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Appalachian Electric Cooperative Zinc Substation Foundation Project

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April 30, 2019

Dr. Rebekah Page
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Dear Dr. Page,

Our senior design team was partnered with C2RL to perform engineering analysis and design for a substation foundation located in New Market, Tennessee. Based on the needs of the project, several areas of work within the civil engineering discipline had to be considered as a team. The foundation was designed to withstand the large loads of the electrical equipment while in the presence of subterranean voids from the abandoned zinc mine. Geo-structural analysis and design was necessary to address the loads and the soil stability for the foundation. The environmental regulations were enforced to ensure that the fluid containment infrastructure was considered in the case of failure to avoid contamination. The sub-station required the use of transformers of significant size, such that a failure causing a fluid leak would cause considerable environmental damage. A temporary traffic plan was developed for use during construction. This plan required an analysis of current traffic patterns to ensure that safe accommodations were met during the temporary conditions. This analysis was done through a transportation study completed at the site. Based on the study of the existing conditions and the requirements of the project, a plan to accommodate the temporary conditions was developed, including a temporary traffic plan

and construction entrances/exits. Finally, the construction schedule was created with consideration of equipment delivery and temporary roadways, and a cost analysis was produced in order to determine that the final design was reasonable in terms of the budget. My contribution to the project was the analysis and design of the substation from a structural perspective. I completed a series of hand calculations and utilized RISAFoundation software to arrive at an optimal solution. A 12 inch thick, 3000 psi concrete mat foundation with #5 bar reinforcement at the top and bottom of the slab, spaced at 18 inches, was selected as the final design. This design satisfied all structural and geotechnical requirements. My calculations for the project are available in Appendix A of the report, which is attached. The other students' work can be seen in the remaining appendices. A complete summary of my structural work can be seen in the "Structural Design" section of the report. I also worked with my team on each of their sections to help with technical writing and editing. In addition, I completed research on alternative foundation designs and compared each based on their benefits and costs.

Sincerely,

Leah Stephens
Senior, Civil and Environmental Engineering

Enclosed:

Appalachian Electric Cooperative Zinc Substation Foundation Project and Appendices

Appalachian Electric Cooperative
Zinc Substation Foundation Project

Smoky Mountain Foundation Inc.

Authored by:

Grayson Layne, Ben Morris, Leah Stephens, James Throckmorton

The University of Tennessee, Knoxville

Tickle College of Engineering

Department of Civil and Environmental Engineering

CE 400: Senior Design Project Course

Graduating May 2019

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Chris Soro- Principal Engineer at C2RL

Brian Williamson- Geotechnical Department Manager at GEOServices

Timothy Siegel- Senior Principal Engineer at Dan Brown and Associates

Dr. Angel Palomino- Associate Professor at the University of Tennessee- Knoxville in CEE Department

Dr. Jennifer Retherford – Senior Lecturer at the University of Tennessee- Knoxville in CEE Department

Disclaimer

The investigation, results, and construction drawings compiled by Smoky Mountain Foundation Inc. for the Appalachian Electric Cooperative Zinc Substation Foundation project was for a senior design project for the University of Tennessee, Knoxville. The design solutions proposed within this report are to be used for academic purposes only and construction should not occur without complete review by a licensed engineer.

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Introduction

Smoky Mountain Foundation Inc. is a civil and environmental engineering student team dedicated to producing innovative and quality designs for engineering projects in order to best serve the needs of the clients, the community, and the environment. The team is made up of four senior civil and environmental engineering students from the University of Tennessee, Knoxville, as shown in Figure 1.1. The contact information for the student team is presented in Table 1.1.

This report contains the analyses and conclusions drawn by Smoky Mountain Foundation Inc. for the design solution for the Appalachian Electric Cooperative Substation Project working in partnership with C2RL. The scope of the project encompasses geotechnical site investigations, analyses of soil stability, structural design of the foundation, creation of a construction-ready drawing set, and an estimation of costs. Smoky Mountain Foundation Inc. worked collaboratively with multiple mentors, such as employees at CR2L and professors at the University of Tennessee, Knoxville, to accomplish this task. The contact information for the mentors on this project can be found in Table 1.2.

Figure 1.1: Smoky Mountain Foundation Inc. Team Members
(Left to Right) Grayson Lane, Ben Morris, James Throckmorton, and Leah Stephens

Name	Primary Position	Secondary Position	Number	Email
Ben Morris	Environmental Designer	Construction Designer	615-278-8121	rmorri34@vols.utk.edu
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Chris Soro	C2RL	csoro@c2rl.com
Ron Whittaker	C2RL	rwhittaker@c2rl.com

Table 1.2: Faculty and Mentor Contact Information

Project Introduction

The Appalachian Electric Cooperative Zinc Substation Foundation project is located in New Market, Tennessee. Figure 2.1 illustrates the location of the project, while an existing site photograph facing southwest is presented in Figure 2.2. Based on Figure 2.2, the substation will be located in the background of the photo and will only utilize approximately half of the entire site. There is an abandoned zinc mine in the construction area which may impact the possible designs for the foundation. Members of Smoky Mountain Foundation Inc. team were tasked with performing engineering design services to address the needs of the project with efficiency and ingenuity. The project requires site investigation to capture the subsurface conditions. It is specifically important to take note of the known abandoned zinc mine and the observed hachured area, both of which may indicate further subsurface instability. Ultimately, the project requires engineering services in order to inform the contractor of the necessary infrastructure to accommodate the transformers, high side breakers, low side reclosers, and the control house. Lastly, the project requires the use of special and heavy equipment that must be accommodated in the final infrastructure design.

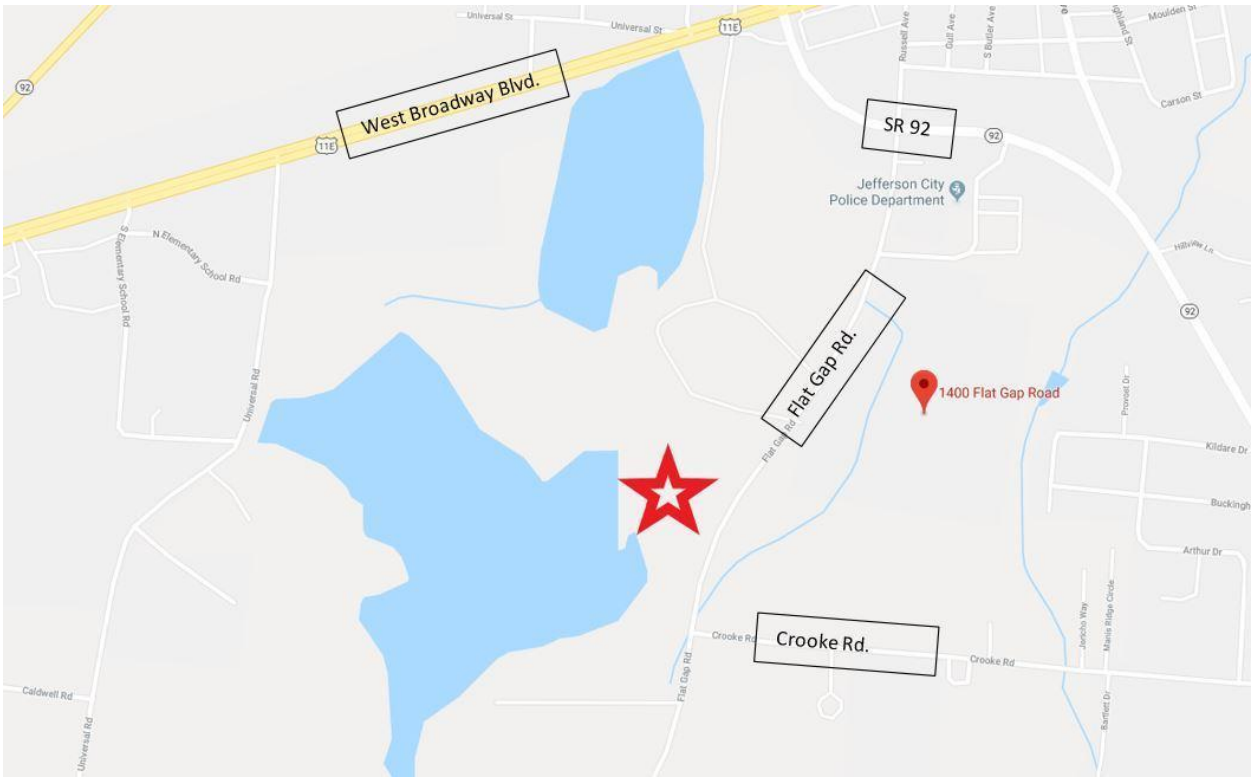


Figure 2.1: Location of Project

Figure 2.2: Current Condition of Site

Defined Scope of Work

Based on the needs of the project, several areas of work within the civil engineering discipline must be considered. The foundation is designed to withstand the large loads of the electrical equipment while in the presence of subterranean voids from the abandoned zinc mine. Thus, geo-structural analysis and design is necessary to address the loads and the soil stability for the foundation. The environmental regulations are enforced to ensure that the fluid containment infrastructure is considered in the case of failure to avoid contamination. The sub-station requires the use of transformers of significant size, such that a failure causing a fluid leak would cause considerable environmental damage. A temporary traffic plan is developed for use during construction. This plan requires an analysis of current traffic patterns to ensure that safe accommodations are met during the temporary conditions. This analysis was done through a transportation study completed at the site. Based on the study of the existing conditions and the requirements of the project, a plan to accommodate the temporary conditions was developed, including a temporary traffic plan and construction entrances/exits. Finally, the construction schedule is created with consideration of equipment delivery and temporary roadways, and a cost analysis is produced in order to determine that the final design is reasonable in terms of the budget.

Site Conditions

One of the initial tasks was to analyze the current site conditions. The project is located at the site of an abandoned zinc mine at 1414 Flat Gap Road, New Market, Tennessee. This mining efforts resulted in a large subsurface void that is located approximately 300 feet below the topsoil. The land above the mine was used for agricultural purposes after the mining efforts were abandoned and the land has a layer of organic alluvial top soil. Several hundred feet beneath the initial topsoil, there is a bedrock layer that consists of Mascot Dolomite, as determined by referencing the USGS Geological Map of the area, which can be found in Appendix B. In addition, the site slopes gently downhill from the southwest corner of the plot to the northeast corner. A hachured contour area located on the southeast corner of the lot was discovered. This area is visible from the surface and was located during a site walk through. This hachured area indicates the future possibility of a sinkhole and must be considered in the design. The site runs parallel with Flat Gap Road, which is a two-lane rural road with a speed limit of 45 mph. A railroad bridge spans across the road on the north side of the site. The bridge has been hit by passing traffic due to the low clearance of 15 feet. All of these conditions were considered throughout the analysis and design process.

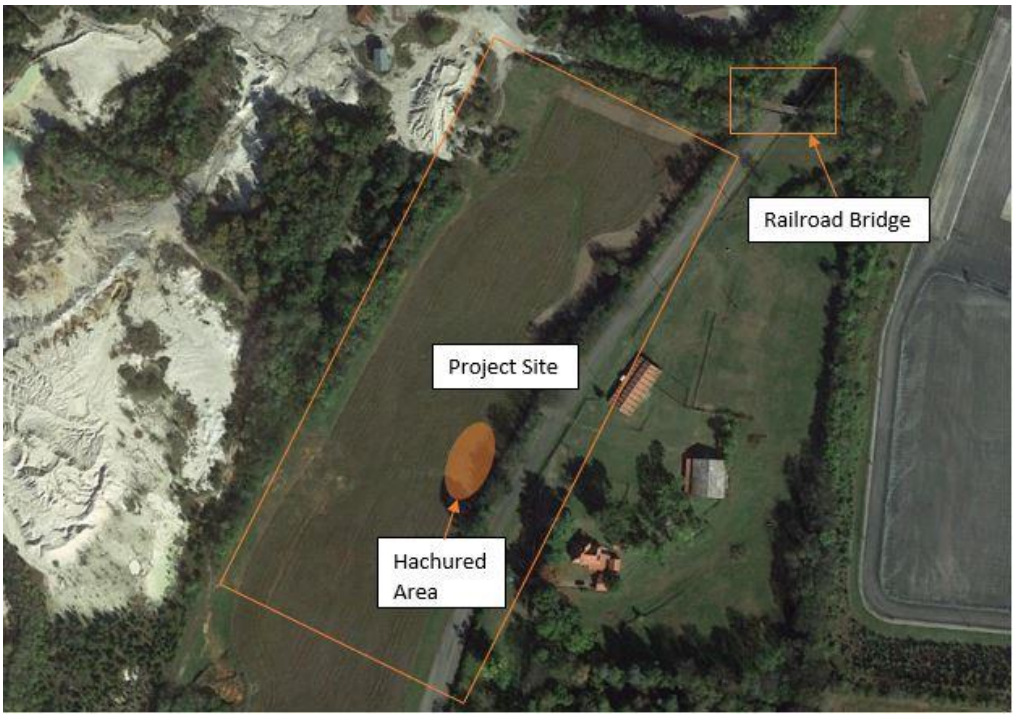


Figure 3.1: Site Layout

Analysis and Design

The project required a design of a substation foundation; therefore, an analysis of the current site conditions was performed to obtain relevant data. The project was subdivided into geo-structural design, environmental and water system design, and construction design. In addition, a traffic study and analysis were completed to better prepare for possible construction impacts to the area.

Geotechnical Design

Geotechnical design is required for this project to account for soil stability issues in the design of the foundation and to determine the area's susceptibility to Karst topography. The foundation design considered the high loads of the electrical equipment, the soil conditions, and the abandoned zinc mine, such that a preferred solution could be identified.

Although it is known that the mine was built through dolomite bedrock, which would primarily indicate stable soil conditions, the location of the abandoned zinc mine brings the stability of the soil into question. Jefferson County is a geological region that contains Karst topography, according to USGS geologic data. This abundance of karst could impact the stability of the site even if the mine is deemed stable currently. The region is susceptible to carbonate erosion. Dolomite is classified as a carbonate and has a similar reaction to water as limestone. This reaction dissolves the carbonate material and could cause the mine's ceiling to become thinner over time. Without this vertical strength, the mine may experience deformation and possibly collapse, creating a void that could damage the substation. These possible issues were the motivating factor to determine soil strength and stability.

A geotechnical consultant from GEOServices was hired to perform the site investigation for the property. The consultant identified 10 boring locations from various areas of interest on the site. These borings were drilled between 25 ft and 35 ft into the soil, with one boring drilled 120 ft below the surface to analyze the bedrock and mine ceiling. Standard Penetration Test (SPT) and split-spoon sampling tests were conducted on these borings as well.

After boring was completed, laboratory work was conducted on specimens from the field to determine soil properties. Atterberg Limits were calculated, and the soil on site was found to be a clay of high plasticity, with a Plasticity Index of 50 on average. Using this data, the unit weight of the soil was determined to be between 110 pcf and 141 pcf. Considering the site consists mainly of this clay, an undrained condition was determined and a friction angle of zero was assumed. Cohesion of the soil was determined graphically using the Skempton Method and was calculated as 1600 psf.

Due to the results found from drilling and soil properties of the site, there are several precautions that have been taken. These precautions include: proper drainage

control of the site to eliminate water seepage into the mine, grading of the site to allow water runoff to drain into the retention pond to reduce the possibility of erosion damage to the bedrock, and cement capping of the bedrock below the site to prevent water damage to the mine. This cap prevents contact between the draining water and the mine's ceiling, reducing carbonate erosion. However, based on geotechnical data collected, this team recommends that this site is at no greater risk for sinkhole development than any other site. Therefore, this plan was deemed unnecessary and not cost effective to implement.

From recommendations from geotechnical advisers, any unusable soil, which would include any remaining vegetation and topsoil, will be removed and replaced by suitable gravel. TDOT D Stone is this team's recommendation for a strong and drainage friendly gravel covering. This gravel layer will cover the entire site to fully allow for drainage across the entire site. This layer will also reduce settlement under the foundation area, due to the much higher compressive strength of gravel when compared to the removed alluvial soil.

Design of the foundation system was performed to confirm limit states of bearing capacity, differential settlement, and total settlement. For the shallow foundation design for this project, this team's recommended allowable soil bearing capacity is 3,271 psf for the soil layer beneath the site. The bearing pressure of the foundation was calculated to be equal to 564 psf, indicating that the soil will provide sufficient strength for the load. The foundation will be placed 18 inches below the surface to protect from frost because the soil does not heave under the frost layer. Thawing causes the soil to heave which in turn causes settlement. The settlement leads to displacement in cladding and the superstructure which can cause aesthetic damage. By placing the foundation 18 inches below the surface, these issues can be avoided. From the allowable soil bearing pressure of the soil, total settlement should not exceed 1 inch, with a differential settlement of ¾ of an inch.

After reviewing all known data, several foundation design plans were considered by Smoky Mountain Engineering. One of these plans was a shallow foundation design. Considering that this foundation would need to support multiple pieces of electrical equipment over more than 50% of the site area, a mat foundation was determined to be an ideal shallow foundation design. Using this mat foundation, steel reinforcement would be relatively simple to install, minimizing labor costs and build time. This team also considered modification of the soil under the foundation to increase the allowable strength of the soil.

Another design option considered by Smoky Mountain Engineering was a deep foundation design. The two deep foundation options discussed included drilled shafts and micropiles. Drilled shafts offer greater strength and stability versus many other shallow foundation designs. Micropiles were considered a better option when compared to drilled shafts, offering much of the strength and stability of drilled shafts with much lower overall

costs. These piles are not drilled as deeply as drilled shafts, minimizing any disturbances to the mine below.

After careful consideration of all data collected and calculated for this site, this team decided to implement a mat foundation with no soil modification in the center of the site as seen in the drawings. This option was deemed to be the most cost and time effective course of action for the loads and soil strength determined. Besides the addition of gravel for drainage and soil grading, soil modification will not be considered for this foundation design. The location was chosen due to it having the least elevation change across the site, which allows for the least amount of excavation and fill to be at final grade. After reviewing data from Shelby Tube samples taken from the borings, much of the clay was found to be lean clay with a minimal expansive nature. Therefore, soil modification was deemed unnecessary to implement. Drilled shafts were deemed unnecessary because this type of foundation is very intrusive, time consuming, and expensive. The loads generated by the substation and its equipment do not warrant such methods. Drilled shafts could also disturb the zinc mine beneath the foundation site, creating unnecessary risks. Micropiles were also found to be unnecessary. The mine is over 120 ft below the surface, according to boring termination. With the mine being at such a depth and loads being relatively low, the use of micropiles or any deep foundation was determined to be too costly and too conservative for the parameters of the project. Also, based on a cost comparison of micropiles, deep foundations, and mat foundations with no soil modifications, the mat foundation was roughly 63% less expensive. Thus, a mat foundation will generate the strength necessary for all loads and will minimize settlement across the site, while also being the most financially reasonable.

This team has determined that from the all data obtained through drilling, laboratory testing, and calculations, a mat foundation will be the best design choice for this site. If all parameters of soil stability and design are taken into account, the team is confident in the functionality of this design.

Structural Design

Due to the large electrical equipment necessary for a substation, there are significant loading requirements applied to the foundation. The mat foundation was designed to support the point loads of the transformers, high side breakers, and low side reclosers, along with the distributed and area loads of the control room. Several limit states needed to be verified for the design of the mat foundation, specifically shear, flexure, 1-way shear, and punching shear.

As shown in Appendix A, the limit states were analyzed through a series of hand calculations and the use of RISA software. RISAFoundation was selected to perform structural analyses for this project by inputting site specific conditions to arrive at the optimal solution. Loading was based on values provided by C2RL from a previous project, Bean Substation, which had very similar project requirements. Loading information was gathered for the transformers, high side breakers, low side reclosers, and control house

based on the drawings found in Appendix A. In addition, the size of the entire project, a 40’ by 50’ footprint, was determined based on the dimensions of the equipment and control house and the available land space. Figure 4.1 shows an image of the model from RISAFoundation which was used to design the mat foundation. This image shows the layout of the site and equipment, with the estimated loads overlaid on top. The model was run and checked for each of the limit states, as described above, which it greatly exceeded. Figure 4.2 shows a visual of the soil pressure variation across the site. The soil pressure variation is fairly standard and illustrates that the loading is small compared to the strength of the design and soil integrity. In addition, outputs from this model can be seen in Appendix A.

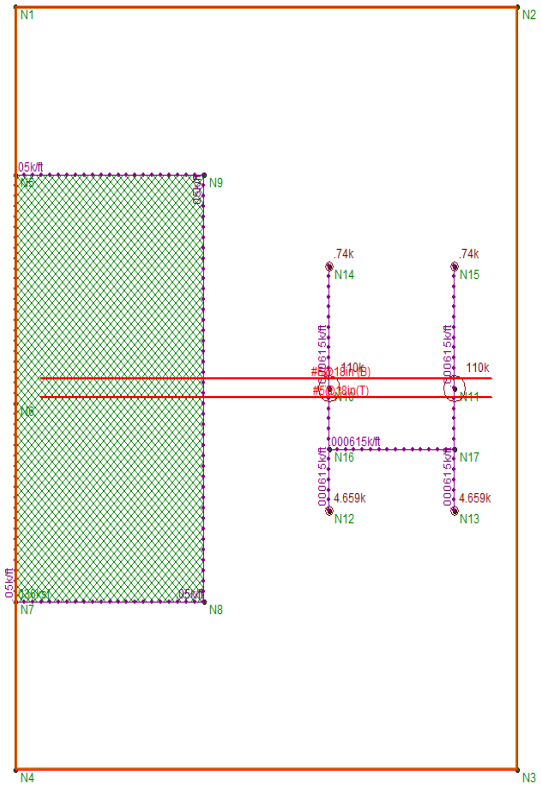


Figure 4.1: RISAFoundation Model Plan View

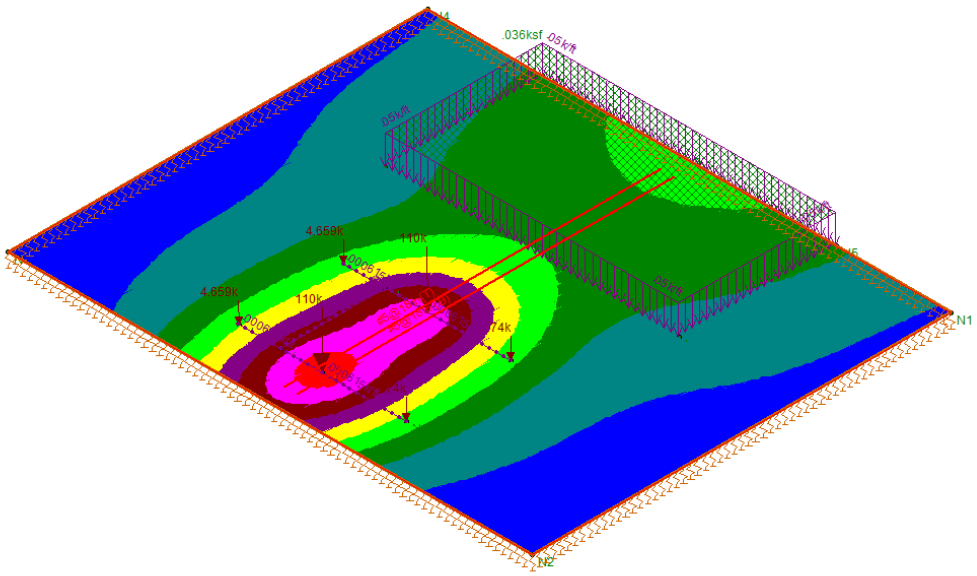


Figure 4.2: RISAFoundation Model Soil Pressure

Based on analysis with the RISAFoundation software, the final strength requirements were met. The final design requires a single the mat foundation with reinforcement. The reinforcement used will be #5 bars at the top and bottom of the foundation at 18 inch spacing. The slab is 12 inches thick and utilizes 3000 psi concrete. This design also satisfies the geotechnical limit states, as outlined in the geotechnical section. Full details for construction are presented in the accompanying construction-ready drawings.

Environmental Design

The existing site conditions and safety protocols for the electrical substation calls for an environmental design that will avoid contamination of local watersheds. The analysis includes the findings and observations of the environmental conditions and required actions from Smoky Mountain Foundations Inc. The requirements include a spill containment pond that will keep oil pollution out of the local storm water drainage system in case of substation failure.

As per the EPA's oil spill protection program, the Spill Prevention, Control and Countermeasure (SPCC), the site requires a spill containment area capable of holding the amount of oil held in the transformers and voltage regulators. The spill containment area is located at the lowest elevation of the site, in the Northeast corner of the property. The total storage volume for the spill containment pond is 244.8 cubic feet. This ensures all oil will be captured from the equipment in case of failure. The containment area is lined

with a geomembrane liner to contain any oil from permeating into the ground, while still allowing water to flow through.

Water Systems and Drainage Design

The water systems design required a plan for storm water drainage to make sure the site has no water collection areas, and that the plan does not overload the local storm water drainage infrastructure. As per the Tennessee criteria for storm water design, a 25-year storm is used to measure peak runoff from the lot. In the event of a 25-year 24-hour storm, the maximum rainwater runoff discharge by 5.75 cfs, according to calculations in Appendix D.

In order to ensure storm water is drained from the site appropriately, the team designed an appropriate grading plan. Once the location was determined for the concrete slab, the grading plan was then designed around it. Since a drainage ditch was already featured along the East perimeter if the lot in the pre-existing site conditions, Smoky Mountain Foundations designed a 2 percent grade, directing storm water runoff to the East side of the lot. This slope will allow some water to be absorbed by the lot, while directing excess to the adjacent storm water ditch. The local storm water drainage system is capable of containing the peak discharge during a 25-year, 24-hour storm for the designed 2 percent grade.

The pre-existing site conditions feature a hachured contour area in which runoff is directed into a void underground. All grading must be directed away from the depression to avoid any additional runoff to be discharged into the underground void. The final grading design, including the hachured contour area are featured in the proposed layout drawing.

Traffic Analysis

A traffic study was performed to determine any traffic safety issues impacting the construction site and to ensure that the current infrastructure of the traffic system is sufficient for the transportation of equipment and materials to the site. The purpose of this study is to identify any traffic safety and infrastructure issues that may be prevented in efforts to eliminate any delays in construction. The study included a review of current traffic volumes and speed along with lane width configurations and height clearance as necessary to confirm that the current infrastructure could sustain the special traffic of delivering the equipment and materials.

Traffic Study

The traffic study was performed on 10/25/2018 in order to observe the current traffic conditions and transportation infrastructure on a portion of Flat Gap road with a speed limit of 45 mph. The study was conducted at 7:30 AM to 9:00 AM in order to observe when the traffic volume would be at its assumed AM peak during the construction work hours of the project. The AM peak of traffic volume was used to assume to be consistent

with the PM peak traffic volumes based of traffic patterns that are linked to 9AM to 5PM work cycles. In order to adequately calculate the average speed of northbound and southbound traffic, a recording of an average time through a traffic study zone was chosen versus using a radar gun in order to be more discreet so that drivers would not slow down when they noticed someone checking their speed. The study consisted of setting two markers 200 feet apart, as shown in the drawings, creating a traffic study zone that northbound and southbound traffic traveled through and recording the time that local traffic took to travel through the zone. During the traffic study, traffic had a consistent free flow without any stoppage. The number of vehicles with time recordings traveling northbound and southbound can be seen in Appendix E. The recorded times were used to find the average speed of northbound and southbound traffic and are presented in Appendix E. The traffic study zone recorded a traffic volume of 123 vehicles per hour during peak AM times with an average speed of traffic traveling 38.77 mph.

Although the average speed was below the posted speed limit, Smoky Mountain Foundations Inc. is taking measures to slow the flow of traffic to increase the safety of the drivers and construction workers alike during delivery periods of equipment and material throughout the construction phase. During scheduled delivery periods, placing temporary construction speed limits of 25 mph for a 2 to 4 hour window along with construction warning signs to cause the drivers to drive more cautiously and at a slower speed for the time period. Reducing the vehicles speed from 45 mph to 25 mph will reduce the needed stopping sight distance from 360 feet to 115 feet, allowing the vehicles sufficient space to stop within the construction zone. Based off the MUTCD procedures, the construction warning signs will be placed 360 feet, per MUTCD Table 6C-2, away from the farthest north and south extents of the construction zone as shown on the Traffic Study drawing. The same warning signs will also be place at every 100 feet, per MUTCD Table 6C-1, approaching the construction site as shown on the Traffic Study drawing. Reducing the speed traffic and providing proper warning will ensure that the construction workers can safely enter and leave the site by allowing the normal traffic and construction works more time to react. This extra time is critical when construction vehicles are towing long trailers that take extended periods of time to maneuver in and out of the site.

Construction Management

Construction design is required for this project to accurately articulate the scheduling, sequencing, resources (labor, equipment, material) needed to construct the foundation within the allotted budget, and the completion date. The two major focuses on the construction design of this project was scheduling and quantity takeoffs. Scheduling the activities in the correct sequence was emphasized in order to prevent any delays. Correctly calculating the quantities of materials resulted in an accurate project value and duration.

Construction Scheduling

The critical path method (CPM), with an emphasis on using a linear path, was used to determine scheduling of each activity and duration of the project. The focus on using a linear path was chosen so that the floats of each activity could be minimized to reduce any lag periods or delays in the schedule. To determine the preliminary phases of the project and the activities of each phase, a work breakdown structure was constructed, which can be seen in Appendix F. The duration of each activity was calculated using the RS Means values of each activity. As appropriate, durations of some activities were determined based on quantity takeoffs from the design drawings and RSMeans values. The activities were scheduled in a sequencing order to establish the required work according to the necessary actions in the construction process which can be seen in Appendix F. Using CPM, the forward pass of the schedule was used to calculate the early start and finish of each activity, while the backward pass of the schedule was used to calculate the late start and finish of each activity. The schedule considered a working day Monday through Friday and 8 hours in length. Table 4.1 shows the three planned milestones along with the duration of each milestone.

Milestone	Number of Activities	Duration (days)
Temporary Construction Entrance	2	2
Site Development	8	27
Substation Foundation	7	23
Total	17	52

Table 4.1: Milestones with Number of Activities and Durations

Site Development

The excavation for the foundation had a calculated borrow of 26 cubic yards which is negligible considering the site had a total cut and fill of 1953 cubic yards. The 26 cubic yards of fill will be borrowed from a portion of the site where the final grade is not important to reduce cost and time. A 212’ long by 137’ wide oval staging area surrounding the foundation will be placed to accommodate the storage of material, equipment and contractor parking. The staging area can be seen on the Proposed Layout drawing. A 220’ long by 20’ wide temporary road will be used to connect Flat Gap Road and the staging area, as seen in the drawings. The staging area and temporary road will be constructed of 4” bedding of TDOT D Stone to support the loads displaced by construction vehicles and equipment.

A temporary construction entrance will be used to accommodate the trucks delivering the various substation equipment and machinery onto the site, due to their formidable weights and dimensions. These trucks displace a distributed load of up to 60 kips dispersed along the length of the truck and trailer on the entrance and staging area. The existing soil conditions would not be able to support the truck’s load due to the stability of the current topsoil. A construction entrance was designed as a temporary

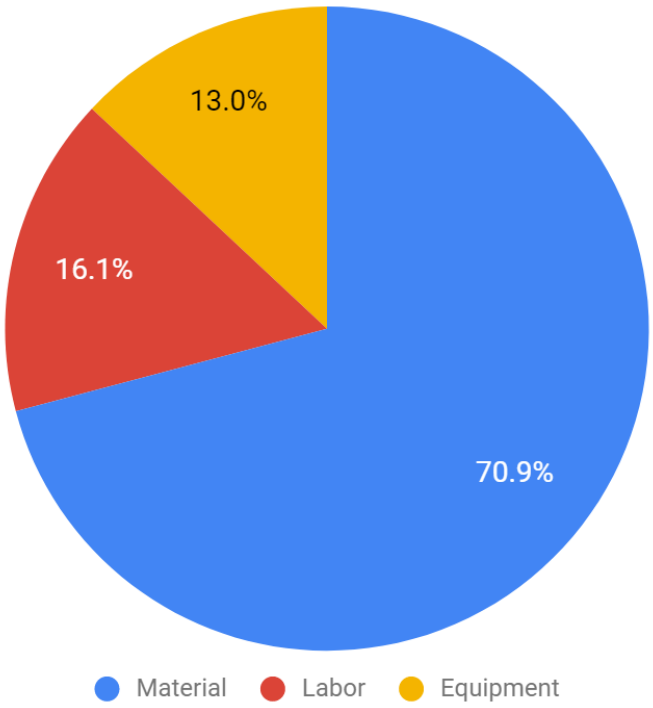
bridge using a 24” diameter Class 3 Concrete Pipe with an 8” bedding of TDOT D Stone and up to 18’ of TDOT D Stone on top of the pipe. This design will allow the bridge to support an ultimate load of 4000 lbs. per horizontal linear foot of the bridge according to the CPDM. While many construction entrance configurations are feasible, a pipe and stone design that allows drainage across the entrance and ease of access into the site was selected to accommodate the anticipated 60 kip truck loads. The temporary construction entrance will be placed along the edge of Flat Gap Road and the center of the eastern side of the site which can be seen in the Construction Entrance drawing. This location was chosen to allow for a stopping site distance that allows traffic to adequately react to vehicles entering and leaving the construction site.

Erosion Control Plan

Smoky Mountain Foundation Inc. followed procedures in accordance to the Clean Water Act (CWA), the local standards for the Tennessee Department of Environment and Conservation. The team designed an erosion control plan to avoid local storm water drainage system overflow and pollution into local watersheds. A 3-foot-tall silt fence along the East and North perimeter was sufficient for the site because it satisfies EPA standards of 100 feet of fencing per ¼ acre, and the slope never exceeds a 3:1 slope gradient, as shown in Appendix D. The silt fence should be arranged as shown in the erosion control drawings.

Cost Estimate

Based on the design described previously, the cost was estimated. The costs associated with the project have been divided into three subcategories of labor, material, and equipment cost. A summary cost estimate with information such as unit, quantity, unit price, and total price has been provided in Appendix G. The largest contributors to the total cost is material with an estimated cost of $138988.92. The total cost estimate for the project was determined to be $196113.53. Figure 5.1 provides a visual illustration showing the cost breakdown per item. By breaking down the costs into three categories, labor, materials, equipment can be seen that materials provide the greatest portion of the total cost.



Division	Cost
Material	138988.92
Labor	31558.66
Equipment	25565.95
Total	**196113.53**

Figure 5.1: Item Cost Breakdown

Conclusion

Smoky Mountain Foundations Inc. has proposed a mat foundation for the Appalachian Utility Board's substation project located in New Market, Tennessee. This foundation was the preferred solution from multiple options and satisfied the structural and geotechnical requirements. A spill containment pond was designed for the northwest corner of the lot to satisfy substation safety protocols. A uniform 2 percent grading plan towards the Northeast corner of the site, and away from the hachured area allowed for the most optimal drainage plan. The total duration of the project was calculated to be 52 working days. The costs for the project were also determined using the RSMeans and TDOT standard pricing index. Based on these values, the project will cost $196113.53 in total to implement.

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15. "Tennessee Geologic Map Data." *USGS,* 2014, https://mrdata.usgs.gov/geology/state/state.php?state=TN

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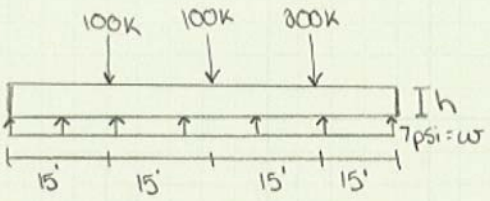
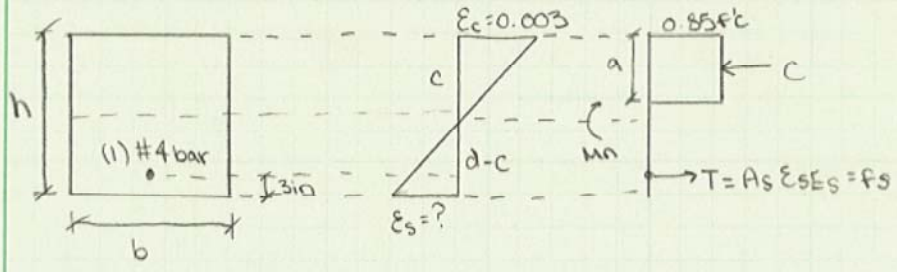
Appendix A: Structural Calculations



L = 60'
W = 40'
w = 7psi
f'c = 4000 psi

$\frac{7\,lb}{in^2}\left(60' \times \frac{12''}{1'}\right)\left(40' \times \frac{12''}{1'}\right) = 2414.2\,k$

$\frac{150\,lb}{ft^3}(60')(40')(h) = 360(h)\ k$



Assume $f_s = f_y$

$\varepsilon_s = \varepsilon_y = 0.003$

$\frac{c}{0.003} = \frac{d-c}{0.002}$; $d = h - 3$

$0.002c = 0.003(h-3-c)$
$0.005c = 0.003h - 0.009$
$0.005(0.00865) = 0.003h - 0.009$
$h = 3.01$ in
∴ unrealistic

$M_n = (0.85f'c)(a \cdot h)(d - a/2)$
$a = 0.85c$
$a = \frac{As\,fy}{b(0.85)f'c} \Rightarrow c = \frac{As\,fy}{bf'c\,(0.85)}$
$c = \frac{(0.2)((60{,}000)}{(40 \cdot 12)(4000)(0.85)^2} = 0.00865$ in.

$\varepsilon_s = \frac{d-c}{c}(0.001) = \frac{(0.01) - 0.00865}{0.00865}(0.003) = 0.000468$
∴ Does not yield

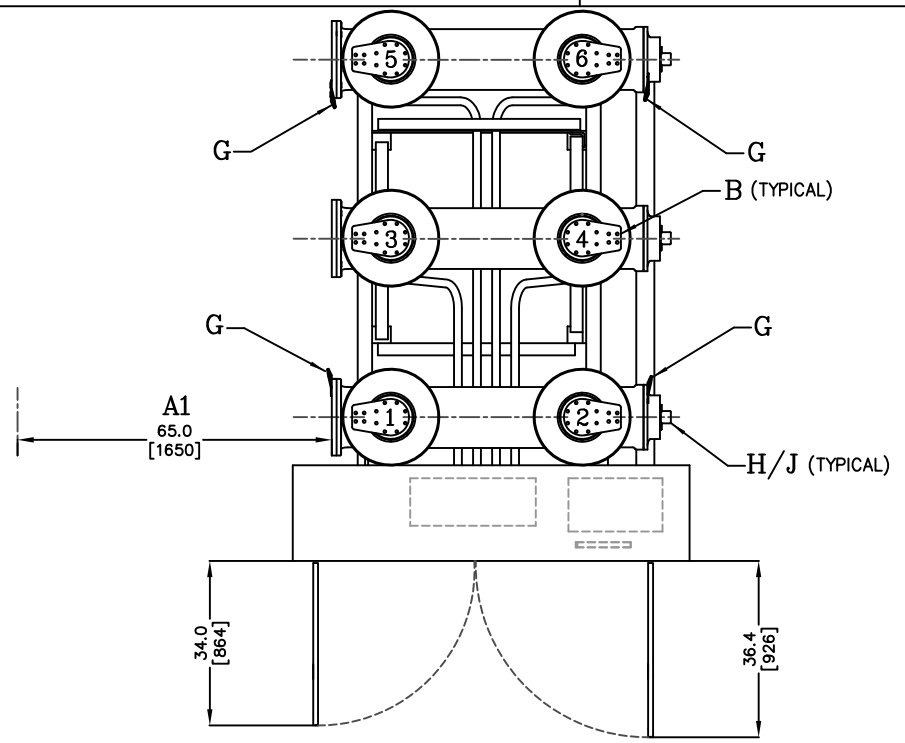
∴ Do not need reinforcement

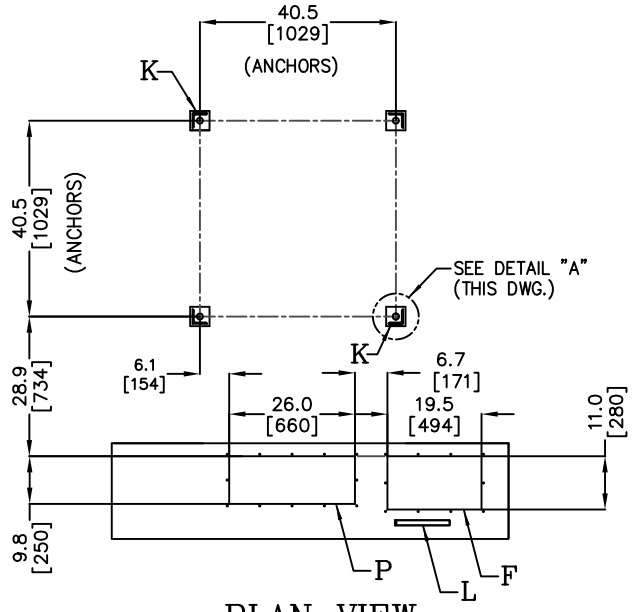
$\sum M_{x=0} = 0 \rightarrow 100(15) + 100(30) + 300(45) - (2414.2)(30) + 360h(30) = 0$
$\hookrightarrow h = 5.47\,ft \approx 5.5\,ft$

$\frac{150\,lb}{ft^3}(60')(40')(5.5') = 1980\,k$

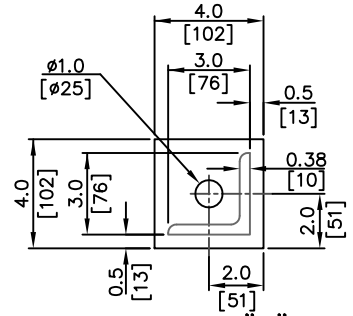
$100k + 100k + 300k + 1980k = 2380\,k \downarrow$; $2414.2k \downarrow$

∴ Design can handle required loads with given allowable soil pressure and an $h = 5.5$ feet.





PLAN VIEW



DETAIL "A"
(BASE PLATE)
(N.T.S.)

LEGEND

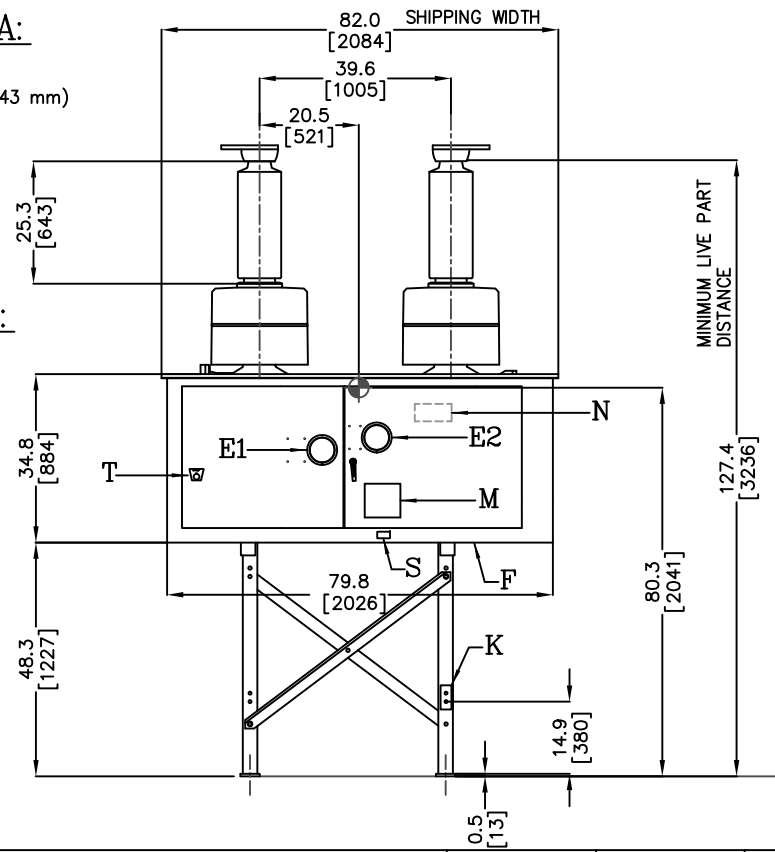
A1 -- MINIMUM DISTANCE FOR INTERRUPTER REMOVAL (65 inches / 1650 mm)
A2 -- MINIMUM DISTANCE FOR BUSHING REMOVAL (27 inches / 686 mm)
B -- NEMA 4-HOLE TERMINAL PAD
C -- SF6 DENSITY MONITOR
D -- SF6 FILL VALVE (DILO DN8)
E1 -- CHARGED/DISCHARGE INDICATORS
E2 -- OPEN/CLOSE INDICATORS & COUNTER
F -- CABLE ENTRANCE
G -- LIFTING LUGS
H -- PRESSURE RELIEF (RUPTURE DISK TYPE)
J -- MOLECULAR SIEVE
K -- NEMA 2 GROUND PAD (DIAMETRICALLY OPPOSED)
L -- CABINET GROUND BAR
M -- RATINGS NAMEPLATE (EXTERNAL)
N -- BCT NAMEPLATE (INTERNAL)
P -- MECHANISM ACCESS PANEL
S -- EXTERNAL GFI RECEPTACLE
T -- EMERGENCY TRIP PUSHBUTTON

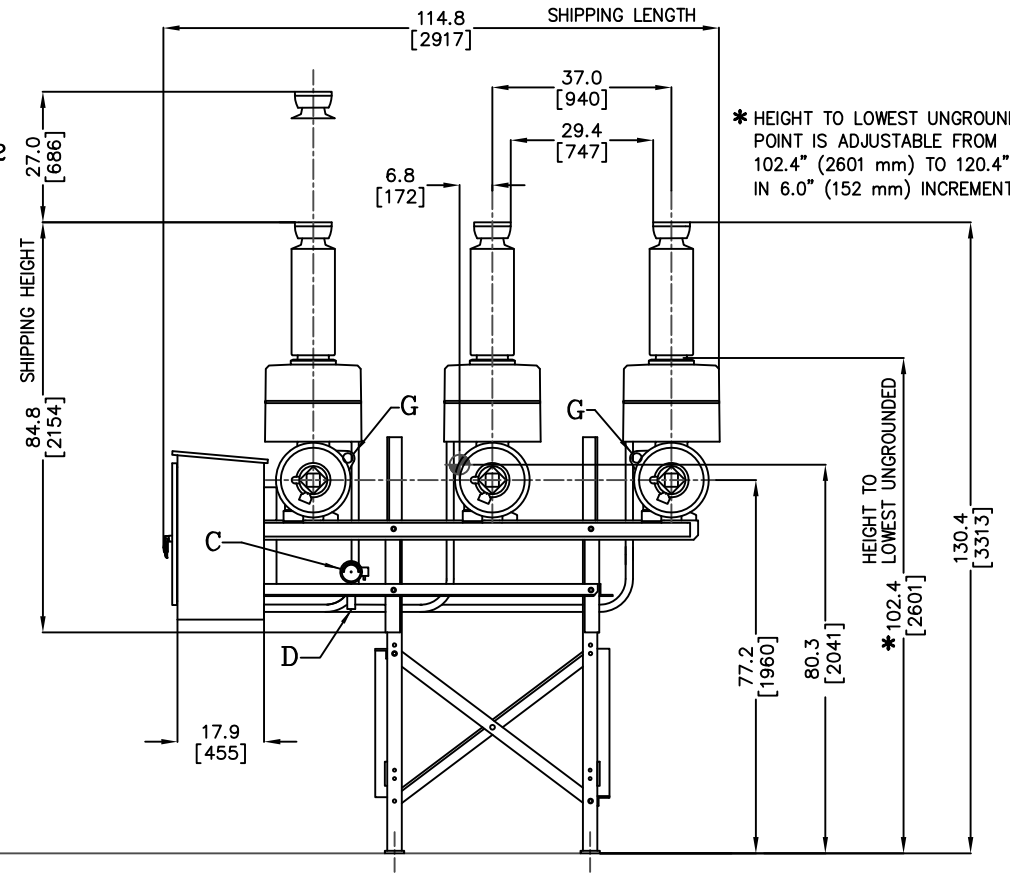
BUSHING DATA:

CREEPAGE: 74" (1891 mm)
STRIKE DISTANCE: 25.3" (643 mm)
MATERIAL: PORCELAIN
COLOR: ANSI 70 GRAY

CABINET DATA:

RATING: NEMA 3R
MATERIAL: STEEL
COLOR: ANSI 70 GRAY





* HEIGHT TO LOWEST UNGROUNDED POINT IS ADJUSTABLE FROM 102.4" (2601 mm) TO 120.4" (3058 mm) IN 6.0" (152 mm) INCREMENTS

2,700 lbs (1,225 kg) -- BREAKER WEIGHT
29 lbs (13 kg) -- SF6 GAS WEIGHT
+ 1,930 lbs (876 kg) -- CT WEIGHT
= 4,659 lbs (2,114 kg) -- TOTAL WEIGHT

TYPE:	DT1-72.5FK F1
IMPULSE WITHSTAND:	350 kV
MAXIMUM VOLTAGE:	72.5 kV
INTERRUPTER CURRENT RATING:	40 kA
CURRENT RATING:	1200 A

DIMENSIONS: INCHES / mm

NOTES:

1) FOUR (4) 0.75" (19 mm) DIAMETER ANCHOR BOLTS REQUIRED.
2) 3.0" (76 mm) MINIMUM PROJECTION ABOVE FOUNDATION.
3) ANCHORING TO BE SUPPLIED BY OTHERS.
4) FOUNDATION TO BE LEVEL WITHIN 0.25" (6 mm) AT FOUR (4) BASEPLATES.
5) SHIM AND GROUT AS REQUIRED.
6) RATED LOW SEISMIC QUALIFICATION LEVEL PER IEEE-693 2005 (0.2g USED FOR ANCHOR BOLT CALCULATION)
7) OPERATIONAL FORCES IN ANY DIRECTION = 1100N (247 lbf)
8) HV TERMINAL STATIC HORIZONTAL FORCE (LONGITUDINAL) = 750N (169 lbf)
9) HV TERMINAL STATIC HORIZONTAL FORCE (TRANSVERSE) = 500N (112 lbf)
10) HV TERMINAL STATIC VERTICAL FORCE = 750N (169 lbf)

TOTAL SHEAR ON EACH FOUNDATION BOLT	2795 N	628 lbf
TOTAL TENSION ON EACH FOUNDATION BOLT	12002 N	2697 lbf
TOTAL FOUNDATION OVERTURNING MOMENT	22216 N-m	196626 lbf-in

REV.	DESCRIPTION	DRAWN	CHECKED	DATE

CUSTOMER: APPALACHIAN ELECTRIC COOPERATIVE
CUSTOMER ORDER No.: 13540
SUBSTATION: BEAN STATION 69-13kV SUBSTATION
SERIAL No.: 239346-010-A, 239346-010-B, 239346-010-C, 239346-010-D
CUSTOMER EQ. NO.:

MATERIAL ID: CCDT1-72.5FK-001
ORDER No. 239346

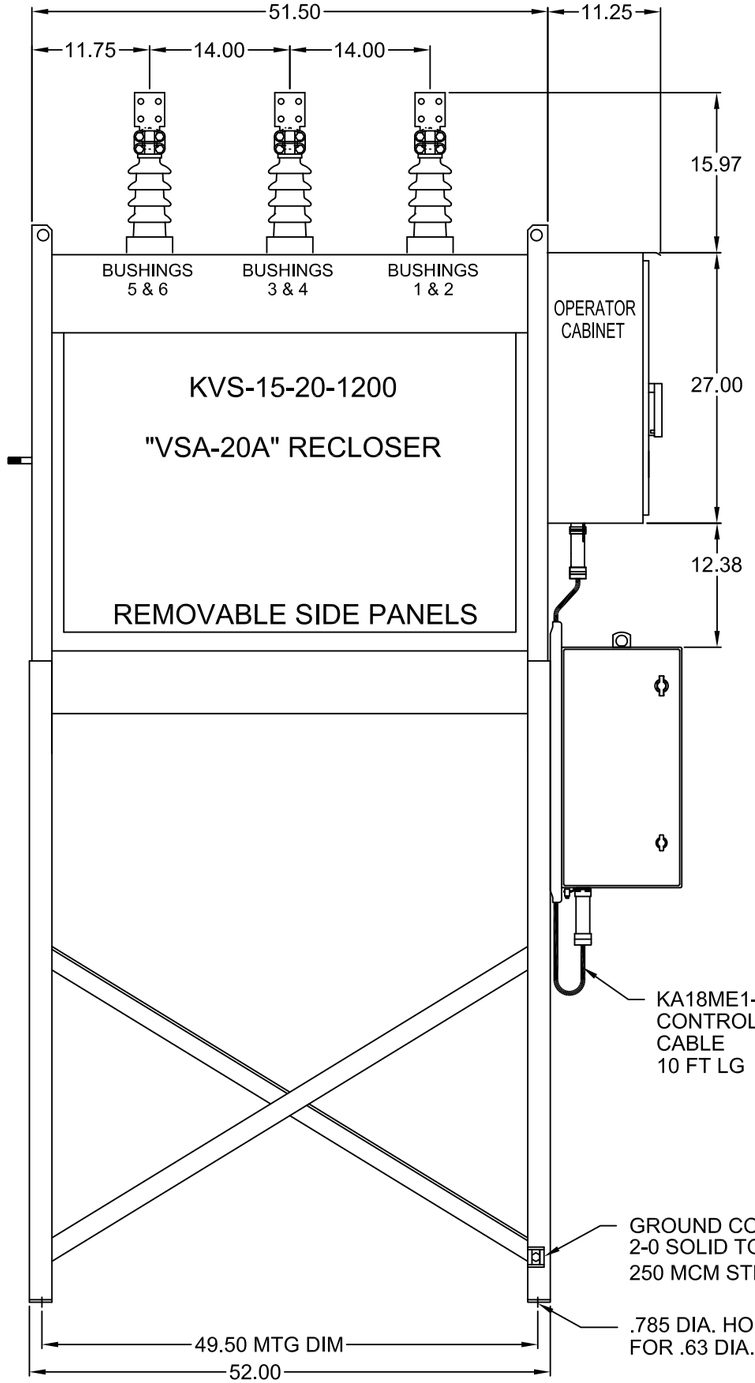
OUTLINE DRAWING

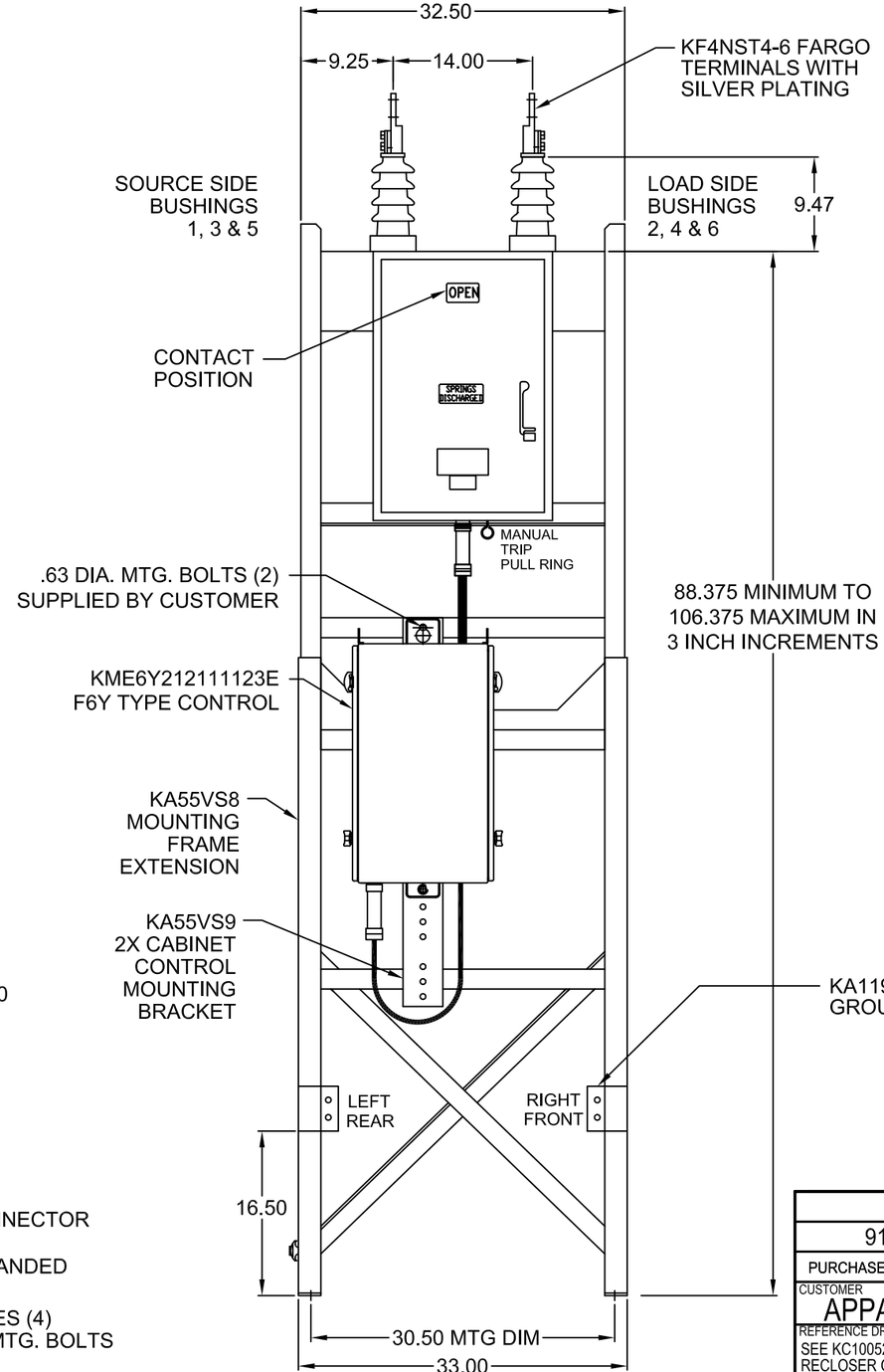
DRAWN	CHECKED	DATE
W. HOLT	A. IZVOREAN	09/12/2017
DRAWN	CHECKED	DATE

Grid Solutions
One Power Lane
Charleroi, PA 15022

DRAWING No.: M239346010

SHT 1 OF 1





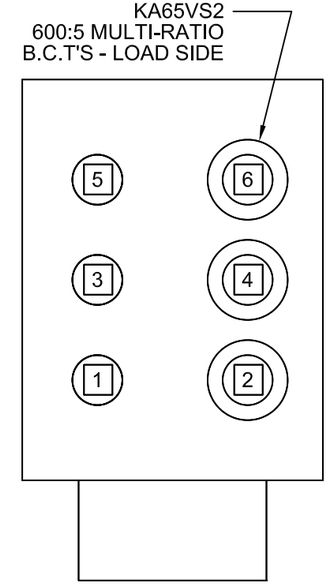
KYLE® RECLOSER TYPE "VSA-20A"

SERIAL NO. [redacted] B.I.L. 110 KV.

RATED MAXIMUM VOLTAGE	15.5 KV.
MAXIMUM INTERRUPTING CURRENT	20 KA.
RATED CONTINUOUS CURRENT	1200 AMP.
APPROXIMATE WEIGHT	740 LBS.

COOPER Power Systems
South Milwaukee, WI, made in USA

MANUFACTURED —



THIS DOCUMENT IS DRAWN AND MAINTAINED AS A 2D MODEL

REV	DATE	BY	STATUS
A0	11-19-10	SCL	APPROVAL

PURCHASE ORDER NO.	SHOP ORDER NO.
9189	9187537

CUSTOMER: APPALACHIAN ELECTRIC

REFERENCE DRAWINGS
- SEE KC1005230A FOR TYPE "VSA20A" RECLOSER OUTLINE WITH ACCESSORIES
- SEE KC1005230B FOR TYPE "F6Y2" CONTROL OUTLINE WITH ACCESSORIES
- SEE KC1005230C FOR TYPE "F6Y2" CONTROL WIRING DIAGRAM WITH ACCESSORIES
- SEE KC1005230D FOR TYPE "VSA20A" MECHANISM CABINET OUTLINE/DIAGRAM WITH ACCESSORIES

COOPER Power Systems
South Milwaukee

DWN.	DATE	APPD.	DATE
SCL	11-19-10	SCL	11-19-10
CKD.	DATE	WHERE USED	
		FINAL	

NAME: RECLOSER OUTLINE: VSA20A

DESCRIPTION: RECLOSER OUTLINE: VSA-20A WITH MTG AND ACCESSORIES

SCALE		SH	REV
NTS	KC1005230A	1 OF 1	A0

EQUIPMENT LIST

IT.#	QTY	MANUF. P/N	DESCRIPTION
1	1		DOOR, 4080 18GA GALV UH BLANK 4-1/2" X 4-1/2" HINGE CLSR REINFORCED PRIME PAINTED
2	1	CECO	DOOR, 3' X 7' INSULATED STEEL 20GA PAINTED WHITE FOR INTERIOR (STD)
3	1	1871A65	DOOR PULL, 12-1/8" LG X 1/2" DIA ALUMINUM, MCMASTER (STD)
4	3	VSL 2403 WS PAK	DOOR, LITE KIT 24"W X 30"H 1-3/4 THICK DOOR BRONZE W/ CLEAR WIRESHIELD GLASS & GLAZE TAPE AIR LOUVERS
5	1	531US26D	DOOR STOP, WITH HOOK BURNS (STD)
6	1	4208RA689429LPEKFH-071C-LC 6PN	LOCKSET, PANIC PDQ 3'2"-4'0" DOOR W/LEVER TRIM & IC MORT HOUSING LESS CORE PDQ
7	2	QO112L125G	LOAD CENTER, 100A ML 120/240VAC 1PH 12 POSITION SQ.D
8	2	NQ42L2C	PANELBOARD, 200A MB 120/240VAC 1PH 42 POSITION SQ.D
9	1	W24H1-A08XP4XXE	HEAT PUMP, 2 TON 1PH 60A WITH 8KW HEAT BARD GRAY
10	1	8403-058	THERMOSTAT, FOR HEAT PUMP AUTO CHANGEOVER BARD (STD)
11	1	1426A41	DOOR STOP, FLOORMOUNT HALF DOME CHROME
12	8	CR5352I	RECEPTACLE, 20A 120V DUPLEX IVORY HUBBELL (STD)
13	1	WP36LED	LIGHT, 36W LED MEDIUM WALL PACK NSI
14	1	ECRLEDM6	EMERGENCY/EXIT LIGHT, 120/277VAC (2)HEAD LED W/BATT. BACKUP LITHONIA (STD)
15	2	EML2LEDM12	EMERGENCY LIGHT, (2)HEAD LED WITH BATTERY BACKUP LITHONIA (STD)
16	3	CS1221I	SWITCH, 20A 120-277 TOGGLE SPST IVORY HUBBELL
17	1	AT1013030E240SXSXAGLXP	BATTERY CHARGER, 30A 130VDC OUTPUT 240VAC INPUT W/ ALARMS HINDLE (CUSTOMER PROVIDED MC INSTALLED)
18	15	4JC-100	BATTERIES, 100AH 125VDC (4 CELLS PER JAR) C&D (CUSTOMER PROVIDED MC INSTALLED
19	1	PUREFLOW 1000	EYEWASH STATION, SELF CONTAINED FEND-ALL
20	1		SWITCH, 600VDC 3W NONFUSABLE (CUSTOMER SUPPLIED MC INSTALLED)
21	1	WW #4C556	LOUVER, 12" X 12" MOTORIZED WITH DAYTON
22	1	CE 12-DS	FAN, 12" EXHAUST 2750 CFM SHUTTER MTD WITH SCREENED HOOD TPI CORP
23	6		RELAY PANEL (CUSTOMER PROVIDED MC INSTALLED)
24	1		WINDOW 24"H X 36"W HORIZONTAL SLIDING W/ SCREEN
25	1	64302	WALL POCKET, DEFLECTO
26	4		GROUND PAD, 1/4" X 4" X 14" (NO HOLES) COPPERTINNED PLATE
27	10	QC143A02	GROUND CLAMP, #4-300MCM DOUBLE WIRE TO FLAT BRONZE 2 PIECE WITH SS HARDWARE ANDERSON HUBBELL
28	1	CBLENC-9 R2	ENCLOSURE, 30"W X 119"H X 20"D 20 GA GALV PAINTED GRAY W/ GSKT CVR
29	1	ALJA-24VO90-12	CABLE TRAY, 24"W X 4"THK 90 DEG VERT. OUTSIDE ELBOW 12" RADIUS FLG IN HUSKY
30	2PCS	A9JA-24-144	CABLE TRAY, 24W" X 4" THK X 12' LONG ALUMINUM FLG IN HUSKY
31	1PC	A9JA-18-144	CABLE TRAY, 18"W X 4"THK X 12' LONG FLG IN ALUMINUM HUSKY
32	1PC	A9JA-12-144	CABLE TRAY, 12"W X 4"THK X 12' LONG FLG IN ALUMINUM HUSKY
33	1	ALJA-24T18-12	CABLE TRAY, 24" HORIZ. REDUCING TEE TO 18", 4" THK WITH 12" RADUIS FLG IN HUSKY
34	2	ALJA-24T12-12	CABLE TRAY, 24" HORIZ. REDUCING TEE TO 12", 4" THK WITH 12" RADUIS FLG IN HUSKY
35	11	GC141A02	GROUND CLAMP, #4-300MCM SINGLE WIRE TO FLAT BRONZE 2 PIECE WITH SS HARDWARE ANDERSON HUBBELL (STD)
36	60FT	580030	WIRE, #2/0 BARE STRANDED COPPER
37	8	ES1121	STRUT, 1-5/8" X 1-5/8" X 30" LONG SLOTTED ZINC PLATED
38	2	ES1121	STRUT, 1-5/8" X 1-5/8" BY 24" LONG SLOTTED ZINC PLATED
39	4	ES1121	STRUT, 1-5/8" X 1-5/8" BY 18" LONG SLOTTED ZINC PLATED
40	28	SHC-100 2/KIT	CABLE TRAY, HANGER CLIP 1" WIDE FLANCE ZP HUSKY (STD)
41	100	PPIS-S12	STRAP, GROUND CONDUCTOR SUPPORT 2" NYLON FOR HALO WIRE PANDUIT (STD)
42	150FT	580011G	WIRE, #6 STRANDED GREEN INSULATED
43	1	SP42092P	SPILL CONTAINMENT, C&D
44	50	ES12411	TYRAP MOUNTING BASE
45	1	FPNS476-71	LIGHTING CONTRACTOR PHOTOCELL RECEPTACLE, 120V TWISTLOCK FISHER PIERCE
46	1	9001KA2	CONTACTOR BLOCK, 30MM 600VAC 10A N.O. SQ.D.
47	1	9001KA3	CONTACTOR BLOCK, 30MM 600VAC 10A N.O. SQ.D.
48	1	5B104	240VAC 50A 2 POLE N.O. CONTACTOR, 208/ENCLOSURE.
49	1	FP120	LIGHTING CONTACTOR PHOTOCELL, 120V TWISTLOCK FISHER PIERCE
50	2	9001KR1U	PUSH BUTTON, METAL 30MM 600VAC 10A UNIVERSAL SQ.D.
51	1	CR463L20ASA14A0	CONTACTOR, 240V 2P N.O. NEMA 1 GE
52	1	CLS #7100-BC-DSHO-689 ANGLE #999011	DOOR CLOSER, HVY DUTY W/THUMB TURN HOLD OPEN ARM ALUM AMERICAN EAGLE AND REINFORCEMENT ANGLE NARROW FRAME BRACKET PDQ **FOR EXTERIOR DOORS**
53	1	HCM50912N	PANELBOARD, 225A LUG 125VDC I-LINE 99" SQ.D
54	2	DTU326	SWITCH, 600A 240VAC 3P MTS N1 SQ-D (CUSTOMER SUPPLIED MC INSTALLED)
55	1	CTAPF2/0-12-Q	COMPRESSION FITTING, #2/0 TO #6 WIRE PANDUIT
56	1	WW#2E816	THERMOSTAT, LINE VOLTAGE 120V FOR EXHAUST DAYTON (STD)
57	17	LCC6-14A-L	CRIMP CONNECTOR, (2) HOLE FOR #6 WIRE
58	1	C-866SCP	ENCLOSURE, 8"H X 6"W X 6" D TYPE 1 PAINTED C&I
59	1	1A491	RELAY CONTACTOR, 120VAC COIL DPDT 25A CONTACTS FOR EXHAUST SYSTEM OVERRIDE DAYTON
60	1	MR136 PFEF	LOCKSET, MORTISE 626 WITH SFIC CYLINDER LESS CORE PDQ NON LOCKING
61	8	AWN4-232-EU	LIGHT, INTERIOR FLUORESCENT 48" (2) T8 BULB 120/277V W/DIFFUSER COLUMBIA (STD)
62	1	RDB0803-7.3EP2P	BATTERY RACK, TWO STEP TIER ZONE 3A W/ ENVIROGUARD SPILL CONTAINMENT (CUSTOMER PROVIDED MC INSTALLED)
63	1		DOOR AWNING , 60" X 48" X .125 ALUMINUM
64		HGD-2	HYDROGEN DETECTOR, 120VAC WITH DUAL ALARM CONTACTS SOUTH SOURCE SALES (STD)
			PACK IN SHELTER
A	1	ALJA-24VO90-12	CABLE TRAY, 24"W X 4"THK 90 DEG VERT. OUTSIDE ELBOW 12" RADIUS FLG IN HUSKY
B	8		UNISTRUT, 1-5/8" X 1-5/8" X 26" LONG SLOTTED ZP
C	1	C-1203636FSRH	ENCLOSURE, 120"H X 36"W X 36"D 3R 14GA FREE STAND SNG DOOR OPEN BACK
D	1	A9JA-24-144	CABLE TRAY, 24"W X 4"THK X 21' LONG ALUMINUM FLG IN HUSKY
E	1	32-001050-0000	EYEWASH CARTRIDGE FOR PUREFLOW 1000 FEND-ALL 7 GAL. (**PACK IN SHELTER**)

NOTES:

1) MAIN DISCONNECT GROUND WIRE MUST BE ATTACHED TO GROUNDING SYSTEM BEFORE APPLYING POWER.

2) ALL WIRE AMPACITIES BASED ON TABLE 310-16 NEC, 310-15(b)(2)(a). ALL WIRE IS RATED AT 90°C W/75°C RATED LUGS. CONDUIT FILL BASED ON ANNEX C NEC(TABLE C1).

3) ALL SERVICE ENTRANCE EQUIPMENT SHALL BE LISTED FOR IT'S USE.

4) LOCAL BUILDING OFFICIALS: ALL THE ITEMS THAT ARE NOT COVERED IN THE APPROVAL PROCESS ARE TO BE SITE INSTALLED. ALL SITE INSTALLED ITEMS ARE SUBJECT TO LOCAL REVIEW, APPROVAL AND INSPECTION PROCESS.

5) DOOR LOCKSET INSIDE LEVER HAS AN ANSI F13 FUNCTION THAT RETRACTS LATCH AND DEADBOLT UPON ROTATION OF LEVER.

6) ALL ITEMS THAT ARE SITE INSTALLED ARE SUBJECT TO LOCAL REVIEW. APPROVAL AND INSPECTION ON SITE BY LOCAL AUTHORITY HAVING JURISDICTION.

7) USE 18 AWG THHN WIRE FOR ALL ALARM WIRES.

8) AFTER FABRICATION OF UNISTRUT AND ALL THREAD ROD SPRAY WITH ZINC-IT PRIMER.

9) IF BATTERIES WITH AN ELECTROLYTE CAPACITY OF MORE THAN 50 GALLONS ARE TO BE INSTALLED WITHIN THIS BUILDING, ONE OF THE FOLLOWING ALTERNATIVES MUST ALSO BE INSTALLED: 1.) AN EXHAUST FAN WITH A HYDROGEN LIMIT SWITCH SO THAT TO LIMIT THE HYDROGEN TO 1% OF THE TOTAL VOLUME OF THE ROOM; OR 2.) CONTINUOUS VENTILATION SHALL BE PROVIDED AT A RATE NOT LESS THAN 1 CUBIC FOOT PER MINUTE PER SQUARE FOOT OF FLOOR AREA OF ROOM.

10) ANY CHEMICALS TO BE STORED IN THIS BUILDING SHALL NOT EXCEED AMOUNTS LISTED IN TABLES 307.1(1) AND 307.1(2) OF THE INTERNATIONAL BUILDING CODE.

⬡ – INDICATES RECEPTACLE GROUP.

TENNESSEE PROJECT DATA

DESIGN CODES:

2006 INTERNATIONAL BUILDING CODE
2006 INTERNATIONAL MECHANICAL CODE
2006 INTERNATIONAL PLUMBING CODE
2006 INTERNATIONAL FUEL GAS CODE
2006 INTERNATIONAL FIRE CODE
2008 NATIONAL ELECTRIC CODE
2006 INTERNATIONAL ENERGY CONSERVATION CODE PER SECTION 501.2, USE ASHRAE/IESNA 90.1 2004 SECTION 2.3c – EXEMPT
TENNESSEE PUBLIC BUILDINGS ACCESSIBILITY ACT, T.C.A. 68-120-2

DESIGN LOADS:

FLOOR LIVE LOAD (THROUGHOUT)	110 PSF (OPTIONAL 200 PSF)
FLOOR DEAD LOAD MAX. (THROUGHOUT)	36 PSF
ROOF LIVE LOAD	50 PSF
ROOF DEAD LOAD	52.2 PSF
GROUND SNOW LOAD	41.3 PSF
FLAT ROOF SNOW LOAD	50 PSF
SNOW EXPOSURE FACTOR	1.2
SNOW LOAD IMPORTANCE FACTOR	1.0
THERMAL FACTOR	1.2
ULTIMATE WIND SPEED (3-SEC GUST)	150 MPH
SEISMIC IMPORTANCE FACTOR	1.0
RISK CATEGORY	II
BUILDING CLASSIFICATION	II
WIND EXPOSURE CATEGORY	C
INTERNAL PRESSURE COEFFICIENT	±0.18
WIND LOAD HORIZONTAL (MWFRS)	42.1 PSF
WIND LOAD (UPLIFT) (MWFRS)	62.9 PSF
WIND LOAD HORIZONTAL (C & C)	61.7 PSF (ZONE 4) 81.6 PSF (ZONE 5)
WIND LOAD HORIZONTAL (WINDOW & DOOR)	39.8 PSF (ZONE 4) BASED ON NORMAL WIND SPEED 40.1 PSF (ZONE 5) BASED ON NORMAL WIND SPEED
WIND LOAD (UPLIFT) (C & C)	52.9 PSF (ZONE 2) 91.9 PSF (ZONE 3)
SEISMIC IMPORTANCE FACTOR	1
SEISMIC USE GROUP	I
SPECTRAL RESPONSE ACCELARATION S_{ss}	1
SPECTRAL RESPONSE ACCELARATION S_{s}	1.25
SEISMIC DESIGN CATEGORY	D
SITE CLASS	D
BASIC SEISMIC-FORCE RESISTING SYSTEM	BEARING WALL SYSTEM – SPECIAL
DESIGN BASE SHEAR	0.2W
ANALYSIS PROCEDURE	EQUIVALENT LATERAL-FORCE PROCEEDURE
OCCUPANCY USE GROUP	S2
CONSTRUCTION TYPE	VB UNSPRINKLED
MINIMUM SETBACK	SEE NOTE 3 FOR COMMON OR ASSUMED PROPERTY LINE TO COMPLY WITH IBC TABLES 602 & 704.8

NOTES:

1. THE INTENDED OCCUPANCY OF THIS EQUIPMENT SHELTER IS FOR PERFORMING THE REQUIRED SERVICE/MAINTENANCE OF EQUIPMENT ONLY.
2. PER IBC 2006 TABLE 720.1(2), 4" SAND-LIGHTWEIGHT CONCRETE WALLS HAVE FIRE RESISTANCE RATING OF 2 HOURS WITH UNPROTECTED OPENINGS.
3. PER IBC 2006 TABLE 705.8, ANY WALL W/ 10% OR LESS OF UNPROTECTED OPENINGS MAY UTILIZE A SETBACK GREATER THAN 5'-0". ANY WALL W/ 15% OR LESS OF UNPROTECTED OPENINGS MAY UTILIZE A SETBACK GREATER THAN 10'-0". ANY WALL W/ 25% OR LESS OF UNPROTECTED OPENINGS MAY UTILIZE A SETBACK GREATER THAN 15'-0". ANY WALL W/ 45% OR LESS OF UNPROTECTED OPENINGS MAY UTILIZE A SETBACK GREATER THAN 20'-0". ANY WALL W/ UNPROTECTED OPENINGS MAY UTILIZE A SETBACK GREATER THAN 30'-0".
4. THIS SHELTER IS REQUIRED TO BE CONNECTED TO PUBLIC UTILITIES.
5. THE USE OF THIS SHELTER WITHOUT RESTROOM FACILITIES IS SUBJECT TO LOCAL REVIEW AND APPROVAL.
6. THESE STRUCTURES ARE NOT DESIGNED FOR FLOOD HAZARD AREAS.

ITEMS TO BE SITE INSTALLED & SUBJECT TO LOCAL CODE REVIEW & COMPLIANCE AND ARE NOT INSPECTED BY THE THIRD PARTY: FOUNDATION, CONNECTION TO PUBLIC UTILITIES, SITE WORK, ETC..

FINISH COLOR SCHEDULE
EXT. WALLS: EXPOSED AGGREGATE – GREYSTONE GRAY
EXT. TRIM: MINDFUL GRAY COARSE
EXT. DOORS: MINDFUL GRAY
INT. WALL & CEILING: STANDARD FINISH
INT. DOOR(S): SAME AS EXTERIOR COLOR
FLOOR: URETHANE PAINTED GRAY W/ ANTISKID

TN PLAN NUMBER: MODEL #MCL801
SITE: BEAN STATION, TN
"MAY BE BUILT MIRROR IMAGE"

REV NO.	DESCRIPTION	DATE	DWN BY
R1	GENERAL REVISIONS	11-15-17	CRR

MODULAR CONNECTIONS, LLC
1090 Industrial Blvd
Bessemer, Al 35022
Phone: 205-980-4565
Fax: 877-675-5851
Email: info@ModularConnections.com

DRAWN BY	DATE	JOB NO.
DH	9-26-17	MCP983-MC4334

TITLE: KVA, INC.
EQUIPMENT LIST FOR 16' X 28' X 9'8" IH SHELTER

SCALE: NA
PROJ MGR: CLP

DRAWING NO.: D16230 R1
SHEET: 01

REV NO.	DESCRIPTION	DATE	DWN BY
R1	GENERAL REVISIONS	11-15-17	CRR

MODULAR CONNECTIONS, LLC
1090 Industrial Blvd
Bessemer, Al 35022
Phone: 205-980-4565
Fax: 877-679-5851
Email: info@ModularConnections.com

DRAWN BY	DATE	JOB NO.
DH	9-26-17	MCP983-MC4334

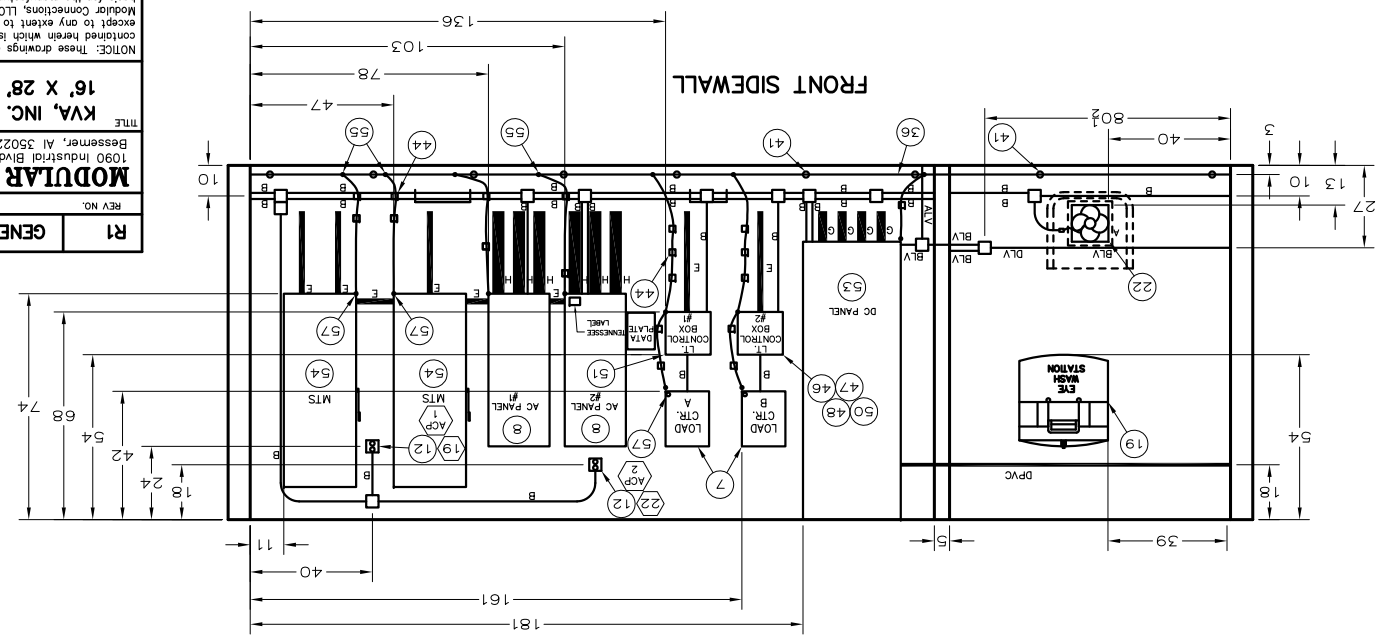
TITLE: **KVA, INC.**
16' X 28' X 9'8" IH SHELTER

SCALE	PROJ MGR
NA	CLP

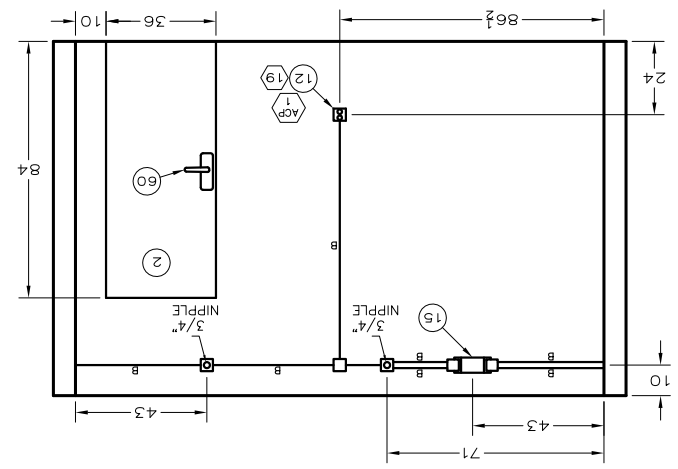
DRAWING NO.	SHEET
D16230 R1	02

TN PLAN NUMBER: MODEL #MCL801
SITE: BEAN STATION, TN
"MAY BE BUILT MIRROR IMAGE"

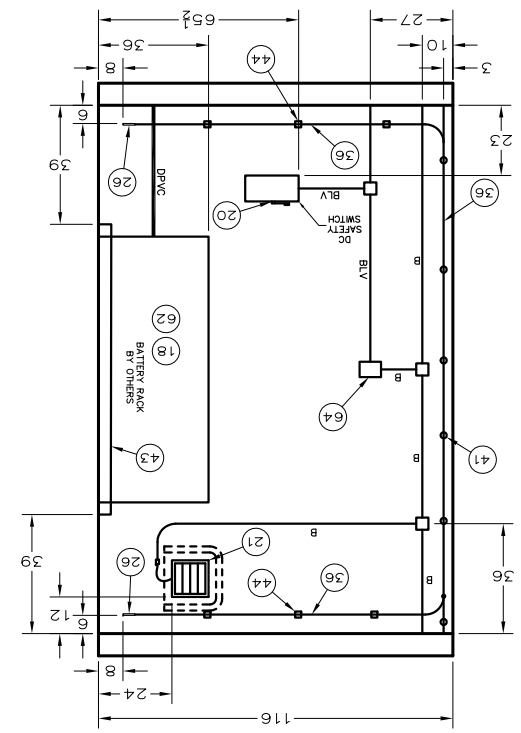
FRONT SIDEWALL



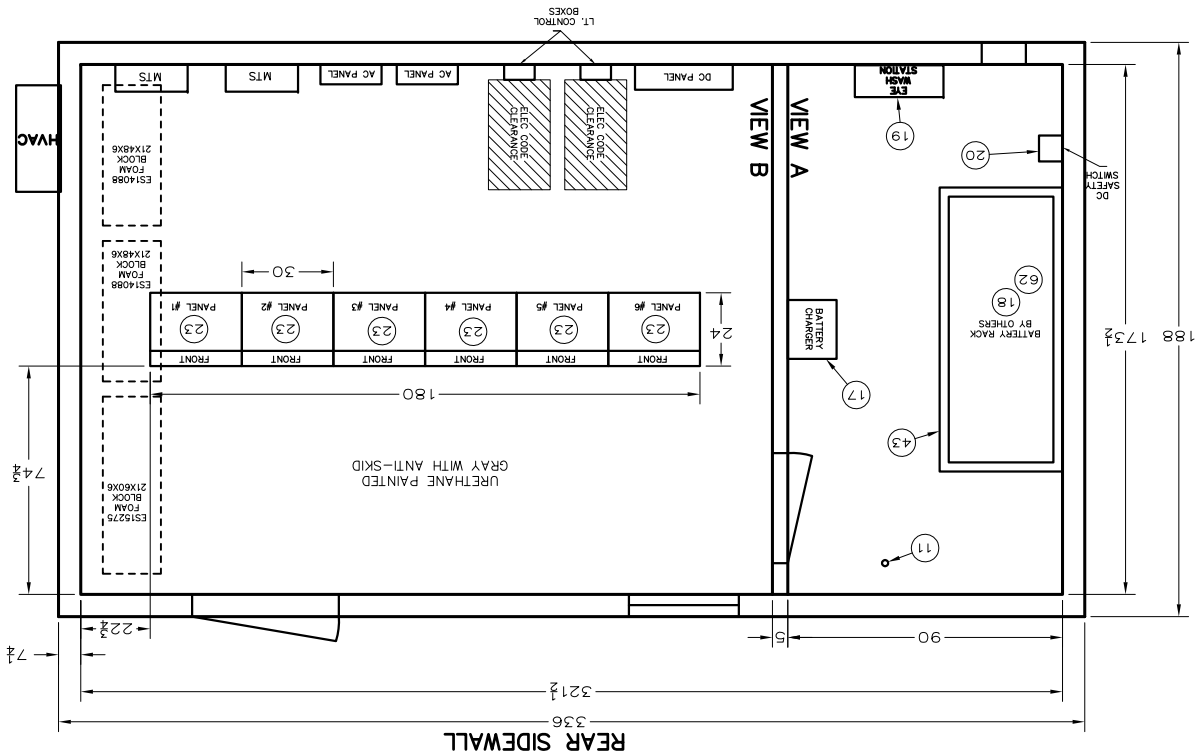
VIEW B



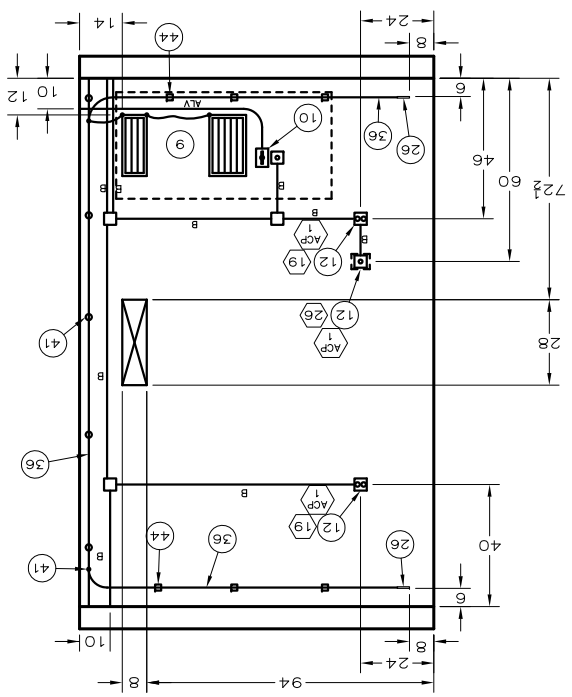
LEFT ENDWALL



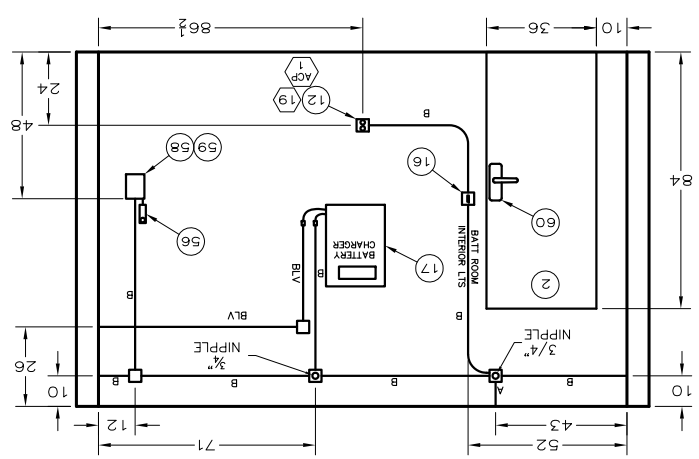
FLOOR – 200PSF LOAD



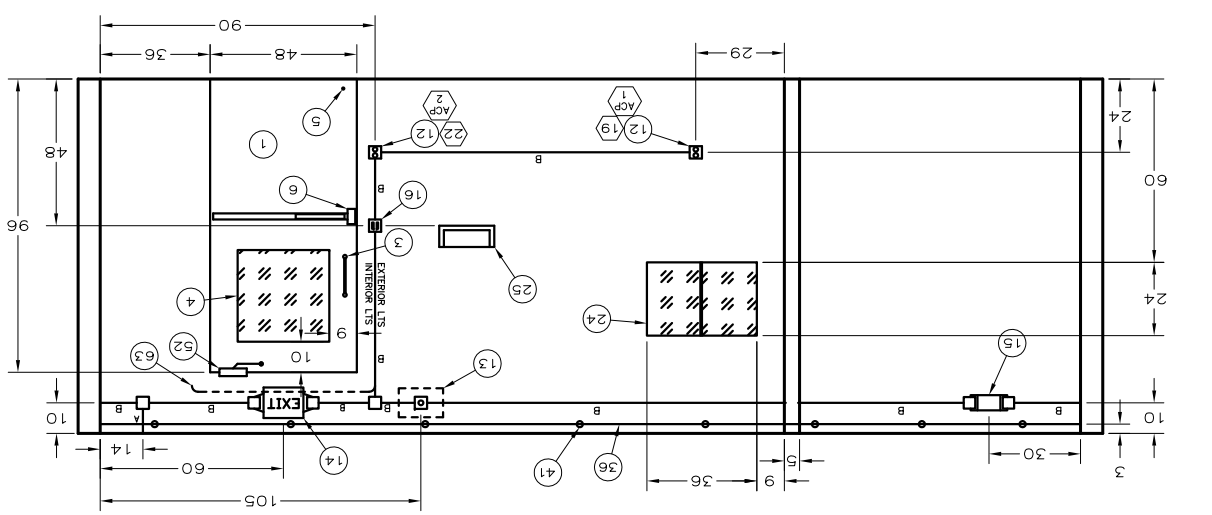
RIGHT ENDWALL



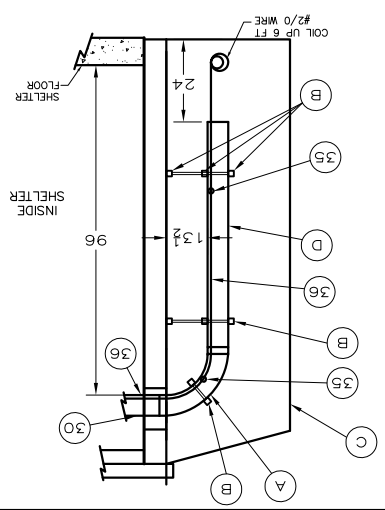
VIEW A



REAR SIDEWALL



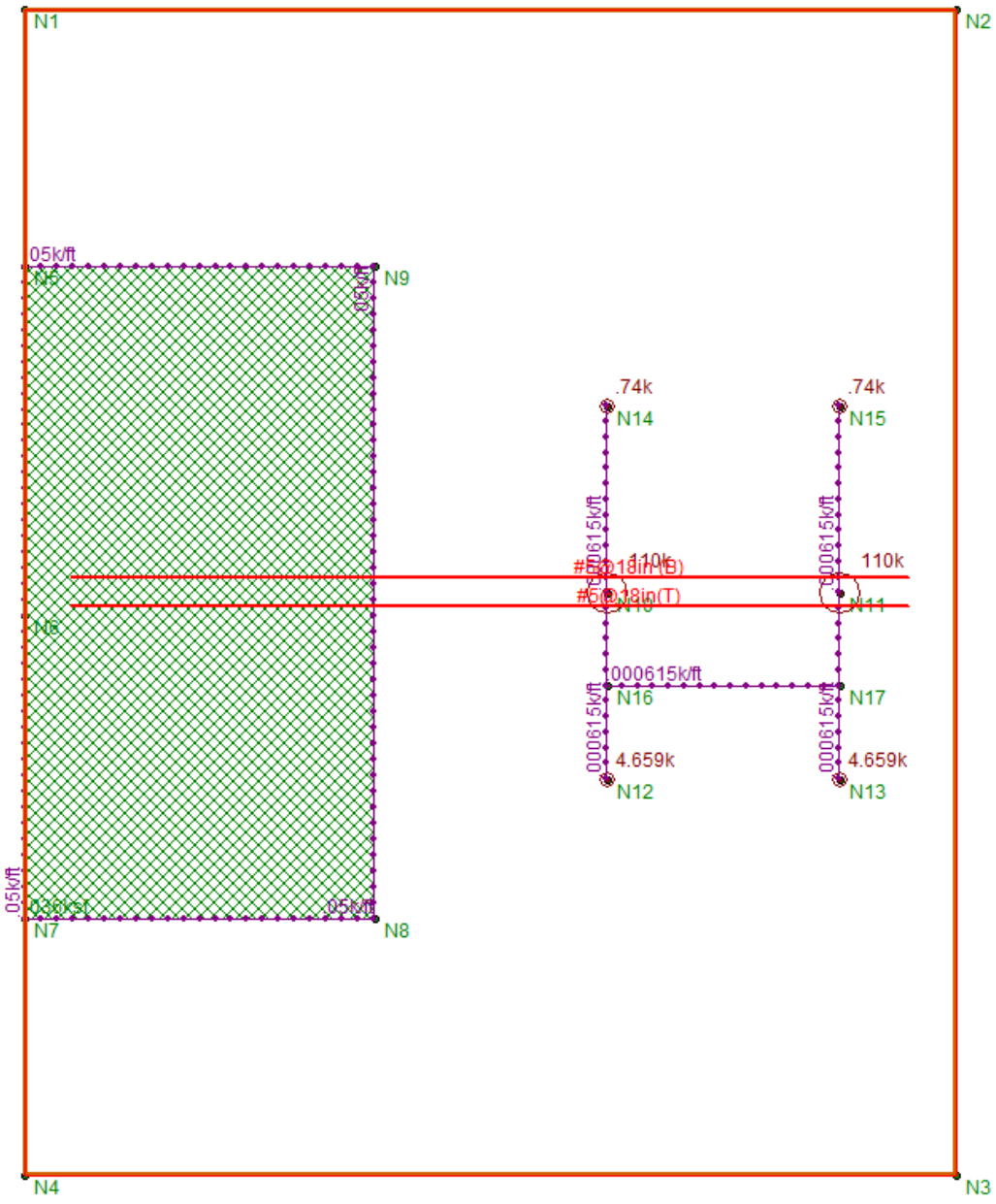
EXTERIOR CABLE TRAY DETAIL



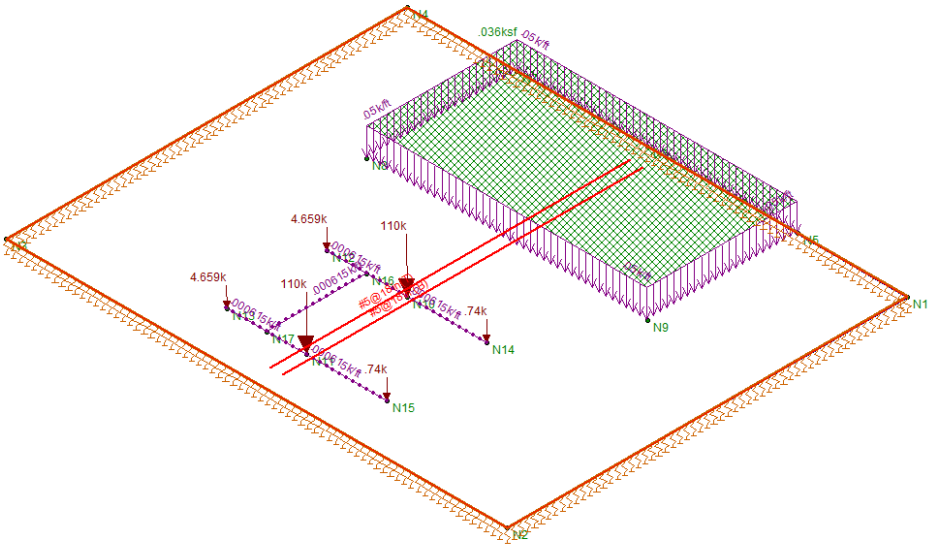
STANDARD CONDUIT FITTINGS ARE DIECAST SET-SCREW TYPE EMT FITTINGS UNLESS SPECIFIED OTHERWISE ON DRAWING

CONDUIT KEY	
(R) A = 1/2" (LV)	(R) G = 3" (LV)
(R) B = 3/4" (LV)	(R) H = 4" (LV)
(R) C = 1" (LV)	
(R) D = 1-1/4" (LV)	
(R) E = 2" (LV)	
(R) F = 2-1/2" (LV)	

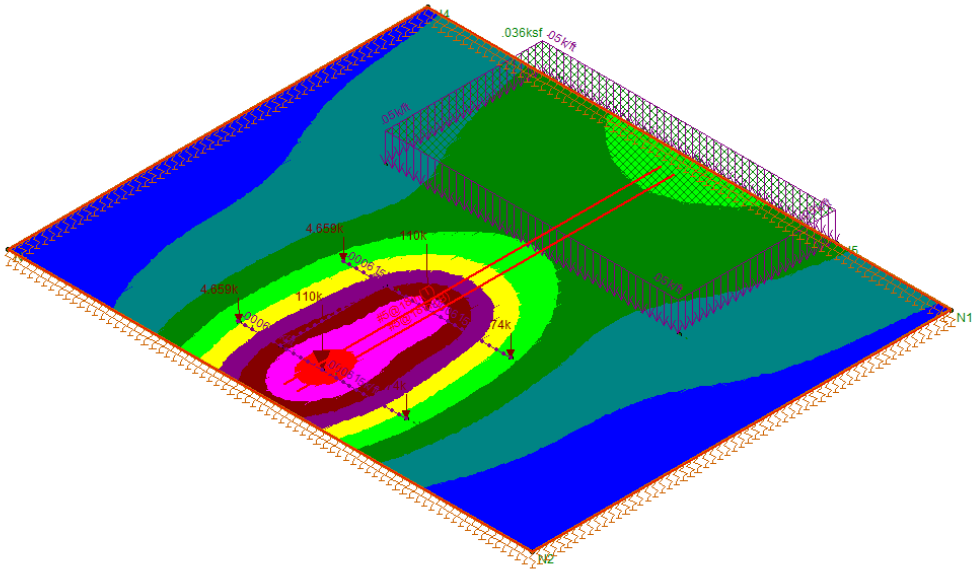
NOTES:
1)'LV' DESIGNATES LOW VOLTAGE CONDUIT.
2)'P' DESIGNATES PVC CONDUIT.



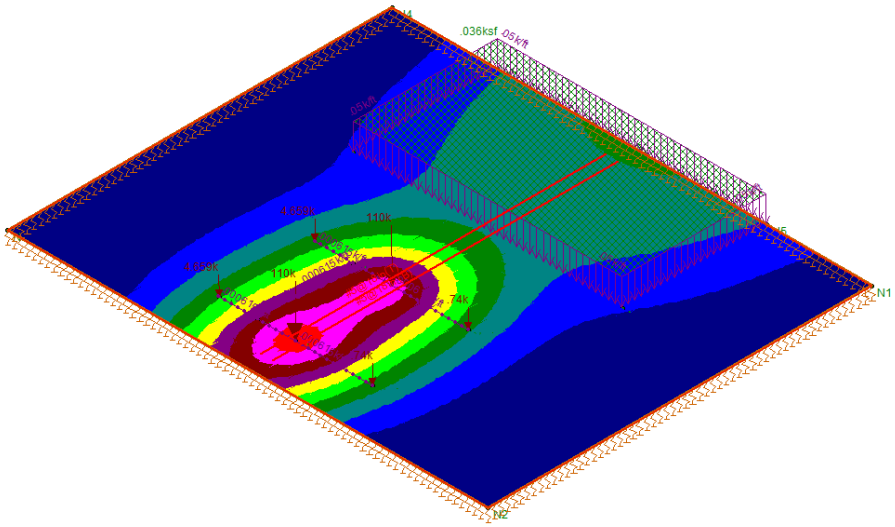
Plan View of Model



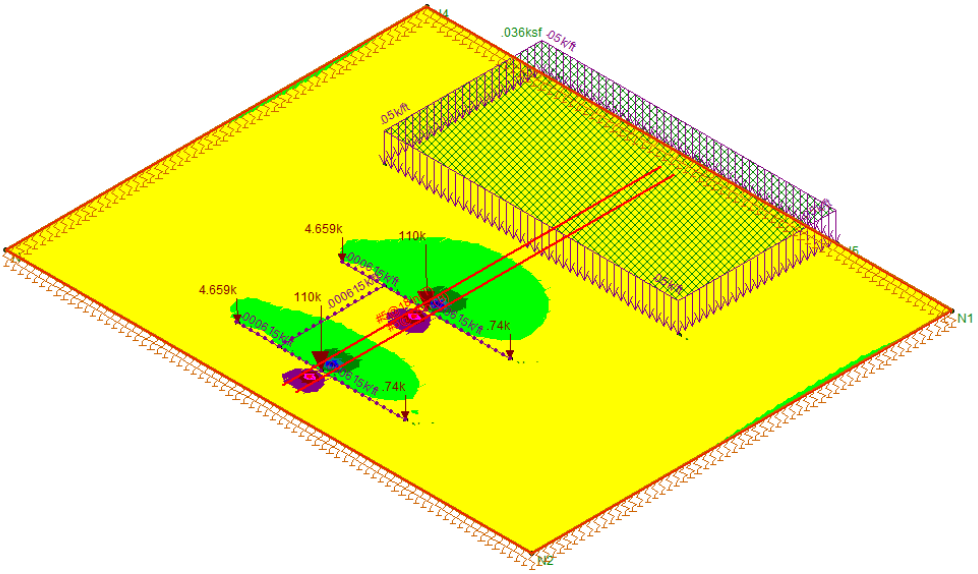
Isometric View of Model



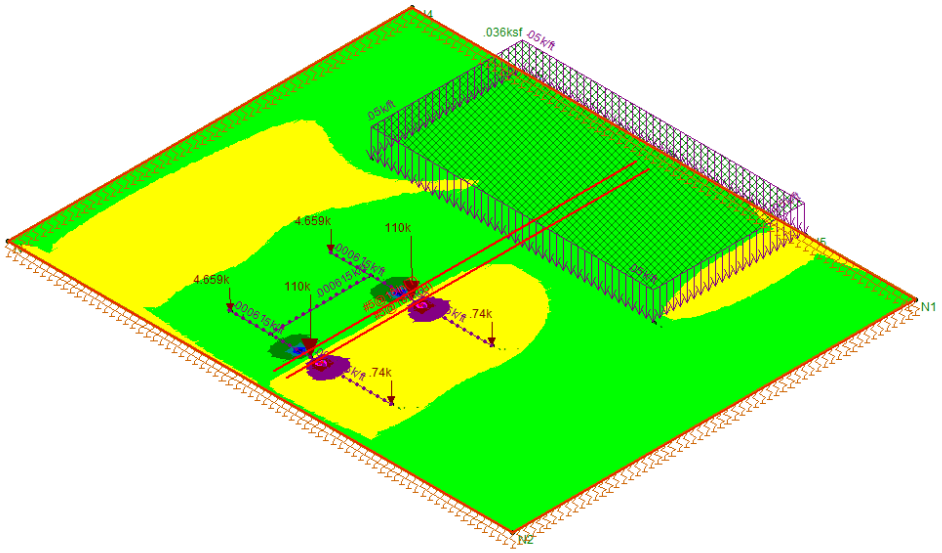
Soil pressure



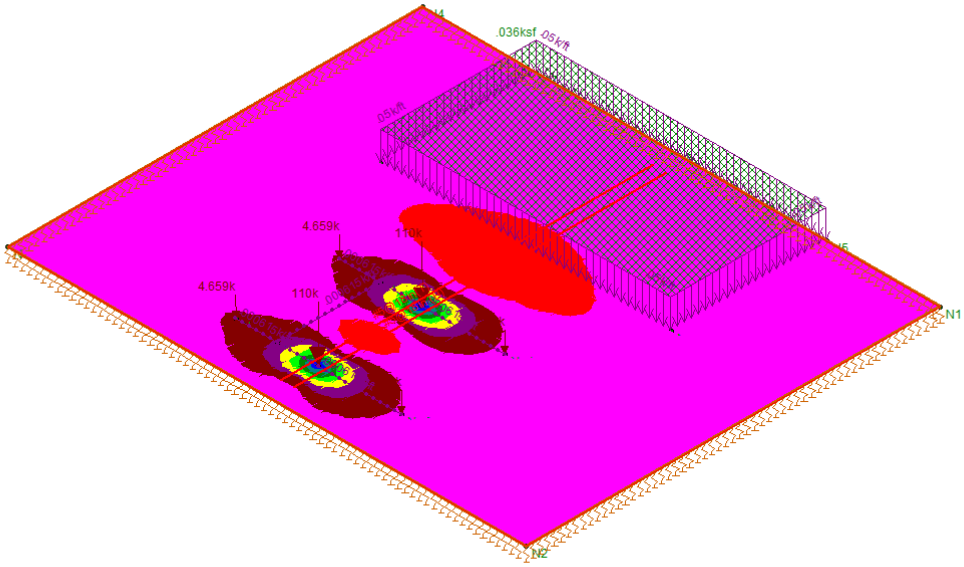
Displacement



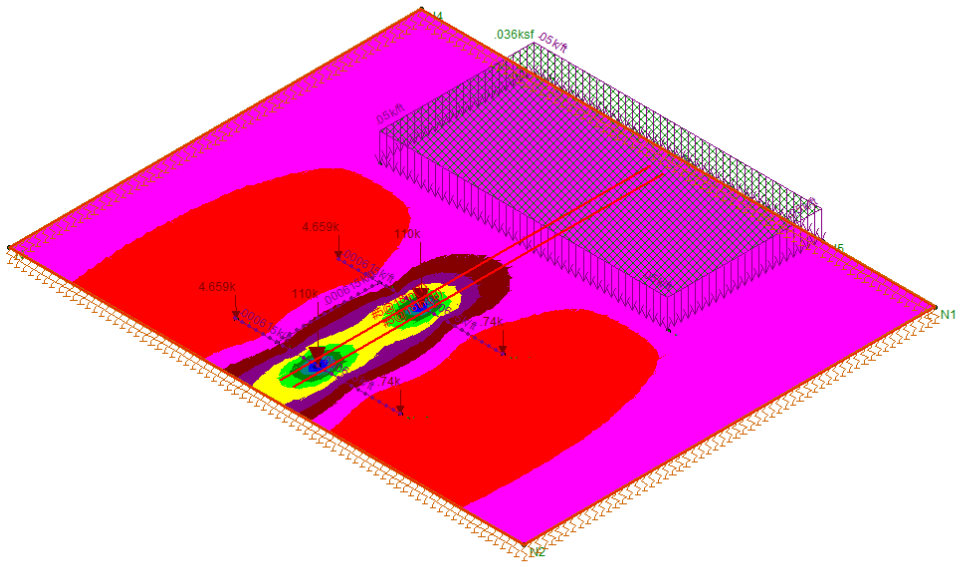
QZ


.036ksf .05k/ft
4.659k
110k
4.659k
110k
.74k
.74k
N1
N2

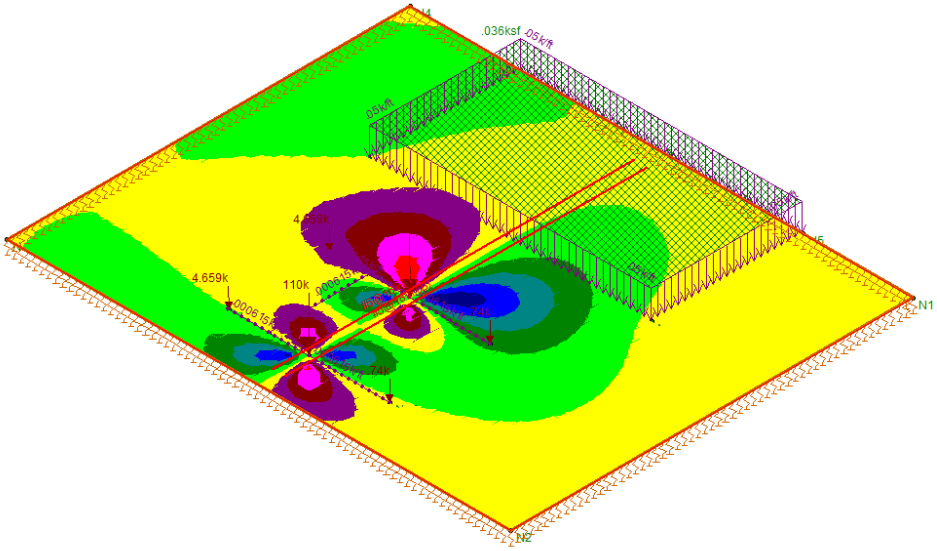
QX


.036ksf .05k/ft
.05k/ft
4.659k
110k
4.659k
110k
N1
N2

MZ


.036ksf .05k/ft
.05k/ft
4.659k
110k
4.659k
110k
2.74k
2.74k
N1
N2

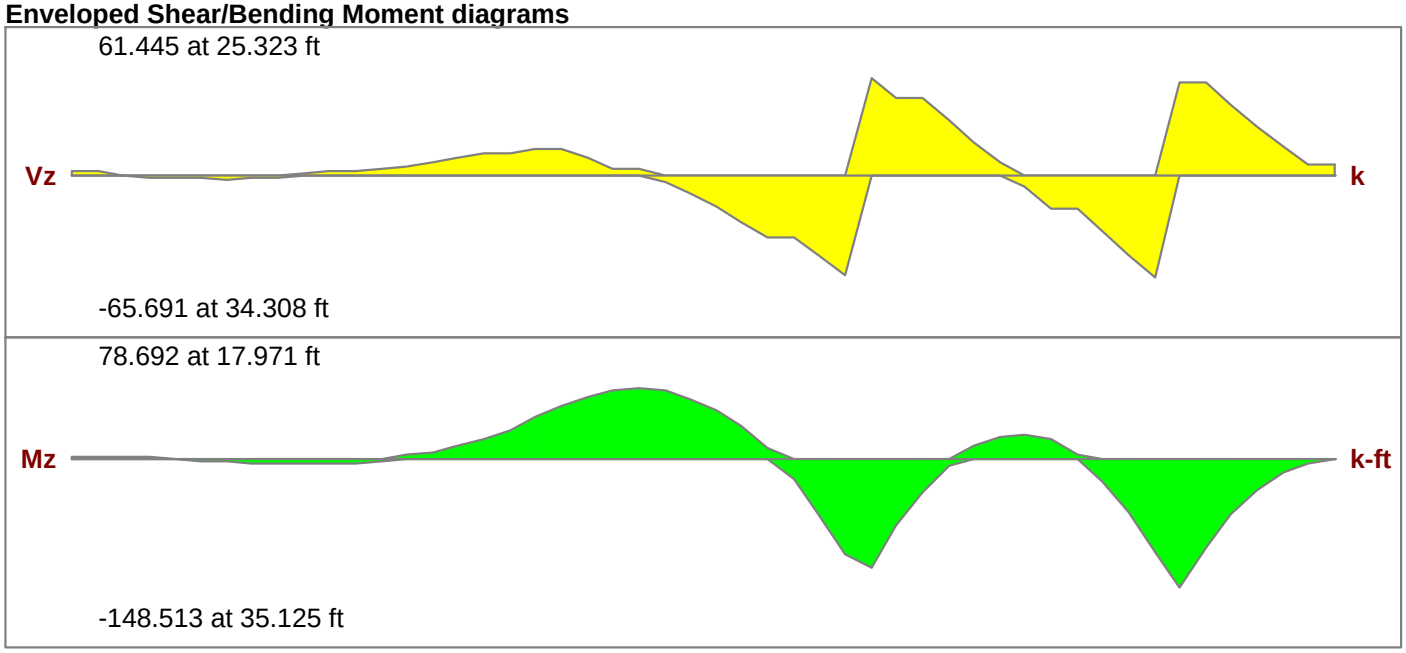
MX


.036ksf .05k/ft
4.659k
110k
4.659k
N1
N2

MXZ

Strip:	**DS1**	Max Top bar Spac.:	**18 in**	Stress Block:	**Rectangular**
Material:	**Conc3000NW**	Min Top bar Spac.:	**3 in**	Rebar Orientation:	**0**
Strip Width:	**600.39 in**	Max Bot bar Spac.:	**18 in**	Rebar Spacing Inc:	**2 in**
Total Cuts:	**50**	Min Bot bar Spac.:	**3 in**	Design Rule:	**Typical**

Enveloped Shear/Bending Moment diagrams



ACI 318-11 Code Check

Top Bending Check	**0.173**	Bot Bending Check	**0.326**	1 Way Shear Check	**0.131**
Gov Mu Top	**78.692 k-ft**	Gov Mu Bot	**-148.513 k-ft**	Gov Vu	**65.691 k**
phi*Mn Top	**455.096 k-ft**	phi*Mn Bot	**455.096 k-ft**	phi*Vn	**502.522 k**
Governing Cut	**DS1-X23**	Governing Cut	**DS1-X44**	Governing Cut	**DS1-X43**
Tension Bar Fy	**60 ksi**	Concrete Weight	**.145 k/ft^3**	Top Cover	**1.5 in**
Shear Bar Fy	**60 ksi**	λ	**1**	Bottom Cover	**1.5 in**
F'c	**3 ksi**	E_Concrete	**3156 ksi**	Side Cover	**3 in**
Flex. Rebar Set	**ASTM A615**	Prvd Bot Bar Spac.	**#5@18in**	Prvd Top Bar Spac.	**#5@18in**

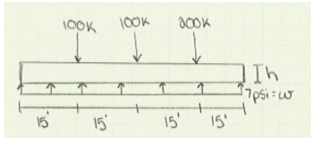
Bending Steel Reqd/Prvd, Units: in^2)

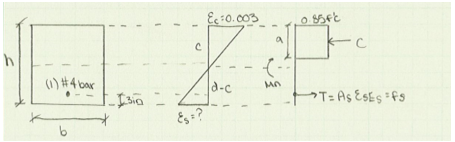
Cut Label	Top As Reqd	Top As Prvd	Bot As Reqd	Bot As Prvd	Rho Reqd(T/S)	Rho Prvd(Gross)
DS1-X23	**1.722**	**10.124**	**NA**	**10.124**	**0.00180**	**0.00281**
DS1-X44	**NA**	**10.124**	**3.26**	**10.124**	**0.00180**	**0.00281**
DS1-X43	**NA**	**10.124**	**2.355**	**10.124**	**0.00180**	**0.00281**

Structural Calculation	
Length (feet)	40
Width (feet)	50
Soil Bearing Capacity (psi)	7
Compressive strength of concrete (f'c) (p	3000
Load 1 (k)	110
Load 2 (k)	110
Load 3 (k)	4.659
Load 4 (k)	4.659
Load 5 (k)	0.74
Load 6 (k)	0.74
Height (feet)	1
Weight of Reinforced Concrete (lbs/ft3)	150

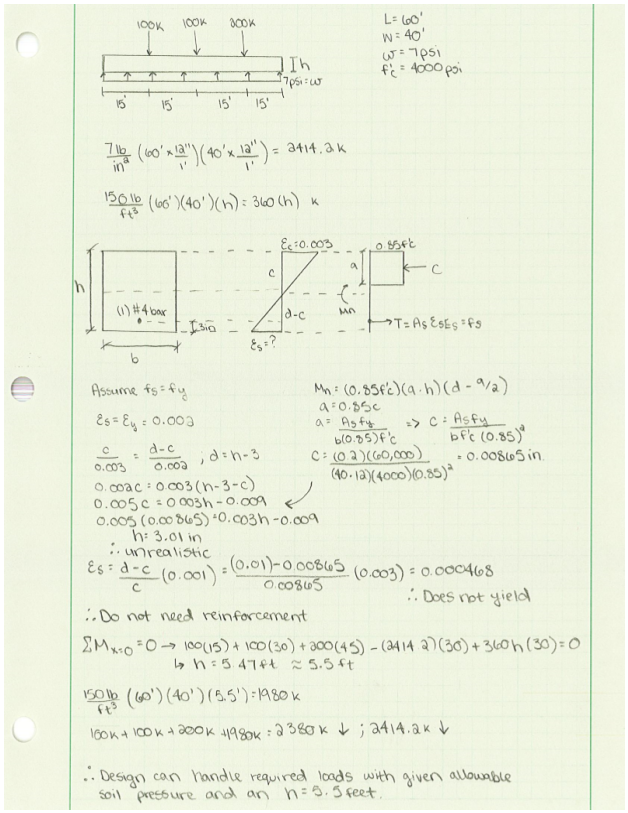
Limit States
Shear
Flexure
Punching Shear
1-Way Shear

Calculations		
Converting soil bearing capacity load (	2016	
Load of concrete (k)	300	
Area of steel (inches2)	0.2	
Compressive strength of steel (psi)	60000	
c (inches)	0.0092272203	
Height (inches)	3.0153787	Unrealistically small, will assume larger height for constructability purposes
d (inches)	0.01	
εs	0.00025125	Does not yield
ϕVn	530.798	Less than soil bearing capacity=good
ϕMn	65.64705882	
a (inches)	0.007843137255	





Will compare to Vu and Mu and draw shear and moment diagrams when I receive loading information



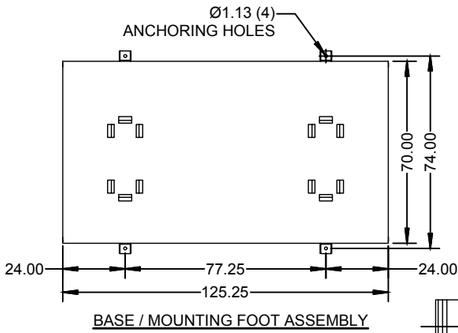
ITEMS:
1. PROVISION ON BASE FOR SKIDDING
2. TRANSFORMER LIFTING LUGS
3. STAINLESS STEEL GROUND PADS (2) ON DIAGONALLY OPPOSITE SIDE OF TANK
4. STAINLESS STEEL DIAGRAMMATIC NAMEPLATE
5. 20" DIA, MANHOLE (2) WITH COVER (BOLTED AND GASKETED)
6. WELDED TOP COVER WITH LIFTING EYES (4) FOR COVER ONLY
7. COOLING RADIATORS (6), HOT DIPPED GALVANIZED, UNPAINTED, DEMOUNTABLE WITH ISOLATION VALVES, LIFTING EYES, AND 1/2" DRAIN/VENT PLUGS
8. HV DRAWLEAD BUSHING, 69 kV, 350 kV BIL (3) WITH 4 HOLE NEMA PAD MAKE: ABB TYPE "O+C"
9. LV BOTTOM CONNECTED BUSHING, 25 kV, 150 kV BIL, (4) WITH 4 HOLE NEMA PAD MAKE: ABB TYPE "O+C"
10. 2" COMBINATION LOWER DRAIN AND FILTER VALVE WITH SAMPLER AND PLUG
11. 1" UPPER FILTER VALVE AND PLUG
12. VTC PRESSURIZATION TEST POINT WITH 1/2" BALL VALVE AND PLUG
13. LIQUID LEVEL GAUGE WITH CONTACTS, GAUGE CENTER IS AT 25deg C OIL LEVEL
14. LIQUID TEMPERATURE GAUGE WITH CONTACTS
15. PRESSURE VACUUM GAUGE, INSIDE NITROGEN BOX, WITH CONTACTS AND BLEEDER
16. PRESSURE RELIEF DEVICE WITH CONTACTS, FLAG & DIRECTIONAL SHROUD, PIPED DOWN THE SIDE OF THE TRANSFORMER & SUPPORTED USING AN 8" PVC PIPE
17. DE-ENERGIZED NO LOAD MANUAL TAP CHANGER WITH PROVISION FOR PADLOCKING
18. CONTROL BOX, NEMA 4, 48 x 60 x 18, WITH BOLTED BOTTOM PLATE
19. JACK PADS (4) WITH PULLING EYES
20. BOX FOR CT FEED-THRU'S AND MAIN CORE GROUND BUSHING
21. COOLING FANS (8)
22. WINDING TEMPERATURE GAUGE, SIMULATION SYSTEM, WITH CONTACTS
23. BOLTED, GASKETED PLATE FOR ACCESS TO DETC
24. THERMOWELLS FOR TEMPERATURE GAUGES & ETM
25. SUDDEN PRESSURE RELAY WITH SEAL-IN RELAY & SHUT OFF VALVE
26. HV STATION CLASS ARRESTER, POLYMER, 54 kV, 42 kV MCOV; MAKE: HUBBELL
27. LV STATION CLASS ARRESTER, POLYMER, 10 kV, 8.4 kV MCOV; MAKE: HUBBELL
28. POCKET FOR PREVENTIVE AUTO TRANSFORMER
29. BOX FOR NITROGEN BOTTLE AND TWO STAGE CONTROLS
30. LOAD TAP CHANGER SWITCH COMPARTMENT, TYPE RMV-II
31. LTC DE-HYDRATING BREATHER, WITH TUBING AND SHUT OFF VALVE
32. LTC OIL FILL NIPPLE & CAP, 1"
33. LTC VACUUM FILLING NIPPLE & CAP, 2"
34. LTC POSITION INDICATOR WITH DRAG HAND
35. 2" LTC GLOBE TYPE, BRONZE, DRAIN VALVE WITH 3/8" SAMPLER AND PLUG
36. LTC HAND CRANK OPERATING LOCATION
37. LTC LIQUID LEVEL GAUGE WITH CONTACTS
38. LTC PRESSURE RELIEF DEVICE WITH CONTACTS, FLAG & DIRECTIONAL SHROUD, PIPED DOWN THE SIDE OF THE TRANSFORMER & SUPPORTED USING AN 8" PVC PIPE
39. FALL PROTECTION MOUNTING PLATE
40. BOX FOR PA CORE GROUND BUSHING
41. 1/2" X 3" CU. GROUND BUS FROM X0 BUSHING TO GROUND PAD AT BASE OF XFMR
42. ELECTRONIC TEMPERATURE MONITOR, INSIDE CONTROL BOX, VISIBLE THRU VIEW GLASS
43. AMBIENT TEMPERATURE RTD

NOTES:
1. TYPE II MINERAL OIL FILLED TRANSFORMER, APPROXIMATELY 3975 GALLONS
2. OUTDOOR SERVICE
3. PAINT: ANSI-70, ZINC RICH PRIMER, URETHANE OVER EPOXY (VTC PAINT SYSTEM IV), TANK INSIDE AND CORE CLAMPS PAINTED WHITE, BASE UNDERCOATED WITH COAL-TAR EPOXY
4. TOUCH UP PAINT KIT PROVIDED
5. UNIT DESIGNED FOR INERT GAS TYPE OIL PRESERVATION
6. SEE 20 SERIES SHEETS FOR SCHEMATIC
7. ACCESSORY WIRING IN RIGID GALVANIZED STEEL CONDUIT; FINAL SHORT RUNS MAY BE FLEXIBLE LIQUID TIGHT CONDUIT; FAN POWER VIA WEATHERPROOF CORDS AND PLUGS
8. CG1 IS FULLY ASSEMBLED, CG2 IS AS SHIPPED
9. UNIT DESIGNED FOR FULL VACUUM FILLING
10. UNIT SHIPS WITH FOLLOWING ITEMS DEMOUNTED;

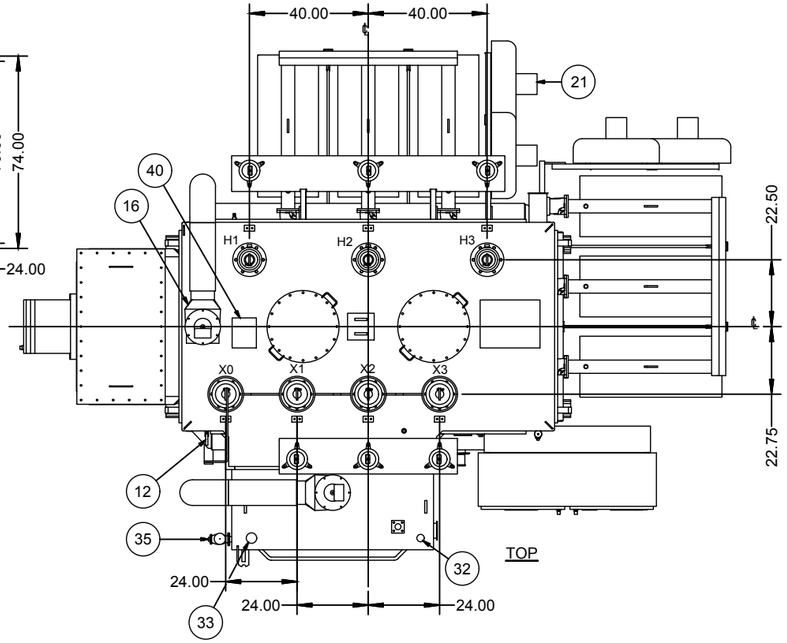
ITEM:	SHIPPING WEIGHT:
HV BUSHINGS/ HV PADS	450 LBS
RADIATORS, FANS & FAN BKTS.	9,520 LBS
OIL FOR RADS	
(2 DRUMS RAD OIL @ 55 GALLONS = 110 GALLONS)	825 LBS
MAIN UNIT	99,205 LBS

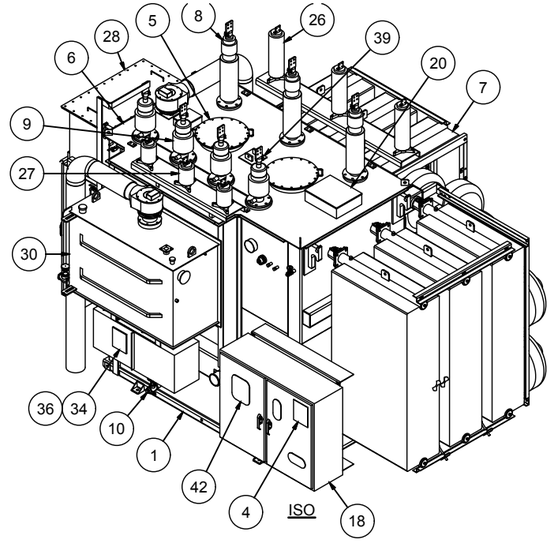
229 GAL OF RAD OIL SHIPS IN GAS SPACE= 5.78" ABOVE 25deg C LEVEL

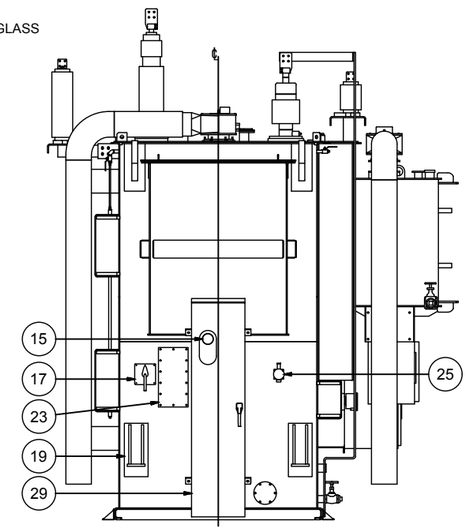
11. UNIT DESIGNED FOR OPERATION AT MINIMUM AMBIENT - 20deg C
12. TANK SEAMS ARE WELDED INSIDE AND OUTSIDE-NO CORNER WELDS WITHIN 8" OF CORNER
13. UNIT SHIPS WITH IMPACT RECORDER
14. 60/60 MONTHS EXTENDED WARRANTY IS PROVIDED
15. CONTRACTED DOCUMENTS SHIP INSIDE CONTROL BOX
16. SFRA TEST TO BE PERFORMED ON THE UNIT IN FACTORY & AT SITE



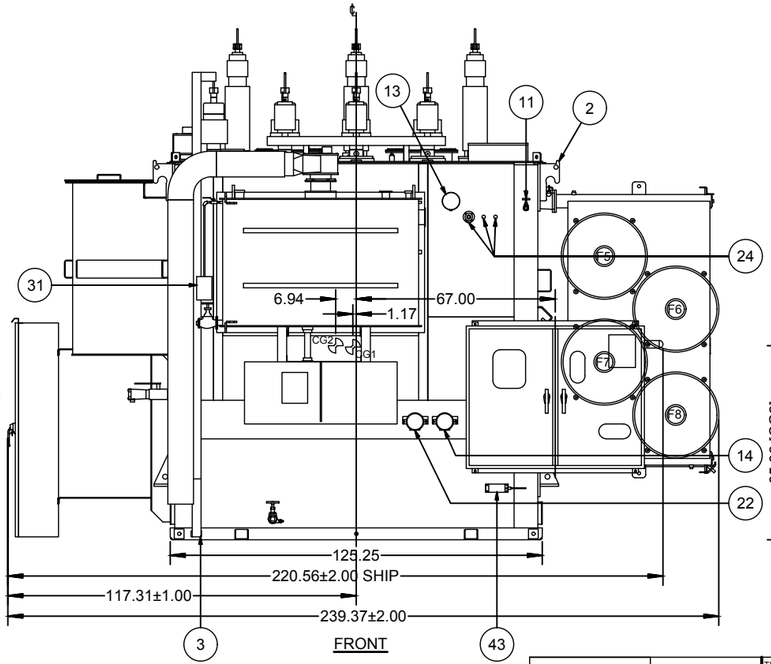
BASE / MOUNTING FOOT ASSEMBLY

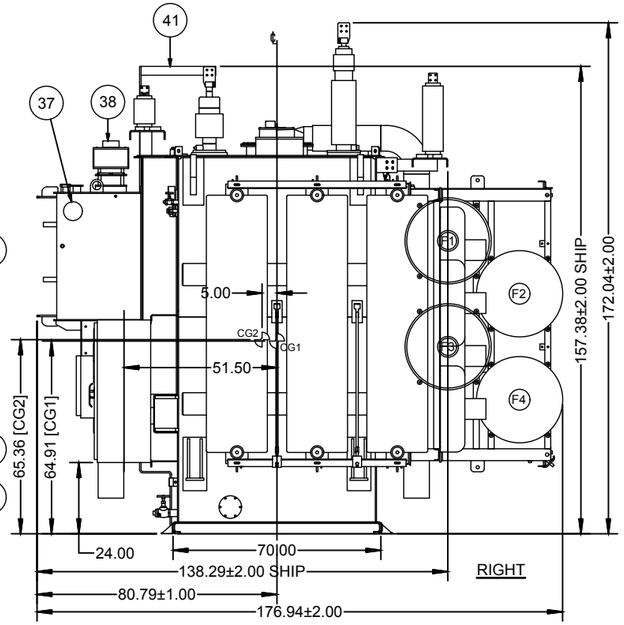






LEFT (W/O RADS. & FANS)





Liquid Filled Transformer Data:

MOD/SN: 47015MA156	MVA: 15/20/25 AT 55°C RISE
	MVA: 16.8/22.4/28 AT 65°C RISE
3 PHASE, 60 Hz	CLASS: ONAN/ONAF/ONAF
IMP: 7.5 % NOM.	WT: 110,000 LBS

WINDINGS: COPPER
HV DE-ENERGIZED TAPS: ± 2 X 2.616 %
LV LOAD TAPS: ±16 X 0.625%
HV: 68800 V DELTA, 350 kV BIL, 235 A NOM @ 28 MVA
LV: 13090 Y/7558 V, 110 kV BIL, 1235 A @ 28 MVA

Customer: APPALACHIAN ELECTRIC COOPERATIVE
Project: BEAN STATION SUBSTATION

Warranty Field Work:
If, at the job site, the equipment is found to have not conformed to specifications or needs re-work covered under warranty, all parties concerned shall provide full access to Virginia Transformer Corp. or their representatives to work on the unit(s) at the job site. The method of repair/re-work will be determined solely by Virginia Transformer Corp.

TOLERANCES
IF NO TOLERANCES SHOWN ±0.5(12.7) OTHERWISE:
Δ ±0.25(6.3)
☐ ±1.0(25.4)

ALL DIMENSIONS IN INCHES & IN mm IF SHOWN IN PARENTHESIS

C796A-101.idw

VIRGINIA TRANSFORMER CORP.
220 GLADE VIEW DR., N.E. ROANOKE, VA 24012
(540) 345-9892

TITLE: DIMENSIONAL OUTLINE JOB # C796A,B
DWN: APK | CHK: SKS | DATE: 08/11/17
D | 47015MA156 | SHEET 101 | REVISION 0

Appendix B: Geotechnical Data

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-1
SHEET 1 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-1
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1252.0 FT.
REFUSAL: No
DEPTH FT.
ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1227.0 FT.
BORING ADVANCED BY:
POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.

PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (12 Inches)
		1.0	2.5	1	SS	4 - 3 - 3 N = 6					
2.5	1249.5										
		3.5	5.0	2	SS	4 - 7 - 8 N = 15					
5.0	1247.0										
		6.0	7.5	3	SS	5 - 8 - 13 N = 21					Lean CLAY (CL) - dark reddish brown - moist - firm to very stiff (RESIDUUM)
7.5	1244.5										
		8.5	10.0	4	SS	6 - 10 - 10 N = 20					
10.0	1242.0										
12.5	1239.5										
		13.5	15.0	5	SS	3 - 5 - 7 N = 12					
15.0	1237.0										Fat CLAY (CH) - with trace chert gravel - orangish brown - moist - stiff to firm (RESIDUUM)
17.5	1234.5										
		18.5	20.0	6	SS	3 - 3 - 4 N = 7					
20.0	1232.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-1
SHEET 2 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-1 DRY ON COMPLETION ? Yes

DATE January 31, 2019 SURFACE ELEV. 1252.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1227.0 FT.
BORING ADVANCED BY: . POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
22.5	1229.5										Fat CLAY (CH) - with trace chert gravel - orangish brown - moist - stiff to firm (RESIDUUM)
		23.5	25.0	7	SS	3 - 3 - 4 N = 7					
25.0	1227.0										Boring Terminated at 25.0 Feet
27.5	1224.5										
30.0	1222.0										
32.5	1219.5										
35.0	1217.0										
37.5	1214.5										
40.0	1212.0										

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-2
SHEET 1 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-2
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1250.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1225.0 FT.
BORING ADVANCED BY:
POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (12 Inches)
		1.0	2.5	1	SS	3 - 5 - 6 N = 11					
2.5	1247.5										
		3.5	5.0	2	SS	2 - 2 - 2 N = 4					
5.0	1245.0										
		6.0	7.5	3	SS	W.O.H - 2 - 2 N = 4					
7.5	1242.5										
		8.5	10.0	4	SS	3 - 3 - 5 N = 8					
10.0	1240.0										Lean CLAY (CL) - with trace root structures in the upper 5' - dark reddish brown and dark brown - moist - stiff to firm (RESIDUUM)
12.5	1237.5										
		13.5	15.0	5	SS	5 - 7 - 8 N = 15					
15.0	1235.0										
17.5	1232.5										
		18.5	20.0	6	SS	3 - 4 - 3 N = 7					
20.0	1230.0										

Continued

REMARKS: W.O.H. - Weight of Hammer

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-2
SHEET 2 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-2
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1250.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1225.0 FT.
BORING ADVANCED BY: POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.

PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
22.5	1227.5	23.5	25.0	7	SS	3 - 4 - 4 N = 8					Lean CLAY (CL) - with trace root structures in the upper 5' - dark reddish brown and dark brown - moist - stiff to firm (RESIDUUM)
25.0	1225.0										Boring Terminated at 25.0 Feet
27.5	1222.5										
30.0	1220.0										
32.5	1217.5										
35.0	1215.0										
37.5	1212.5										
40.0	1210.0										

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-3
SHEET 1 OF 6

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-3
DRY ON COMPLETION ? Yes

DATE January 31, 2019
REFUSAL: Yes
SAMPLED 124.5 FT. 37.9 M
TOP OF ROCK
BEGAN CORING
FOOTAGE CORED (LF) 75.0 FT.
BOTTOM OF HOLE DEPTH 124.5 FT.
BORING ADVANCED BY:

SURFACE ELEV. 1250.0 FT.
DEPTH 49.5 FT. ELEV. 1200.5 FT.
DEPTH 49.5 FT. ELEV. 1200.5 FT.
DEPTH 49.5 FT. ELEV. 1200.5 FT.
ELEV. 1125.5 FT.
POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (12 Inches)
		1.0	2.5	1	SS	1 - 3 - 3 N = 6					
2.5	1247.5										
		3.5	5.0	2	SS	2 - 3 - 3 N = 6					
5.0	1245.0										
		6.0	7.5	3	SS	3 - 4 - 5 N = 9					
7.5	1242.5										
		8.5	10.0	4	SS	3 - 4 - 7 N = 11					
10.0	1240.0										Lean CLAY (CL) - dark reddish brown and dark brown - moist to wet - firm to very stiff (RESIDUUM)
12.5	1237.5										
		13.5	15.0	5	SS	4 - 5 - 6 N = 11					
15.0	1235.0										
17.5	1232.5										
		18.5	20.0	6	SS	4 - 4 - 7 N = 11					
20.0	1230.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-3
SHEET 2 OF 6

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-3
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1250.0 FT.
REFUSAL: Yes DEPTH 49.5 FT. ELEV. 1200.5 FT.
SAMPLED 124.5 FT. 37.9 M
TOP OF ROCK DEPTH 49.5 FT. ELEV. 1200.5 FT.
BEGAN CORING DEPTH 49.5 FT. ELEV. 1200.5 FT.
FOOTAGE CORED (LF) 75.0 FT.
BOTTOM OF HOLE DEPTH 124.5 FT. ELEV. 1125.5 FT.
BORING ADVANCED BY: . POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT. ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT. ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT. ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
22.5	1227.5										
		23.5	25.0	7	SS	2 - 3 - 4 N = 7					
25.0	1225.0										
27.5	1222.5										
		28.5	30.0	8	SS	4 - 5 - 6 N = 11					
30.0	1220.0										Lean CLAY (CL) - dark reddish brown and dark brown - moist to wet - firm to very stiff (RESIDUUM)
32.5	1217.5										
		33.5	35.0	9	SS	2 - 3 - 3 N = 6					
35.0	1215.0										
37.5	1212.5										
		38.5	40.0	10	SS	3 - 4 - 7 N = 11					
40.0	1210.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-3
SHEET 3 OF 6

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-3
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1250.0 FT.
REFUSAL: Yes DEPTH 49.5 FT. ELEV. 1200.5 FT.
SAMPLED 124.5 FT. 37.9 M
TOP OF ROCK DEPTH 49.5 FT. ELEV. 1200.5 FT.
BEGAN CORING DEPTH 49.5 FT. ELEV. 1200.5 FT.
FOOTAGE CORED (LF) 75.0 FT.
BOTTOM OF HOLE DEPTH 124.5 FT. ELEV. 1125.5 FT.
BORING ADVANCED BY: POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT. ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT. ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT. ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
42.5	1207.5										
		43.5	45.0	11	SS	6 - 7 - 17 N = 24					Lean CLAY (CL) - dark reddish brown and dark brown - moist to wet - firm to very stiff (RESIDUUM)
45.0	1205.0										
47.5	1202.5										
		48.5	49.6	12	SS	7 - 9 - 50/1" N = 59/7"					Weathered ROCK (WR) - Dolomite - light gray - moist - very hard (RESIDUUM)
											Auger Refusal at 49.5 Feet
50.0	1200.0	RUN 1	From (ft.) 49.5	To (ft.) 59.5	REC 66%	RQD 65%					Began Coring at 49.5 Feet DOLOMITE - with healed calcite seams - light gray - moderately fractured and slightly weathered - moderately hard - no discernable dip angle - weak HCl reaction
52.5	1197.5										**VOID (51.9 to 55.3 Feet)**
55.0	1195.0										
57.5	1192.5										DOLOMITE - with healed calcite seams - light gray - moderately fractured and slightly weathered - moderately hard - no discernable dip angle - weak HCl reaction
60.0	1190.0										Continued

REMARKS: Black indicates depth of void encountered.

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-3
SHEET 4 OF 6

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-3 DRY ON COMPLETION ? Yes

DATE January 31, 2019 SURFACE ELEV. 1250.0 FT.
REFUSAL: Yes DEPTH 49.5 FT. ELEV. 1200.5 FT.
SAMPLED 124.5 FT. 37.9 M
TOP OF ROCK DEPTH 49.5 FT. ELEV. 1200.5 FT.
BEGAN CORING DEPTH 49.5 FT. ELEV. 1200.5 FT.
FOOTAGE CORED (LF) 75.0 FT.
BOTTOM OF HOLE DEPTH 124.5 FT. ELEV. 1125.5 FT.
BORING ADVANCED BY: . POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
		RUN 2	From (ft.) 59.5	To (ft.) 69.5	REC 100%	RQD 91%					(continued)
62.5	1187.5										
65.0	1185.0										DOLOMITE - with healed calcite seams - light gray - slightly fractured and slightly weathered - moderately hard - no discernable dip angle - weak HCl reaction
67.5	1182.5										
70.0	1180.0	RUN 3	From (ft.) 69.5	To (ft.) 79.5	REC 91%	RQD 81%					
72.5	1177.5										
75.0	1175.0										DOLOMITE - with healed calcite seams - light gray - slightly to moderately fractured and slightly weathered - moderately hard - no discernable dip angle - weak HCl reaction
77.5	1172.5										
80.0	1170.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-3
SHEET 5 OF 6

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-3
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1250.0 FT.
REFUSAL: Yes DEPTH 49.5 FT. ELEV. 1200.5 FT.
SAMPLED 124.5 FT. 37.9 M
TOP OF ROCK DEPTH 49.5 FT. ELEV. 1200.5 FT.
BEGAN CORING DEPTH 49.5 FT. ELEV. 1200.5 FT.
FOOTAGE CORED (LF) 75.0 FT.
BOTTOM OF HOLE DEPTH 124.5 FT. ELEV. 1125.5 FT.
BORING ADVANCED BY: . POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
		RUN 4	From (ft.) 79.5	To (ft.) 89.5	REC 100%	RQD 98%					(continued)
82.5	1167.5										
85.0	1165.0										DOLOMITE - with healed calcite seams - light gray - slightly fractured and slightly weathered - moderately hard - no discernable dip angle - weak HCl reaction
87.5	1162.5										
90.0	1160.0	RUN 5	From (ft.) 89.5	To (ft.) 99.5	REC 98%	RQD 75%					
92.5	1157.5										
95.0	1155.0										DOLOMITE - with healed calcite seams - light gray - slightly to moderately fractured and slightly weathered - moderately hard - no discernable dip angle - weak HCl reaction
97.5	1152.5										
100.0	1150.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-3
SHEET 6 OF 6

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-3
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1250.0 FT.
REFUSAL: Yes
DEPTH 49.5 FT.
ELEV. 1200.5 FT.
SAMPLED 124.5 FT.
37.9 M
TOP OF ROCK DEPTH 49.5 FT. ELEV. 1200.5 FT.
BEGAN CORING DEPTH 49.5 FT. ELEV. 1200.5 FT.
FOOTAGE CORED (LF) 75.0 FT.
BOTTOM OF HOLE DEPTH 124.5 FT. ELEV. 1125.5 FT.
BORING ADVANCED BY:
POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
		RUN 6	From (ft.) 99.5	To (ft.) 109.5	REC 90%	RQD 63%					(continued)
102.5	1147.5										DOLOMITE - light gray - slightly to moderately fractured and slightly weathered - moderately hard - no discernable dip angle - weak HCl reaction
105.0	1145.0										**VOID (104.0 to 105.0 Feet)**
107.5	1142.5										DOLOMITE - light gray - slightly to moderately fractured and slightly weathered - moderately hard - no discernable dip angle - weak HCl reaction
110.0	1140.0	RUN 7	From (ft.) 109.5	To (ft.) 124.5	REC 90%	RQD 81%					
112.5	1137.5										DOLOMITE - with trace healed calcite seams - light gray - slightly fractured and slightly weathered - moderately hard - no discernable dip angle - weak HCl reaction
115.0	1135.0										
117.5	1132.5										
120.0	1130.0										Coring Terminated at 124.5 Feet

REMARKS: Black indicates depth of void encountered.

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-4
SHEET 1 OF 4

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-4
DRY ON COMPLETION ? No

DATE February 4, 2019
SURFACE ELEV. 1248.0 FT.
REFUSAL: Yes DEPTH 68.0 FT. ELEV. 1180.0 FT.
SAMPLED 78.3 FT. 23.9 M
TOP OF ROCK DEPTH 68.0 FT. ELEV. 1180.0 FT.
BEGAN CORING DEPTH 68.0 FT. ELEV. 1180.0 FT.
FOOTAGE CORED (LF) 10.3 FT.
BOTTOM OF HOLE DEPTH 78.3 FT. ELEV. 1169.7 FT.
BORING ADVANCED BY: . POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH 59.0 FT.
ELEV. 1189.0 FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (10 Inches)
		1.0	2.5	1	SS	2 - 3 - 2 N = 5					
2.5	1245.5										
		3.5	5.0	2	SS	5 - 5 - 6 N = 11					
5.0	1243.0										
		6.0	7.5	3	SS	4 - 7 - 6 N = 13					
7.5	1240.5										
		8.5	10.0	4	SS	5 - 9 - 12 N = 21					
10.0	1238.0										Fat CLAY (CH) - with trace root structures in the upper 5' - reddish brown, dark reddish brown and orangish brown - moist - very stiff to firm (RESIDUUM)
12.5	1235.5										
		13.5	15.0	5	SS	6 - 9 - 9 N = 18					
15.0	1233.0										
17.5	1230.5										
		18.5	20.0	6	SS	6 - 6 - 8 N = 14					
20.0	1228.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-4
SHEET 2 OF 4

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-4
DRY ON COMPLETION ? No

DATE February 4, 2019
SURFACE ELEV. 1248.0 FT.
REFUSAL: Yes DEPTH 68.0 FT. ELEV. 1180.0 FT.
SAMPLED 78.3 FT. 23.9 M
TOP OF ROCK DEPTH 68.0 FT. ELEV. 1180.0 FT.
BEGAN CORING DEPTH 68.0 FT. ELEV. 1180.0 FT.
FOOTAGE CORED (LF) 10.3 FT.
BOTTOM OF HOLE DEPTH 78.3 FT. ELEV. 1169.7 FT.
BORING ADVANCED BY: . POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH 59.0 FT.
ELEV. 1189.0 FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
22.5	1225.5										
		23.5	25.0	7	SS	2 - 3 - 3 N = 6					Fat CLAY (CH) - with trace root structures in the upper 5' - reddish brown, dark reddish brown and orangish brown - moist - very stiff to firm (RESIDUUM)
25.0	1223.0										
27.5	1220.5										
		28.5	30.0	8	SS	3 - 4 - 3 N = 7					
30.0	1218.0										
32.5	1215.5										
		33.5	35.0	9	SS	2 - 3 - 2 N = 5					Lean CLAY (CL) - orangish brown and light brown - moist to wet - very soft to firm (RESIDUUM)
35.0	1213.0										
37.5	1210.5										
		38.5	40.0	10	SS	3 - 2 - 3 N = 5					
40.0	1208.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-4
SHEET 3 OF 4

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-4
DRY ON COMPLETION ? No

DATE February 4, 2019
SURFACE ELEV. 1248.0 FT.
REFUSAL: Yes DEPTH 68.0 FT. ELEV. 1180.0 FT.
SAMPLED 78.3 FT. 23.9 M
TOP OF ROCK DEPTH 68.0 FT. ELEV. 1180.0 FT.
BEGAN CORING DEPTH 68.0 FT. ELEV. 1180.0 FT.
FOOTAGE CORED (LF) 10.3 FT.
BOTTOM OF HOLE DEPTH 78.3 FT. ELEV. 1169.7 FT.
BORING ADVANCED BY: . POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH 59.0 FT.
ELEV. 1189.0 FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
42.5	1205.5										
		43.5	45.0	11	SS	W.O.H. - W.O.H. - 1 N = 1					
45.0	1203.0										
47.5	1200.5										
		48.5	50.0	12	SS	W.O.H. - 2 - 3 N = 5					
50.0	1198.0										Lean CLAY (CL) - orangish brown and light brown - moist to wet - very soft to firm (RESIDUUM)
52.5	1195.5										
		53.5	55.0	13	SS	W.O.H. - W.O.H. - 1 N = 1					
55.0	1193.0										
57.5	1190.5										
		58.5	60.0	14	SS	W.O.H. - W.O.H. - W.O.H. N = 0					
60.0	1188.0										

Continued

REMARKS: W.O.H. - Weight of Hammer

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-4
SHEET 4 OF 4

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-4
DRY ON COMPLETION ? No

DATE February 4, 2019
SURFACE ELEV. 1248.0 FT.
REFUSAL: Yes DEPTH 68.0 FT. ELEV. 1180.0 FT.
SAMPLED 78.3 FT. 23.9 M
TOP OF ROCK DEPTH 68.0 FT. ELEV. 1180.0 FT.
BEGAN CORING DEPTH 68.0 FT. ELEV. 1180.0 FT.
FOOTAGE CORED (LF) 10.3 FT.
BOTTOM OF HOLE DEPTH 78.3 FT. ELEV. 1169.7 FT.
BORING ADVANCED BY: . POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH 59.0 FT.
ELEV. 1189.0 FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
62.5	1185.5										
		63.5	65.0	15	SS	3 - 3 - 3 N = 6					Lean CLAY (CL) - orangish brown and light brown - moist to wet - very soft to firm (RESIDUUM)
65.0	1183.0										
67.5	1180.5										Auger Refusal at 68.0 Feet
		RUN 1	From (ft.) 68.0	To (ft.) 78.3	REC 100%	RQD 96%					Began Coring at 68.0 Feet
70.0	1178.0										
72.5	1175.5										DOLOMITE - with healed calcite seams - light gray - slightly fractured and slightly weathered - moderately hard - no discernable dip angle - weak HCl reaction
75.0	1173.0										
77.5	1170.5										Coring Terminated at 78.3 Feet
80.0	1168.0										

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-5
SHEET 1 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-5
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1248.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1223.0 FT.
BORING ADVANCED BY: . POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil / Gravel (12 Inches)
		1.0	2.5	1	SS	5 - 7 - 8 N = 15					
2.5	1245.5										
		3.5	5.0	2	SS	3 - 5 - 6 N = 11					Fat CLAY (CH) - with trace chert gravel - orangish brown and reddish brown - moist - stiff to very stiff (RESIDUUM)
5.0	1243.0										
		6.0	7.5	3	SS	5 - 6 - 8 N = 14					
7.5	1240.5										
		8.5	10.0	4	SS	5 - 8 - 8 N = 16					
10.0	1238.0										
12.5	1235.5										
		13.5	15.0	5	SS	5 - 6 - 8 N = 14					Lean CLAY (CL) - with chert gravel at depth - orangish brown and reddish brown - moist - stiff (RESIDUUM)
15.0	1233.0										
17.5	1230.5										
		18.5	20.0	6	SS	3 - 4 - 6 N = 10					
20.0	1228.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-5
SHEET 2 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-5
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1248.0 FT.
REFUSAL: No
DEPTH FT.
ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1223.0 FT.
BORING ADVANCED BY:
POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.

PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
22.5	1225.5										Lean CLAY (CL) - with chert gravel at depth - orangish brown and reddish brown - moist - stiff (RESIDUUM)
		23.5	25.0	7	SS	5 - 7 - 8 N = 15					
25.0	1223.0										Boring Terminated at 25.0 Feet
27.5	1220.5										
30.0	1218.0										
32.5	1215.5										
35.0	1213.0										
37.5	1210.5										
40.0	1208.0										

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-6
SHEET 1 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-6 DRY ON COMPLETION ? Yes

DATE January 31, 2019 SURFACE ELEV. 1248.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1223.0 FT.
BORING ADVANCED BY: POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.

PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (12 Inches)
		1.0	2.5	1	SS	1 - 1 - 2 N = 3					
2.5	1245.5										
		3.5	5.0	2	SS	4 - 4 - 5 N = 9					
5.0	1243.0										
		6.0	7.5	3	SS	4 - 5 - 5 N = 10					
7.5	1240.5										
		8.5	10.0	4	SS	7 - 9 - 10 N = 19					
10.0	1238.0										Fat CLAY (CH) - with chert gravel at depth - dark reddish brown, orangish brown and dark brown - moist - soft to very stiff (RESIDUUM)
12.5	1235.5										
		13.5	15.0	5	SS	5 - 6 - 5 N = 11					
15.0	1233.0										
17.5	1230.5										
		18.5	20.0	6	SS	2 - 4 - 4 N = 8					
20.0	1228.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-6
SHEET 2 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-6
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1248.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1223.0 FT.
BORING ADVANCED BY:
POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.

PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
22.5	1225.5										Fat CLAY (CH) - with chert gravel at depth - dark reddish brown, orangish brown and dark brown - moist - soft to very stiff (RESIDUUM)
		23.5	25.0	7	SS	2 - 3 - 3 N = 6					
25.0	1223.0										Boring Terminated at 25.0 Feet
27.5	1220.5										
30.0	1218.0										
32.5	1215.5										
35.0	1213.0										
37.5	1210.5										
40.0	1208.0										

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-7
SHEET 1 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-7
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1248.0 FT.
REFUSAL: No
DEPTH FT.
ELEV. FT.
SAMPLED 35.0 FT. 10.7 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 35.0 FT. ELEV. 1213.0 FT.
BORING ADVANCED BY:
POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.

PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (12 Inches)
		1.0	2.5	1	SS	3 - 3 - 4 N = 7					
2.5	1245.5										
		3.5	5.0	2	SS	5 - 7 - 8 N = 15					
5.0	1243.0										
		6.0	7.5	3	SS	5 - 7 - 9 N = 16					
7.5	1240.5										
		8.5	10.0	4	SS	5 - 7 - 9 N = 16					
10.0	1238.0										Fat CLAY (CH) - with trace chert gravel - orangish brown, brown and reddish brown - moist - very stiff to soft (RESIDUUM)
12.5	1235.5										
		13.5	15.0	5	SS	2 - 2 - 5 N = 7					
15.0	1233.0										
17.5	1230.5										
		18.5	20.0	6	SS	2 - 2 - 3 N = 5					
20.0	1228.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-7
SHEET 2 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-7
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1248.0 FT.
REFUSAL: No
DEPTH FT.
ELEV. FT.
SAMPLED 35.0 FT. 10.7 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 35.0 FT. ELEV. 1213.0 FT.
BORING ADVANCED BY:
POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
22.5	1225.5										
		23.5	25.0	7	SS	1 - 2 - 2 N = 4					
25.0	1223.0										
27.5	1220.5										Fat CLAY (CH) - with trace chert gravel - orangish brown, brown and reddish brown - moist - very stiff to soft (RESIDUUM)
		28.5	30.0	8	SS	4 - 3 - 5 N = 8					
30.0	1218.0										
32.5	1215.5										
		33.5	35.0	9	SS	3 - 3 - 3 N = 6					
35.0	1213.0										Boring Terminated at 35.0 Feet
37.5	1210.5										
40.0	1208.0										

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-8
SHEET 1 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-8
DRY ON COMPLETION ? Yes

DATE February 1, 2019
SURFACE ELEV. 1244.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1219.0 FT.
BORING ADVANCED BY:
POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	Qu	LABORATORY RESULTS LL	PI	%M	STRATUM DESCRIPTION
											Topsoil (12 Inches)
		1.0	2.5	1	SS	1 - 2 - 3 N = 5					
2.5	1241.5										Lean CLAY (CL) - with trace organics - dark brown - moist - firm to soft (CULT?)
		3.5	5.0	2	SS	1 - 2 - 2 N = 4					
5.0	1239.0										
		6.0	7.5	3	SS	1 - 2 - 3 N = 5					
7.5	1236.5										
		8.5	10.0	4	SS	5 - 8 - 9 N = 17					
10.0	1234.0										
12.5	1231.5										Fat CLAY (CH) - with trace root structures in the upper 2' - orangish brown and reddish brown - moist - very stiff to firm (RESIDUUM)
		13.5	15.0	5	SS	3 - 5 - 6 N = 11					
15.0	1229.0										
17.5	1226.5										
		18.5	20.0	6	SS	1 - 3 - 3 N = 6					
20.0	1224.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-8
SHEET 2 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-8
DRY ON COMPLETION ? Yes

DATE February 1, 2019
SURFACE ELEV. 1244.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1219.0 FT.
BORING ADVANCED BY: POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
22.5	1221.5										Fat CLAY (CH) - with trace root structures in the upper 2' - orangish brown and reddish brown - moist - very stiff to firm (RESIDUUM)
		23.5	25.0	7	SS	2 - 3 - 4 N = 7					
25.0	1219.0										Boring Terminated at 25.0 Feet
27.5	1216.5										
30.0	1214.0										
32.5	1211.5										
35.0	1209.0										
37.5	1206.5										
40.0	1204.0										

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-9
SHEET 1 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-9
DRY ON COMPLETION ? No

DATE February 1, 2019
SURFACE ELEV. 1242.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 35.0 FT. 10.7 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 35.0 FT. ELEV. 1207.0 FT.
BORING ADVANCED BY: POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH 27.0 FT.
ELEV. 1215.0 FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (12 Inches)
		1.0	2.5	1	SS	1 - 2 - 2 N = 4					
2.5	1239.5										
		3.5	5.0	2	SS	4- 5 - 4 N = 9					
5.0	1237.0										
		6.0	7.5	3	SS	3 - 4 - 6 N = 10					
7.5	1234.5										
		8.5	10.0	4	SS	6 - 8 - 9 N = 17					
10.0	1232.0										Fat CLAY (CH) - with trace root structures in the upper 5' and chert gravel from 8 - 10' - reddish brown and dark reddish brown - moist - soft to very stiff (RESIDUUM)
12.5	1229.5										
		13.5	15.0	5	SS	3 - 4 - 4 N = 8					
15.0	1227.0										
17.5	1224.5										
		18.5	20.0	6	SS	2 - 2 - 3 N = 5					
20.0	1222.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-9
SHEET 2 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-9
DRY ON COMPLETION ? No

DATE February 1, 2019
SURFACE ELEV. 1242.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 35.0 FT. 10.7 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 35.0 FT. ELEV. 1207.0 FT.
BORING ADVANCED BY: POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH 27.0 FT.
ELEV. 1215.0 FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
22.5	1219.5										
		23.5	25.0	7	SS	2 - 3 - 2 N = 5					
25.0	1217.0										
27.5	1214.5										Lean CLAY (CL) - orangish brown and dark reddish brown - moist - firm to very soft (RESIDUUM)
		28.5	30.0	8	SS	1 - 1 - 1 N = 2					
30.0	1212.0										
32.5	1209.5										
		33.5	35.0	9	SS	2 - 2 - 2 N = 4					
35.0	1207.0										Boring Terminated at 35.0 Feet
37.5	1204.5										
40.0	1202.0										

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-10
SHEET 1 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-10 DRY ON COMPLETION ? Yes

DATE January 31, 2019 SURFACE ELEV. 1254.0 FT.
REFUSAL: No DEPTH FT. ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1229.0 FT.
BORING ADVANCED BY: POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (4 Inches)
		1.0	2.5	1	SS	3 - 4 - 5 N = 9					
2.5	1251.5										
		3.5	5.0	2	SS	4 - 5 - 7 N = 12					
5.0	1249.0										
		6.0	7.5	3	SS	5 - 8 - 9 N = 17					
7.5	1246.5										
		8.5	10.0	4	SS	4 - 7 - 9 N = 16					
10.0	1244.0										Fat CLAY (CH) - with trace chert gravel at depth - reddish brown and orangish brown - moist - stiff to very stiff (RESIDUUM)
12.5	1241.5										
		13.5	15.0	5	SS	3 - 5 - 7 N = 12					
15.0	1239.0										
17.5	1236.5										
		18.5	20.0	6	SS	4 - 5 - 6 N = 11					
20.0	1234.0										

Continued

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

AEC Substation
Jefferson City, Tennessee
GEOServices Project # 21-19057

LOG OF BORING B-10
SHEET 2 OF 2

DRILLER B. Snow
ON-SITE REP.

BORING NO. / LOCATION B-10
DRY ON COMPLETION ? Yes

DATE January 31, 2019
SURFACE ELEV. 1254.0 FT.
REFUSAL: No
DEPTH FT.
ELEV. FT.
SAMPLED 25.0 FT. 7.6 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 25.0 FT. ELEV. 1229.0 FT.
BORING ADVANCED BY:
POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH DRY FT.
ELEV. FT.
AFTER 1 HRS: DEPTH TNP FT.
ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT.
ELEV. FT.

PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											(continued)
22.5	1231.5										Fat CLAY (CH) - with trace chert gravel at depth - reddish brown and orangish brown - moist - stiff to very stiff (RESIDUUM)
		23.5	25.0	7	SS	3 - 5 - 7 N = 12					
25.0	1229.0										Boring Terminated at 25.0 Feet
27.5	1226.5										
30.0	1224.0										
32.5	1221.5										
35.0	1219.0										
37.5	1216.5										
40.0	1214.0										

REMARKS:

Appendix B	Geotech section	Sample Calculations

- Bearing Capacity of Mat Foundation

Assumptions

Undrained condition -> $\phi' = 0$

Given

$PI = 50$ -> From graphical correlation in Skempton's Method

$\Rightarrow S_u / \sigma'_p = 0.24$

$\sigma'_p = (110\ ^{lb}/_{ft^3})(50\ ft) = ~~1600\ ^{lb}/_{ft^2}~~\ 5500\ ^{lb}/_{ft^2}$

$S_u = 1600\ ^{lb}/_{ft^2} = c$ due to undrained condition

Vesic Method Spreadsheet

$FS = 3$ -> Jefferson County Regulation

$q_{allowable} = 3,271\ ^{lb}/_{ft^2}$

$P_{allowable} = 6,541\ K$

BEARING CAPACITY OF SHALLOW FOUNDATIONS
Terzaghi and Vesic Methods

Date April 15, 2019
Identification

Input

Units of Measurement

	E	SI or E

Foundation Information

Shape	RE	SQ, CI, CO, or RE
B =	40	ft
L =	50	ft
D =	1.5	ft

Soil Information

c =	1600	lb/ft^2
phi =	0	deg
gamma =	110	lb/ft^3
Dw =	120	ft

Factor of Safety

F =	3	

Results

Terzaghi

Bearing Capacity

q ult =	n/a	lb/ft^2
q a =	n/a	lb/ft^2

Allowable Column Load

P =	#VALUE!	k

Vesic

9,812 lb/ft^2
3,271 lb/ft^2

6,541 k

Unit conve	1000
Gamma w	62.4
phi (radian	0

Terzaghi Computations

a theta =	1
Nc =	5.70
Nq =	1.00
N gamma	0.00
gamma' =	110
coefficient	0
coefficient	0
sigma zD'	165

Vesic Computation

Nc =	5.14
sc =	1.16
dc =	1.02
Nq =	1.00
sq =	1.00
dq =	1.00
N gamma	0.00
s gamma =	0.68
d gamma =	1.00
B/L =	0.8
k =	0.0375

W sub f	0

SETTLEMENT ANALYSIS OF SHALLOW FOUNDATIONS
Sch ert ann Method

Date April 15, 2019
Identification E ample 7.6

Input

Units	E	E or SI
Shape	RE	SQ, CI, CO, or RE
B =	40	ft
L =	50	ft
D =	2.5	ft
P =	380	k
Dw =	120	ft
gamma =	141	lb/ft^3
t =	50	yr

Results

q =	565	lb/ft^2
delta =	0.94	in

Depth to Soil Layer Top (ft)	Bottom (ft)	Es (lb/ft^2)	zf (ft)	I epsilon	strain ( )	delta (in)
0.0	2.5					
2.5	3.5	4902	0.5	0.113	0.1280	0.0154
3.5	4.5	4902	1.5	0.134	0.1516	0.0182
4.5	5.5	4902	2.5	0.155	0.1753	0.0210
5.5	6.5	4902	3.5	0.176	0.1989	0.0239
6.5	7.5	4902	4.5	0.197	0.2226	0.0267
7.5	8.5	7353	5.5	0.218	0.1642	0.0197
8.5	9.5	7353	6.5	0.239	0.1799	0.0216
9.5	10.5	7353	7.5	0.260	0.1957	0.0235
10.5	11.5	7353	8.5	0.281	0.2115	0.0254
11.5	12.5	7353	9.5	0.302	0.2273	0.0273
12.5	13.5	7353	10.5	0.323	0.2430	0.0292
13.5	14.5	7353	11.5	0.344	0.2588	0.0311
14.5	15.5	7353	12.5	0.364	0.2746	0.0329
15.5	16.5	7353	13.5	0.385	0.2903	0.0348
16.5	17.5	7353	14.5	0.406	0.3061	0.0367
17.5	18.5	10049	15.5	0.427	0.2355	0.0283
18.5	19.5	10049	16.5	0.448	0.2471	0.0296
19.5	20.5	10049	17.5	0.469	0.2586	0.0310
20.5	21.5	10049	18.5	0.490	0.2702	0.0324
21.5	22.5	10049	19.5	0.511	0.2817	0.0338
22.5	23.5	16667	20.5	0.518	0.1720	0.0206
23.5	24.5	16667	21.5	0.509	0.1693	0.0203
24.5	25.5	16667	22.5	0.501	0.1665	0.0200
25.5	26.5	16667	23.5	0.493	0.1638	0.0197
26.5	27.5	16667	24.5	0.484	0.1610	0.0193
27.5	28.5	22059	25.5	0.476	0.1196	0.0143
28.5	29.5	22059	26.5	0.468	0.1175	0.0141
29.5	30.5	22059	27.5	0.459	0.1154	0.0138
30.5	31.5	22059	28.5	0.451	0.1133	0.0136
31.5	32.5	22059	29.5	0.443	0.1112	0.0133
32.5	33.5	14216	30.5	0.435	0.1694	0.0203
33.5	34.5	14216	31.5	0.426	0.1661	0.0199
34.5	35.5	14216	32.5	0.418	0.1629	0.0195
35.5	36.5	14216	33.5	0.410	0.1597	0.0192
36.5	37.5	14216	34.5	0.401	0.1564	0.0188
37.5	38.5	26471	35.5	0.393	0.0823	0.0099
38.5	39.5	26471	36.5	0.385	0.0805	0.0097
39.5	40.5	26471	37.5	0.377	0.0788	0.0095
40.5	41.5	26471	38.5	0.368	0.0771	0.0092
41.5	42.5	26471	39.5	0.360	0.0753	0.0090
42.5	43.5	26471	40.5	0.351	0.0736	0.0088
43.5	44.5	26471	41.5	0.343	0.0717	0.0086

44.5	45.5	26471	42.5	0.334	0.0699	0.0084
45.5	46.5	26471	43.5	0.325	0.0681	0.0082
46.5	47.5	26471	44.5	0.317	0.0663	0.0080
47.5	48.5	26471	45.5	0.308	0.0645	0.0077
48.5	49.5	26471	46.5	0.300	0.0627	0.0075
49.5	50.5	26471	47.5	0.291	0.0609	0.0073
50.5	51.5	26471	48.5	0.282	0.0591	0.0071
51.5	52.5	26471	49.5	0.274	0.0573	0.0069
52.5	53.5	386000	50.5	0.265	0.0038	0.0005
53.5	54.5	386000	51.5	0.256	0.0037	0.0004
54.5	55.5	386000	52.5	0.248	0.0036	0.0004
55.5	56.5	386000	53.5	0.239	0.0034	0.0004
56.5	57.5	386000	54.5	0.230	0.0033	0.0004
57.5	58.5	386000	55.5	0.222	0.0032	0.0004
58.5	59.5	386000	56.5	0.213	0.0031	0.0004
59.5	60.5	386000	57.5	0.204	0.0029	0.0004
60.5	61.5	386000	58.5	0.196	0.0028	0.0003
61.5	62.5	386000	59.5	0.187	0.0027	0.0003
62.5	63.5	386000	60.5	0.178	0.0026	0.0003
63.5	64.5	386000	61.5	0.170	0.0024	0.0003
64.5	65.5	386000	62.5	0.161	0.0023	0.0003
65.5	66.5	386000	63.5	0.153	0.0022	0.0003
66.5	67.5	386000	64.5	0.144	0.0021	0.0002
67.5	68.5	386000	65.5	0.135	0.0019	0.0002
68.5	69.5	386000	66.5	0.127	0.0018	0.0002
69.5	70.5	386000	67.5	0.118	0.0017	0.0002
70.5	71.5	386000	68.5	0.109	0.0016	0.0002
71.5	72.5	386000	69.5	0.101	0.0014	0.0002
72.5	73.5	386000	70.5	0.092	0.0013	0.0002
73.5	74.5	386000	71.5	0.083	0.0012	0.0001
74.5	75.5	386000	72.5	0.075	0.0011	0.0001
75.5	76.5	386000	73.5	0.066	0.0009	0.0001
76.5	77.5	386000	74.5	0.057	0.0008	0.0001
77.5	78.5	386000	75.5	0.049	0.0007	0.0001
78.5	79.5	386000	76.5	0.040	0.0006	0.0001
79.5	80.5	386000	77.5	0.031	0.0005	0.0001
80.5	81.5	386000	78.5	0.023	0.0003	0.0000
81.5	82.5	386000	79.5	0.014	0.0002	0.0000
82.5	83.5	386000	80.5	0.010	0.0001	0.0000
83.5	84.5	386000	81.5	0.010	0.0001	0.0000
84.5	85.5	386000	82.5	0.010	0.0001	0.0000
85.5	86.5	386000	83.5	0.009	0.0001	0.0000
86.5	87.5	386000	84.5	0.009	0.0001	0.0000
87.5	88.5	386000	85.5	0.009	0.0001	0.0000
88.5	89.5	386000	86.5	0.009	0.0001	0.0000
89.5	90.5	386000	87.5	0.009	0.0001	0.0000
90.5	91.5	386000	88.5	0.009	0.0001	0.0000
91.5	92.5	386000	89.5	0.009	0.0001	0.0000
92.5	93.5	386000	90.5	0.009	0.0001	0.0000
93.5	94.5	386000	91.5	0.008	0.0001	0.0000
94.5	95.5	386000	92.5	0.008	0.0001	0.0000
95.5	96.5	386000	93.5	0.008	0.0001	0.0000
96.5	97.5	386000	94.5	0.008	0.0001	0.0000
97.5	98.5	386000	95.5	0.008	0.0001	0.0000
98.5	99.5	386000	96.5	0.008	0.0001	0.0000
99.5	100.5	386000	97.5	0.008	0.0001	0.0000
100.5	101.5	386000	98.5	0.008	0.0001	0.0000
101.5	102.5	386000	99.5	0.007	0.0001	0.0000
102.5	103.5	386000	100.5	0.007	0.0001	0.0000
103.5	104.5	386000	101.5	0.007	0.0001	0.0000
104.5	105.5	386000	102.5	0.007	0.0001	0.0000
105.5	106.5	386000	103.5	0.007	0.0001	0.0000
106.5	107.5	386000	104.5	0.007	0.0001	0.0000
107.5	108.5	386000	105.5	0.007	0.0001	0.0000

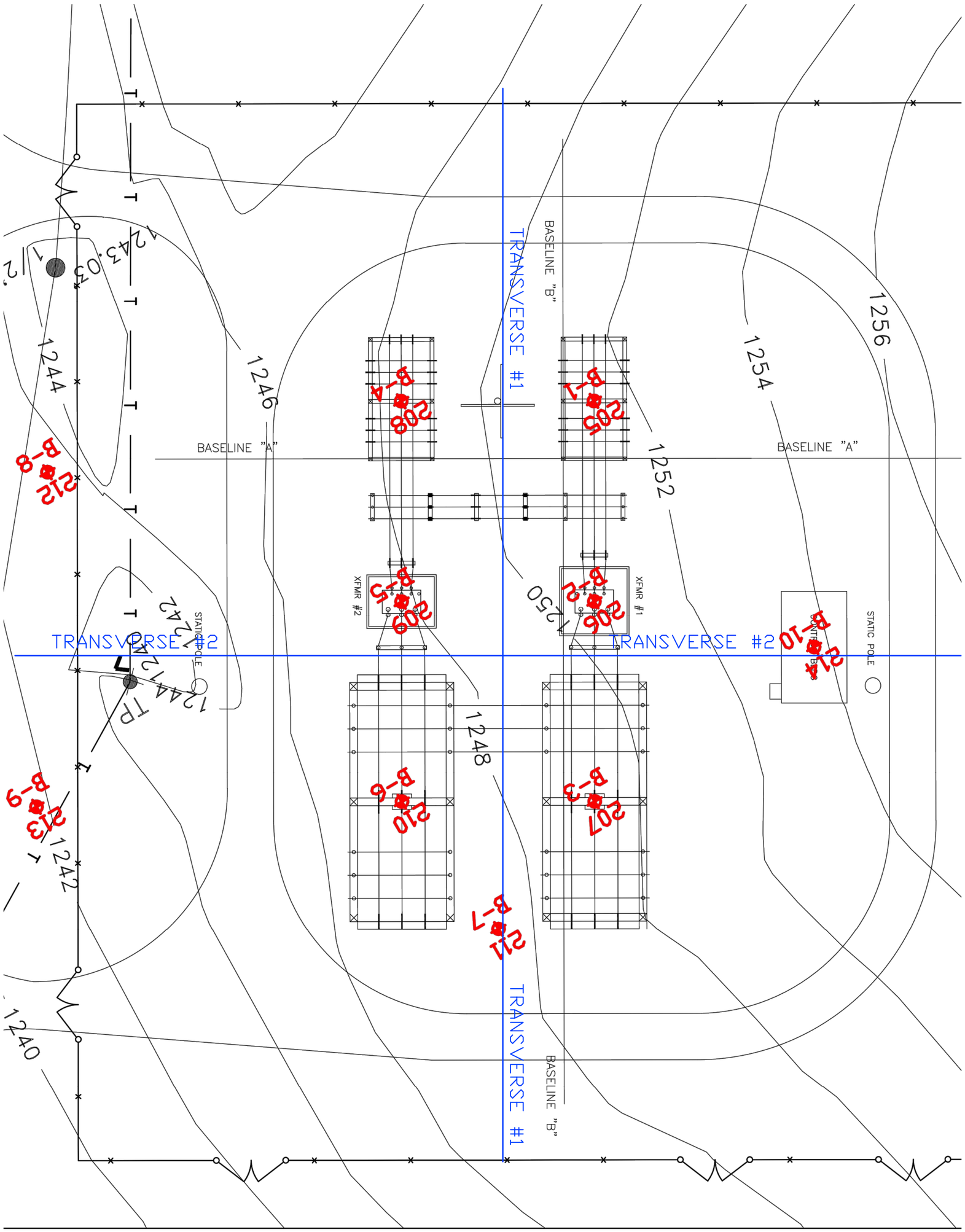


Figure 2

GEOS

GEOServices, LLC-Geotechnical and Materials Engineers

2561 Willow Point Way
Knoxville, Tennessee 37931

Office: 865-539-8242
Fax: 865-539-8252

DRAWN BY:	MTB
APPROVED BY:	MBH
SCALE:	N.T.S.
JOB NO.:	21-19057
DATE:	2-12-2019

SOIL TEST BORING AND TRANSVERSE LINE LOCATION PLAN

PROPOSED AEC SUBSTATION

JEFFERSON CITY, TENNESSEE

NOTES:

1.) BORING LOCATIONS ARE SHOWN IN GENERAL ARRANGEMENT ONLY.
2.) DO NOT USE BORING LOCATIONS FOR DETERMINATIONS OF DISTANCES OR QUANTITIES.
3.) BASE MAP PROVIDED BY: C2RL, INC.

LOCATION OF SOIL TEST BORINGS
LOCATION OF SOIL TEST BORINGS

GEOServices, LLC-Geotechnical and Materials Engineers

Bean Station
Knoxville, Tennessee
GEOServices Project # 21-16438

LOG OF BORING B-1
SHEET 1 OF 1

DRILLER Fred Reynolds
ON-SITE REP.

BORING NO. / LOCATION B-1 DRY ON COMPLETION ? Yes

DATE July 8, 2016 SURFACE ELEV. 1108.0 FT.
REFUSAL: Yes DEPTH 9.1 FT. ELEV. 1098.9 FT.
SAMPLED 9.1 FT. 2.8 M
TOP OF ROCK DEPTH ____ FT. ELEV. ____ FT.
BEGAN CORING DEPTH ____ FT. ELEV. ____ FT.
FOOTAGE CORED (LF) ____ FT.
BOTTOM OF HOLE DEPTH ____ FT. ELEV. 1108.0 FT.
BORING ADVANCED BY: POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH Dry FT. ELEV. ____ FT.
AFTER 1 HRS: DEPTH TNP FT. ELEV. ____ FT.
AFTER 24 HRS. DEPTH TNP FT. ELEV. ____ FT.
PROPOSED FFE: ____ FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
		1.0	2.5	1	SS	28					Lean CLAY - with silt and trace root structure - orangish brown and gray - moist - very stiff to very hard (RESIDUUM)
2.5	1105.5										
		3.5	5.0	2	SS	74					
5.0	1103.0										Weathered Shale - gray - dry - very hard
		6.0	6.7	3	SS	50/2"					
7.5	1100.5										
		8.5	8.6	4	SS	50/1"					Auger Refusal at 9.1 feet
10.0	1098.0										
12.5	1095.5										
15.0	1093.0										
17.5	1090.5										
20.0	1088.0										

REMARKS:

GEOS
GEOServices, LLC-Geotechnical and Materials Engineers

Bean Station
Knoxville, Tennessee
GEOServices Project # 21-16438

LOG OF BORING B-2
SHEET 1 OF 1

DRILLER Fred Reynolds
ON-SITE REP.

BORING NO. / LOCATION B-2
DRY ON COMPLETION ? Yes

DATE July 8, 2016
REFUSAL: Yes DEPTH 6.0 FT. ELEV. 1100.0 FT.
SAMPLED 6.0 FT. 1.8 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 6.0 FT. ELEV. 1100.0 FT.
SURFACE ELEV. 1106.0 FT.

BORING ADVANCED BY: POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH Dry FT. ELEV. FT.
AFTER 1 HRS: DEPTH Dry FT. ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT. ELEV. FT.

PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
		1.0	2.5	1	SS	25					Lean CLAY (CL) - with shale fragments and shale like structure - orangish brown and gray - dry - very stiff to very hard (RESIDUUM)
2.5	1103.5										
		3.5	4.7	2	SS	50/2"					Weathered Shale - gray - dry
5.0	1101.0										
											Auger Refusal at 6.0 Feet
7.5	1098.5										
10.0	1096.0										
12.5	1093.5										
15.0	1091.0										
17.5	1088.5										
20.0	1086.0										

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

Bean Station
Knoxville, Tennessee
GEOServices Project # 21-16438

LOG OF BORING B-3
SHEET 1 OF 1

DRILLER Fred Reynolds
ON-SITE REP.

BORING NO. / LOCATION B-3
DRY ON COMPLETION ? Yes

DATE July 8, 2016
SURFACE ELEV. 1107.0 FT.
REFUSAL: Yes DEPTH 7.7 FT. ELEV. 1099.3 FT.
SAMPLED 7.7 FT. 2.3 M
TOP OF ROCK DEPTH ____ FT. ELEV. ____ FT.
BEGAN CORING DEPTH ____ FT. ELEV. ____ FT.
FOOTAGE CORED (LF) ____ FT.
BOTTOM OF HOLE DEPTH ____ FT. ELEV. 1107.0 FT.

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH Dry FT. ELEV. ____ FT.
AFTER 1 HRS: DEPTH Dry FT. ELEV. ____ FT.
AFTER 24 HRS. DEPTH TNP FT. ELEV. ____ FT.

BORING ADVANCED BY: POWER AUGERING X
PROPOSED FFE: ____ FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (6 inches)
		1.0	2.5	1	SS	21					
2.5	1104.5										
		3.5	5.0	2	SS	38					Lean CLAY (CL) - with shale fragments - orangish brown and gray - moist - very stiff (RESIDUUM)
5.0	1102.0										
		6.0	7.5	3	SS	33					
7.5	1099.5										Auger Refusal at 7.7 feet
10.0	1097.0										
12.5	1094.5										
15.0	1092.0										
17.5	1089.5										
20.0	1087.0										

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

Bean Station
Knoxville, Tennessee
GEOServices Project # 21-16438

LOG OF BORING B-4
SHEET 1 OF 1

DRILLER Fred Reynolds
ON-SITE REP.

BORING NO. / LOCATION B-4
DRY ON COMPLETION ? Yes

DATE July 8, 2016
REFUSAL: Yes DEPTH 20.0 FT. ELEV. 1086.0 FT.
SAMPLED 20.0 FT. 6.1 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 20.0 FT. ELEV. 1086.0 FT.
BORING ADVANCED BY: POWER AUGERING X
SURFACE ELEV. 1106.0 FT.

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH Dry FT. ELEV. FT.
AFTER 1 HRS: DEPTH Dry FT. ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT. ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
		1.0	2.5	1	SS	7					Lean CLAY (CL) - with silt - brown - wet - firm (RESIDUUM)
2.5	1103.5										
		3.5	5.0	2	SS	20					
5.0	1101.0										
		6.0	7.5	3	SS	20					Lean CLAY (CL) - with shale fragments and shale like structure - orangish brown and gray - dry - very stiff (RESIDUUM)
7.5	1098.5										
		8.5	10.0	3	SS	34					
10.0	1096.0										
12.5	1093.5										
		13.5	14.7	4	SS	50/2"					Weathered Shale - gray -very hard
15.0	1091.0										
17.5	1088.5										
		18.5	18.8	5	SS	50/4"					
20.0	1086.0										Auger Refusal at 20.0 Feet

REMARKS:

GEOS
GEOServices, LLC-Geotechnical and Materials Engineers

Bean Station
Knoxville, Tennessee
GEOServices Project # 21-16438

LOG OF BORING B-5
SHEET 1 OF 1

DRILLER Fred Reynolds
ON-SITE REP.

BORING NO. / LOCATION B-5
DRY ON COMPLETION ? NO

DATE July 8, 2016
REFUSAL: Yes DEPTH 9.0 FT. ELEV. 1099.0 FT.
SAMPLED 9.0 FT. 2.7 M
TOP OF ROCK DEPTH 9.0 FT. ELEV. 1099.0 FT.
BEGAN CORING DEPTH 9.0 FT. ELEV. 1099.0 FT.
FOOTAGE CORED (LF) 10.0 FT.
BOTTOM OF HOLE DEPTH 19.0 FT. ELEV. 1089.0 FT.
BORING ADVANCED BY: POWER AUGERING X
SURFACE ELEV. 1108.0 FT.

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH Dry FT. ELEV. FT.
AFTER 1 HRS: DEPTH Dry FT. ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT. ELEV. FT.
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (4 Inches)
		1.0	1.8	1	SS	50/4"					Lean CLAY (CL) - with silt and shale fragments - orangish brown and gray - dry - very hard (RESIDUUM)
2.5	1105.5										
		3.5	4.3	2	SS	50/3"					
5.0	1103.0										Weathered Shale - orangish brown and gray - very hard
		6.0	6.5	3	SS	50/0					
7.5	1100.5										
		8.5	8.5	3	SS	50/0					
10.0	1098.0										Auger Refusal at 9.0 Feet Begin Coring at 9.0 feet Run #1 (9.0 to 14.0 feet) REC - 40% RQD - 0%
12.5	1095.5										Weathered Shale - orangish brown and brown - with calcite healed veins and evidence of water transport - moderately fractured and moderately to heavily weathered
15.0	1093.0										Run #2 (14.0 to 19.0 feet) REC - 40% RQD - 0%
17.5	1090.5										Weathered Shale - orangish brown and brown - moderately fractured and moderately to heavily weathered
											Coring Terminated at 19.0 Feet
20.0	1088.0										

REMARKS:

GEOS
GEOServices, LLC-Geotechnical and Materials Engineers

Bean Station
Knoxville, Tennessee
GEOServices Project # 21-16438

LOG OF BORING B-6
SHEET 1 OF 1

DRILLER Fred Reynolds
ON-SITE REP.

BORING NO. / LOCATION B-6
DRY ON COMPLETION ? Yes

DATE July 8, 2016
REFUSAL: Yes DEPTH 22.5 FT. ELEV. 1106.0 FT.
SAMPLED 22.5 FT. 6.9 M
TOP OF ROCK DEPTH FT. ELEV. FT.
BEGAN CORING DEPTH FT. ELEV. FT.
FOOTAGE CORED (LF) FT.
BOTTOM OF HOLE DEPTH 22.5 FT. ELEV. -22.5 FT.

SURFACE ELEV. FT.

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH Dry FT. ELEV. FT.
AFTER 1 HRS: DEPTH Dry FT. ELEV. FT.
AFTER 24 HRS. DEPTH TNP FT. ELEV. FT.

BORING ADVANCED BY: POWER AUGERING X
PROPOSED FFE: FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
											Topsoil (7 inches)
		1.0	2.5	1	SS	10					Lean CLAY (CL) - with silt - light brown and orangish brown - moist - stiff (RESIDUUM)
2.5	-2.5										
		3.5	5.0	2	SS	12					
5.0	-5.0										
		6.0	7.5	3	SS	21					
7.5	-7.5										
		8.5	10.0	4	SS	18					
10.0	-10.0										
12.5	-12.5										
		13.5	15.0	5	SS	19					
15.0	-15.0										
17.5	-17.5										Weathered Shale - gray - dry - very stiff to very hard
		18.5	19.1	6	SS	50/1"					
20.0	-20.0										Auger Refusal at 22.5 Feet

REMARKS:

GEOServices, LLC-Geotechnical and Materials Engineers

Bean Station
Knoxville, Tennessee
GEOServices Project # 21-16438

LOG OF BORING B-7
SHEET 1 OF 1

DRILLER Fred Reynolds
ON-SITE REP.

BORING NO. / LOCATION B-7
DRY ON COMPLETION ? No

DATE July 8, 2016
SURFACE ELEV. 1106.0 FT.
REFUSAL: Yes DEPTH 17.2 FT. ELEV. 1088.8 FT.
SAMPLED 17.2 FT. 5.2 M
TOP OF ROCK DEPTH ____ FT. ELEV. ____ FT.
BEGAN CORING DEPTH ____ FT. ELEV. ____ FT.
FOOTAGE CORED (LF) ____ FT.
BOTTOM OF HOLE DEPTH 17.2 FT. ELEV. 1088.8 FT.
BORING ADVANCED BY: POWER AUGERING X

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH 8.0 FT. ELEV. ____ FT.
AFTER 1 HRS: DEPTH Dry FT. ELEV. ____ FT.
AFTER 24 HRS. DEPTH TNP FT. ELEV. ____ FT.

PROPOSED FFE: ____ FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
		1.0	2.5	1	SS	8					
2.5	1103.5										Lean CLAY (CL) - with abundant wood fragments at depth - brown and dark brown - moist (FILL)
		3.5	5.0	2	SS	3					
5.0	1101.0										
		6.0	6.8	3	SS	50/3"					Lean CLAY (CL) - with shale fragments and shale like structure - gray - moist to wet (RESIDUUM)
7.5	1098.5										
		8.5	8.9	4	SS	50/5"					
10.0	1096.0										
12.5	1093.5										Weathered Shale - gray - dry - very hard
		13.5	13.7	5	SS	50/2"					
15.0	1091.0										
17.5	1088.5										Auger Refusal at 17.2 Feet
20.0	1086.0										

REMARKS: ____

GEOS
GEOServices, LLC-Geotechnical and Materials Engineers

Bean Station
Knoxville, Tennessee
GEOServices Project # 21-16438

LOG OF BORING B-8
SHEET 1 OF 1

DRILLER Fred Reynolds
ON-SITE REP.

BORING NO. / LOCATION B-8
DRY ON COMPLETION ? Yes

DATE July 8, 2016
REFUSAL: Yes DEPTH 16.7 FT. ELEV. 1096.3 FT.
SAMPLED 16.7 FT. 5.1 M
TOP OF ROCK DEPTH ____ FT. ELEV. ____ FT.
BEGAN CORING DEPTH ____ FT. ELEV. ____ FT.
FOOTAGE CORED (LF) ____ FT.
BOTTOM OF HOLE DEPTH 16.7 FT. ELEV. 1096.3 FT.
BORING ADVANCED BY: POWER AUGERING X
SURFACE ELEV. 1113.0 FT.

WATER LEVEL DATA (IF APPLICABLE)
COMPLETION: DEPTH Dry FT. ELEV. ____ FT.
AFTER 1 HRS: DEPTH Dry FT. ELEV. ____ FT.
AFTER 24 HRS. DEPTH TNP FT. ELEV. ____ FT.

PROPOSED FFE: ____ FT.

STRATUM DEPTH FT.	STRATUM DEPTH ELEV.	SAMPLE DEPTH FROM FT.	SAMPLE DEPTH TO FT.	SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS N-Value	FIELD RESULTS Qu	LABORATORY RESULTS LL	LABORATORY RESULTS PI	LABORATORY RESULTS %M	STRATUM DESCRIPTION
		1.0	1.6	1	SS	50/1"					
2.5	1110.5										
		3.5	3.9	2	SS	50/4"					
5.0	1108.0										
		6.0	6.4	3		50/5"					
7.5	1105.5										
		8.5	9.2	4	SS	50/2"					Weathered Shale - gray - dry - very hard
10.0	1103.0										
12.5	1100.5										
		13.5	13.5	5	SS	50/0					
15.0	1098.0										
17.5	1095.5										Auger Refusal at 16.7 Feet
20.0	1093.0										

REMARKS: ____

GEOServices, LLC-Geotechnical and Materials Engineers

Appalachian Electric Cooperative Substation

GEOServices Project No. 21-19057

February 13, 2019

SOIL DATA SUMMARY

Boring Number	Sample Number	Depth (feet)	Natural Moisture Content	Atterberg Limits			Soil Type	Percent Organic Content
				LL	PL	PI		
B-3	1	1.0-2.5'	23.9%					
	2	3.5-5.0'	26.7%					
	3	6.0-7.5'	23.3%					
	4	8.5-10.0'	24.3%					
	5	13.5-15.0'	31.4%					
	6	18.5-20.0'	32.3%					
	7	23.5-25.0'	41.1%					
	8	28.5-30.0'	41.0%					
	9	33.5-35.0'	29.8%					
	10	38.5-40.0'	29.9%					
	11	43.5-45.0	35.9%					
	12	48.5-50.0'	27.8%					
B-4	1	1.0-2.5'	24.0%					
	2	3.5-5.0'	23.6%	71	18	53	CH	
	3	6.0-7.5'	22.7%					
	4	8.5-10.0'	34.3%					
	5	13.5-15.0'	41.0%					
	6	18.5-20.0'	39.6%					
	7	23.5-25.0'	50.3%					
	8	28.5-30.0'	48.4%					
	9	33.5-35.0'	44.0%					
	10	38.5-40.0'	41.8%					
	11	43.5-45.0'	59.3%					
	12	48.5-50.0'	63.2%					
	13	53.5-55.0'	63.3%					
	15	63.5-65.0'	51.7%					

GEOServices, LLC-Geotechnical and Materials Engineers

Appalachian Electric Cooperative Substation

GEOServices Project No. 21-19057

February 13, 2019

SOIL DATA SUMMARY

Boring Number	Sample Number	Depth (feet)	Natural Moisture Content	Atterberg Limits			Soil Type	Percent Organic Content
				LL	PL	PI		
B-8	1	1.0-2.5'	25.7%					8.1
	3	6.0-7.5'	27.7%					
	4	8.5-10.0'	34.9%					
	5	13.5-15.0'	38.0%					
	6	18.5-20.0'	41.5%					
	7	23.5-25.0'	38.8%					
B-9	1	1.0-2.5'	26.8%					4.9
	2	3.5-5.0'	27.0%	58	20	38	CH	
	3	6.0-7.5'	28.8%					
	4	8.5-10.0'	29.9%					
	5	13.5-15.0'	38.6%					
	6	18.5-20.0'	41.3%					
	7	23.5-25.0'	55.9%					
	8	28.5-30.0'	63.8%					
	9	33.5-35.0'	59.2%					
B10	1	1.0-2.5'	27.1%					
	2	3.5-5.0'	27.5%					
	3	6.0-7.5'	28.7%	82	25	57	CH	
	4	8.5-10.0'	33.6%					
	5	13.5-15.0'	36.2%					
	6	18.5-20.0'	37.1%					
	7	23.5-25.0'	37.3%					


Mascot Dolomite
Detailed description
Light-gray, fine-grained, well-bedded cherty dolomite; mottled (red and green) dolomite characteristic; interbeds of bluish-gray limestone in upper part; chert-matrix quartz sandstone at base. Erosional unconformity at top. Thickness 350 to 800 feet.
New Market
414 Flat Gap Rd

Appendix C: Environmental Calculations

Transformer oil runoff

one(1) transformer @ 750 gallons: 750 gallons
three(3) voltage regulators @ 55 gallons: 165 gallons

$750_g + 165_g = 915$ gallons

1 gallon = 0.00378541 gallons

$915\ g\ (0.00378541) = 3.5\ m^3$

factor of safety = 2

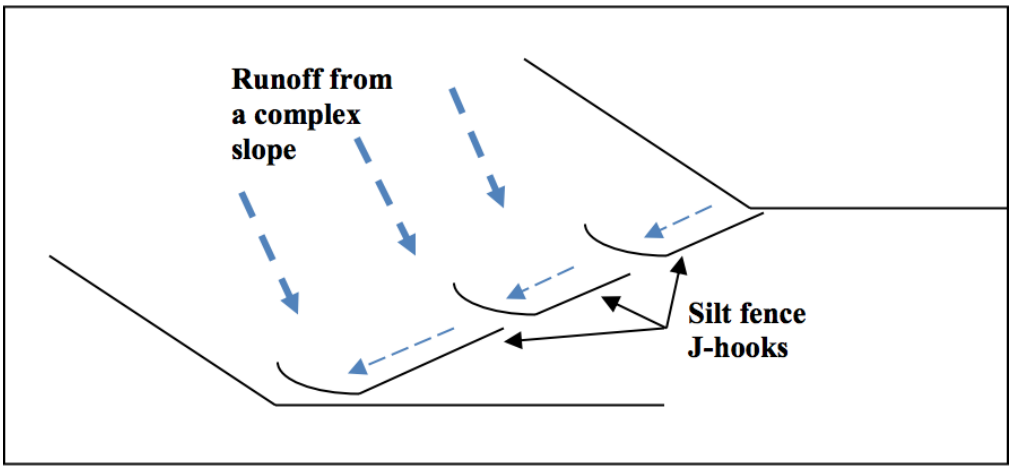
final oil containment pond volume = $\underline{7\ m^3}$

1 gallon = $0.133681\ ft^3$

$915\ g\ (0.133681\ ft^3) = 122.4\ ft^3$

factor of safety = 2

final oil containment pond volume = $\underline{244.8\ ft^3}$



Silt Fence J-Hook Layout

	Volume (Gallons)	Quantity	Total Oil (Gallons)
Transformer Oil	750	1	750
Voltage Regulator Oil	55	3	165
			915

Maximum Oil Runoff

Appendix D: Water Resources Calculations

25 year, 24 hour storm

$Q_{before} = (1.10)(0.41)(5.5\ in/hr)(3.25\ ac) = 8.01\ cfs$

$Q_{after} = (1.10)(0.70)(5.5\ in/hr)(3.25\ ac) = 13.76\ cfs$

all values from runoff coefficient table in Appendix D

Grading

$\%\ slope = \Delta y / \Delta x$

$2\% = \Delta y / 100ft$ $\Delta y = 2$ ft of elevation decrease from West to East beginning at the 1250' elevation point.

pre-existing slope for erosion control plan

$\%\ slope = \Delta y / \Delta x$

$\% = (1252 - 1240) / 224ft = 0.0536 = 5.36\%$

$5.36\% < 33.3\%$

silt fence is sufficient

25-year 24-hour maximum rainwater runoff calculations:

Maximum Runoff Equation: Q = (frequency factor)*C*I*A

C= Runoff Coefficient

I=Average Rainfall Intensity (in/hr)

A= Area (acres)

Land Use	Runoff Coefficient (C) by Hydrologic Soil Group and Ground Slope											
	A			B			C			D		
	<2%	2 - 6%	>6%	<2%	2 - 6%	>6%	<2%	2 - 6%	>6%	<2%	2 - 6%	>6%
Forest	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Meadow	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Pasture	0.15	0.25	0.37	0.23	0.34	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Farmland	0.14	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Res. 1 acre	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Res. 1/2 acre	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.46
Res. 1/3 acre	0.28	0.32	0.35	0.30	0.35	0.39	0.33	0.38	0.45	0.36	0.40	0.50
Res. 1/4 acre	0.30	0.34	0.37	0.33	0.37	0.42	0.36	0.40	0.47	0.38	0.42	0.52
Res. 1/8 acre	0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Industrial	0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
Streets: ROW	0.76	0.77	0.79	0.80	0.82	0.84	0.84	0.85	0.89	0.89	0.91	0.95
Parking	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97
Disturbed Area	0.65	0.67	0.69	0.66	0.68	0.70	0.68	0.70	0.72	0.69	0.72	0.75

Runoff Coefficient Table

$$Q\ (after) = (1.10) * (0.70) * (5.5\ in/hr) * (3.25\ acres)\ = 13.76\ cfs$$

$$Q\ (before)\ =\ (1.10) * (0.41) *\ (5.5\ in/hr) * (3.25\ acres) = 8.01\ cfs$$

Appendix E: Transportation Study

Time Slot	Nourthbound Count	Traffic Time (sec)	Southbound Count	Traffic Time (sec)
		3.4		3.4
		3.86		4.38
		3.49		3.23
		3.03		2.85
7:30 - 7:45	15	3.63	15	5.12
		4.08		3
		3.56		3.85
		3.62		3.3
		3.55		3.32
		3.73		3.98
		3.63		2.82
		3.63		3.02
7:45 - 8:00	12	3.86	10	3.3
		2.76		3.42
		3.58		3.62
		2.65		
		3.22		
		3.71		4.63
		4.26		3.72
		4.09		3.49
		3.96		3.83
		3.46		3.19
		3.58		3.63
8:00 - 8:15	15	3.7	14	2.95
		2.33		3.4
		4.38		3.56
		3.38		3.72
		2.85		
		3.62		
		3.55		
		4.22		3.36
		3.2		3.39
		2.68		3.96
		3.53		3.78
8:15 - 8:30	13	3.4	9	2.96
		3.13		3.96
		4.25		3
		3.02		3.92
		2.85		
		3.23		
		3.25		3.16
		3.32		2.85
		3.66		3.68
		2.15		3.9
		2.87		4.82
		3.22		3.55
		3.13		4
8:30 - 8:45	21	3.48	18	3.82
		3.03		4.78
		3.83		3.53
		3.18		3.73
		3.52		3.53
		4.19*		3.95
				3.73
				3.65
				4.15
		2.86		3.55
		3.35		3.33
		2.96		4.58
		3.45		3.32
		3.5		4.43
		3.46		3.36
		3.08		3.15
		3.46		4.36
8:45 - 9:00	17	2.95	25	4.05
		2.88		2.95
		3.53		4.41
		3.12		3.3
				4.06
				3.13
				3.11
				4.23
				4.03

	Northbound	Southbound
Average	3.3890625	3.655151515
	59.01337022	54.71729398
	40.23638878	37.3072459

	Northbound	Southbound
Total Traffic Count	93	91
Average Time	3.39	3.66
Average Speed (ft/s)	59.01	54.72
Average Speed (mph)	40.24	37.31

3.236666667 61.79196704 42.13088662

85.83690987 58.52516582

93.02325581 63.42494715
66.66666667 45.45454545

*=heavy

184

	Northbound	Southbound
Total Traffic Count	93	91
Average Time	3.39	3.66
Average Speed (ft/s)	59.01	54.72
Average Speed (mph)	40.24	37.31

	Nourthbound	Traffic	Southbound	Traffic
Time Slot	**Count**	**Time (sec)**	**Count**	**Time (sec)**
7:30 - 7:45	15	3.4 3.86 3.49 3.03 3.63 4.08 3.56 3.62	15	3.4 4.38 3.23 2.85 5.12 3 3.85 3.3
7:45 - 8:00	12	3.55 3.73 3.63 3.63 3.86 2.76 3.58 2.65 3.22	10	3.32 3.98 2.82 3.02 3.3 3.42 3.62
8:00 - 8:15	15	3.71 4.26 4.09 3.96 3.46 3.58 3.7 2.33 4.38 3.38 2.85 3.62 3.55	14	4.63 3.72 3.49 3.83 3.19 3.63 2.95 3.4 3.56 3.72
8:15 - 8:30	13	4.22 3.2 2.68 3.53 3.4 3.13 4.25 3.02 2.85 3.23	9	3.36 3.39 3.96 3.78 2.96 3.96 3 3.92
8:30 - 8:45	21	3.25 3.32 3.66 2.15 2.87 3.22 3.13 3.48 3.03 3.83 3.18 3.52 4.19*	18	3.16 2.85 3.68 3.9 4.82 3.55 4 3.82 4.78 3.53 3.73 3.53 3.95 3.73 3.65 4.15
8:45 - 9:00	17	2.86 3.35 2.96 3.45 3.5 3.46 3.08 3.46 2.95 2.88 3.53 3.12	25	3.55 3.33 4.58 3.32 4.43 3.36 3.15 4.36 4.05 2.95 4.41 3.3 4.06 3.13 3.11 4.23 4.03

11' lane width

Left Turn 200'-400' away from study

14' Bridge

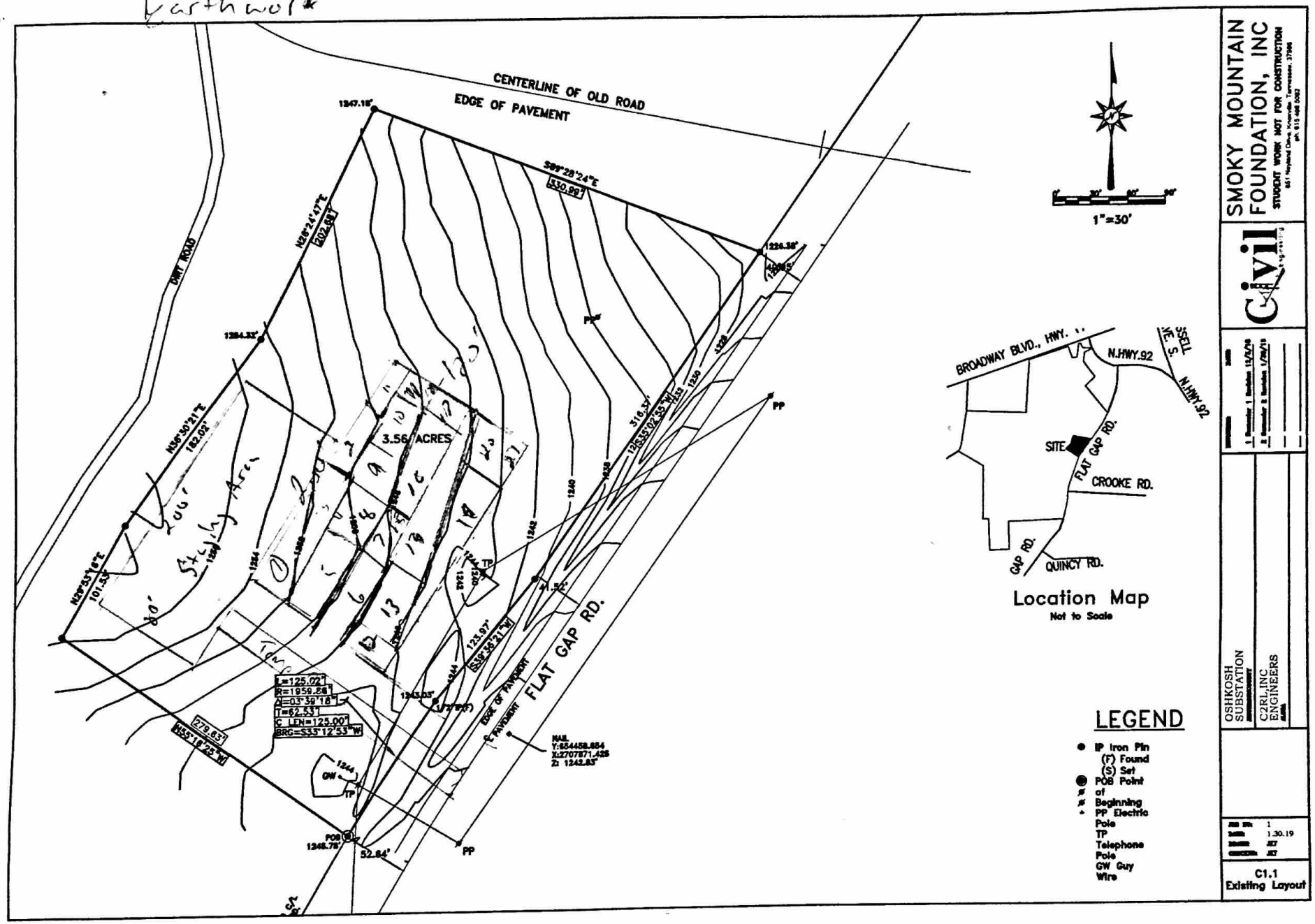
200' Taper

southbound

	Northbound	Heavy	Southbound	Heavy
7:30-7:45	𝍸 𝍸 𝍸	1	𝍸 𝍸	
	𝍸		𝍸	
7:45-8:00	𝍸 𝍸		𝍸 𝍸	
	𝍸			
8:00-8:15	𝍸 𝍸		𝍸 𝍸	
	𝍸		𝍸	
8:15-8:30	𝍸 𝍸 𝍸		𝍸	
			𝍸	
8:30-8:45	𝍸 𝍸 𝍸	1	𝍸 𝍸 𝍸	
	𝍸		𝍸	
8:45-9:00	𝍸 𝍸		𝍸 𝍸	
	𝍸		𝍸 𝍸	

Appendix F: Construction Scheduling

Earthwork



Location Map

Not to Scale

LEGEND

- IP Iron Pin
  - (F) Found
  - (S) Set
- POB Point of Beginning
- PP Electric Pole
- TP Telephone Pole
- GW Guy Wire

SMOKY MOUNTAIN FOUNDATION, INC

STUDENT WORK NOT FOR CONSTRUCTION

Civil

OSHKOSH SUBSTATION

C2RL,INC ENGINEERS

1.30.19

C1.1
Existing Layout

Zinc Substation

Earthwork

Section 1 : $\left(\left(\frac{1252+1254}{2}\right)-(1248)\right)(0.5)(80')(90') = 6750\ ft^3\ cut$

2 : $\left(\left(\frac{1250+1254}{2}\right)-(1248)\right)(20')(50') = 3000\ ft^3\ cut$

3 : $(1251-1248)(0.5)(100')(20') = 3600\ ft^3\ cut$

4 : $(1251-1248)(0.5)(40')(40') = 2400\ ft^3\ cut$

5 : $(1251-1248)(70')(25') = 5250\ ft^3\ cut$

6 : $\left(\left(\frac{1250+1254}{2}\right)-(1248)\right)(70')(25') = 1750\ ft^3\ cut$

7 : $\left(\left(\frac{1250+1248}{2}\right)-(1248)\right)(35')(25')(0.5) = 437.5\ ft^3\ cut$

8 : $\left(\left(\frac{1250+1248}{2}\right)-(1248)\right)(40)(35')(0.5) = 700\ ft^3\ cut$

9 : $\left(\left(\frac{1250+1248}{2}\right)-(1248)\right)(40)(30') = 1200\ ft^3\ cut$

10 : $\left(\left(\frac{1250+1248}{2}\right)-(1248)\right)(40')(30') = 1200\ ft^3\ cut$

11 : $\left(\left(\frac{1252+1248}{2}\right)-(1248)\right)(25')(25')(0.5) = 312.5\ ft^3\ cut$

$\Sigma\ cut = 26000\ ft^3\ cut$

12 : $\left(1248-\left(\frac{1248+1246}{2}\right)\right)(20)(40) = 800\ ft^3\ fill$

13 : $\left(1248-\left(\frac{1248+1250}{2}\right)\right)(50)(35) = 1750\ ft^3\ fill$

14 : $\left(1248-\left(\frac{1246+1250}{2}\right)\right)(0.5)(140)(35) = 3675\ ft^3\ fill$

15 : $\left(1248-\left(\frac{1248+1246}{2}\right)\right)(0.5)(40)(15) = 300\ ft^3\ fill$

16 : $\left(1248-\left(\frac{1248+1250}{2}\right)\right)(80)(70) = 1200\ ft^3\ fill$

17 : $\left(1248-\left(\frac{1248+1246}{2}\right)\right)(120)(50) = 6000\ ft^3\ fill$

18 : $\left(1248-\left(\frac{1248+1250}{2}\right)\right)(0.5)(20)(50) = 1000\ ft^3\ fill$

19 : $\left(1248-\left(\frac{1246+1250}{2}\right)\right)(0.5)(150)(40) = 7500\ ft^3\ fill$

20 : $\left(1248-\left(\frac{1246+1244}{2}\right)\right)(30)(40) = 3600\ ft^3\ fill$

21 : $\left(1248-\left(\frac{1244+1250}{2}\right)\right)(0.5)(40)(20) = 1800\ ft^3\ fill$

$\Sigma\ fill = 26725\ ft^3$

$\Sigma\ cut - fill = 26000\ ft^3 - 26725\ ft^3 = -725\ ft^3\ fill$

$725\ ft^3\left(\frac{1\ yd^3}{27\ ft^3}\right) = 26.9\ yd^3\ fill$

Fence + Barbwire

Northside : $\sqrt{(3311)^2 + (1247.14 - 1226.38)^2} = 331.65' = 332$

Southside = $\sqrt{279.63^2 + (1256 - 1246)^2} = 279.8 = 280$

Eastside = 125.02 + 123.97 + 316.77 + (1d Gate) = 553.6 = 554'

Westside = 101.53 + 188.02 + 202.68 = 485.2 = 486'

Total Fence = 332 + 280 + 554 + 486 = 1652'

Total Barbwire = Total Fence + 12' = 1652 + 12' = 1664'

Gates = 2

Corner / End Post = 4 + 2 = 6

TDOT D Stone

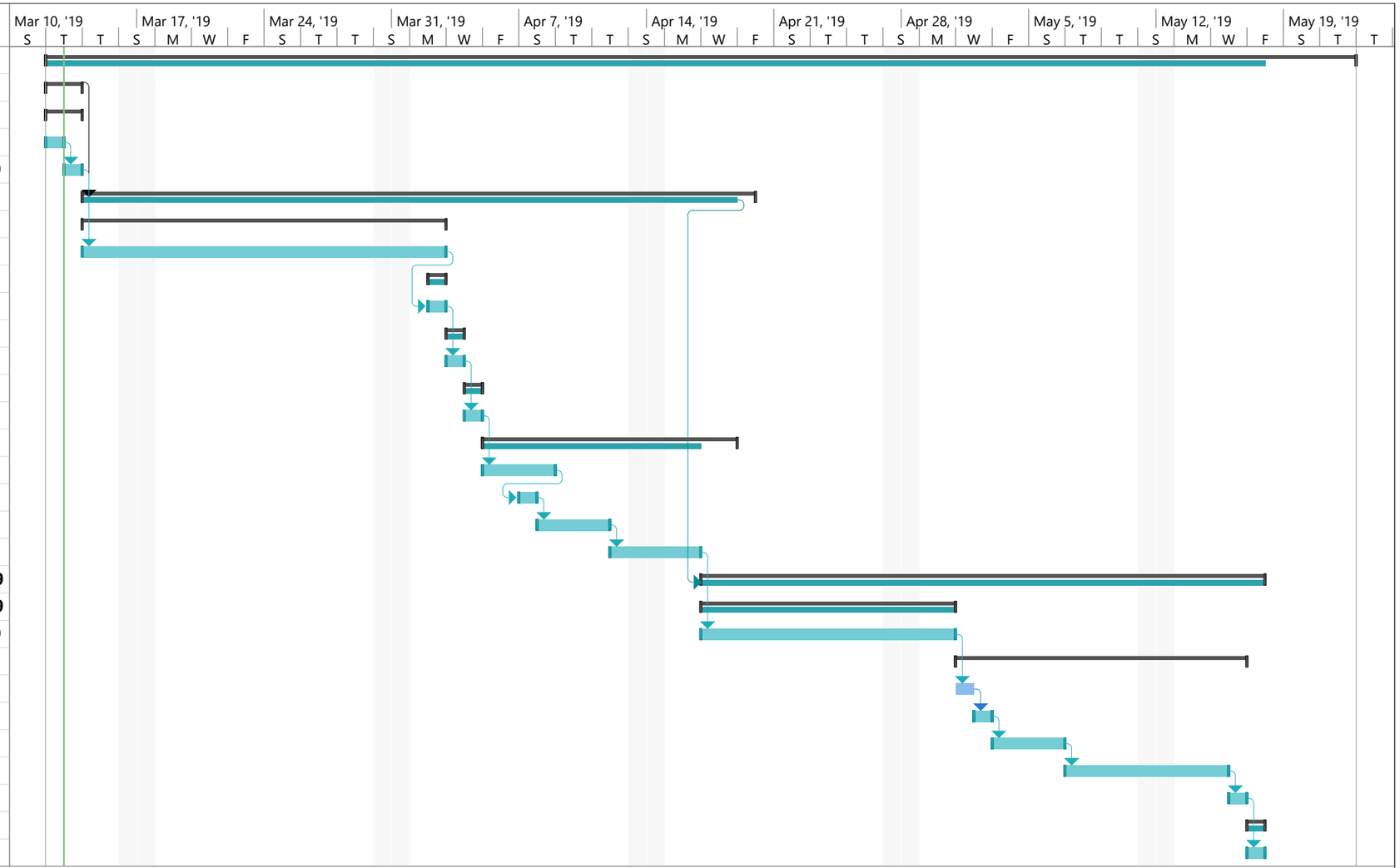
Staging Area = $200' \times 60' \times (\frac{3}{4}'')(\frac{1ft}{12''}) = 533.33\ ft^3$

Road = $220' \times 20' (4'')(\frac{1ft}{12''}) = 1466.67\ ft^3 = 146.7\ ft^3$

Bridge = $(12')(12'')(\frac{1}{12}'')(10') + (4)(12')(12'')(\frac{1}{12}'')(10') = 60.0\ ft^3$

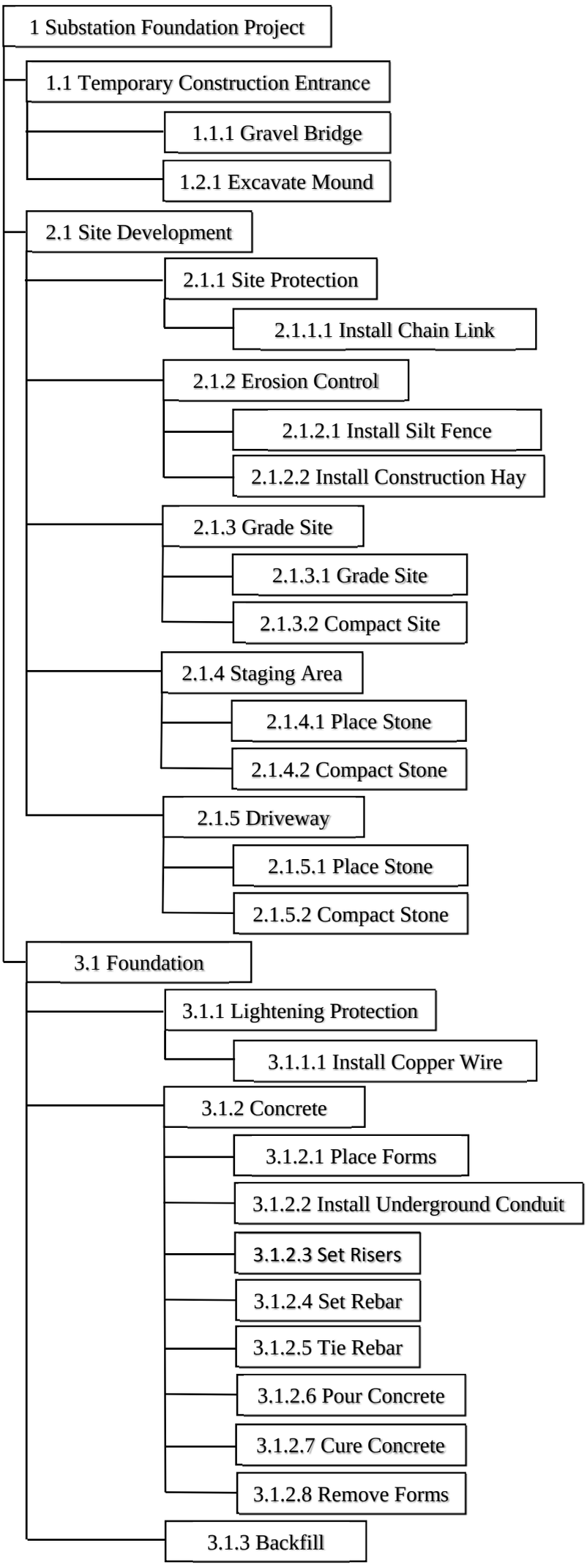
$= (12')(10') + 4(12')(10') = 600\ ft^2$

ID	Task Mode	Task Name	Duration	Start
1		**Substation Foundation**	**52 days**	**Tue 3/12/19**
2		**Temporary**	**2 days**	**Tue 3/12/19**
3		**Bridge**	**2 days**	**Tue 3/12/19**
4		Place Concrete	1 day	Tue 3/12/19
5		Place Stone	1 day	Wed 3/13/19
6		**Site Development**	**27 days**	**Thu 3/14/19**
7		**Site Protection**	**14 days**	**Thu 3/14/19**
8		Place Chain Link	14 days	Thu 3/14/19
9		**Erosion Control**	**1 day**	**Tue 4/2/19**
10		Place Silt Fence	1 day	Tue 4/2/19
11		**Temporary**	**1 day**	**Wed 4/3/19**
12		Place Stone	1 day	Wed 4/3/19
13		**Staging Area**	**1 day**	**Thu 4/4/19**
14		Place Stone	1 day	Thu 4/4/19
15		**Grading Site**	**10 days**	**Fri 4/5/19**
16		Excavate Portion	2 days	Fri 4/5/19
17		Fill Portion	1 day	Sun 4/7/19
18		Compact Site	4 days	Mon 4/8/19
19		Grade Site to	3 days	Fri 4/12/19
20		**Foundation**	**23 days**	**Wed 4/17/19**
21		**Lightening**	**10 days**	**Wed 4/17/19**
22		Place Copper Wire	10 days	Wed 4/17/19
23		**Concrete**	**12 days**	**Wed 5/1/19**
24		Place Forms	1 day	Wed 5/1/19
25		Place Rebar	1 day	Thu 5/2/19
26		Pour Concrete	2 days	Fri 5/3/19
27		Cure Concrete	7 days	Tue 5/7/19
28		Strip Forms	1 day	Thu 5/16/19
29		**Backfill**	**1 day**	**Fri 5/17/19**
30		Backfill Around	1 day	Fri 5/17/19



Project: Senior Design Construc
Date: Wed 3/13/19

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone


1 Substation Foundation Project
1.1 Temporary Construction Entrance
1.1.1 Gravel Bridge
1.2.1 Excavate Mound
2.1 Site Development
2.1.1 Site Protection
2.1.1.1 Install Chain Link
2.1.2 Erosion Control
2.1.2.1 Install Silt Fence
2.1.2.2 Install Construction Hay
2.1.3 Grade Site
2.1.3.1 Grade Site
2.1.3.2 Compact Site
2.1.4 Staging Area
2.1.4.1 Place Stone
2.1.4.2 Compact Stone
2.1.5 Driveway
2.1.5.1 Place Stone
2.1.5.2 Compact Stone
3.1 Foundation
3.1.1 Lightening Protection
3.1.1.1 Install Copper Wire
3.1.2 Concrete
3.1.2.1 Place Forms
3.1.2.2 Install Underground Conduit
3.1.2.3 Set Risers
3.1.2.4 Set Rebar
3.1.2.5 Tie Rebar
3.1.2.6 Pour Concrete
3.1.2.7 Cure Concrete
3.1.2.8 Remove Forms
3.1.3 Backfill

Appendix G: Item Cost Breakdown

Cost Analysis												
Activity	**Quantity**	**Unit**	**Daily Output**	**Duration (Days)**	**Material $/Unit**	**Material Cost**	**Labor $/Unit**	**Labor Cost**	**Equipment $/Unit**	**Equipment Cost**	**Total Cost**	**Reference**
Place Concrete Pipe	12	L.F.	-	0.5	55.98	671.76	-	-	-	-	671.76	TDOT 607-03.02
Stone for Construction Entrance	5 layers of 120	S.F.	6000	0.1	38	22800	0.22	132	0.02	12	22944	RS Means - 31.23.23.17-0800
Silt Fence	544	L.F.	950	0.5726315789	1.35	734.4	0.59	320.96	0	0	1055.36	TDOT 209.08.03
Stone for Road	55	C.Y.	600	0.09166666667	38	2090	30	1650	3.44	189.2	3929.2	RS Means - 31.05.16.10-0300
Stone for Staging Area	311	C.Y.	600	0.33	38	11818	30	9330	3.44	1069.84	22217.84	RS Means - 31.05.16.10-0300
Chain Link Fence	1652	L.F.	-	4	12.58	20782.16	10	1600	-	-	22382.16	TDOT 707-08.30
End and Corner Post	6	Ea.	-	2	241.34	1448.04	10	800	-	-	2248.04	TDOT 707-01.11
6' Gate	2	Ea.	-	1	1055	2110	10	400	-	-	2510	TDOT 707-01.13
Barbwire	1664	L.F.	-	3	0.48	798.72	10	1200	-	-	1998.72	TDOT 707-14.03
Excavation	963	B.C.Y	800	1.20375	-	-	0.62	597.06	0.91	876.33	1473.39	RS Means - 31.26.16.42-0200
Fill	990	L.C.Y	1000	0.99	-	-	0.28	277.2	1.05	1039.5	1316.7	RS Means - 31.23.23.17-0020
Compaction	24000	S.F.	7500	3.2	-	-	0.22	5280	0.33	7920	13200	RS Means - 31.25.17.16-00200
Grading	24000	S.F.	8900	2.696629213	-	-	0.06	1440	0.6	14400	15840	RS Means - 31.22.16.10-3300
Lightenign Protection Copper Wire	4000	L.F.	-	10	2.06	8240	20	3200	-	-	11440	TDOT 730-08.30
Place Forms	180	L.F.	1200	0.15	1.64	295.2	0.79	142.2	-	-	437.4	RS Means - 03.11.13.65-1400
Place Rebar	136	Ea.	435	0.3126436782	10.99	1494.64	1.34	182.24	-	-	1676.88	RS Means - 03.21.10.60-2420
Pour Concrete	74	C.Y	56.4	1.312056738	169	12506	63.5	4699	0.42	31.08	17236.08	RS Means - 03.30.53.40-4050
Cour Concrete	-	-	-	7	-	-	-	-	-	-	0	-
Strip Forms	180	L.F.	4800	0.0375	0	0	0	0	0	0	0	Included in Place Forms Price
Backfill	1400	S.F.	6000	0.2333333333	38	53200	0.22	308	0.02	28	53536	RS Means - 31.23.23.17-0800
Total						138988.92		31558.66		25565.95	**196113.53**	