MEMORANDUM

TO: Gary Garbacik

FROM: Ben Gordon, P.E., and Gabe Bollinger, E.I.T.

DATE: 3/7/2025

RE: Geotechnical Recommendations
PA DMVA C130J Simulator Facility
Lower Swatara Township, Dauphin County, Pennsylvania
GF Project Number 076046

Introduction

Proposed construction of the PA DMVA C130J Simulator Facility at the Pennsylvania Air National Guard (PAANG) facility near Middletown includes construction of an approximately 61 foot by 63 foot bay to house the C130J simulator and an adjacent approximately 64 foot by 126 foot multi story office building. The proposed simulator bay is approximately 66 feet in height and the proposed office building is approximately 30 feet in height. Geotechnical recommendations regarding the structure foundations, allowable loading and construction considerations are provided herein. These recommendations are based on a review of boring data completed in August 2024 and Structural Plans provided by Gannett Fleming, dated August 2024. The location of the project site is shown in Figure 1, Site Location Plan.

Site Geology

The proposed simulator facility is located in the Gettysburg-Newark Lowland Section of the Piedmont Province (Sevon, 2000). The section consists of rolling lowlands, shallow valleys, and isolated hills with low to moderate relief. The underlying bedrock structure consists of half-graben having low, monoclinal, northwest-dipping beds. The overlying unconsolidated sediments originate from fluvial erosion of rocks of variable resistance.

The proposed simulator facility is underlain by the Gettysburg Formation which was described as being composed of reddish-brown to maroon silty mudstone and shale and soft, red-brown, medium- to fine-grained sandstone, with minor amounts of yellowish-brown shale and sandstone and thin beds of impure limestone. Beds are thin to flaggy and moderately well developed (Geyer and Wilshusen, 1982). See Figure 3 – Geologic Map.

Information about the soils surrounding the proposed simulator facility was obtained from the U.S. Department of Agriculture Natural Resource and Conservation Service (NRCS) online Web Soil Survey (USDA, 2024). See Figure 4 - NRCS Soils Map. One soil map unit is mapped in the immediate vicinity of the proposed pumping station site:

Ub Urban land, limestone materials

The map soil unit underlaying the proposed simulator facility is the Urban lands, limestone material (Ub), which consists of pavement, buildings, and other artificially covered areas.

Subsurface Conditions

Five borings were drilled in the vicinity of the proposed simulator facility, designated as Borings GF-1 through GF-5. The borings were drilled on the existing paved surface where the proposed structure will be located. Borings GF-1 and GF-2 were drilled on the corners of the west side of the proposed building. Boring GF-3 was drilled near the center of the proposed structure. Borings GF-4 and GF-5 were drilled on the corners of the east side of the proposed structure. Borings were completed in August 2024 by Eichelbergers, Inc. and were inspected by personnel from Gannett Fleming. The approximate locations of the boring are shown in Figure 2, Boring Location Plan.

Spilt-spoon samples and rock core samples were obtained during the subsurface exploration. Typed boring logs are included in Appendix A. Laboratory test reports are included in Appendix B.

The subsurface conditions encountered in the borings were generally consistent. The subsurface consisted of granular fill underlain by alluvium and then residual soils and bedrock. Detailed descriptions and blow counts of the subsurface soils, and rock core descriptions, recoveries, and rock quality designation (RQD) are presented in the subsequent paragraphs, listed in descending order (i.e., shallowest to deepest).

Fill material was encountered directly beneath the pavement to depths ranging from approximately 2 to 6 feet. The fill was visually classified as loose to dense silty sand with gravel (sm). Uncorrected SPT N-values ranged from 7 blows per foot (bpf) to 31 bpf and averaged 19 bpf.

Fine-grained, predominantly alluvial material was encountered beneath the fill and extended to depths of approximately 6 to 12 feet below ground surface. This layer was typically visually classified as soft to very stiff clay and silt with varying amounts of sand and gravel. Samples from this layer were laboratory classified as silt (ML), silt with sand (ML), silty clay (CL-ML), and lean clay with gravel (CL). Uncorrected SPT N-values within this material ranged from 3 bpf to 16 bpf and averaged 8 bpf.

Approximately 10 to 15 feet of predominantly poorly graded sand or gravel or highly weathered bedrock (saprolite) was encountered beneath the fine-grained soils. Uncorrected SPT N-values within this material ranged from 5 bpf to refusal and averaged 24 bpf.

Bedrock was encountered at depths ranging from 20.3 to 22.3 feet below ground surface, corresponding to Elevations 272.9 feet to 275.2 feet. Bedrock typically consisted of siltstone and sandstone. The siltstone was typically described as very soft to medium hard with fresh to moderate weathering. The sandstone was typically described as medium hard to hard with fresh to moderate weathering. Total rock recovery averaged 100 percent and total RQD averaged 11 percent.

Groundwater measurements were collected immediately upon the completion of drilling and again before backfilling the holes and ranged from 5.6 to 7.2 feet below ground surface corresponding to elevations between 289.5 feet and 289.3 feet. Recorded groundwater levels are believed to be higher than normal groundwater levels as water was injected into the boreholes to aid in casing advancement and rock coring. In addition, groundwater levels fluctuate with seasonal and climatic changes.

Design Recommendations

Based on the subsurface conditions encountered in the borings, deep foundations consisting of end-bearing H-piles driven to rock are recommended to support the proposed structures.

It is recommended that the seismic structural design of the proposed simulator facility be based on Seismic Site Class C.

Bottom of pile caps for the structures are recommended to be embedded a minimum 3.0 feet below site grades for frost protection.

Due to the likelihood of significant settlement beneath the proposed structures, deep foundations consisting of steel H-piles are the recommended foundation type. Use end bearing HP 10x57 steel (Grade 50) piles equipped with heavy duty pile tip reinforcement. Center-to-center pile spacing should not be less than 30.0 in. or 3 pile diameters. Piles should project a minimum of 12.0 in. into the pile cap. The piles should be driven to absolute refusal on bedrock, encountered at depths of approximately 20.3 to 22.3 feet (Elevations 272.9 to 275.2 feet) in the borings.

Since the piles will be driven to refusal, the structural capacity of the pile controls the allowable axial capacity. Laboratory corrosion testing results indicate that the site soils are not corrosive, however a 1/16-inch section loss was conservatively used to determine the axial capacity. For severe driving conditions and a reduced pile section, it is recommended to use an allowable axial capacity of 212 kips per DM-4, Table 6.15.3.2-2. Due to the large uplift loads on the proposed structures, APILE was used to determine an uplift capacity for the HP 10x57 piles. APILE uses the FHWA method to determine the uplift capacity of a single pile based on side friction. The allowable uplift capacity for a group of piles should be taken as the lesser of (a) the single pile uplift capacity (13.4 kips) multiplied by the number of piles in the group; or (b) two-thirds of the effective weight of the pile group and the soils contained within a block defined by the perimeter of the group and the embedded length of the piles. For this analysis, use a pile length of 17 feet and a soil unit weight of 110 pounds per cubic foot.

LPILE was used to estimate the lateral capacity of the piles. The weak axis pile properties were used in the analysis. An estimated pile length of 19.3 feet was used along with the subsurface conditions based on GF-3. Based on the analysis, the recommended allowable lateral capacity of the HP 10x57 piles, assuming 50 percent fixity, is 11 kips. The allowable lateral capacity of 11 kips corresponds to 0.5 inches of pile head deflection.

The simulator bay façade is recommended to be supported by shallow foundations bearing on the fine-grained material. A maximum allowable bearing capacity of 1,500 psf is recommended for the façade foundations per IBC, Table 1806.2.

Construction Considerations

<u>Recommended Backfill</u>

A minimum of 6 inches of AASHTO No. 57 coarse aggregate is recommended for backfilling beneath the floor slabs to create an even bearing surface and aid in drainage. Prior to aggregate placement, in the presence of a Geotechnical Engineer or experienced Construction Inspector, inspect the subgrade and remove any soft, loose, or otherwise unsuitable materials to competent material.

Backfill around the structure foundations is recommended to consist of a granular, free draining material with a maximum particle size of 3 inches with less than 15 percent of the material passing a No. 200 sieve and being non-plastic.

Excavation

Excavations for the proposed foundations are anticipated to consist of fill or alluvium soil material. Boulders and cobbles are not anticipated during excavations. Blasting is not permitted. Bedrock excavation is not anticipated during foundation excavation.

The contractor is responsible for the stability of all excavated slopes. Divert all surface runoff away from the excavation. Perform excavations in accordance with OSHA requirements based on material encountered.

Groundwater

The Contractor is responsible for providing sufficient dewatering so that foundation excavations are dry enough to be inspected by the Engineer. Although boring data indicates the presence of groundwater to be below the anticipated foundation elevations, the Contractor is advised that groundwater levels may fluctuate with seasonal and climate changes. Foundation excavations for the pile caps are to be sufficiently dry prior to concrete placement.

Surface Water

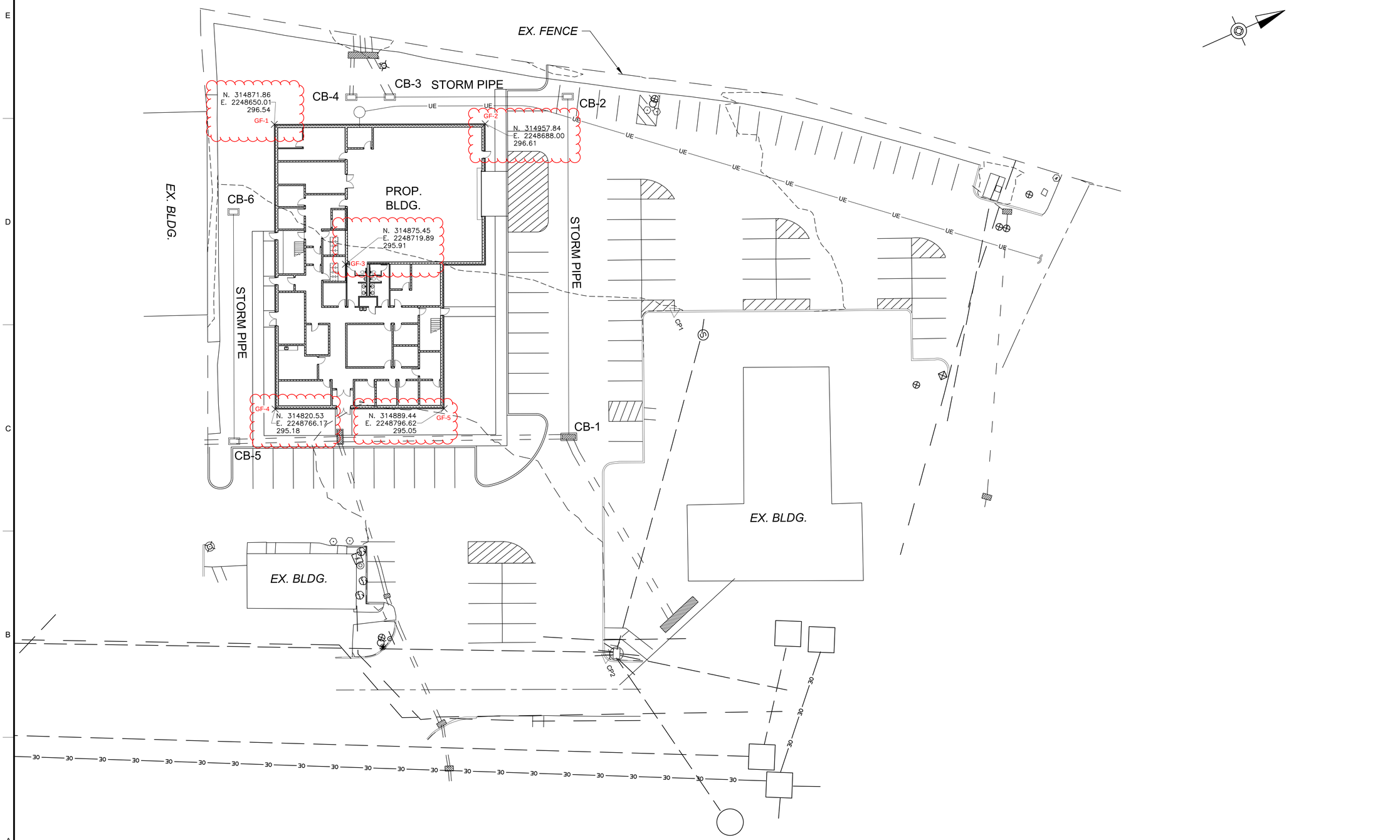
Proper control of surface water will be an important aspect of the construction process. Maintain positive drainage of all exposed subgrade areas. To minimize the potential for strength loss of the subgrade when exposed to excessive moisture, water should not be allowed to pond in foundation excavations.

If you have any questions or comments regarding these geotechnical recommendations, please contact Ben Gordon or Gabe Bollinger.

FIGURES

Figure 1
Site Location Plan
Legend
Simulator Building
American Airlines Cargo
UPS
HIA Long Term Parking
FedEx
MDT
Olmsted Dr
Box Car Rd
Simulator Building
Box Car Rd
Olmsted Dr
Olmsted Blvd
193rd Special Operations Wing Association
Hercules Way
Air National Guard Pa
Olmsted Blvd
Google Earth
Image © 2024 Airbus
500 ft
N

Figure 2 – Boring Location Plan



1 / C102 GRADING AND DRAINAGE PLAN
SCALE: 1"= 20'

0' 20' 40'
SCALE: 1"=20'

GANNETT FLEMING
207 Senate Avenue
Camp Hill • PA • 17011
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www.gannettfleming.com

PENNSYLVANIA AIR NATIONAL GUARD

HARRISBURG ANGB, MIDDLETOWN, PA

SOF CONSTRUCT SIMULATOR FACILITY MC-130J

NO.	DATE	DESCRIPTION

REVISIONS

PROJECT STATUS

PROJECT NUMBER: 962-0043

DESIGNED:	MODELED:	CHECKED:
CNB	DBM	CNB

DATE: 02/01/2024

DRAWING TITLE: CIVIL

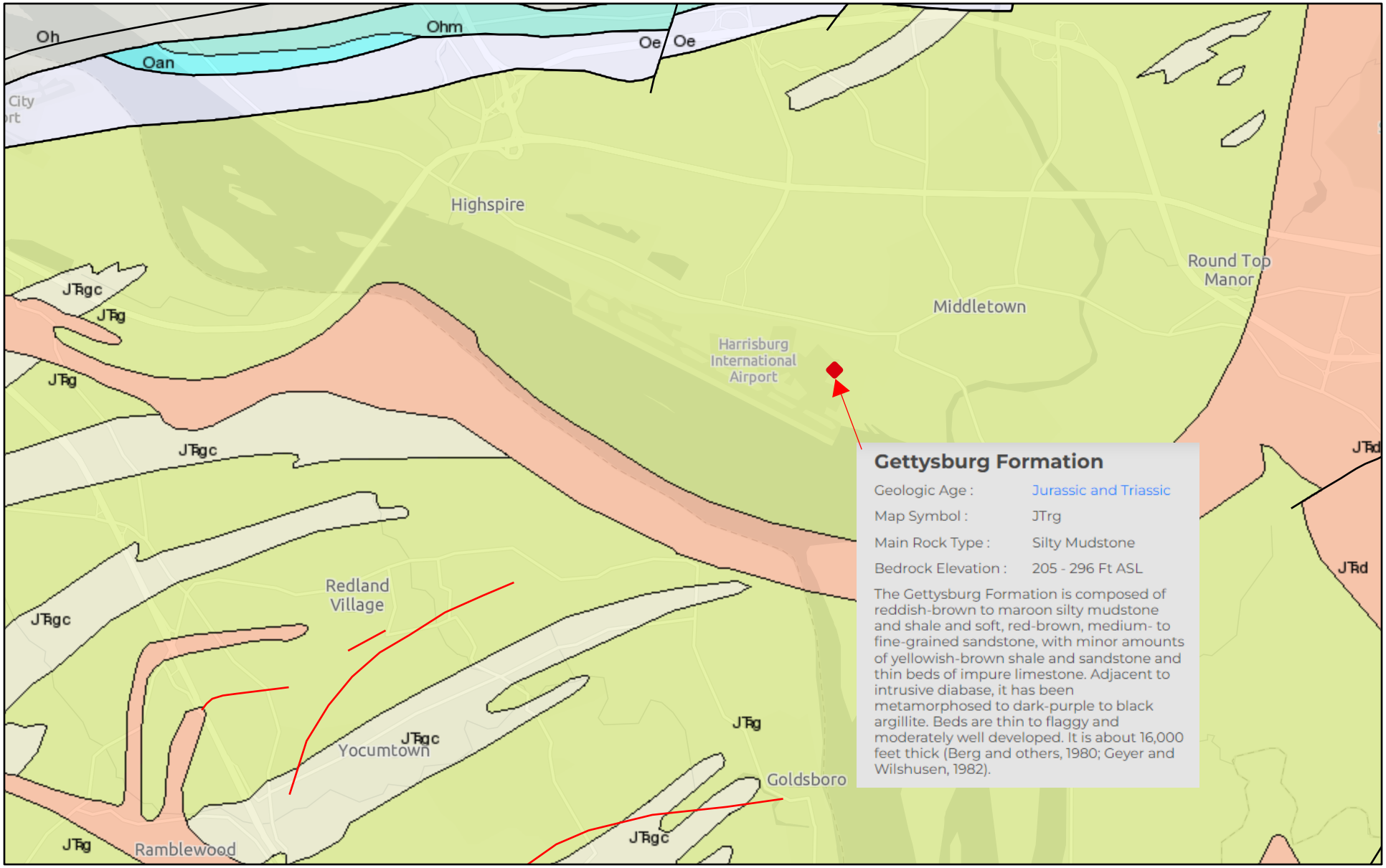
GRADING AND DRAINAGE PLAN

DRAWING NO.: # OF 99

C102

Local File: C:\USERS\CBRAY\DC\ACCDOCS\GANNETT FLEMING INC\076046-PAANG_EC_130J_SIMULATOR\PROJECT Central Files\FILES\SHEETS\PA\SITE\076046_C_102.DWG
Project Number: 962-0043
3/18/2024 12:14 PM

Figure 3 – Geologic Map



LEGEND
Oan = Annville Formation
Oe = Epler Formation
Oh = Hamburg Sequence Rocks
Ohm = Hershey and Myerstown Formations, Undivided
Oo = Ontelaunne Formation
Osp = St. Paul Group

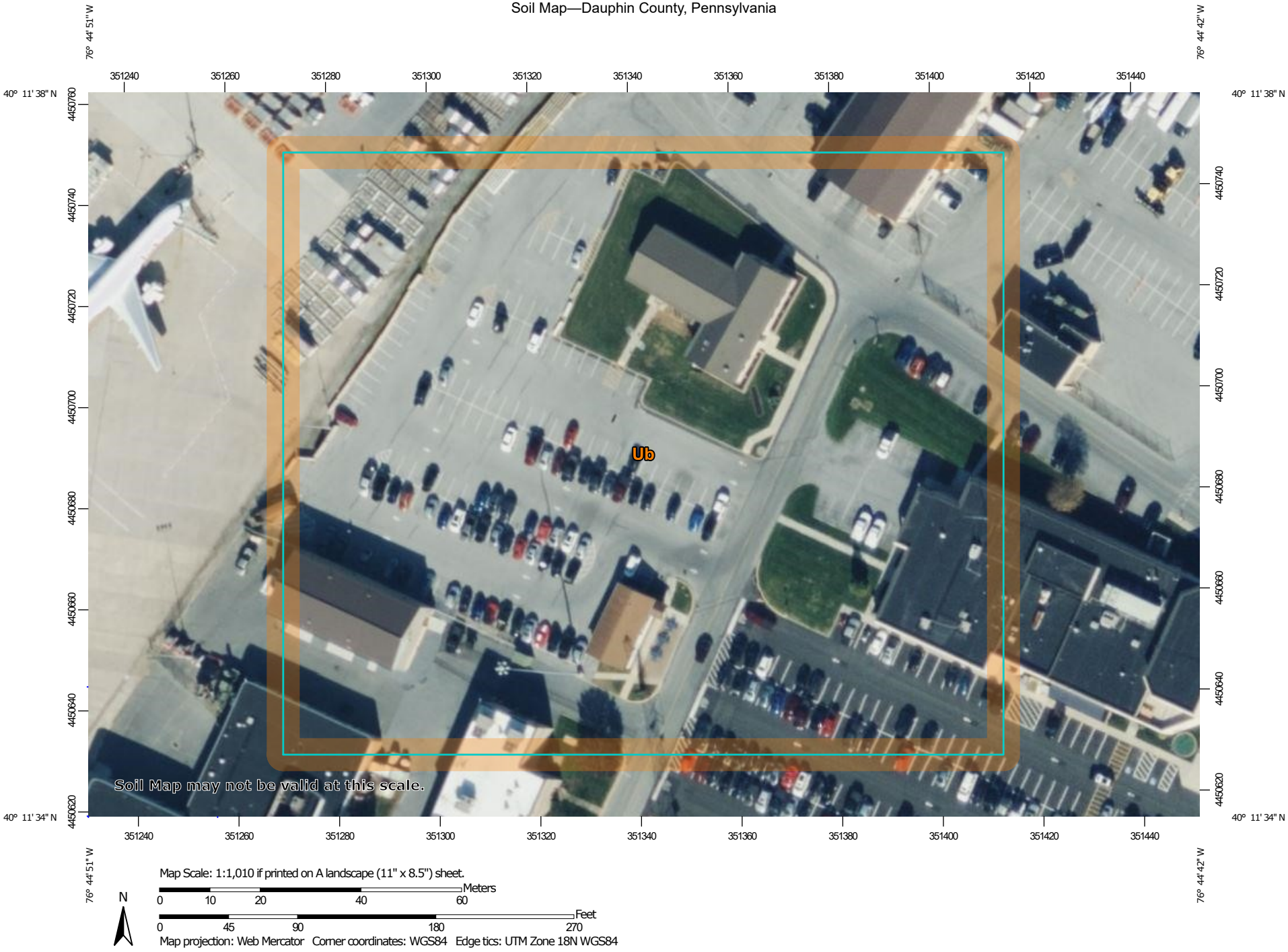
JTrd = Diabase
JTrg = Gettysburg Formation
JTrgc = Gettysburg Conglomerate
Trn = New Oxford Formation

1:75,000
0 0.5 1 2 mi
0 0.75 1.5 3 km

York County Planning Commission, data.pa.gov, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA,

Figure 4 – NRCS Soils Map

Soil Map—Dauphin County, Pennsylvania



Map Scale: 1:1,010 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 45 90 180 270

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

Figure 4 – NRCS Soils Map

Soil Map—Dauphin County, Pennsylvania

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Dauphin County, Pennsylvania
Survey Area Data: Version 20, Sep 4, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 6, 2020—Nov 7, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ub	Urban land, limestone materials	4.2	100.0%
Totals for Area of Interest		**4.2**	**100.0%**

APPENDIX A
Typed Boring Logs

DRILLING LOG

GANNETT FLEMING

Date Started:	8/21/24	Hole Number:	GF-1
Date Finished:	8/21/24	Sheet:	1 of 2
Soil Drilling:	21.5 ft	Line & Station:	
Rock Sampling:	5.0 ft	Project: PAANG C130J Simulator Facility	Offset:
Total Depth of Hole:	26.5 ft	Drilling Agency: Eichelbergers	N Coordinate: 314871.9 ft
No. of Undist. Samples:	0	Driller: Ben Hurley	E Coordinate: 2248650.0 ft
Total Number of Core Boxes:	1	Bit Size and Type: NQ3 / Spoon Size: 2.0 " OD	Elev. Top of Hole: +296.5 ft
GROUNDWATER OBSERVATIONS At 7.1 ft after 0 Hrs At 7.2 ft after 24 Hrs Elev. 289.3 ft after 24 Hrs		Casing Size: 3.0 " ID / Hammer Wt.: 140 lb Hollow Stem Auger: N/A / Hammer Drop: 30.0 " Drilling Fluid: Water / Hammer Type: Automatic Drill Rig: Acker Rebel Track	Direction of Hole Vertical ☒ Inclined ☐ Degrees from Vertical --- Logged By: M. Babar

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.0	S-1	36-9-15-14	2.0	100		0.0'-0.5': ASPHALT (El. 296.0) 0.5'-1.0': SUBBASE (El. 295.5) 1.0'-4.0': Brown Silty SAND with gravel (sm), moist to wet, very dense, coarse sand, non-plastic fines	Started at 11:45
2.0 - 2.4	S-2	50/0.4	0.3	75			
2.4 - 4.0	A-1					(El. 292.5)	2.4-4.0': Unsampled. 3.0-4.0': Gravel
4.0 - 6.0	S-3	5-4-2-2	0.6	30		4.0'-6.0': Grayish brown SILT with sand (ML), stiff, low plastic fines (El. 290.5)	
6.0 - 8.0	S-4	3-11-14-12	2.0	100		6.0'-14.0': Gray Poorly Graded SAND with gravel (sp), wet, medium dense to very dense, sand coarse to medium, gravel fine and subrounded	
8.0 - 10.0	S-5	11-15-29-18	1.6	80			
10.0 - 12.0	S-6	8-12-11-18	1.2	60			
12.0 - 14.0	S-7	17-9-14-9	2.0	100		(El. 282.5)	
14.0 - 16.0	S-8	8-4-4-4	1.5	75		14.0'-18.3': Gray Poorly Graded GRAVEL with sand (gp), wet, medium dense to very dense, gravel subrounded, sand coarse to medium	
16.0 - 18.0	S-9	5-2-3-4	1.5	75		(El. 278.2)	16.0-18.0': Pieces of weathered siltstone and sandstone.
18.0 - 18.9	S-10	22-50/0.4	0.9	100		18.3'-21.5': Reddish brown SILT (ml), weathered siltstone. [Residual]	
18.9 - 20.0	A-2						18.9-20.0': Unsampled.
20.0 - 20.6	S-11	35-50/0.1	0.6	100			
20.6 - 21.5	A-3					Top of Rock @ 21.5 ft (El. 275.0)	20.6-21.5': Unsampled.
21.5 - 23.5	R-1	0.0' / 0%	2.0	100		21.5'-26.5': Red SILTSTONE; severe to moderate weathering, very soft to soft, joints broken to very close spaced, RD = 10° - 20°	21.5': Casing refused. Started coring.

Purpose: Explore subsurface for future design of C130J Simulator Facility.
Drilling Method: Continuous SPT testing through soils. Rock coring with water.
Termination: Terminate boring at least 5 feet into rock.
Abandonment: Boring backfilled with Sodium Bentonite and drill cuttings. Asphalt replaced with cold patch.
Additional Remarks:

Agency:	Eichelbergers	DRILLING LOG	Hole Number:	GF-1
Driller:	Ben Hurley	GANNETT FLEMING	Sheet:	2 of 2
Inspector:	M. Babar		Elev. Top of Hole:	+296.5 ft

PAANG C130J Simulator Facility

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
23.5 - 26.5	R-2	1.6' / 53%	3.0	100		El. 270.0	

Bottom of Borehole at 26.5 feet.
Total Core Recovery: 100%
Total RQD: 32%

DRILLING LOG

GANNETT FLEMING

Date Started:	8/21/24	Hole Number:	GF-2
Date Finished:	8/21/24	Sheet:	1 of 2
Soil Drilling:	22.1 ft	Line & Station:	
Rock Sampling:	5.0 ft	Project: PAANG C130J Simulator Facility	Offset:
Total Depth of Hole:	27.0 ft	Drilling Agency: Eichelbergers	N Coordinate: 314957.8 ft
No. of Undist. Samples:	0	Driller: Ben Hurley	E Coordinate: 2248688.0 ft
Total Number of Core Boxes:	1	Bit Size and Type: NQ3 / Spoon Size: 2.0 " OD	Elev. Top of Hole: +296.6 ft
GROUNDWATER OBSERVATIONS At 6.8 ft after 0 Hrs At 7.1 ft after 24 Hrs Elev. 289.5 ft after 24 Hrs		Casing Size: 3.0 " ID / Hammer Wt.: 140 lb Hollow Stem Auger: N/A / Hammer Drop: 30.0 " Drilling Fluid: Water / Hammer Type: Automatic Drill Rig: Acker Rebel Track	Direction of Hole Vertical ☒ Inclined ☐ Degrees from Vertical --- Logged By: M. Babar

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
						0.0'-0.5': ASPHALT (El. 296.1)	Started 09:26
0.0 - 2.0	S-1	49-19-12-39	2.0	100		0.5'-1.0': SUBBASE (El. 295.6) 1.0'-6.0': Brown Silty SAND with gravel (sm), moist, dense to very dense, trace non-plastic fines. [Fill]	
2.0 - 2.4	S-2	50/0.4	0.3	75			2.0-4.0': Started pushing casing. 2.0-2.4': Gravel 2.4-4.0': Unsampled.
2.4 - 4.0	A-1						
4.0 - 6.0	S-3	9-9-5-4	0.4	20		(El. 290.6)	
6.0 - 8.0	S-4	3-2-3-2	1.5	75		6.0'-8.0': Brown SILT with sand (ML), moist, stiff, medium plastic fines. [Alluvial] (El. 288.6)	P.P. = 0.5-1.0 tsf
8.0 - 10.0	S-5	3-3-4-4	1.5	75		8.0'-12.0': Grayish brown SILT with sand (ML), moist, stiff, low plastic fines	P.P. = 1.5-2.0 tsf
10.0 - 12.0	S-6	3-2-7-6	1.5	75		(El. 284.6)	P.P. = 1.5-2.0 tsf10.0': Color changed to gray.
12.0 - 14.0	S-7	6-11-15-7	2.0	100		12.0'-14.0': Grayish brown Silty SAND with gravel (sm), moist to wet, dense, medium plastic fines, pieces of red sandstone and claystone in sample. [Residual] (El. 282.6)	
14.0 - 16.0	S-8	6-7-3-3	0.3	15		14.0'-22.1': Reddish brown Poorly Graded GRAVEL with sand (gp), wet, medium dense to very dense, gravel subrounded, sand coarse to medium. [Residual]	
16.0 - 18.0	S-9	6-5-7-6	1.3	65			16.0-18.0': Pieces of weathered sandstone and claystone.
18.0 - 18.9	S-10	11-50/0.4	0.9	100			18.0-20.0': Pieces of weathered red sandstone in sample. 18.9-20.0': Unsampled.
18.9 - 20.0	A-2						
20.0 - 20.4	S-11	50/0.4	0.4	100			
20.4 - 22.0	A-3						20.4-22.0': Unsampled.
22.0 - 22.1	S-12	50/0.1				Top of Rock @ 22.1 ft (El. 274.5)	S-12: Reddish brown claystone.
22.1 - 24.0	R-1	0.4' / 20%	2.0	100		22.1'-27.0': Red SILTSTONE; moderate to fresh weathering, soft to medium hard, joints very close to moderately close spaced, RD = 10° - 20°, interbedded with sandstone.	22.1': Started coring.

Purpose: Explore subsurface for future design of C130J Simulator Facility.
Drilling Method: Continuous SPT testing through soils. Rock coring with water.
Termination: Terminate boring at least 5 feet into rock.
Abandonment: Boring grouted with Sodium Bentonite and drill cuttings and asphalt replaced with cold patch on 08/22/2024.
Additional Remarks:

Agency:	Eichelbergers	DRILLING LOG	Hole Number:	GF-2
Driller:	Ben Hurley	GANNETT FLEMING	Sheet:	2 of 2
Inspector:	M. Babar		Elev. Top of Hole:	+296.6 ft

PAANG C130J Simulator Facility

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
24.0 - 27.0	R-2	0.0' / 0%	3.0	100		El. 269.6	

Bottom of Borehole at 27.0 feet.
Total Core Recovery: 100%
Total RQD: 8%

DRILLING LOG

GANNETT FLEMING

Date Started:	8/21/24	Hole Number:	GF-3
Date Finished:	8/22/24	Sheet:	1 of 2
Soil Drilling:	22.3 ft	Line & Station:	
Rock Sampling:	5.0 ft	Project: PAANG C130J Simulator Facility	Offset:
Total Depth of Hole:	27.3 ft	Drilling Agency: Eichelbergers	N Coordinate: 314881.4 ft
No. of Undist. Samples:	0	Driller: Ben Hurley	E Coordinate: 2248721.0 ft
Total Number of Core Boxes:	1	Bit Size and Type: NQ3 / Spoon Size: 2.0 " OD	Elev. Top of Hole: +295.9 ft
GROUNDWATER OBSERVATIONS At 6.5 ft after 0 Hrs Elev. 289.4 ft after 0 Hrs		Casing Size: 3.0 " ID / Hammer Wt.: 140 lb	Direction of Hole
		Hollow Stem Auger: N/A / Hammer Drop: 30.0 "	Vertical ☒ Inclined ☐
		Drilling Fluid: Water / Hammer Type: Automatic	Degrees from Vertical ---
		Drill Rig: Acker Rebel Track	Logged By: M. Babar

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.0	S-1	35-13-8-7	2.0	100		0.0'-0.5': ASPHALT (El. 295.4) 0.5'-1.0': SUBBASE (El. 294.9) 1.0'-2.3': Brown Silty SAND with gravel (sm), moist, medium dense, non-plastic fines. [Fill] (El. 293.6)	Started 1410
2.0 - 4.0	S-2	10-7-5-4	1.8	90		2.3'-6.0': Brown SILT with sand (ML), moist, non-plastic fines. [Alluvial] (El. 289.9)	P.P. = 2.5-3.0 tsf
4.0 - 6.0	S-3	6-5-5-3	1.3	65			
6.0 - 8.0	S-4	2-2-1-2	0.7	35		6.0'-10.0': Grayish brown CLAY (cl), wet, soft to stiff, trace fine sand, highly plastic (El. 285.9)	P.P. = 1.5 tsf
8.0 - 10.0	S-5	4-4-5-6	1.2	60			P.P. = 3.0 tsf
10.0 - 12.0	S-6	4-7-5-6	0.8	40		10.0'-14.0': Poorly Graded SAND with gravel (sp), wet, medium dense, sand fine to medium grained (El. 281.9)	
12.0 - 14.0	S-7	6-9-6-7	0.5	25			S-7: Rock stuck at the shoe of sampler.
14.0 - 16.0	S-8	10-10-4-4	0.5	25		14.0'-20.0': Poorly Graded GRAVEL with sand (gp), wet, medium dense to very dense, gravel subrounded, sand coarse to medium (El. 275.9)	
16.0 - 18.0	S-9	3-5-6-4	0.6	30			
18.0 - 19.4	S-10	5-3-50/0.4	1.4	100			18-19.6': Pieces of weathered red sandstone.
19.4 - 20.0	A-1						19.4': Stopped for the day at 15:15. Resumed at 08:00 on 8/22/24.
20.0 - 20.9	S-11	27-50/0.4	0.5	56		20.0'-22.3': Red Poorly Graded SAND (sp), wet, very dense, sand medium to coarse grained, weathered red sandstone. [Residual]	19.4-20.0': Unsampled. 20.9-22.0': Unsampled.
20.9 - 22.0	A-2						
22.0 - 22.3	S-12	50/0.3	0.2	67		Top of Rock @ 22.3 ft (El. 273.6) 22.3'-27.3': Red ARKOSIC SANDSTONE; moderate to fresh weathering, medium hard, coarse grained sandstone with fine round gravels	22.3': Started coring.

Purpose: Explore subsurface for future design of C130J Simulator Facility.
Drilling Method: Continuous SPT testing through soils. Rock coring with water.
Termination: Terminate boring at least 5 feet into rock.
Abandonment: Boring backfilled with Sodium Bentonite and drill cuttings. Asphalt replaced with cold patch on 08/22/2024.
Additional Remarks:

Agency:	Eichelbergers	DRILLING LOG	Hole Number:	GF-3
Driller:	Ben Hurley	GANNETT FLEMING	Sheet:	2 of 2
Inspector:	M. Babar		Elev. Top of Hole:	+295.9 ft

PAANG C130J Simulator Facility

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
22.3 - 27.3	R-1	0.8' / 16%	5.0	100		embedded in sandstone. El. 268.6	

Bottom of Borehole at 27.3 feet.
Total Core Recovery: 100%
Total RQD: 16%

DRILLING LOG

GANNETT FLEMING

Date Started:	8/22/24	Hole Number:	GF-4
Date Finished:	8/22/24	Sheet:	1 of 2
Soil Drilling:	20.3 ft	Line & Station:	
Rock Sampling:	5.0 ft	Project: PAANG C130J Simulator Facility	Offset:
Total Depth of Hole:	25.3 ft	Drilling Agency: Eichelbergers	N Coordinate: 314820.5 ft
No. of Undist. Samples:	0	Driller: Ben Hurley	E Coordinate: 2248766.0 ft
Total Number of Core Boxes:	1	Bit Size and Type: NQ3 / Spoon Size: 2.0 " OD	Elev. Top of Hole: +295.2 ft
GROUNDWATER OBSERVATIONS At 5.9 ft after 0 Hrs Elev. 289.3 ft after 0 Hrs		Casing Size: 3.0 " ID / Hammer Wt.: 140 lb	Direction of Hole
		Hollow Stem Auger: N/A / Hammer Drop: 30.0 "	Vertical ☒ Inclined ☐
		Drilling Fluid: Water / Hammer Type: Automatic	Degrees from Vertical ---
		Drill Rig: Acker Rebel Track	Logged By: M. Babar

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 0.3	S-1	50/0.3	0.1	33		0.0'-0.5': ASPHALT (El. 294.7)	Started at 09:45. 0.3-2.0': Unsampled.
0.3 - 2.0	A-1					0.5-4.0': Sample missing. 0.5-1.0': Possibly subbase. 1.0-4.0': Possibly brown silty sand (sm).	
2.0 - 4.0	S-2	7-4-3-1	0.0	0		(El. 291.2)	
4.0 - 6.0	S-3	7-3-2-2	1.0	50		4.0'-6.0': Grayish brown SILT (ml), moist, medium stiff, low plastic fines. [Alluvial] (El. 289.2)	
6.0 - 8.0	S-4	3-3-3-5	1.8	90		6.0'-10.0': Gray Lean CLAY with sand and gravel (CL), moist, medium stiff to hard, medium plastic fines. [Alluvial]	
8.0 - 10.0	S-5	9-7-9-19	1.3	65		(El. 285.2)	
10.0 - 12.0	S-6	15-21-20-21	0.0	0		10.0-12.0': Sample missing. (El. 283.2)	
12.0 - 14.0	S-7	20-15-10-6	1.0	50		12.0'-13.0': Gray Poorly Graded SAND with gravel (sp), wet, dense, sand coarse to medium, gravel fine, subrounded (El. 282.2)	
14.0 - 16.0	S-8	11-7-8-7	1.5	75		13.0'-18.5': Gray Poorly Graded GRAVEL with sand (gp), wet, medium dense to dense, sand coarse, gravel fine to medium, subrounded	
16.0 - 18.0	S-9	6-4-23-11	1.5	75			
18.0 - 19.7	S-10	17-27-42-50/0.2	1.7	100		(El. 276.7) 18.5'-20.0': Reddish brown CLAY (cl), moist, hard, weathered claystone. [Residual]	
19.7 - 20.0	A-2					Top of Rock @ 20.3 ft (El. 275.2)	19.7-20.0': Unsampled.
20.0 - 20.3	S-11	50/0.3	0.3	100		20.0'-20.3': Red SILTSTONE; rock broken by SPT. (El. 274.9)	20.3': Started coring.
20.3 - 25.3	R-1	0.0' / 0%	5.0	100		20.3'-25.3': Red SILTSTONE; moderate to fresh weathering, medium hard, joints broken to very close spaced, RD = 0° - 20°	

Purpose: Explore subsurface for future design of C130J Simulator Facility.
Drilling Method: Continuous SPT testing through soils. Rock coring with water.
Termination: Terminate boring at least 5 feet into rock.
Abandonment: Boring backfilled with Sodium Bentonite and drill cuttings. Asphalt replaced with cold patch.
Additional Remarks:

Agency:	Eichelbergers	DRILLING LOG	Hole Number:	GF-4
Driller:	Ben Hurley	GANNETT FLEMING	Sheet:	2 of 2
Inspector:	M. Babar		Elev. Top of Hole:	+295.2 ft

PAANG C130J Simulator Facility

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
						El. 269.9	

Bottom of Borehole at 25.3 feet.
Total Core Recovery: 100%
Total RQD: 0%

DRILLING LOG

GANNETT FLEMING

Date Started:	8/22/24	Hole Number:	GF-5
Date Finished:	8/22/24	Sheet:	1 of 2
Soil Drilling:	22.1 ft	Line & Station:	
Rock Sampling:	5.0 ft	Project: PAANG C130J Simulator Facility	Offset:
Total Depth of Hole:	27.1 ft	Drilling Agency: Eichelbergers	N Coordinate: 314889.4 ft
No. of Undist. Samples:	0	Driller: Ben Hurley	E Coordinate: 2248797.0 ft
Total Number of Core Boxes:	1	Bit Size and Type: NQ3 / Spoon Size: 2.0 " OD	Elev. Top of Hole: +295.0 ft
GROUNDWATER OBSERVATIONS At 5.6 ft after 0 Hrs Elev. 289.4 ft after 0 Hrs		Casing Size: 3.0 " ID / Hammer Wt.: 140 lb	Direction of Hole
		Hollow Stem Auger: N/A / Hammer Drop: 30.0 "	Vertical ☒ Inclined ☐
		Drilling Fluid: Water / Hammer Type: Automatic	Degrees from Vertical ---
		Drill Rig: Acker Rebel Track	Logged By: M. Babar

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.0	S-1	40-10-5-7	1.5	75		0.0'-0.5': ASPHALT (El. 294.5) 0.5'-1.0': SUBBASE (El. 294.0) 1.0'-2.0': Brownish gray Silty SAND with gravel (sm), moist, medium dense (El. 293.0)	
2.0 - 4.0	S-2	5-4-5-14	1.4	70		2.0'-4.0': Brown Silty CLAY with sand (CL-ML), moist, stiff, low plastic fines (El. 291.0)	
4.0 - 6.0	S-3	5-2-1-1	0.8	40		4.0'-10.0': Gray SILT with sand and gravel (ML), moist, soft to medium stiff, medium plastic fines	
6.0 - 8.0	S-4	1-2-3-4	1.5	75			
8.0 - 10.0	S-5	3-4-5-4	1.7	85		(El. 285.0)	
10.0 - 12.0	S-6	14-5-7-5	0.9	45		10.0'-19.0': Gray Poorly Graded SAND with gravel (sp), wet, medium dense to dense, sand coarse, gravel fine to medium, subangular	
12.0 - 14.0	S-7	11-10-14-9	1.5	75			
14.0 - 16.0	S-8	6-4-6-7	1.4	70			14.0-16.0': Few lenses of clayey sand.
16.0 - 18.0	S-9	7-3-8-11	1.0	50			
18.0 - 19.7	S-10	29-39-43-50/0.3	1.7	100		(El. 276.0)	
19.7 - 20.0	A-1					19.0'-22.1': Red SAND (sp), moist, very dense, weathered fine-grained sandstone. [Residual]	19.7-20.0': Unsampled.
20.0 - 20.9	S-11	34-50/0.4	0.9	100			
20.9 - 22.0	A-2						20.9-22.0': Unsampled.
22.0 - 22.1	S-12	50/0.1	0.1	100		Top of Rock @ 22.1 ft (El. 272.9) 22.1'-27.1': Red SANDSTONE; moderate weathering, hard, joints broken to very close spaced, RD = 10° - 20°, few intrusions of low grade metamorphic rock.	22.1': Started coring.

Purpose: Explore subsurface for future design of C130J Simulator Facility.
Drilling Method: Continuous SPT testing through soils. Rock coring with water.
Termination: Terminate boring at least 5 feet into rock.
Abandonment: Boring backfilled with Sodium Bentonite and drill cuttings. Asphalt replaced with cold patch.
Additional Remarks:

Agency:	Eichelbergers	DRILLING LOG	Hole Number:	GF-5
Driller:	Ben Hurley	GANNETT FLEMING	Sheet:	2 of 2
Inspector:	M. Babar		Elev. Top of Hole:	+295.0 ft

PAANG C130J Simulator Facility

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
22.1 - 27.1	R-1	0.0' / 0%	5.0	100		El. 267.9	

Bottom of Borehole at 27.1 feet.
Total Core Recovery: 100%
Total RQD: 0%

APPENDIX B
Laboratory Test Reports

EXHIBIT D

LABORATORY'S QUALITY VERIFICATION STATEMENT

Laboratory must provide a signed copy of this form with each deliverable specified in the Work Order or the deliverable will not be accepted. Laboratory must provide Gannett Fleming with a true copy of its internal QA/QC review and approval forms related to the deliverable.

This form must be signed by the Laboratory's Quality Control/Quality Assurance Officer

Project Name: PAANG SOF Construct Simulator Facility MC-130J

Gannett Fleming Project Number: 76046

Deliverable Description: laboratory data

I, James D. Patton, warrant and represent that the project deliverable described above and attached to this form was developed in accordance with the project scope of work and that all elements relating to the quality of the deliverable were verified in accordance with the requirements of my firm's internal quality management/quality assurance system. This deliverable satisfies all requirements of our Contract with Gannett Fleming.

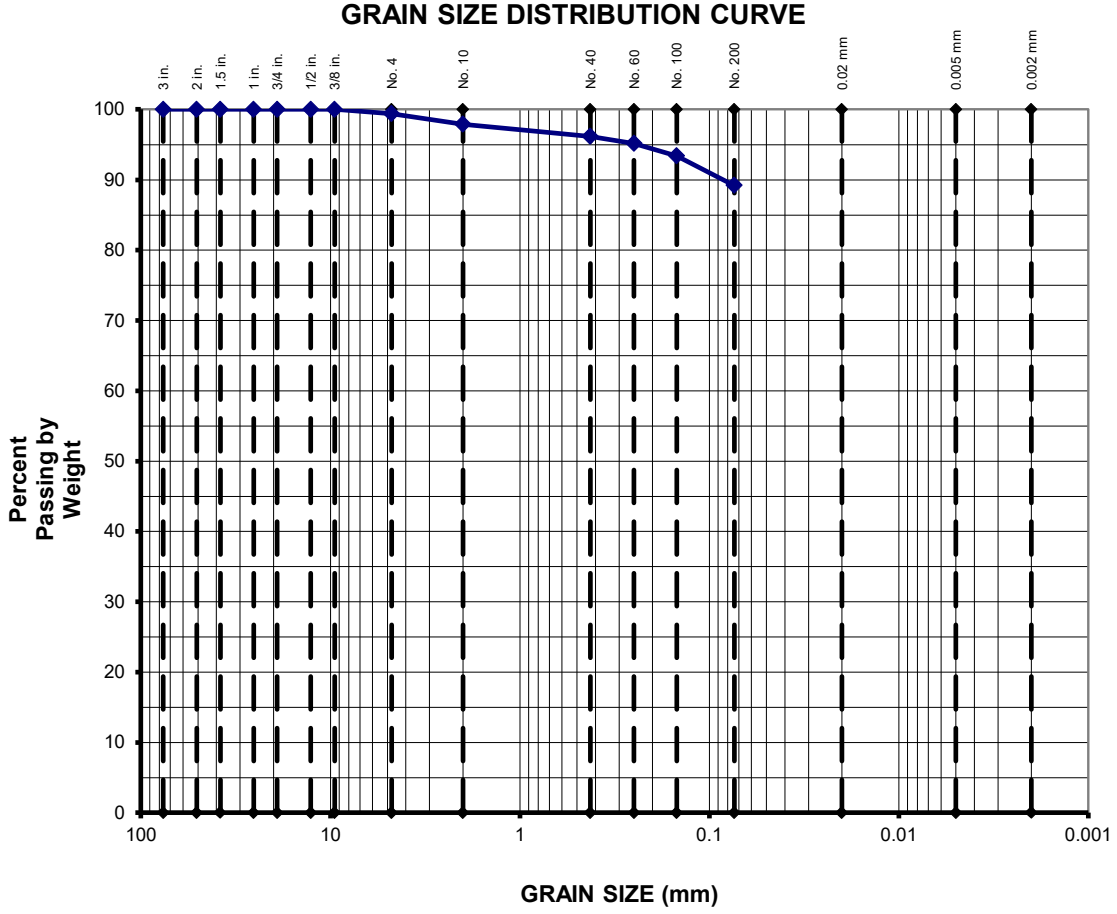
Signature: _____ **Date: 9/13/2024**

(by Laboratory's QC/QA Officer)

Laboratory: Navarro & Wright Consulting Engineers, Inc.

'Deliverable' shall mean all aspects of design including, without limitation, drawings, calculations, maps, materials and specifications, reports, data bases, logs and other information developed from wells, borings and cores, laboratory data, materials schedules, instrument calibration data and all other items developed, prepared and delivered to Gannett Fleming by Contractor as specified in the Scope of Work in any media.

GRAIN SIZE DISTRIBUTION CURVE



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.6%		10.2%			89.2%	
0.0%	0.6%	1.5%	1.7%	7.0%	-	-

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY
2.1%			8.7%		89.2%	
0.0%	0.0%	2.1%	1.7%	7.0%	-	-

Project:	PAANG SOF MC-130J	**Soil Type:**	SILT
Boring No.:	GF-1		
Station:	-	**USCS Classification:**	ML
Offset:	-	**AASHTO Classification:**	A-4 (3)
Sample No.:	S-3	LL = 26 %	PL = 22 %
Depth:	4.0-6.0 ft	PI = 4 %	w = 23.6%
Spec. Grav.:	2.7 (assumed)		

NAVARRO & WRIGHT CONSULTING ENGINEERS, INC.

AASHTO R18

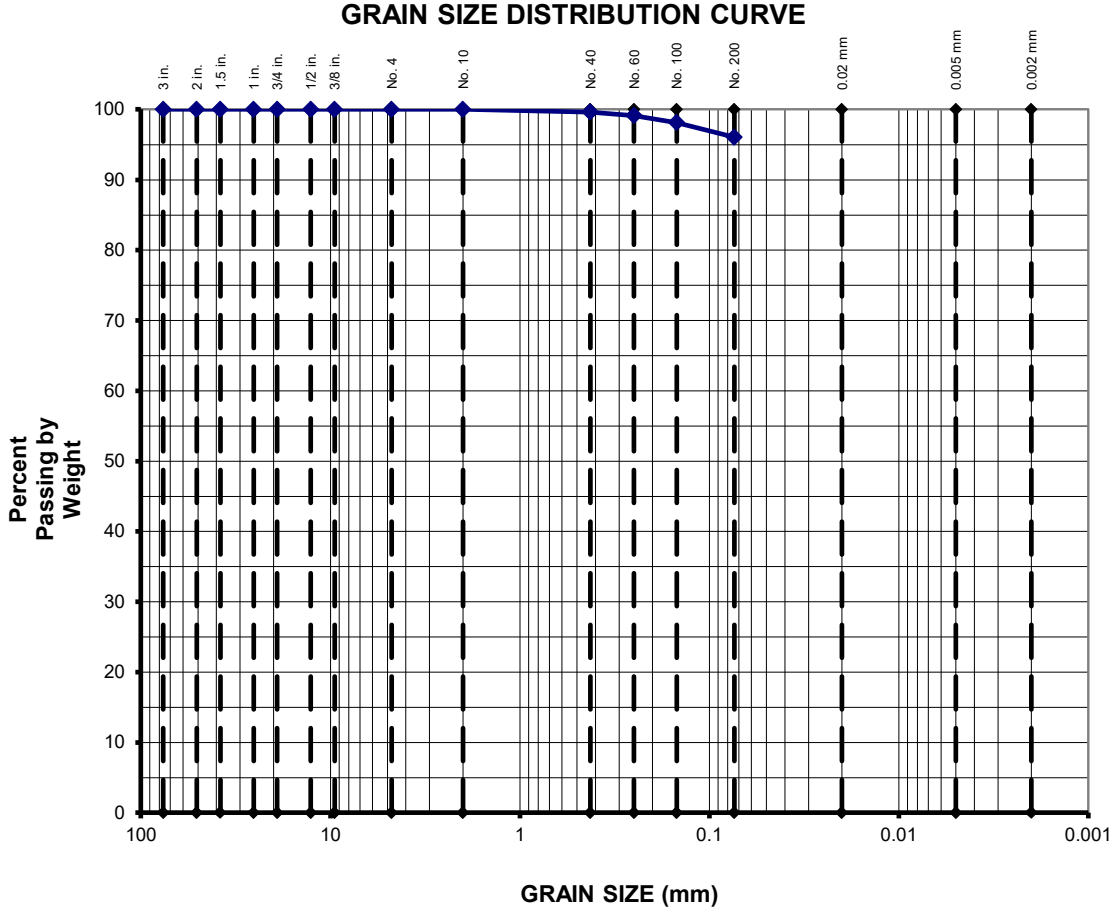
9/13/2024

Classification Testing Results

USCS & AASHTO

By: JDP Ckd: BBB

GRAIN SIZE DISTRIBUTION CURVE



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0%		4.0%			96.0%	
0.0%	0.0%	0.0%	0.4%	3.6%	-	-

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY
0.0%			4.0%		96.0%	
0.0%	0.0%	0.0%	0.4%	3.6%	-	-

Project:	PAANG SOF MC-130J	**Soil Type:**	SILT
Boring No.:	GF-2		
Station:	-	**USCS Classification:**	ML
Offset:	-	**AASHTO Classification:**	A-7-6 (16)
Sample No.:	S-4	LL = 42 %	PL = 28 %
Depth:	6.0-8.0 ft	PI = 14 %	w = 35.1%
Spec. Grav.:	2.7 (assumed)		

NAVARRO & WRIGHT CONSULTING ENGINEERS, INC.

AASHTO R18

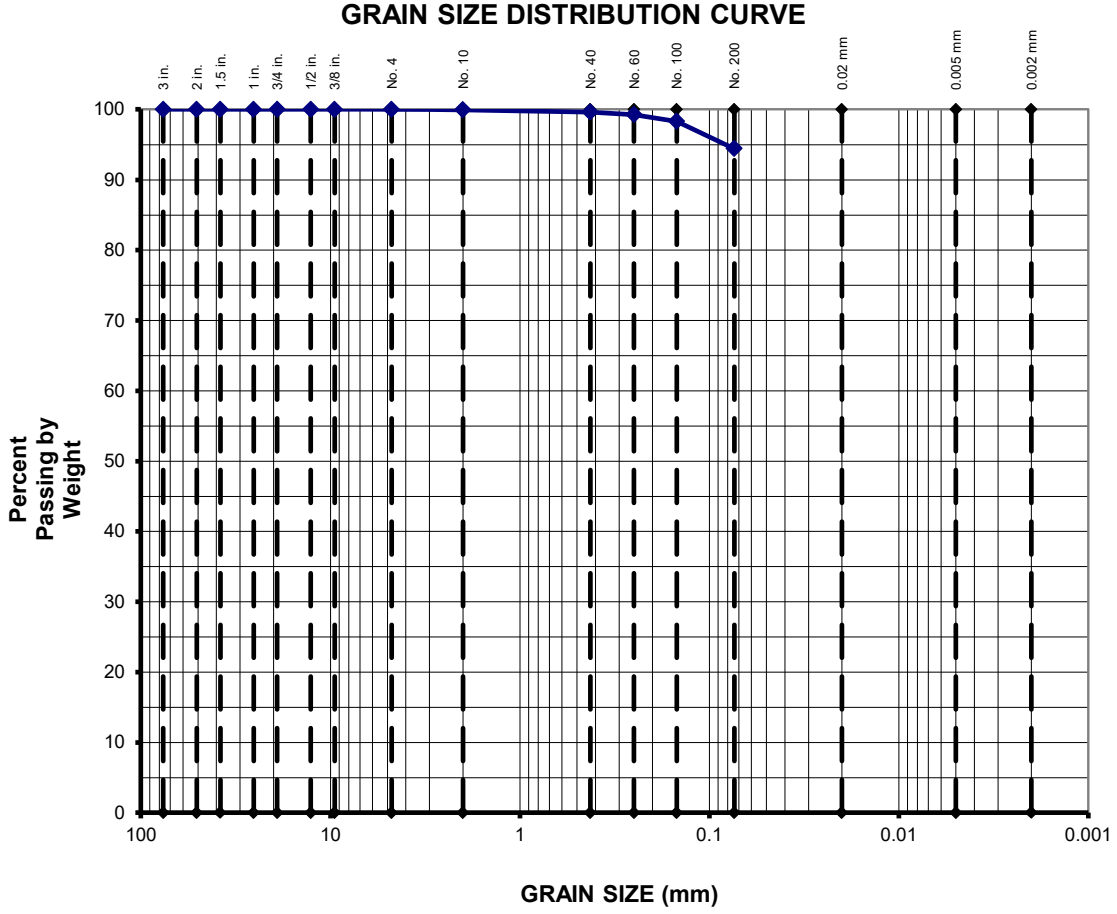
9/13/2024

Classification Testing Results

USCS & AASHTO

By: JDP Ckd: BBB

GRAIN SIZE DISTRIBUTION CURVE



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0%		5.6%			94.4%	
0.0%	0.0%	0.1%	0.3%	5.2%	-	-

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY
0.1%			5.5%		94.4%	
0.0%	0.0%	0.1%	0.3%	5.2%	-	-

Project:	PAANG SOF MC-130J	**Soil Type:**	SILT
Boring No.:	GF-2		
Station:	-	**USCS Classification:**	ML
Offset:	-	**AASHTO Classification:**	A-4 (5)
Sample No.:	S-5 to S-6	LL = 29 %	PL = 23 %
Depth:	8.0-12.0 ft	PI = 6 %	w = 23.3%
Spec. Grav.:	2.7 (assumed)		

NAVARRO & WRIGHT CONSULTING ENGINEERS, INC.

AASHTO R18

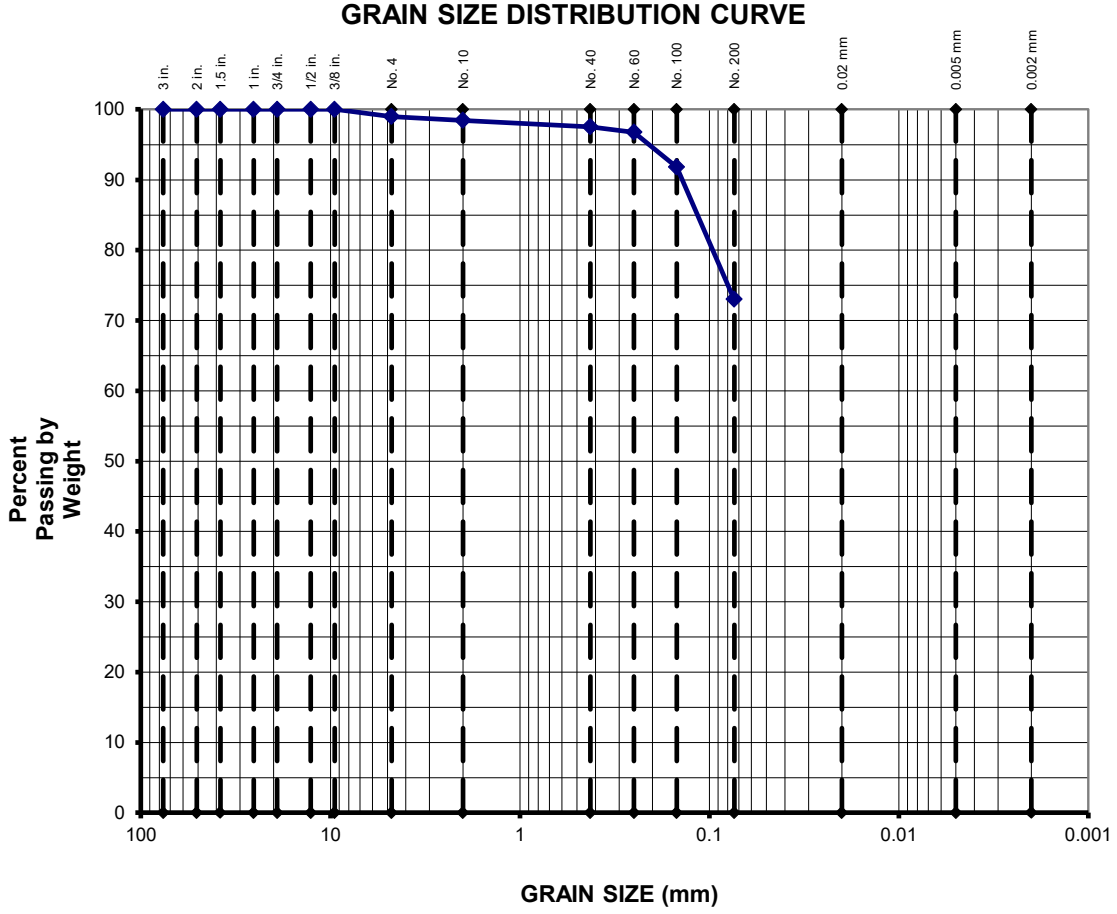
9/13/2024

Classification Testing Results

USCS & AASHTO

By: JDP Ckd: BBB

GRAIN SIZE DISTRIBUTION CURVE



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
1.0%		26.0%			73.0%	
0.0%	1.0%	0.5%	0.9%	24.5%	-	-

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY
1.5%			25.4%		73.0%	
0.0%	0.0%	1.5%	0.9%	24.5%	-	-

Project:	PAANG SOF MC-130J	**Soil Type:**	SILT with sand
Boring No.:	GF-3		
Station:	-	**USCS Classification:**	ML
Offset:	-	**AASHTO Classification:**	A-4 (0)
Sample No.:	S-3	LL = 22 %	PL = 20 %
Depth:	4.0-6.0 ft	PI = 2 %	w = 17.1%
Spec. Grav.:	2.7 (assumed)		

NAVARRO & WRIGHT CONSULTING ENGINEERS, INC.

AASHTO R18

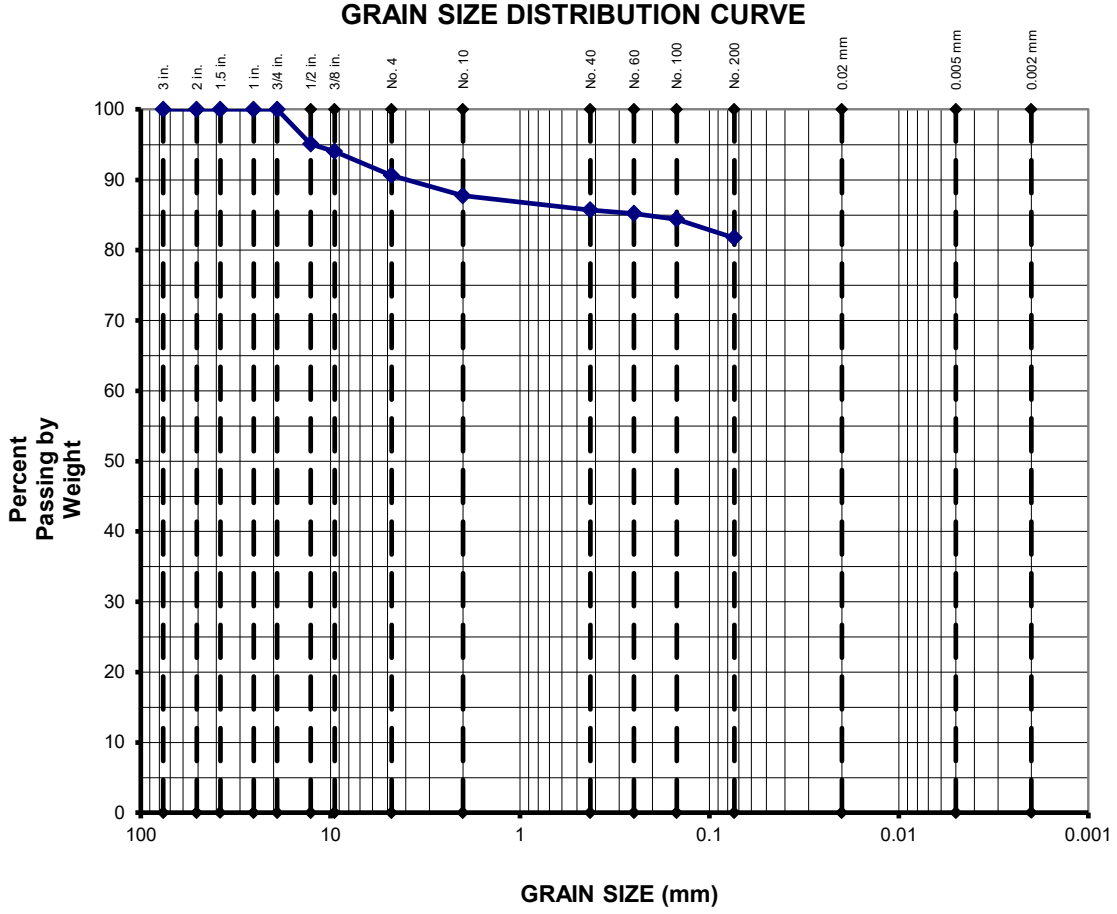
9/13/2024

Classification Testing Results

USCS & AASHTO

By: JDP Ckd: BBB

GRAIN SIZE DISTRIBUTION CURVE



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
9.4%		8.9%			81.7%	
0.0%	9.4%	2.9%	2.0%	4.0%	-	-

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY
12.3%			6.0%		81.7%	
0.0%	5.9%	6.3%	2.0%	4.0%	-	-

Project:	PAANG SOF MC-130J	**Soil Type:**	lean CLAY with gravel
Boring No.:	GF-4		
Station:	-	**USCS Classification:**	CL
Offset:	-	**AASHTO Classification:**	A-4 (5)
Sample No.:	S-4 to S-5	LL = 29 %	PL = 21 %
Depth:	6.0-10.0 ft	PI = 8 %	w = 22.7%
Spec. Grav.:	2.7 (assumed)		

NAVARRO & WRIGHT CONSULTING ENGINEERS, INC.

AASHTO R18

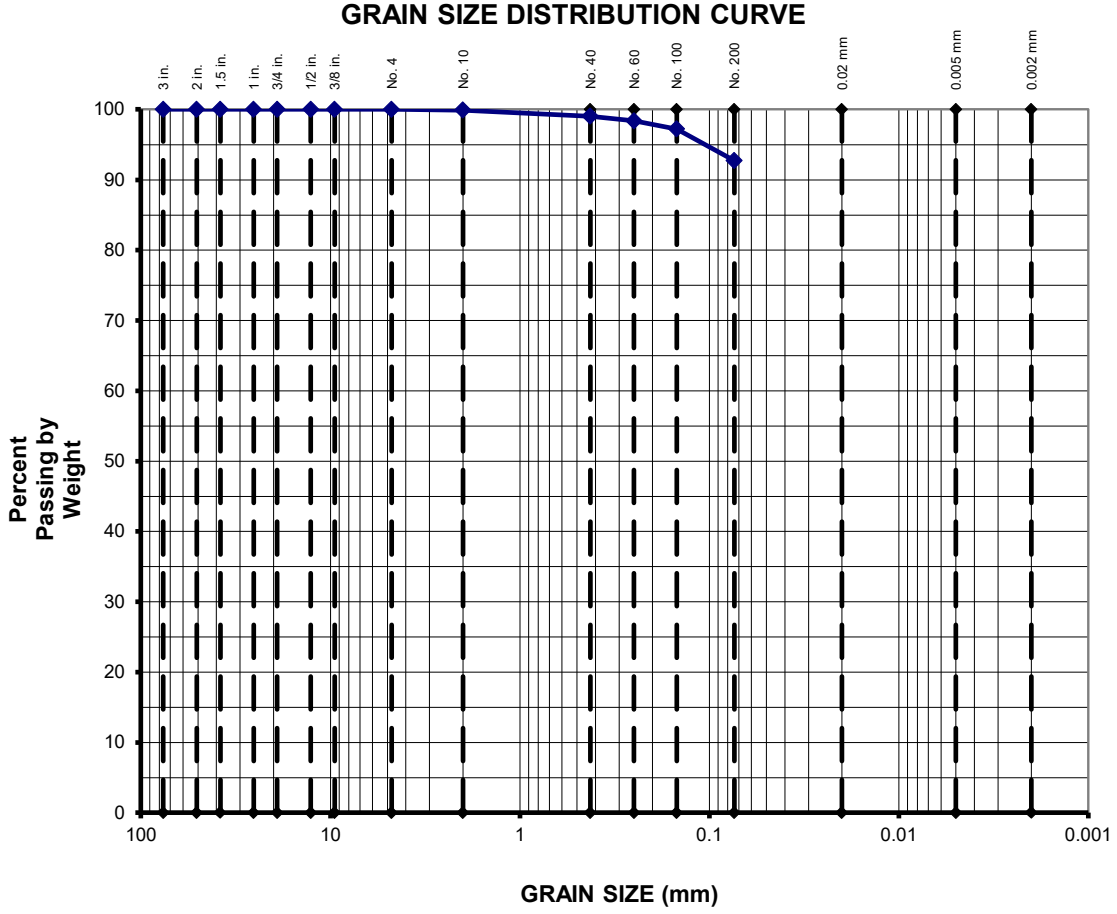
9/13/2024

Classification Testing Results

USCS & AASHTO

By: JDP Ckd: BBB

GRAIN SIZE DISTRIBUTION CURVE



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0%		7.3%			92.7%	
0.0%	0.0%	0.1%	0.8%	6.3%	-	-

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY
0.1%			7.2%		92.7%	
0.0%	0.0%	0.1%	0.8%	6.3%	-	-

Project:	PAANG SOF MC-130J	**Soil Type:**	silty CLAY
Boring No.:	GF-5		
Station:	-	**USCS Classification:**	CL-ML
Offset:	-	**AASHTO Classification:**	A-4 (6)
Sample No.:	S-2	LL = 29 %	PL = 22 %
Depth:	2.0-4.0 ft	PI = 7 %	w = 22.6%
Spec. Grav.:	2.7 (assumed)		

NAVARRO & WRIGHT CONSULTING ENGINEERS, INC.

AASHTO R18

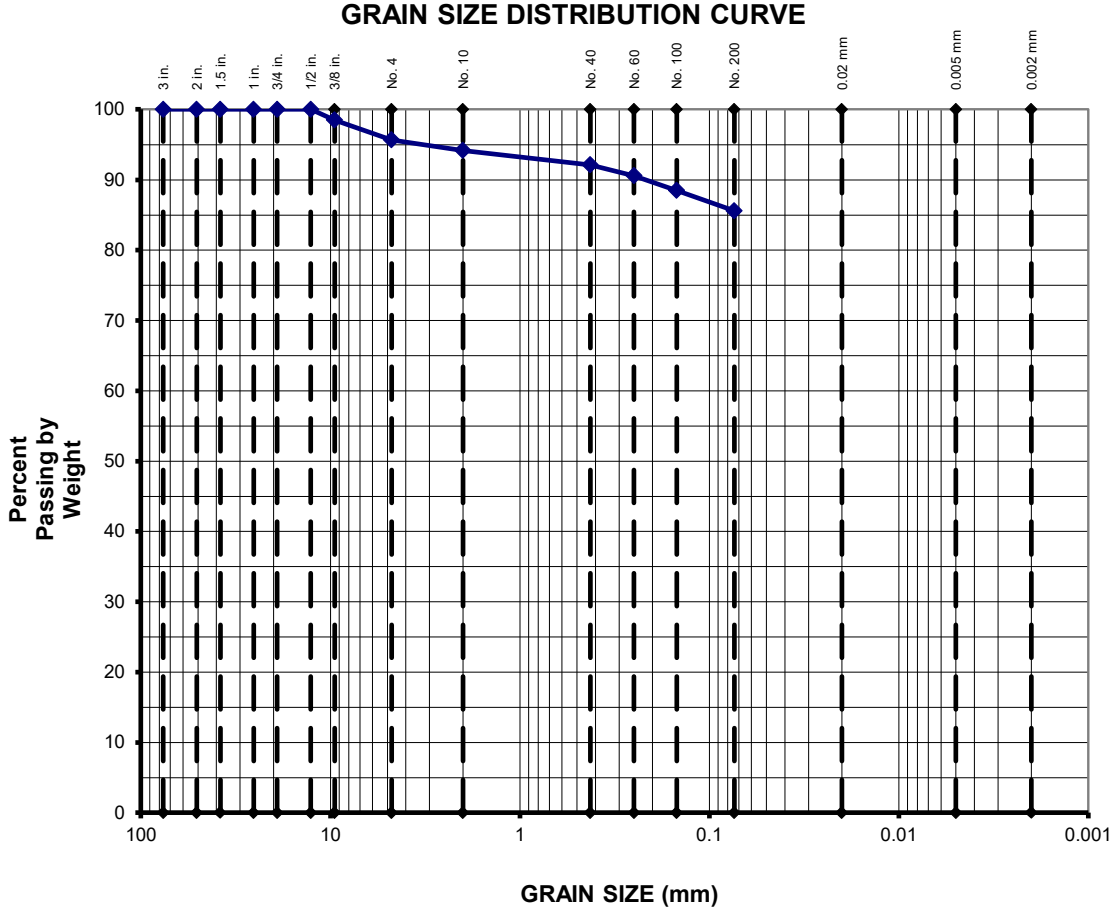
9/13/2024

Classification Testing Results

USCS & AASHTO

By: JDP Ckd: BBB

GRAIN SIZE DISTRIBUTION CURVE



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
4.3%		10.1%			85.6%	
0.0%	4.3%	1.5%	2.0%	6.5%	-	-

GRAVEL			SAND		FINES	
COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY
5.8%			8.6%		85.6%	
0.0%	1.5%	4.3%	2.0%	6.5%	-	-

Project:	PAANG SOF MC-130J	**Soil Type:**	SILT
Boring No.:	GF-5		
Station:	-	**USCS Classification:**	ML
Offset:	-	**AASHTO Classification:**	A-7-6 (13)
Sample No.:	S-3 to S-4	LL = 41 %	PL = 27 %
Depth:	4.0-8.0 ft	PI = 14 %	w = 33.5%
Spec. Grav.:	2.7 (assumed)		

NAVARRO & WRIGHT CONSULTING ENGINEERS, INC.

AASHTO R18

9/13/2024

Classification Testing Results

USCS & AASHTO

By: JDP Ckd: BBB

Boring No.	Sample No.	Sample Depth (ft)	pH (H_2O)	pH ($CaCl_2$)	Chloride Content in Soil (mg/kg)	Sulfate Content in Soil (mg/kg)	Chloride Content in Water (mg/L)	Sulfate Content in Water (mg/L)	Minimum Resistivity (kohms x cm)	Soil Resistivity (kohmxcm)
GF-4	S-4 to S-5	6.0-10.0	8.6	-	40	1	-	-	2.231	-

Project: PAANG SOF Construct Simulator Facility MC-130J
Project #: 76046
Test Date: 9/12/2024
Tested By: JDP
Checked By: BBB

NAVARRO & WRIGHT CONSULTING ENGINEERS, INC.

AASHTO R18

CHEMICAL TESTING SUMMARY
pH - ASTM D 4972 / AASHTO T289
Minimum Resistivity AASHTO T288 / Soil Resistivity ASTM G187
Chloride - AASHTO T291 / ASTM D512, Sulfate - AASHTO T290 / ASTM D516