	ent? Yes_	No	o
(includes capillary fringe) Describe Recorded Data (stre	am gauge, m	onitoring	well, aerial photo	os, prev	vious inspection	ons), if ava	ilable:			
Remarks:										
Remarks.										
One primary and two s	econdary	indica	tors confirme	ed we	etland hyd	rology.				

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-14
	Absolute	Dominant	Indicator	Dominance Test worksheet:
<u>Tree Stratum</u> (Plot size: 30 ft r) 1.	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)
2				
3				Total Number of Dominant Species Across All Strata: 2 (B)
4				opecies notes shire diluta.
5.				Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)
6				That Are OBL, FACW, or FAC: 50 (A/B)
7				Prevalence Index worksheet:
1.		= Total Cov		Total % Cover of: Multiply by:
50% of total cover:				OBL species $0 x 1 = 0$
Sapling/Shrub Stratum (Plot size: 15 ft r)	20 70 01	total cover.		FACW species $0 \times 2 = 0$
1				FAC species 30 x 3 = 90
				FACU species 15 x 4 = 60
2				UPL species $0 x 5 = 0$
3				Column Totals: 45 (A) 150 (B)
4				
5				Prevalence Index = B/A = 3.33
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
50% of total cover:	20% of	total cover:		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r)	25		FAC	Problematic Hydrophytic Vegetation ¹ (Explain)
1. Panicum capillare	25 15		FACU	
2. Poa pratensis	5			¹ Indicators of hydric soil and wetland hydrology must
3. Rumex crispus	5		FAC	be present, unless disturbed or problematic.
4				Definitions of Four Vegetation Strata:
5				The Mandage and discovering Circ (7 Com)
6				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of
7				height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11				Herb – All herbaceous (non-woody) plants, regardless
	45%	= Total Cov	er	of size, and woody plants less than 3.28 ft tall.
50% of total cover: 22.5	20% of	total cover:	9.0	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2				
3				
4				Hydrophytia
5				Hydrophytic Vegetation
		= Total Cov	er	Present? Yes V No No
50% of total cover:	20% of	total cover:		
Remarks: (Include photo numbers here or on a separate s	heet.)			1
Vegetation was disturbed from farming, dea	id soybe	ans from	the pre	vious year present. Due
to the position in the landscape and the pre	sence of	hydric s	oil and v	vetland hydrology, we
assume the vegetation would be hydrophyti		-		
assume the vegetation would be hydrophyti	C II HOL U	natui DEU	•	

Profile Desc	ription: (Describe	to the de	oth needed to docu	ment the	indicator	or confirn	n the absence	of indicators.)	
Depth	Matrix		Redo	x Feature	es				
(inches)	Color (moist)	%	Color (moist)	%	Type ¹	Loc ²	Texture	Remarks	
0 - 4	2.5Y 5/3	99	7.5YR 5/6	1	С	М	Sandy Clay Loa		
4 - 10	2.5Y 5/2	90	5YR 4/6	10	С	М	Clay Loam	-	
10 - 20	2.5Y 5/2	85	10YR 6/8	10	С	М	Clay Loam	-	
10 - 20			5YR 4/6	5	<u>C</u>	<u>M</u>			
	-							-	
								-	
		letion, RM	=Reduced Matrix, M	S=Maske	d Sand G	rains.		L=Pore Lining, M=Matrix.	3.
Hydric Soil	Indicators:							ators for Problematic Hydric Soils	s*:
Histosol			Dark Surface					cm Muck (A10) (MLRA 147)	
	pipedon (A2)		Polyvalue Be				, 148) C	Coast Prairie Redox (A16)	
Black Hi	stic (A3)		Thin Dark Su	•	, .	147, 148)		(MLRA 147, 148)	
Hydroge	n Sulfide (A4)		Loamy Gleye		(F2)		P	riedmont Floodplain Soils (F19)	
Stratified	d Layers (A5)		Depleted Ma	atrix (F3)				(MLRA 136, 147)	
2 cm Mu	ick (A10) (LRR N)		Redox Dark	Surface (F6)		v	ery Shallow Dark Surface (TF12)	
Depleted	d Below Dark Surfac	e (A11)	Depleted Da	ırk Surfac	e (F7)		C	Other (Explain in Remarks)	
Thick Da	ark Surface (A12)		Redox Depre	essions (F	- 8)				
Sandy M	lucky Mineral (S1) (I	RR N,	Iron-Mangar	nese Mass	ses (F12)	(LRR N,			
MLRA	A 147, 148)		MLRA 13			-			
	Bleyed Matrix (S4)		Umbric Surfa	•	(MLRA 1	36. 122)	³ Ind	icators of hydrophytic vegetation ar	ıd
					-	-		, , , ,	-
Sandy Redox (S5) Piedmont Floodplain Soils (F19) (MLRA 148) wetland hydrology must be present,									
Stripped Matrix (S6) Red Parent Material (F21) (MLRA 127, 147) unless disturbed or problematic.									
			Red Parent	Materiai (i	F21) (WILF	KA 121, 14	7) un	less disturbed or problematic.	
Restrictive I	Matrix (S6) Layer (if observed):		Red Parent I	Materiai (i	F21) (MILF	KA 127, 14	7) un	less disturbed or problematic.	
	_ayer (if observed):		Red Parent I	матепаі (І	-21) (WL F	KA 127, 14	Hydric Soil	·	
Type: Depth (inc	_ayer (if observed):		Red Parent I	матепаі (і	F21) (MLF	KA 127, 14		·	
Type: Depth (incomercial)	_ayer (if observed):				-21) (Mil	KA 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):		Red Parent I		-21) (WILF	KA 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				-21) (ML F	KA 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				-21) (ML F	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				-21) (ML F	KA 127, 14.		·	_
Restrictive I Type: Depth (incommerce) Remarks:	Layer (if observed):				-21) (ML F	KA 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				F21) (MLF	KA 127, 14.		·	
Restrictive I Type: Depth (incommerce) Remarks:	Layer (if observed):				- <u>-</u> 21) (ML P	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				- <u>-</u>	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				- <u>-</u>	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				- <u>-</u>	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				- <u>-</u>	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				- <u>/</u> 21) (MLF	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				- <u>/</u> 21) (MLF	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				<u>-</u> 21) (WLF	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				<u>-</u> 21) (WLF	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				<u>-</u> 21) (WLF	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				<u>-</u> 21) (WLF	(A 127, 14.		·	
Type: Depth (incomercial)	Layer (if observed):				- <u>-</u>	(A 127, 14.		·	
Type: Depth (incommerce)	Layer (if observed):				- <u>-</u>	(A 127, 14.		·	
Type: Depth (incommerce)	Layer (if observed):				- <u></u>	(A 127, 14.		·	
Type: Depth (incommerce)	_ayer (if observed):				- <u>-</u>	(A 127, 14.		·	
Type: Depth (incommerce)	_ayer (if observed):				- <u>-</u>	(A 127, 14.		·	
Type: Depth (incommerce)	_ayer (if observed):				- <u>-</u>	(A 127, 14.		·	
Restrictive I Type: Depth (incommerce) Remarks:	_ayer (if observed):				- <u>-</u>	(A 127, 14.		·	
Type: Depth (incommerce)	_ayer (if observed):				<u>-</u> 21) (WLF	(A 127, 14.		·	

Project/Site: LGEKU Glendale City/C	County: Glendale/Hardin Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU	State: Kentucky Sampling Point: SP-15
Investigator(s):Burns & McDonnell (SB & CK) Section	
Landform (hillslope, terrace, etc.): Hillslope Local rel	
Subregion (LRR or MLRA): N 122 Lat: 37.6123179	
Soil Map Unit Name: Sonora silt loam, 6 to 12 percent slopes	
Are climatic / hydrologic conditions on the site typical for this time of year?	
Are Vegetation, Soil, or Hydrology significantly distur	
Are Vegetation, Soil, or Hydrology naturally problem	
	npling point locations, transects, important features, etc.
Hydrophytic Vegetation Present? Hydric Soil Present? Yes No V	Is the Sampled Area
Tryunc 3011 Fresent:	within a Wetland? Yes No
Wetland Hydrology Present? Yes No 🗸	
SP-15 is located adjacent to W-6. Flooded conditions were ob According to the Antecedent Precipitation Tool (APT), the are	
HYDROLOGY	
Wetland Hydrology Indicators:	Secondary Indicators (minimum of two required)
Primary Indicators (minimum of one is required; check all that apply)	Surface Soil Cracks (B6)
Surface Water (A1) True Aquatic Plants	· · · · · · · · · · · · · · · · · · ·
High Water Table (A2) Hydrogen Sulfide Oc Saturation (A3) Oxidized Rhizospher	· ,
Saturation (A3) Oxidized Rhizospher Water Marks (B1) Presence of Reduce	
Sediment Deposits (B2) Recent Iron Reduction	
Drift Deposits (B3) Thin Muck Surface (· · · · · · · · · · · · · · · · · · ·
Algal Mat or Crust (B4) Other (Explain in Re	marks) Stunted or Stressed Plants (D1)
Iron Deposits (B5)	Geomorphic Position (D2)
Inundation Visible on Aerial Imagery (B7)	Shallow Aquitard (D3)
Water-Stained Leaves (B9)	Microtopographic Relief (D4)
Aquatic Fauna (B13)	FAC-Neutral Test (D5)
Field Observations:	
Surface Water Present? Yes No Depth (inches): Water Table Present? Yes No Depth (inches):	
Water Table Present? Yes No Depth (inches): Saturation Present? Yes No Depth (inches): Depth (inches):	
(includes capillary fringe)	
Describe Recorded Data (stream gauge, monitoring well, aerial photos, pre	evious inspections), if available:
Remarks:	
No indicators of wetland hydrology were present at the	time of the site visit.

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-15
		Dominant	Indicator	Dominance Test worksheet:
<u>Tree Stratum</u> (Plot size: 30 ft r) 1.	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)
2				That rice obe, thow, of the
				Total Number of Dominant
3		-		Species Across All Strata: 1 (B)
4		-		Percent of Dominant Species
5		-		That Are OBL, FACW, or FAC: 0 (A/B)
6				Prevalence Index worksheet:
7				
	:	= Total Cov	er	Total % Cover of: Multiply by:
50% of total cover:	20% of	total cover		OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)				FACW species x 2 =
1				FAC species x 3 =
2				FACU species x 4 =
3				UPL species x 5 =
4				Column Totals: (A) (B)
5				Prevalence Index = B/A =
6		-	· 	Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
	:	= Total Cov	er	4 - Morphological Adaptations ¹ (Provide supporting
50% of total cover:	20% of	total cover		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r)				•
1. Poa pratensis	80	~	FACU	Problematic Hydrophytic Vegetation ¹ (Explain)
2. Rumex crispus	5		FAC	
3				¹ Indicators of hydric soil and wetland hydrology must
4.				be present, unless disturbed or problematic.
				Definitions of Four Vegetation Strata:
5		-		Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
				more in diameter at breast height (DBH), regardless of
7				height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11				Herb – All herbaceous (non-woody) plants, regardless
	85%	= Total Cov	er	of size, and woody plants less than 3.28 ft tall.
50% of total cover: 42.5	20% of	total cover	17.0	West to the All and the controller COOR's
Woody Vine Stratum (Plot size: 30 ft r)				Woody vine – All woody vines greater than 3.28 ft in height.
1.				nogne.
2				
3		-		
4		-		
		-		Hydrophytic
5				Vegetation Present? Yes No
F00/ -51-1-1		= Total Cov		11636Ht1 163 NO
50% of total cover:		total cover		
Remarks: (Include photo numbers here or on a separate s	sheet.)			
No indicators of hydrophytic vegetation wer	e nresen	nt at the	time of t	he site visit. Vegetation
	=			
was disturbed from farming, dead soybeans	from the	e previou	ıs year v	vere present.

Profile Desc	ription: (Describe	to the depti	h needed to docu	ment the i	ndicator o	or confirm	n the absence of in	dicators.)	
Depth	Matrix			ox Features	s				
(inches)	Color (moist)	%	Color (moist)	%	Type ¹	Loc ²	<u>Texture</u>	Remar	ks
0 - 20	2.5Y 4/3	100					Silty Clay Loan		
-									
_									
	-								
-									
_									
-		 .							
	-								
¹Type: C=Ce	oncentration, D=De	oletion. RM=F	Reduced Matrix. M	S=Masked	Sand Gra	ains.	² Location: PL=Poi	re Lining, M=Ma	trix.
Hydric Soil		,	,						: Hydric Soils ³ :
Histosol	(A1)		Dark Surfac	e (S7)			2 cm N	luck (A10) (MLR	A 147)
	oipedon (A2)		Polyvalue B		ce (S8) (M	ILRA 147,		Prairie Redox (A	
Black Hi	stic (A3)		Thin Dark S					RA 147, 148)	•
Hydroge	n Sulfide (A4)		Loamy Gley	ed Matrix (I	F2)		Piedmo	ont Floodplain S	oils (F19)
Stratified	d Layers (A5)		Depleted Ma	atrix (F3)			(ML	RA 136, 147)	
	ick (A10) (LRR N)		Redox Dark	,	,			hallow Dark Sur	,
	Below Dark Surfac	ce (A11)	Depleted Da		. ,		Other (Explain in Rema	ırks)
	ark Surface (A12)		Redox Depr		•	DD 11			
	lucky Mineral (S1) (LKK N,	Iron-Mangai		es (F12) (I	LKK N,			
	A 147, 148) Gleyed Matrix (S4)		MLRA 1: Umbric Surf	•	MI DA 13	6 122\	³ Indicator	s of hydrophytic	vegetation and
	ledox (S5)		Piedmont FI					hydrology must	
	Matrix (S6)		Red Parent					listurbed or prob	•
	_ayer (if observed)	:		(1	/ (, , , , ,	1		
Type:									
Depth (in							Hydric Soil Pres	ent? Yes	No 🗸
Remarks:							,		
	o indicators of	hydric co	il were preser	nt at the	time of	the cite	vicit		
i N	o indicators or	riyuric so	ii wele presei	it at tile	time or	tile site	visit.		
1									

Project/Site: LGEKU Glendale	City/County: Glendale/Ha	ardin Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU		State: Kentucky Sampling Point: SP-16
Investigator(s):Burns & McDonnell (SB & CK)	Section. Township. Range:	
Landform (hillslope, terrace, etc.): Hillslope		
Subregion (LRR or MLRA): N 122 Lat:		85.8734014 Datum: WGS 84
Soil Map Unit Name: Sonora silt loam, 2 to 6 per		NWI classification: No
Are climatic / hydrologic conditions on the site typical for		
Are Vegetation, Soil, or Hydrology		nal Circumstances" present? Yes No
Are Vegetation, Soil, or Hydrology		
SUMMARY OF FINDINGS – Attach site ma	p snowing sampling point loca	tions, transects, important features, etc.
Hydrophytic Vegetation Present? Yes	No <u>V</u> Is the Sampled Area	.
Hydric Soil Present? Yes	No within a Wetland?	Yes No 🗸
Wetland Hydrology Present? Yes	No 🔽	
Remarks:		
SP-16 is a test pit adjacent to standing water. Flood	ed conditions were observed at the tim	ne of the site visit due to recent rainfall.
	- \	
According to the Antecedent Precipitation Tool (AP	i), the area was experiencing wet cond	litions at the time of the survey.
HYDROLOGY		
Wetland Hydrology Indicators:		Secondary Indicators (minimum of two required)
Primary Indicators (minimum of one is required; check	all that apply)	Surface Soil Cracks (B6)
Surface Water (A1) T	rue Aquatic Plants (B14)	Sparsely Vegetated Concave Surface (B8)
High Water Table (A2)	lydrogen Sulfide Odor (C1)	Drainage Patterns (B10)
Saturation (A3) C	oxidized Rhizospheres on Living Roots (C3	B) Moss Trim Lines (B16)
Water Marks (B1) P	resence of Reduced Iron (C4)	Dry-Season Water Table (C2)
Sediment Deposits (B2) R	ecent Iron Reduction in Tilled Soils (C6)	Crayfish Burrows (C8)
	hin Muck Surface (C7)	Saturation Visible on Aerial Imagery (C9)
	other (Explain in Remarks)	Stunted or Stressed Plants (D1)
Iron Deposits (B5)		Geomorphic Position (D2)
Inundation Visible on Aerial Imagery (B7)		Shallow Aquitard (D3)
Water-Stained Leaves (B9)		Microtopographic Relief (D4)
Aquatic Fauna (B13) Field Observations:		FAC-Neutral Test (D5)
	Depth (inches):	
	Depth (inches):	
		d Hydrology Present? Yes No
(includes capillary fringe)		
Describe Recorded Data (stream gauge, monitoring we	ii, aeriai pnotos, previous inspections), if a	valiable:
Remarks:		
No indicators of wetland hydrology were	present at the time of the site v	risit
The manuactors of monanta my areas gy mone	p. 000 at and anno 0. and 0	

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-16
	Absolute		Indicator	Dominance Test worksheet:
<u>Tree Stratum</u> (Plot size: 30 ft r) 1.	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)
2				matrice obe, triow, of trio (ii)
				Total Number of Dominant
3		-		Species Across All Strata: 2 (B)
4				Percent of Dominant Species
5				That Are OBL, FACW, or FAC: 50 (A/B)
6				Prevalence Index worksheet:
7		-		Total % Cover of: Multiply by:
F00/ - f1-1-1		= Total Co		OBL species x 1 =
50% of total cover:	20% or	total cover	<u> </u>	FACW species x 2 =
Sapling/Shrub Stratum (Plot size: 15 ft r				-
1				FAC species x 3 =
2				FACU species x 4 =
3		-		UPL species x 5 =
4				Column Totals: (A) (B)
5				Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				
9				2 - Dominance Test is >50%
		= Total Co	/er	3 - Prevalence Index is ≤3.0¹
50% of total cover:				4 - Morphological Adaptations (Provide supporting
Herb Stratum (Plot size: 5 ft r)				data in Remarks or on a separate sheet)
1. Panicum capillare	30	~	FAC	Problematic Hydrophytic Vegetation¹ (Explain)
2 Poa pratensis	20	~	FACU	
3				¹ Indicators of hydric soil and wetland hydrology must
				be present, unless disturbed or problematic.
		-		Definitions of Four Vegetation Strata:
5				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
		-		more in diameter at breast height (DBH), regardless of
7				height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11				Herb – All herbaceous (non-woody) plants, regardless
		= Total Co		of size, and woody plants less than 3.28 ft tall.
	20% of	total cover	10.0	Woody vine – All woody vines greater than 3.28 ft in height.
1				
2				
3				
4				III to at go
5				Hydrophytic Vegetation
		= Total Co	/er	Present? Yes No
50% of total cover:				
Remarks: (Include photo numbers here or on a separate s				
No indicators of hydrophytic vegetation wer	,	it at the	time of t	he site visit. Vegetation
· · · · · ·	- p. 00011			
was disturbed due to farming.				

Profile Desc	ription: (Describe	to the dep	oth needed to docu	ment the	indicator	or confirn	n the absence	of indicato	rs.)	
Depth	Matrix		Redo	x Feature						
(inches)	Color (moist)	%	Color (moist)	%	Type ¹	Loc ²	Texture		Remark	8
0 - 2	10YR 4/4	100					Silty Clay Loan			_
2 - 20	10YR 5/4	90	7.5YR 5/6	5	С	М	Silty Clay Loan			
2 - 20	-		10YR 7/4	5	D	M				-
			1011(7)4	<u> </u>						
	-				· ·					
-										
-										
	•				. —		-			
-										
¹Type: C=Co	oncentration D=De	nletion RM	=Reduced Matrix, M	S=Maske	d Sand G	rains	² Location: P	I =Pore I inir	ng M=Matri	x
Hydric Soil		piotion, raivi	rtoddod Matrix, W	o maono.	a cana c	unio.				Hydric Soils ³ :
Histosol			Dark Surface	e (S7)				cm Muck (A		-
	oipedon (A2)		Polyvalue Be		ce (S8) (MLRA 147.		Coast Prairie		
Black Hi			Thin Dark Su					(MLRA 147	•	,
	n Sulfide (A4)		Loamy Gleye				F	Piedmont Flo	odplain Soi	ls (F19)
Stratified	d Layers (A5)		Depleted Ma	trix (F3)				(MLRA 136	6, 147)	
	ıck (A10) (LRR N)		Redox Dark		•			ery Shallow		
-	d Below Dark Surfa	ce (A11)	Depleted Da				c	Other (Explain	n in Remarl	(S)
	ark Surface (A12)		Redox Depre							
	Mucky Mineral (S1)	LRR N,	Iron-Mangan		es (F12)	(LRR N,				
	A 147, 148) Bleyed Matrix (S4)		MLRA 13	•	(MLDA4	26 422\	3100	liantara of hu	dranhidia	agatation and
Sandy G			Umbric Surfa Piedmont Flo					etland hydrol		egetation and
	Matrix (S6)		Red Parent I					less disturbe		•
	Layer (if observed		red r diener	viateriai (i	21) (INL	(A 121, 141	1) (1)	icos distarbe	a or probic	matic.
Type:		<i>,</i> -								
Depth (in	ohoo):						Uvdria Cail	Present?	Yes	No <u>′</u>
	Liles)						riyuric 30ii	FIESCIII	163	NO
Remarks:	. :	la contrat a la	-9			£ 41 :4 -				
IN:	o indicators of	nyaric s	oil were presen	t at the	time o	r the site	e visit.			
1										

Project/Site: LGEKU Glendale	City/C	county: Glendale/Hardi	n .	Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU	·			Sampling Point: SP-17
Investigator(s):Burns & McDonnell (SB & CK)	Section		· · · · · · · · · · · · · · · · · · ·	_ ,
Landform (hillslope, terrace, etc.): Depression		• •		Slope (%):_4
		Long:85.8		Datum: WGS 84
Soil Map Unit Name: Melvin silt loam				ation: R4SBC
Are climatic / hydrologic conditions on the site typi	ical for this time of year? Y	es No (If		
Are Vegetation, Soil, or Hydrology				resent? Yes No
Are Vegetation, Soil, or Hydrology			plain any answers	
SUMMARY OF FINDINGS – Attach si			-	•
V		7 37		
Hydrophytic Vegetation Present? Hydric Soil Present? Yes Yes	No	Is the Sampled Area		
Tryunc con riesent:	No —	within a Wetland?	Yes _	No
Wetland Hydrology Present? Yes	<u> No</u>			
Remarks:				
Wetland (W)-8 is a palustrine emergent (PEM) wetland. Flooded condi	itions were observed at t	the time of the si	ite visit due to recent rainfall.
A undituru da de la Auda - andaud Dunasiu idadia u Ta	al (ADT) the area was a			Ala
According to the Antecedent Precipitation To	or (APT), the area was ex	speriencing wet condition	ns at the time of	the survey.
HYDROLOGY				
Wetland Hydrology Indicators:		<u> </u>	Secondary Indicate	ors (minimum of two required)
Primary Indicators (minimum of one is required;	check all that apply)		Surface Soil C	Cracks (B6)
Surface Water (A1)	True Aquatic Plants (B14)	Sparsely Vege	etated Concave Surface (B8)
✓ High Water Table (A2)	Hydrogen Sulfide Odd		Drainage Patt	
✓ Saturation (A3)	✓ Oxidized Rhizosphere	es on Living Roots (C3)	Moss Trim Lin	nes (B16)
Water Marks (B1)	Presence of Reduced		Dry-Season W	Vater Table (C2)
Sediment Deposits (B2)	Recent Iron Reductio	n in Tilled Soils (C6)	Crayfish Burro	ows (C8)
Drift Deposits (B3)	Thin Muck Surface (C	C7)	Saturation Vis	sible on Aerial Imagery (C9)
Algal Mat or Crust (B4)	Other (Explain in Ren			ressed Plants (D1)
Iron Deposits (B5)		-	Geomorphic F	Position (D2)
Inundation Visible on Aerial Imagery (B7)		-	Shallow Aquita	ard (D3)
Water-Stained Leaves (B9)		_		phic Relief (D4)
Aquatic Fauna (B13)		-	FAC-Neutral T	Test (D5)
Field Observations:				
Surface Water Present? Yes No _	Depth (inches):			
	Depth (inches):1			,
	Depth (inches): 0	Wetland Hy	drology Present	? Yes / No
(includes capillary fringe) Describe Recorded Data (stream gauge, monitor	ring well, aerial photos, pre	vious inspections), if availa	able:	
Remarks:				
Three primary indicators and three s	econdary indicators	s confirmed wetland	l hydrology.	

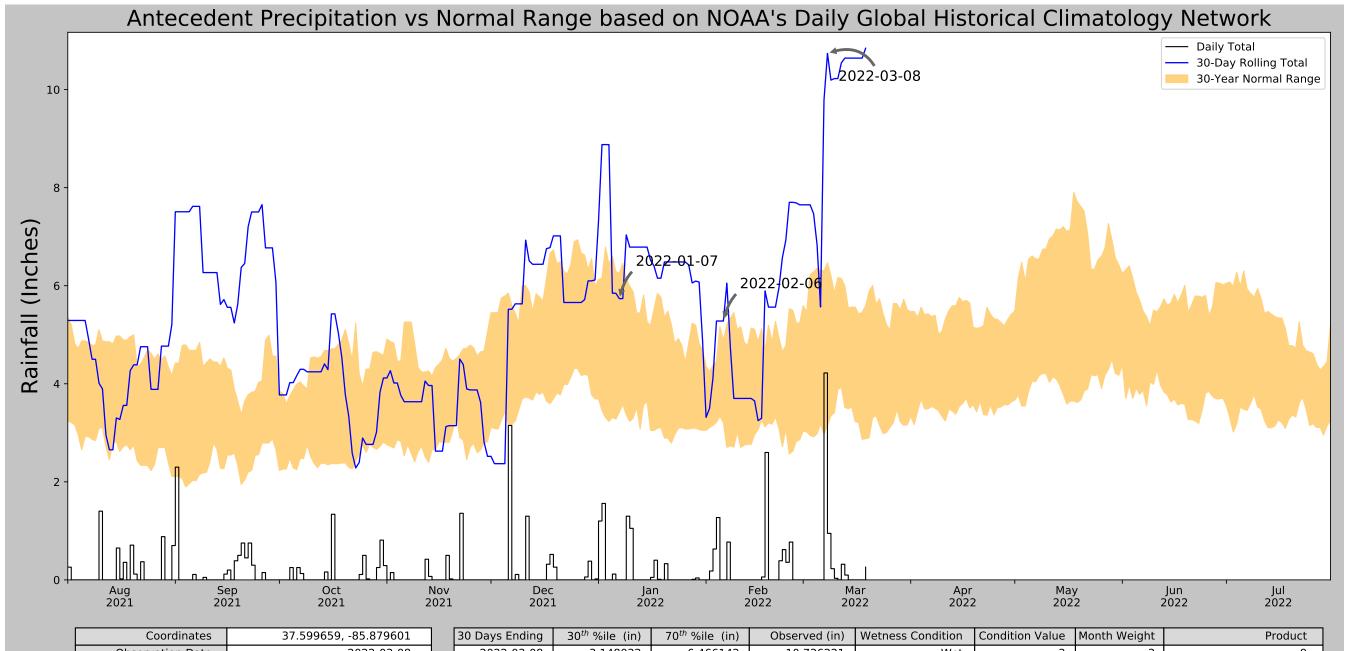
/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-17
	Absolute	Dominant	Indicator	Dominance Test worksheet:
<u>Tree Stratum</u> (Plot size: 30 ft r) 1.	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)
2				
3				Total Number of Dominant Species Across All Strata: 3 (B)
4				opecies Across Air otrata.
5.				Percent of Dominant Species That Are ORL FACW or FAC: 100 (A/R)
6				That Are OBL, FACW, or FAC: 100 (A/B)
7.				Prevalence Index worksheet:
1.	-	= Total Cov		Total % Cover of: Multiply by:
50% of total cover:				OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)				FACW species x 2 =
1				FAC species x 3 =
2				FACU species x 4 =
3				UPL species x 5 =
				Column Totals: (A) (B)
4				()
5				Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				✓ 2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0 ¹
F00/ -f4-4-1		= Total Cov		4 - Morphological Adaptations ¹ (Provide supporting
50% of total cover:	20% 01	total cover:		data in Remarks or on a separate sheet)
Herb Stratum (Plot size: 5 ft r) 1. Carex sp.	30	~	FACW	Problematic Hydrophytic Vegetation ¹ (Explain)
1. Carex sp. 2. Panicum virgatum	25		FAC	
3. Scirpus atrovirens	20		OBL	¹ Indicators of hydric soil and wetland hydrology must
	15		FACW	be present, unless disturbed or problematic.
4. Ludwigia alternifolia	5		FACU	Definitions of Four Vegetation Strata:
_{5.} Poa pratensis			FACO	Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
6				more in diameter at breast height (DBH), regardless of
7				height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9				than 3 in. DBH and greater than or equal to 3.28 ft (1
10				m) tall.
11				Herb – All herbaceous (non-woody) plants, regardless
		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover: 47.5 Woody Vine Stratum (Plot size: 30 ft r)	20% of	total cover:	19.0	Woody vine – All woody vines greater than 3.28 ft in height.
1				· · · · · · · · · · · · · · · · · · ·
2				
3				
4. <u> </u>				Hadaa ahadia
5. <u> </u>				Hydrophytic Vegetation
		= Total Cov	 er	Present? Yes V No
50% of total cover:	20% of	total cover:		
Remarks: (Include photo numbers here or on a separate s	sheet.)			
The Dominance Test confirmed hydrophytic	vegetat	ion. Care	x sp. cc	ould not be identified to
the species level. Due to the presence of hy	dric soil	wetland	hvdrolo	pay, and other
nydrophytic vegetation, it is assumed to be		Wottand	, α. σ. σ	9), 4.14 01.16.

Profile Desc	ription: (Describe	to the de	pth needed to docur	nent the	indicator	or confirm	the absence	of indicators.)
Depth	Matrix		Redo	x Feature	:S			
(inches)	Color (moist)	%	Color (moist)	%	Type ¹	Loc ²	Texture	Remarks
0 - 2	10YR 6/2	98	10YR 5/8	2	С	PL / M	Silty Clay Loan	
2 - 16	2.5Y 6/1	90	10YR 6/8	10	С	PL / M	Silty Clay Loan	
16 - 20	2.5Y 6/1	50	7.5YR 5/6	10	С	PL / M	Clay Loam	
16 - 20	5Y 2.5/1	40					Silty Clay Loan	
-								
-								
-								
-	-							
-	-							
		_						
¹Type: C=Ce	oncentration, D=De	pletion, RM	I=Reduced Matrix, MS	S=Maske	d Sand G	rains.	² Location: Pl	L=Pore Lining, M=Matrix.
Hydric Soil		,	,					ators for Problematic Hydric Soils ³ :
Histosol			Dark Surface	(S7)				cm Muck (A10) (MLRA 147)
	oipedon (A2)		Polyvalue Be		ice (S8) (I	MLRA 147,		oast Prairie Redox (A16)
Black Hi			Thin Dark Su				, <u>—</u>	(MLRA 147, 148)
Hydroge	n Sulfide (A4)		Loamy Gleye				P	iedmont Floodplain Soils (F19)
Stratified	d Layers (A5)		✓ Depleted Ma	trix (F3)				(MLRA 136, 147)
2 cm Mu	ick (A10) (LRR N)		Redox Dark	Surface (I	=6)			ery Shallow Dark Surface (TF12)
Depleted	d Below Dark Surface	ce (A11)	Depleted Da	rk Surface	e (F7)		0	ther (Explain in Remarks)
Thick Da	ark Surface (A12)		Redox Depre	essions (F	8)			
Sandy N	lucky Mineral (S1)	LRR N,	Iron-Mangan	ese Mass	es (F12)	(LRR N,		
MLRA	\ 147, 148)		MLRA 13					
	Gleyed Matrix (S4)		Umbric Surfa	ice (F13)	(MLRA 1	36, 122)	³ Indi	icators of hydrophytic vegetation and
Sandy R	tedox (S5)		Piedmont Flo	odplain S	Soils (F19)	(MLRA 14	I8) we	tland hydrology must be present,
Stripped	Matrix (S6)		Red Parent N	Material (F	21) (MLF	RA 127, 147	7) unl	less disturbed or problematic.
Restrictive I	_ayer (if observed)):						
Type:								
Depth (in	ches):						Hydric Soil	Present? Yes No
Remarks:								
D.	epleted Matrix	(F3) co	nfirmed hydric s	oil.				

Project/Site: LGEKU Glendale	City/C	ounty: Glendale/Hardin	Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU	•		entucky Sampling Point: SP-18
Investigator(s):Burns & McDonnell (S	B & CK) Section		
Landform (hillslope, terrace, etc.): Hillsl	ope Local reli	ef (concave, convex, none): Conve	ex Slope (%): 5
Subregion (LRR or MLRA): N 122			
Soil Map Unit Name: Sonora silt loan			
Are climatic / hydrologic conditions on the		<u> </u>	
Are Vegetation, Soil, or H			
Are Vegetation, Soil, or H			
SUMMARY OF FINDINGS – At			
Hydrophytic Vegetation Present?	Yes No V	Is the Sampled Area	
Hydric Soil Present? Wetland Hydrology Present?	Yes No No	within a Wetland?	es No <u>~</u>
Remarks:			
SP-18 is located adjacent to W-8	3. Flooded conditions were ob	served at the time of the site v	risit due to recent rainfall.
,			
According to the Antecedent Pre	cipitation Tool (APT), the area	a was experiencing wet condit	ions at the time of the survey.
HYDROLOGY			
Wetland Hydrology Indicators:		Secondary	Indicators (minimum of two required)
Primary Indicators (minimum of one is r	equired; check all that apply)		e Soil Cracks (B6)
Surface Water (A1)	True Aquatic Plants (ely Vegetated Concave Surface (B8)
High Water Table (A2)	Hydrogen Sulfide Odo	• •	ge Patterns (B10)
Saturation (A3)	Oxidized Rhizosphere		Frim Lines (B16)
Water Marks (B1)	Presence of Reduced		eason Water Table (C2)
Sediment Deposits (B2) Drift Deposits (B3)	Recent Iron Reductio Thin Muck Surface (C	• • • •	sh Burrows (C8) tion Visible on Aerial Imagery (C9)
Algal Mat or Crust (B4)	Other (Explain in Ren		d or Stressed Plants (D1)
Iron Deposits (B5)	<u> </u>		orphic Position (D2)
Inundation Visible on Aerial Imager	ry (B7)		w Aquitard (D3)
Water-Stained Leaves (B9)		Microto	opographic Relief (D4)
Aquatic Fauna (B13)		FAC-N	leutral Test (D5)
Field Observations:	.,		
	No Depth (inches):		
	No Depth (inches): 14		
Saturation Present? Yes (includes capillary fringe)	No Depth (inches): 10	Wetland Hydrology F	Present? Yes No
Describe Recorded Data (stream gauge	e, monitoring well, aerial photos, pre	vious inspections), if available:	
Remarks:			
One primary indicator confirm	ned wetland hydrology.		
, ,	, 0,		

/EGETATION (Four Strata) – Use scientific n	ames of	plants.		Sampling Point: SP-18
	Absolute	Dominant	Indicator	Dominance Test worksheet:
<u>Tree Stratum</u> (Plot size: 30 ft r) 1)	% Cover	Species?	Status	Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)
2				
3		-		Total Number of Dominant Species Across All Strata: 3 (B)
4				opecies Across Air otrata.
		-		Percent of Dominant Species
				That Are OBL, FACW, or FAC: 0 (A/B)
6		-		Prevalence Index worksheet:
7		T. (.) O .		Total % Cover of: Multiply by:
50% of total cover:		= Total Cov		OBL species x 1 =
Sapling/Shrub Stratum (Plot size: 15 ft r)	20 /0 01	total cover	·	FACW species x 2 =
				FAC species x 3 =
1				FACU species x 4 =
2				UPL species x 5 =
3			. ——	
4. <u> </u>				Column Totals: (A) (B)
5			. ——	Prevalence Index = B/A =
6				Hydrophytic Vegetation Indicators:
7				1 - Rapid Test for Hydrophytic Vegetation
8				2 - Dominance Test is >50%
9				3 - Prevalence Index is ≤3.0¹
		= Total Cov	er	4 - Morphological Adaptations¹ (Provide supporting
50% of total cover:	20% of	total cover		
Herb Stratum (Plot size: 5 ft r)				data in Remarks or on a separate sheet)
_{1.} Poa pratensis	30		FACU	Problematic Hydrophytic Vegetation ¹ (Explain)
_{2.} Sonchus oleraceus	10		UPL	1
3. Trifolium campestre	10	~	UPL	¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.
4.				, , ,
5				Definitions of Four Vegetation Strata:
6				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or
				more in diameter at breast height (DBH), regardless of
7		-		height.
8				Sapling/Shrub – Woody plants, excluding vines, less
9. <u> </u>				than 3 in. DBH and greater than or equal to 3.28 ft (1
10	. ———		. ——	m) tall.
11	F00/			Herb – All herbaceous (non-woody) plants, regardless
70% 64.44 25.0		= Total Cov		of size, and woody plants less than 3.28 ft tall.
50% of total cover: 25.0	20% of	total cover	10.0	Woody vine – All woody vines greater than 3.28 ft in
Woody Vine Stratum (Plot size: 30 ft r)				height.
1				
2	. ——		· ——	
3				
4				Hydrophytic
5				Vegetation
	:	= Total Cov	er	Present? Yes No
50% of total cover:	20% of	total cover		
Remarks: (Include photo numbers here or on a separate s	heet.)			
de indicatore of budroubuit constation			.:	bha aita viait Manatatian
No indicators of hydrophytic vegetation we	=			-
vas disturbed from farming. Dead soybeans	from the	e previo	us year v	were present.

0 - 5 2. 5 - 12 2. 2 - 20 2	icators: 1) 2don (A2) 3 (A3) 3 (A4) 3 (A5) 4 (A10) (LRR N) 6 (A10) (LRR N) 6 (A10) (LRR N) 6 (A12) 8 (A12) 8 (A13) 8 (A14) 9 (A14)	ace (A11) (LRR N ,	Polyvalu Thin Dar Loamy G Depleted Redox D Depleted Redox D Iron-Mar MLRA Umbric S Piedmon	2 5	ace (S8) 9) (MLRA (F2) F6) e (F7) F8) ses (F12) (MLRA	M PL / M	Indicat	Remarks =Pore Lining, M=Matrix. tors for Problematic Hydric Soils cm Muck (A10) (MLRA 147) past Prairie Redox (A16) (MLRA 147, 148) edmont Floodplain Soils (F19) (MLRA 136, 147) ery Shallow Dark Surface (TF12) ther (Explain in Remarks) cators of hydrophytic vegetation and land hydrology must be present,
5 - 12 2. 2 - 20 2	entration, D=Deicators: 1) edon (A2) : (A3) sulfide (A4) ayers (A5) (A10) (LRR N) elow Dark Surface (A12) ky Mineral (S1) 47, 148) ed Matrix (S4) ex (S5) atrix (S6)	98 95 95 epletion, RM	M=Reduced Matrix Dark Sur Polyvalu Thin Dar Loamy G Depleted Redox D Depleted Redox D Iron-Mar MLR/ Umbric S Piedmon	x, MS=Masker rface (S7) e Below Surface ck Surface (S8 Gleyed Matrix d Matrix (F3) Dark Surface (d Dark Surface) depressions (Faganese Mass A 136) Surface (F13) at Floodplain S	d Sand (Care (S8) (MLRA) (F2) (MLRA) (MLRA) (MLRA) (MLRA) (MLRA) (MLRA) (MLRA) (MLRA) (MLRA)	PL / M PL	Silty Clay Loan	tors for Problematic Hydric Soils of Muck (A10) (MLRA 147) past Prairie Redox (A16) (MLRA 147, 148) past Property (MLRA 147, 148) past Property (MLRA 147, 148) past Property (MLRA 136, 147) part Shallow Dark Surface (TF12) part (Explain in Remarks) past of hydrophytic vegetation and land hydrology must be present,
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trictive Laye				onic material (7) unle	ess disturbed or problematic.
•		1):			21)(1112	101121, 141	1, 4,110	see dictarged of problematic.
	-							
Depth (inches	s):						Hydric Soil I	Present? Yes No 🗸
narks:							<u> </u>	
No in	ndicators of	r nyarıc s	soil were pres	sent at the	e time d	of the site	e VISIT.	



Coordinates	37.599659, -85.879601
Observation Date	2022-03-08
Elevation (ft)	738.25
Drought Index (PDSI)	Severe wetness (2022-02)
WebWIMP H₂O Balance	Wet Season

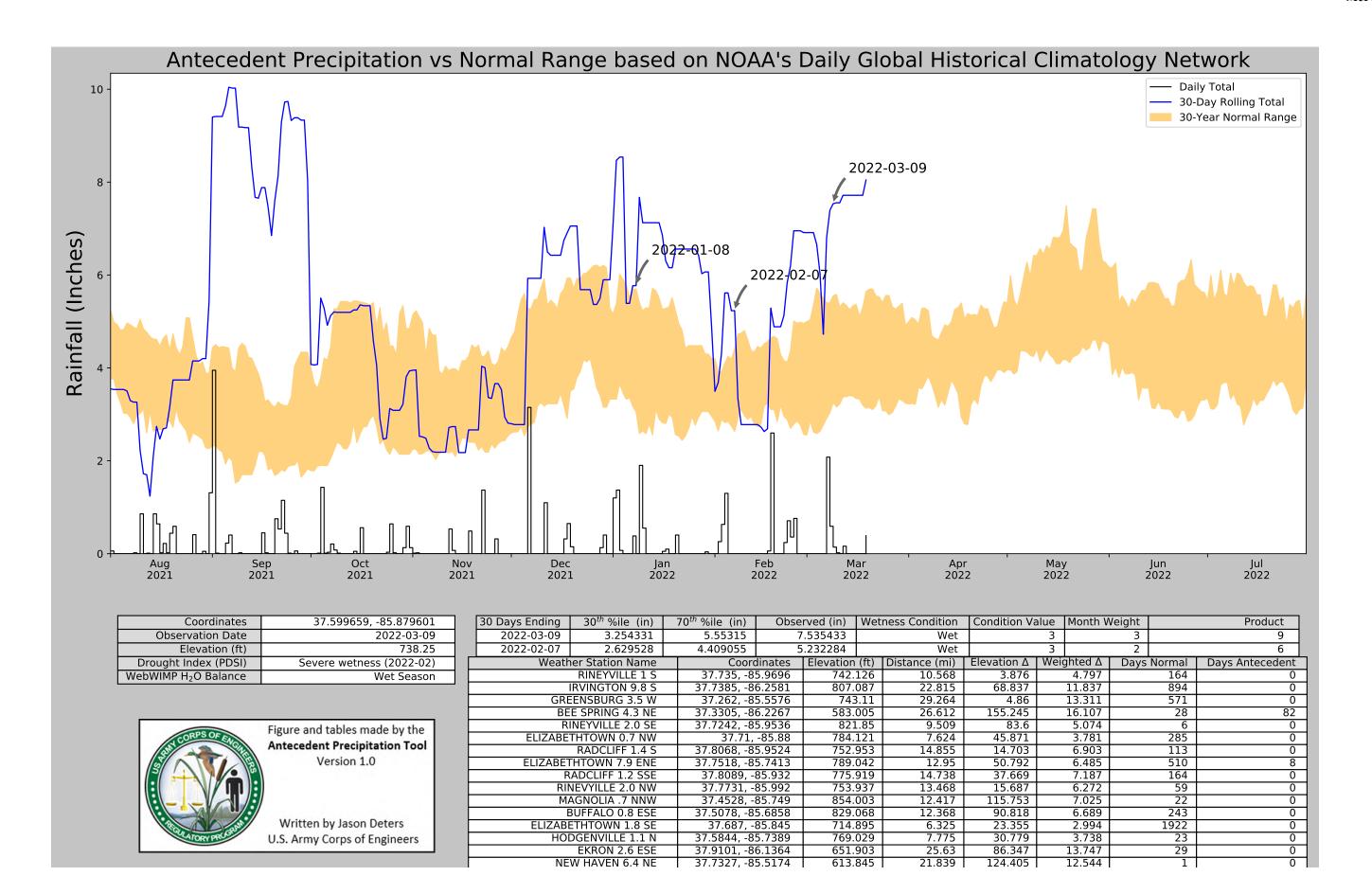
30 Days Ending	30 th %ile (in)	70 th %ile (in)	Observed (in)	Wetness Condition	Condition Value	Month Weight	Product
2022-03-08	3.148032	6.466142	10.736221	Wet	3	3	9
2022-02-06	3.206693	4.879921	5.279528	Wet	3	2	6
2022-01-07	3.420866	6.251969	5.736221	Normal	2	1	2
Result							Wetter than Normal - 17

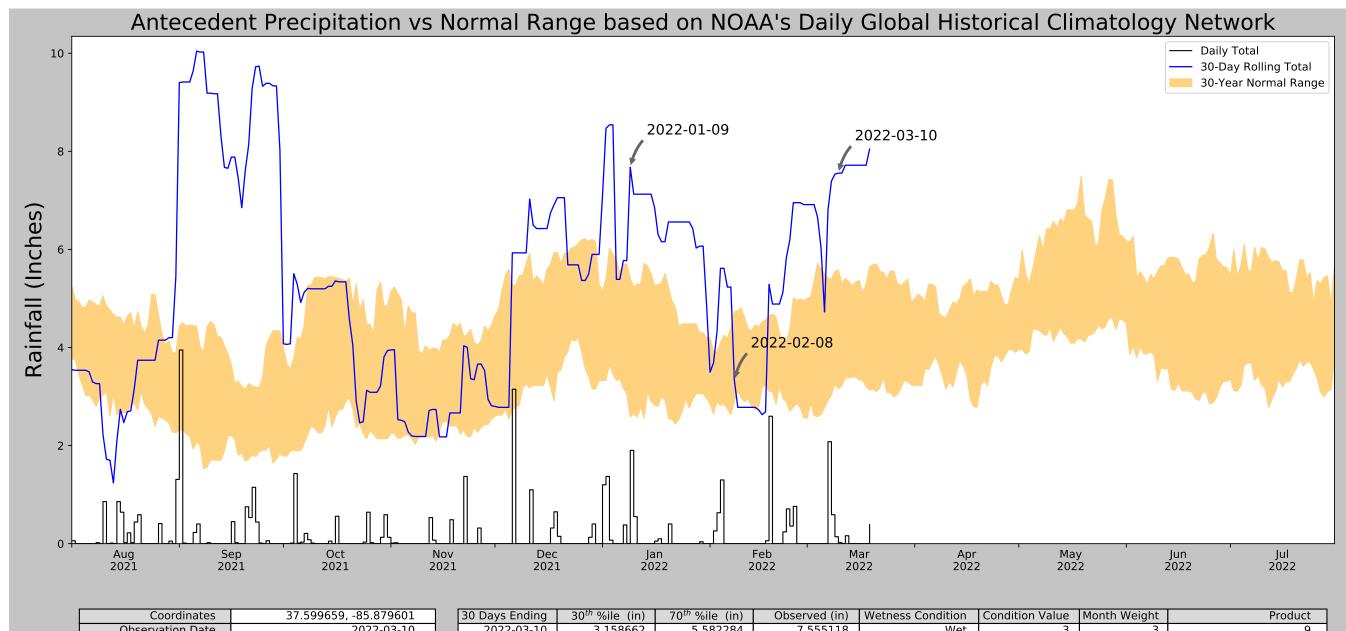


Figure and tables made by the Antecedent Precipitation Tool Version 1.0

Written by Jason Deters U.S. Army Corps of Engineers

Weather Station Name	Coordinates	Elevation (ft)	Distance (mi)	Elevation Δ	Weighted Δ	Days Normal	Days Antecedent
NOLIN RVR LAKE	37.2814, -86.2497	623.032	29.929	115.218	16.917	11188	63
BEE SPRING 4.3 NE	37.3305, -86.2267	583.005	3.62	40.027	1.774	0	21
LEITCHFIELD 2 N	37.5108, -86.2892	620.079	15.998	2.953	7.246	165	0
MILLERSTOWN 4E	37.4336, -86.0089	600.066	16.896	22.966	7.991	0	6





Coordinates	37.599659, -85.879601
Observation Date	2022-03-10
Elevation (ft)	738.25
Drought Index (PDSI)	Severe wetness (2022-02)
WebWIMP H₂O Balance	Wet Season

Fig And V. U.S.

Figure and tables made by the Antecedent Precipitation Tool Version 1.0

Written by Jason Deters U.S. Army Corps of Engineers

	2022-03-10	3.158662	5.582284		7.555118	Wet		3	3	9	
ſ	2022-02-08	2.905512	4.726378		3.330709	Normal		2	2	4	
Weather Station Name		Coord	linates	Elevation (f	:) Distance (mi)	Elevation Δ	Weighted Δ	Days Normal	Days Antecedent		
RINEYVILLE 1 S		37.735, -8	37.735, -85.9696		6 10.568	3.876	4.797	164	0		
IRVINGTON 9.8 S		37.7385, -8		807.08	7 22.815	68.837	11.837	894	0		
GREENSBURG 3.5 W		37.262, -8	5.5576	743.1		4.86	13.311	571	0		
BEE SPRING 4.3 NE		37.3305, -8		583.00	5 26.612	155.245	16.107	28	81		
		NEYVILLE 2.0 SE	37.7242, -85.9536		821.8		83.6	5.074	6	0	
ELIZABETHTOWN 0.7 NW			-85.88	784.12		45.871	3.781	285	0		
		RADCLIFF 1.4 S	37.8068, -8	37.8068, -85.9524		3 14.855	14.703	6.903	113	0	
		HTOWN 7.9 ENE		37.7518, -85.7413		2 12.95	50.792	6.485	510	9	
		ADCLIFF 1.2 SSE 37.8089, -85.93			775.91		37.669	7.187	164	0	
	RIN	INEVYILLE 2.0 NW 37.7731, -85.9			753.93		15.687	6.272	59	0	
		MAGNOLIA .7 NNW 37.4528, -85.749			854.00		115.753	7.025	22	0	
		BUFFALO 0.8 ESE	8 ESE 37.5078, -85.6858		829.06		90.818	6.689	243	0	
	ELIZABE	ELIZABETHTOWN 1.8 SE 37.687, -85.845			714.89	5 6.325	23.355	2.994	1922	0	
	HOD	OGENVILLE 1.1 N	37.5844, -8		769.02		30.779	3.738	23	0	
		EKRON 2.6 ESE	37.9101, -8		651.90		86.347	13.747	29	0	
	NE	W HAVEN 6.4 NE	37.7327, -8	5.5174	613.84	5 21.839	124.405	12.544	1	0	

Attachment 4 to Response to PSC-4 Question No. 1
Page 168 of 191
McFarland

APPENDIX C - PHOTOGRAPH LOG



Photograph C-1: View of Sample Plot (SP)-1, located in a test pit facing south.



Photograph C-2: View of SP-2, located in a test pit facing northeast.





Photograph C-3: View of SP-3, facing northwest towards farmed Wetland (W)-1.



Photograph C-4: View of SP-4, in upland, facing northwest.





Photograph C-5: View of SP-5, located in a test pit facing east.



Photograph C-6: View of SP-6, facing southeast towards PFO W-2.





Photograph C-7: View of SP-7, in upland, facing southeast.



Photograph C-8: View of SP-8, facing west towards PEM W-3.





Photograph C-9: View of SP-9, in upland, facing southwest.



Photograph C-10: View of SP-10, facing west towards PEM W-4.





Photograph C-11: View of SP-11, in upland, facing southeast.



Photograph C-12: View of SP-12, facing southwest towards PEM W-5.





Photograph C-13: View of SP-13, in upland, facing southwest.



Photograph C-14: View of SP-14, facing north towards farmed W-6.





Photograph C-15: View of SP-15, in upland, facing north.



Photograph C-16: View of SP-16, located in a test pit facing east.





Photograph C-17: View of PUB W-7, facing southeast.



Photograph C-18: View of SP-17, facing northeast towards PEM W-8.





Photograph C-19: View of SP-18, in upland, facing northeast.



Photograph C-20: View of ephemeral Stream (S)-1, facing south.





Photograph C-21: View of perennial S-2, facing east.



Photograph C-22: View of perennial S-3, facing southeast.





Photograph C-23: View of intermittent S-4, facing northeast.



Photograph C-24: View of intermittent S-5, facing northwest.





Photograph C-25: View of perennial S-6, facing east.



Photograph C-26: View of perennial S-7, facing west.



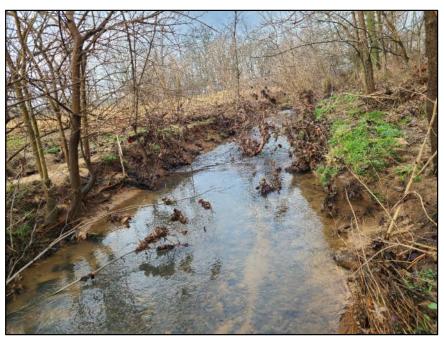


Photograph C-27: View of ephemeral S-8, facing northeast.



Photograph C-28: View of ephemeral S-9, facing southwest.





Photograph C-29: View of perennial S-10, facing west.



Photograph C-30: View of perennial S-11, facing west.





Photograph C-31: View of intermittent S-12, facing east.



Photograph C-32: View of ephemeral S-13, facing north.





Photograph C-33: View of perennial S-14, facing east.



Photograph C-34: View of intermittent S-15, facing south.





Photograph C-35: View of intermittent S-16, facing north.



Photograph C-36: View of ephemeral S-17, facing southwest.





Photograph C-37: View of intermittent S-18, facing southeast.



Photograph C-38: View of ephemeral S-19, facing west.





Photograph C-39: View of intermittent S-20, facing west.



Photograph C-40: View of ephemeral S-21, facing southwest.





Photograph C-41: View of ephemeral S-22, facing east.



Photograph C-42: View of intermittent S-23, facing west.





Photograph C-43: View of intermittent S-24, facing south.



Photograph C-44: View of intermittent S-25, facing east.





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Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 2

Responding Witness: Elizabeth J. McFarland

- Q-2. Refer to KU's response to Wade Family's Second Request, Item 7a. Confirm that KU is prepared to commit that the proposed 345 kV transmission line will be located to not interfere with the operation of the pivot irrigation system.
- A-2. Yes, KU will not locate the proposed 345 kV transmission centerline or easement in such a way that it would interfere with the existing operation of the pivot irrigation system.

Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 3

Responding Witness: Elizabeth J. McFarland

- Q-3. Refer to the Application, the Direct Testimony of Beth McFarland, page 5, lines 7–10.
 - a. Describe all alternatives to rerouting the existing Brown North-Hardin County 345 kV line that were considered.
 - b. Provide any documentation or studies to support the decision to reroute the line.
 - c. Provide the cost-benefit analysis for the rerouting of the 345 kV line as opposed to tapping the existing 345 kV line.
 - d. Refer to KU's response to Staff's Third Request, Item 7. Provide where the \$1.7 million figure appears in the Application.

A-3.

- a. Given the size of the load, the Brown North-Hardin County 345 kV line is the closest nearby line capable of providing service to the Glendale Megasite and rerouting that line was the only viable option. Any other option would have been more expensive, less reliable, or both. The next closest 345 kV line to the Glendale Megasite is the Daviess County-Hardin County 345 kV line and is approximately 0.75 miles further away. Connecting to other nearby lower voltage lines, i.e. 69 kV was ruled out due to system capacity and reliability issues.
- b. See the response to part (a).
- c. Prudent transmission planning and reliability require this load to be served by two sources, as described in the response to PSC 2-1(a), and in the response to Wade 2-1. Tapping the existing 345 kV line in a radial manner is not a viable option because it would have only provided one transmission source to the Glendale South Substation. Thus, no cost-benefit analysis was completed.

d. The \$1.7 million cost for removal of the existing 2.7 mile segment of the 345 kV line was included within the \$48 million total for constructing the 345 kV and 138 kV lines as noted in Paragraph 5 of the Application.

Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 4

Responding Witness: Elizabeth J. McFarland

- Q-4. Provide a breakdown of all anticipated costs of constructing each of the proposed 138 kV transmission lines.
- A-4. The preliminary estimates for the construction of the 138 kV East and West route are as follows:

138kV West Route

		(\$,000,000)	
Equipment/Materials			
Steel Pole	\$ 2.600		
Conductor	\$ 0.400		
Shield Wire	\$ 0.001		
OPGW	\$ 0.025		
Insulators	\$ 0.075		
Hardware	\$ 0.180		
Overheads	\$ 0.450		
Contingencies	\$ 0.924	\$	4.655
Labor		\$	4.700
Total		\$	9.355

138kV East Route

		(\$,0	00,000)
Equipment/Materials			
Steel Pole	\$ 1.900		
Conductor	\$ 0.170		
OPGW	\$ 0.021		
Insulators	\$ 0.033		
Hardware	\$ 0.103		
Overheads	\$ 0.301		
Contingencies	\$ 0.619	\$	3.147
Labor		\$	4.000
Total		\$	7.147

Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 5

Responding Witness: Elizabeth J. McFarland

- Q-5. Provide a breakdown of all anticipated costs of constructing Glendale South Substation.
- A-5. The preliminary estimates for the construction of the Glendale South substation are as follows:

	(\$,000,000)
Engineering/PM	\$ 4.000
Equipment/Materials	
Power Transformers \$10.00	0
345KV Circuit Breakers \$ 1.50	0
345KV Motor-operated Switches \$ 1.80	0
345KV CCVT \$ 1.00	0
138KV Circuit Breakers \$ 0.90	0
138KV Disconnects \$ 0.30	0
138KV CCVT \$ 0.36	0
138KV SSVT \$ 0.15	0
Control House \$ 3.00	0
Grounding Materials (Lot) \$ 2.00	0
Steel (Lot) \$ 2.50	0
Aluminum Bus, connectors (Lot) \$ 2.50	0
Control Cable (Lot) \$ 3.50	0
Miscellaneous equipment \$ 2.50	0 \$ 32.010
Labor	\$ 12.000
Total	\$ 48.010

Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 6

Responding Witness: Elizabeth J. McFarland

- Q-6. Provide a breakdown of all anticipated costs of constructing the Glendale Industrial Substation.
- A-6. The preliminary estimates for the construction of the Glendale Industrial substation are as follows:

		(\$,0	00,000)
Engineering/PM		\$	2.000
138KV Circuit Breakers	\$ 1.440		
138KV Disconnects	\$ 0.800		
138KV CCVT	\$ 0.560		
138KV SSVT	\$ 0.150		
Control House	\$ 3.000		
Grounding Materials (Lot)	\$ 2.000		
Steel (Lot)	\$ 0.700		
Aluminum Bus, connectors (Lot)	\$ 1.500		
Control Cable (Lot)	\$ 2.500	\$	12.650
Labor		\$	10.000
Total		\$ 2	24.650

Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 7

Responding Witness: Elizabeth J. McFarland

- Q-7. Provide a breakdown of all anticipated costs of constructing each of the 345 kV transmission lines.
- A-7. The preliminary estimates for the construction of the 345 kV East and West route are as follows:

345kV West Route

2 1012			(\$,	000,000)
Equipment/Materials				
Lattice Tower	\$	0.679		
Steel Poles	\$	2.079		
Conductor	\$	0.340		
Shield Wire	\$	0.015		
OPGW	\$	0.038		
Insulators	\$	0.093		
Hardware	\$	0.220		
Overheads	\$	0.450		
Contingencies	\$	0.772	\$	4.686
Labor			\$	11.362
Removal Labor (Existing Line Segment)		\$	1.700
Total			\$	17.748
, c)		\$	

Response to Question No. 7 Page 2 of 2 McFarland

345kV East Route

	(\$,000,00	00)
Equipment/Materials		
Lattice Tower	\$ 0.581	
Steel Poles	\$ 1.696	
Conductor	\$ 0.247	
Shield Wire	\$ 0.011	
OPGW	\$ 0.028	
Insulators	\$ 0.077	
Hardware	\$ 0.179	
Overheads	\$ 0.366	
Contingencies	\$ 0.628 \$ 3.8	13
Labor	\$ 9.54	44
Total	\$ 13.3:	57

Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 8

Responding Witness: Elizabeth J. McFarland

- Q-8. Refer to KU's response to Wade Family's Second Request, Item 6, as well as KU's response to Staff's Second Request, Item 6 and reconcile the two responses.
- A-8. The response to Staff 2-6(b) references the 138 kV lines on the Glendale Megasite. The response is as follows.

Separation of the lines is Good Utility Practice to maintain reliability for a proposed load of this size. Having parallel lines allows the Company to perform maintenance on the line and line structures while keeping the Glendale Industrial Substation in service. Additionally, the current design accommodates a future 138 kV circuit to support load growth in the region. This future circuit is planned to be double circuited on the west 138 kV route. This configuration also allows for increased reliability and maintenance flexibility during construction of this future 138 kV circuit.

The response to Wade 2-6 references the construction of a future 138 kV line on the "Western 345 kV Transmission Line's structures...". The Western 345 kV line is not located in the area referenced in the response to Staff 2-6 (Glendale South Industrial substation). Additionally, the line being double circuited on the north portion of the Glendale Megasite is the KU 138 kV line with the EKPC 69 kV line as stated in the answer to the staff in 6 (a).

There are no current plans to double circuit the Western 345 kV line on the Wade Family Farm with a future 138 kV line.

Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 9

Responding Witness: Elizabeth J. McFarland

- Q-9. Refer to KU's response to Browns' Second Request for Information, Items 2–5. State whether any material agreements were reached on May 3, 2022, between the parties with regard to locating the proposed transmission lines on the Browns' parcels.
- A-9. At the May 3, 2022 meeting, KU agreed to study the Browns' routing preferences as expressed in that meeting and which were subsequently expressed in Mr. Allen Summers' May 12, 2022 intervenor testimony. To that end, KU is in the process of performing geotechnical work to analyze their routing preferences.

Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 10

Responding Witness: Elizabeth J. McFarland

- Q-10. Provide a list of all possible safety or code violations that could occur should KU build the transmission lines over the Wade Family Farms' irrigation system. Provide any studies or permits KU has performed or obtained to address the irrigation system and safety issues presented by water stream pressure.
- A-10. KU's transmission line will not interfere with the existing Wade Family Farms' irrigation system. See the response to Question No. 2. The IEEE Standard 1542-2018 "IEEE Guide for Installation, Maintenance, and Operation of Irrigation Equipment Located Near or Under Power Lines" was utilized for distances to a center pivot irrigation system. The transmission line falls outside of the distance specified by the IEEE standard. In addition, KU verified the clearance criteria to comply with NESC 2017 Rule 234 C. Based on these standards and the current location of the Wade Family Farms' irrigation system, there are no safety issues or clearance concerns.

Response to Commission Staff's Fourth Request for Information Dated May 11, 2022

Case No. 2022-00066

Question No. 11

Responding Witness: Robert M. Conroy

- Q-11. Describe any contractual agreements related to fines or incentives to prevent power outages between KU and Ford. Provide copies of any executed agreements concerning commitments KU has made to Ford regarding outage prevention.
- A-11. KU does not have any contractual agreements with Ford related to fines or incentives to prevent outages. KU expects the Ford facilities to be bound to KU's terms and conditions set out within its tariffs as it relates to power outages. Specifically tariff sheet P.S.C. No. 20, Original Sheet No. 98.1.