Addendum #1 to SJPC-22-51 (Barrier Wall): June 15, 2022

Please see attached revised Geotechnical Memo. This document replaces the file entitled "Geotechnical-Memo-Replacement-of-Balzano-Terminal-Security-Fence-2020-03-17-rev03.pdf."

REMINGTON & VERNICK ENGINEERS
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May 17, 2022

Chris Perks, PE; Director of Engineering
South Jersey Port Corporation
2 Aquarium Drive
Suite 100
Camden, NJ 08103

Re: Geotechnical Investigation Memorandum
Security Perimeter Barrier Wall – Balzano Marine Terminal
City of Camden, Camden County, New Jersey
RVA Ref. No. 3965-X-001

Gentlemen:

Remington & Vernick Engineers (RVE) has performed a geotechnical investigation for the referenced project. The purpose of the investigation was to determine subsurface conditions at the site of the proposed Security Perimeter Barrier Wall at the Balzano Marine Terminal and to make recommendations, from a soils engineering viewpoint, for the design and construction for the wall foundation system. All of the information obtained, together with our interpretation of the findings, is presented herein.

Sincerely,
REMINGTON & VERNICK ENGINEERS

K. Charles Westen, P.E.
NJ PE License No. 47013

REMINGTON & VERNICK ENGINEERS
51 Haddonfield Road - Suite 260
Cherry Hill, NJ 08002
Ph 856-795-9595

MEMORANDUM

To: Dustin Schopen, PE
William Bisirri, PE

From: K. Charles Westen, PE
Christopher Gilbert, PE

Subject: Geotechnical Investigation Report
Replacement of Security Perimeter Protection – Balzano Terminal
South Jersey Port Corporation
City of Camden, Camden County, New Jersey
RVE Ref. No. 3965-X-001

Date: 03/17/2021

cc:

Introduction

Remington & Vernick Engineers (RVE) has been retained by the South Jersey Port Corporation to carry out a geotechnical investigation for the replacement of a portion of the existing security barrier at the Balzano Marine Terminal in Camden, NJ. The project area in question is the section of existing security fencing and barriers located approximately midway between Spruce Street and Joseph A. Balzano Boulevard, extending west approximately 270 feet, then turning south and extending parallel to Front Street approximately 545 feet and finally turning west and extending approximately 400 feet along the extension of Spruce Street. The existing fence and barrier currently divide the port facility from the Camden Iron and Metal's steel scrap yard and consists of both chain link fence sections and barriers consisting of empty shipping containers. It is our understanding that the new security barrier will consist of a rigid wall structure using a soldier pile and reinforced concrete panel system. The purpose of the investigation was to determine the subsurface conditions at the site of the proposed replacement barrier and to provide recommendations for the design and construction of new foundations. All of the information obtained, together with our interpretation of the findings, is presented herein.

Fieldwork & Subsurface Conditions

The field work for the test boring investigation was conducted on December 7, 2020 and consisted of six geotechnical test borings, drilled to a depth of 20 feet below existing grade. The test borings were performed by Sano Drilling, Inc. utilizing a truck mounted drill rig and utilizing the drilled in casing (hollow stem augers) method of drilling at locations selected by RVE. All drilling and soil sampling operations were supervised by RVE and the field logging of the soil samples was performed by a representative of RVE. Soil samples were recovered via a two-inch O.D. split-spoon sampler; driven by a hydraulically activated 140-pound hammer, free falling 30 inches (ASTM D 1586). The number of hammer blows required to advance the 24-inch spoon in 6-inch increments (four increments in all) were recorded. The number of blows required to penetrate the middle two increments (6 to 18 inches) is known as the Standard Penetration Resistance (N). Soil samples were obtained continuously in the upper 10 feet and at 5 feet intervals thereafter. The recovered soil samples were visually classified in the field using the Burmister and Unified Soil Classification Systems and the results of the visual analyses were utilized to prepare the attached Test Boring Log. The location of the test boring is shown on the attached boring location plan.

In all borings, with exception of boring B-1, a layer of cobblestones and deleterious fill was encountered beneath a 4 to 6 inch layer of asphalt and crushed stone subbase, and was observed down to depths ranging from 2 to 4 feet below existing grade. Underlaying this layer, and beneath a 6-inch layer of asphalt in boring B-1, granular fill soils were encountered in all borings down to a depths of 2 to 18 feet below existing grade. These fill soils consist of brown to dark brown coarse to fine sand with some to no brick fragments, little to trace silt and little to no medium to fine crushed stone. In boring B-6, wood fragments, cinders and ash were also encountered in the soil matrix. Underlaying the fill layer, natural cohesive and granular soils of marine origin were encountered in all borings down to the termination depth of 20 feet below existing grade. In borings B-1, B-2 and B-4, layers of organic silt were encountered within this stratum. The natural granular soils in this stratum can be described as brown and gray coarse to fine sand with trace to little silt and clay. The natural cohesive soils in this stratum can be described as organic and non-organic clayey silt and silt with little fine sand. In general, this layer of marine deposits are considered to become more granular with depth, becoming predominately sand at a depth of 18 feet below existing grade.

The relative density of the fill soils ranges from loose to compact, with SPT $N1_{60}$ values ranging from 5 to 28 blows per foot (bpf). The relative consistency of the natural cohesive marine soils varies from soft to stiff, with SPT $N1_{60}$ values ranging from 3 to 13 bpf. The relative density the natural granular marine soils varies from loose to compact, with a normalized SPT $N1_{60}$-value of from 4 to 21 blows per foot.

Groundwater was encountered at a depth approximately 6 to 10 feet below existing grade in all borings at the time of drilling, with the exception of boring B-5, in which no groundwater was observed. It should be noted that smearing and sealing of sides of the borehole by the rotating augers can occur when drilling through silty clayey soils and an accurate groundwater level reading may not be obtainable at the end of drilling. In order to more accurately determine the natural groundwater level, extended water level readings from a water observation pipe should be performed; however this is beyond the scope of this investigation. Groundwater levels generally can fluctuate due to changes in precipitation, infiltration and surface run-off, tidal influences or other hydrogeological factors. Therefore, the groundwater level present at the time of construction may vary from that observed at the time of the drilling operations. Shallow perched groundwater may be encountered during construction, especially if work commences after a wet weather period.

Recommendations

Based on the results of the field investigation, we have performed evaluations of the existing subsurface soil conditions to determine their engineering properties. The subsurface investigation indicated the site soils consist of granular fill underlain by cohesive and granular deposits. Due to the sensitive nature of these cohesive soils, and the lateral forces the rigid security barrier will need to support, it is our recommendation that the proposed rigid security barrier be supported on a drilled pier type foundation system. Additionally, we have made the following recommendations.

Excavation & Backfill

Based on information from the test boring investigation, relatively shallow excavations to a depth of 2 to 4 feet may be required to remove obstructions for foundation construction. Open excavations are feasible provided there is enough room so that the stability of any adjacent existing structures is not affected. Existing structures may be considered not affected by the open cut excavation if a line projected downward from the bottom edge of the existing footings at a slope of 1.5H:1V does not intersect the excavation slope. Temporary side slopes of open cut excavations should not be steeper than 2H:1V. All excavations should be in compliance with “Excavating and Trenching Operations” manual (latest revision), issued by the US Department of Labor, OSHA 2226 and local requirements.

Imported fill for backfilling of excavations should consist of uncontaminated, relatively well-graded granular soils containing no more than 15% by weight passing the No. 200 sieve and having a maximum particle size of 3 inches. The moisture content of the fill materials should be controlled to within 2% of the optimum moisture content, as determined by the Modified Proctor Test, ASTM D 1557

The backfill should be placed in 8-inch lifts and compacted to at least 90% of the maximum dry density as determined by the Modified Proctor Test, ASTM D 1557. Compaction of the backfill should be carried out with relatively light equipment such as a jumping jack, a walk behind roller, or similar device as approved by the on-site representative of the Geotechnical Engineer.

Drilled Piers

The existing fill and soft cohesive soils are not suitable for direct support of the proposed security barrier on a shallow foundation system. Therefore, based on the results of the field investigation and our engineering analyses, straight shaft drilled piers will be the most suitable foundation system for the proposed security barrier.

The drilled piers should be straight shaft reinforced concrete piers having a minimum diameter of 3 feet (36 inches) with a minimum tip elevation of 20 feet below existing grade. For drilled piers founded at 20 feet deep, an allowable vertical bearing capacity of 3,500 pounds per square foot (psf) can be used in the design. Additionally, we have analyzed the lateral capacity of the 3 foot diameter drilled pier with a minimum embedment depth of 20 feet deep and a maximum spacing of the drilled piers of 20 feet. Based on this lateral analysis the specified drilled pier is capable of resisting a maximum shear load of 20 kips and a maximum overturning moment of 90 kip-feet at the top of the pier with an estimated maximum deflection of 0.98 inches.

Concrete fill for the drilled shafts should have a minimum compressive strength at 28 days of 3000 psi. The concrete should be of a sulfate-resistant type. Concrete placement should follow standard and appropriate concrete work practices.

Problems with groundwater seeping into the drilled shaft excavation are anticipated due to the high groundwater level encountered during drilling. Therefore, the use of a temporary steel liner or casing and drilling “mud” or slurry to maintain stability of the sidewalls and bottom of the hole during the drilling operation is recommended. As previously mentioned, during the time of drilling, groundwater was encountered at 6 ft below existing grade. It will not be practical to dewater the cased drilled shaft for placing the concrete under dry conditions. Therefore, it will be necessary to place the concrete from the bottom up by tremie methods. An experienced contractor must do all foundation installation and the work should be performed under the full-time inspection of a representative of the Geotechnical Engineer.

Seismic Zone

According to the New Jersey Edition of the 2018 International Building Code, Section 1613.2.2 referencing ASCE 7, Chapter 20 the project site is categorized as a Site Class “E” for seismic design purposes. This classification is based on subsoil conditions encountered in the borings. In general, the density of the soil below the test borings should increase with depth, based on experience.

LIMITATIONS

The conclusions and recommendations contained in this report are based upon the subsurface data obtained during this investigation and on details stated in this report. It is understood that the number of borings made are consistent with good engineering practice, but actual conditions encountered may differ significantly from those projected in this report. Should conditions arise which differ from those described in this report, RVE should be notified immediately and provided with all information regarding differing subsurface conditions.

Our recommendations are based upon the assumption that the services of a qualified Geotechnical Engineer will be retained during construction for the observation of all critical earthwork operations and foundation installation. RVE cannot minimize, or provide recommended solutions for, any problems resulting from construction or differing soil conditions unless our services include full-time construction inspection to determine that the work performed is in compliance with RVE's recommendations, and to ensure the work is carried out in the owner's best interests.

Environmental considerations and contaminants, such as petroleum products, hazardous waste, radioactivity, irritants, pollutants, radon or other dangerous substances and conditions were not the subject of this study. Their presence and/or absence are not implied, inferred or suggested by this report or results of this study.

This report is intended for use with regard to the specific project discussed herein, and any changes in the design of the structure or location, however slight, should be brought to our attention so that we may determine how they may affect our conclusions. We are responsible for the conclusions and opinions contained in this report based on the data relating only to the specific project and location discussed herein.


Test Boring Locations
Security Fence - Balzano Marine Terminal, Camden
Legend
B-6
B-5
B-4
B-3
B-2
B-1
S Front St
B-1
Denotes Boring number and approximate location
Note: Borings B-5 & B-6 were relocated away from the proposed location of the security fence due to obstructions from materials stockpiled at the proposed boring locations
N
400 ft
Google Earth
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SOIL BORING LOG

Project No. 3965X001 **Project** New Security Fence **Boring No.** B-1

Date Started: 12/7/20 **Location** Balzano Marine Terminal, City of Camden, NJ **Sheet** 1 **of** 1

Date Finished: 12/7/20 **Client** South Jersey Port Corporation **Surface Elev.** Ex. Grade

Drilling Contractor: Sano Drilling Inc. **Groundwater Data**

Drilling Method: Hollow-Stem Augers **Depth** 6 ft

Hammer Type: Automatic **Driller:** Nick Parisano **Date** 12/7/20

Equipment: Mobile B-57 Truck Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0						6" Asphalt Pavement & Stone Subbase			
		S-1	16-12-18	12"		Dark brown c-f SAND, some Asphalt Fragments, trace Silt (Fill)			
		S-2	8-7-7-6	12"		Dark brown m-f SAND, some Silt, little Clay			
5		S-3	6-7-4-2	20"		Gray m-f SAND, trace Silt			
		S-4	2-1-1-1	NR		Dark gray CLAYEY SILT, little f Sand			
		S-5	2-1-1-1	20"					
10									
		S-6	1-2-2-1	20"		Dark gray ORGANIC SILT, little f Sand, little Clay			
15									
		S-7	6-5-3-3	20"		Light gray m-f SAND, little Silt			
20						Boring End at 20 Feet boring end			
25									
30									
35									

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SOIL BORING LOG

Project No. 3965X001 **Project** New Security Fence **Boring No.** B-2

Date Started: 12/7/20 **Location** Balzano Marine Terminal, City of Camden, NJ **Sheet** 1 **of** 1

Date Finished: 12/7/20 **Client** South Jersey Port Corporation **Surface Elev.** Ex. Grade

Drilling Contractor: Sano Drilling Inc. **Groundwater Data**

Drilling Method: Hollow-Stem Augers **Depth** 10 ft

Hammer Type: Automatic **Driller:** Nick Parisano **Date** 12/7/20

Equipment: Mobile B-57 Truck Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0–4			AUGER			Cobblestones and deleterious fill, metal fragments			
4–6		S-1	22-11-7-7	20"		Brown m-f SAND, some Brick Fragments, trace Silt (Fill) Dark gray ORGANIC SILT, little f Sand, trace Clay			
6–8		S-2	10-8-9-7	20"		Dark gray ORGANIC CLAYEY SILT, little f Sand			
8–10		S-3	6-4-5-2	20"		Dark gray CLAYEY SILT, little f Sand			
13–15		S-4	2-2-1-2	20"		Gray SILT, little Clay, little f Sand			
18–20		S-5	2-2-4-6	6"		Light gray m-f SAND, little Silt			
20						Boring End at 20 Feet boring end			

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SOIL BORING LOG

Project No. 3965X001 **Project** New Security Fence **Boring No.** B-3

Date Started: 12/7/20 **Location** Balzano Marine Terminal, City of Camden, NJ **Sheet** 1 **of** 1

Date Finished: 12/7/20 **Client** South Jersey Port Corporation **Surface Elev.** Ex. Grade

Drilling Contractor: Sano Drilling Inc. **Groundwater Data**

Drilling Method: Hollow-Stem Augers **Depth** 9 ft

Hammer Type: Automatic **Driller:** Nick Parisano **Date** 12/7/20

Equipment: Mobile B-57 Truck Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0			AUGER			Cobblestones and deleterious fill, metal fragments			
5		S-1	4-6-4-3	10"		Dark brown m-f SAND, little Silt, little Brick Fragments (Fill)			
		S-2	9-6-5-3	NR					
		S-3	3-2-2-2	6"		Brown m-f SAND, little Silt			
10									
		S-4	2-2-2-1	16"		Gray CLAYEY SILT, little f Sand			
15									
		S-5	2-3-3-5	16"		Gray f SAND, little Silt, trace Clay			
20						Boring End at 20 Feet boring end			
25									
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 3965X001 **Project** New Security Fence **Boring No.** B-4

Date Started: 12/7/20 **Location** Balzano Marine Terminal, City of Camden, NJ **Sheet** 1 **of** 1

Date Finished: 12/7/20 **Client** South Jersey Port Corporation **Surface Elev.** Ex. Grade

Drilling Contractor: Sano Drilling Inc. **Groundwater Data**

Drilling Method: Hollow-Stem Augers **Depth** 6 ft

Hammer Type: Automatic **Driller:** Nick Parisano **Date** 12/7/20

Equipment: Mobile B-57 Truck Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0			AUGER			4" Asphalt over Cobbles and Deleterious Fill			
		S-1	13-13-5-7	18"		Dark brown m-f SAND, some Brick Fragments, trace Silt (Fill)			
5		S-2	6-7-5-3	20"		Brown ORGANIC SILT, little Clay, little f Sand			
		S-3	3-2-4-3	10"		Dark gray c-f SAND, little Silt, little f Gravel, trace Clay			
10		S-4	6-6-4-4	20"		Gray CLAYEY SILT, little f Sand			
15		S-5	1-2-2-2	NR					
		S-6	3-8-7-7	20"		Light gray CLAYEY SILT, little f Sand			
20						Light gray m-f SAND, trace Silt, trace Clay			
						Boring End at 20 Feet boring end			
25									
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 3965X001 **Project** New Security Fence **Boring No.** B-5

Date Started: 12/7/20 **Location** Balzano Marine Terminal, City of Camden, NJ **Sheet** 1 **of** 1

Date Finished: 12/7/20 **Client** South Jersey Port Corporation **Surface Elev.** Ex. Grade

Drilling Contractor: Sano Drilling Inc. **Groundwater Data**

Drilling Method: Hollow-Stem Augers **Depth** None

Hammer Type: Automatic **Driller:** Nick Parisano **Date** 12/7/20

Equipment: Mobile B-57 Truck Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0			AUGER			4" Asphalt over Cobbles and Deleterious Fill			
5		S-1	11-10-8-4	10"		Brown m-f SAND, little Brick Fragments, little m-f Crushed Stone, trace Silt (Fill)			
		S-2	5-5-4-3	6"		Brown f SAND, some Silt, trace Clay (Fill)			
		S-3	4-3-3-4	10"		Dark brown SILT, little f Sand, little Clay, trace Brick Fragments, trace f Crushed Stone (Fill)			
10									
		S-4	4-2-2-3	16"		Dark gray f SAND & SILT, little Clay			
15									
		S-5	5-7-6-15	20"		Gray f SAND, little Silt, trace Wood Fragments			
20						Boring End at 20 Feet boring end			
25									
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 3965X001 **Project** New Security Fence **Boring No.** B-6

Date Started: 12/7/20 **Location** Balzano Marine Terminal, City of Camden, NJ **Sheet** 1 **of** 1

Date Finished: 12/7/20 **Client** South Jersey Port Corporation **Surface Elev.** Ex. Grade

Drilling Contractor: Sano Drilling Inc. **Groundwater Data**

Drilling Method: Hollow-Stem Augers **Depth** 6 ft

Hammer Type: Automatic **Driller:** Nick Parisano **Date** 12/7/20

Equipment: Mobile B-57 Truck Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0			AUGER			4" Asphalt over Cobbles and Deleterious Fill			
5		S-1	2-2-2-3	16"		Dark brown m-f SAND, little Silt, trace Clay, trace f Crushed Stone (Fill)			
		S-2	4-8-7-16	10"		Dark brown c-f SAND, some Wood Fragments, little Cinders and Ash, little Silt, trace Clay (Fill)			
		S-3	8-13-8-4	12"		Dark brown c-f SAND, little Silt, little Cinders and Ash (Possible Fill)			
10									
		S-4	2-1-1-1	12"		Dark brown c-f SAND, little Silt, little Cinders and Ash, little Clay (Possible Fill)			
15									
		S-5	2-1-2-2	16"		Gray m-f SAND, little Silt, trace Clay			
20						Boring End at 20 Feet boring end			
25									
30									
35									

MODIFIED METHOD
FOR
IDENTIFICATION OF SOILS
AFTER
DR. D. M. BURMISTER

Soil Component	Descriptive Terms As Written on Log	Range of Proportions
PRINCIPAL COMPONENT (All Letters Capitalized)	-	35% or more
MINOR COMPONENTS (First Letter Capitalized)	and (a.)	35% to 50%
	some (s.)	20% to 35%
	little (l.)	10% to 20%
	trace (tr.)	1% to 10%

Coarse Grained Soils-Gradation of Components

Coarse to fine	cf	All sizes
Coarse to medium	cm	Less than 10% fine
Medium to fine	mf	Less than 10% coarse
Coarse	c	Less than 10% medium & fine
Medium	m	Less than 10% coarse & fine
Fine	f	Less than 10% coarse & medium

Component	Symbol	Sieve Range
Boulders		9” and larger
Cobbles		3” to 9”
Gravel	G	
Coarse		¾” to 3”
Fine		#4 to ¾”
Sand	S	
Coarse		#4 to #10
Medium		#10 to #40
Fine		#40 to #200

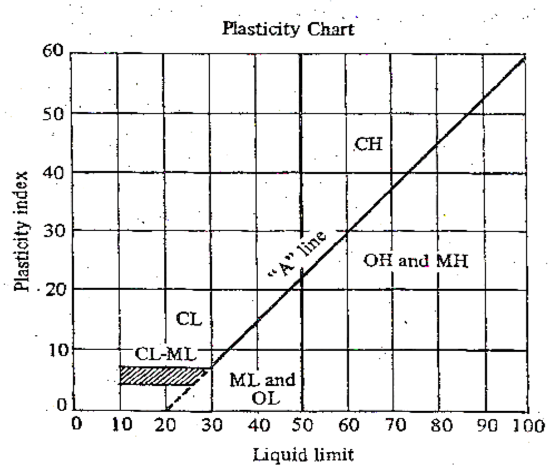
Fine Grained Soils-Plasticity of Components

Component	Symbol	Overall Plasticity	Plasticity Index
SILT	S	Non-Plastic	0
CLAYEY SILT	CyS	Slight	1 to 5
SILT & CLAY	S & C	Low	5 to 10
CLAY & SILT	C & S	Medium	10 to 20
SILTY CLAY	SyC	High	20 to 40
CLAY	C	Very High	. over 40

UNIFIED SOIL CLASSIFICATION SYSTEM. (ASTM D-2487)

Major Divisions			Group Symbols	Typical Names	Laboratory Classification Criteria	
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mix-tures, little or no fines	Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a] d / u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. Less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mix-tures	Atterberg limits below "A" line with P.I. Greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a] d / u	Silty sands, sand-silt mixtures	Atterberg limits above "A" line or P.I. Less than 4	Limits plotting in hatched zone with P.I. Between 4 and 7 are *borderline* cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line with P.I. Greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity, organic silts		
	Highly organic soils		Pt	Peat and other highly organic soils		

Coarse-grained soils criteria: Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:
Less than 5 per cent — GW, GP, SW, SP
More than 12 per cent — GM, GC, SM, SC
5 to 12 per cent — *Borderline* cases requiring dual symbols[b]



[a]Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. Is 6 or less; the suffix u used when L.L. is greater than 28.
[b]Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

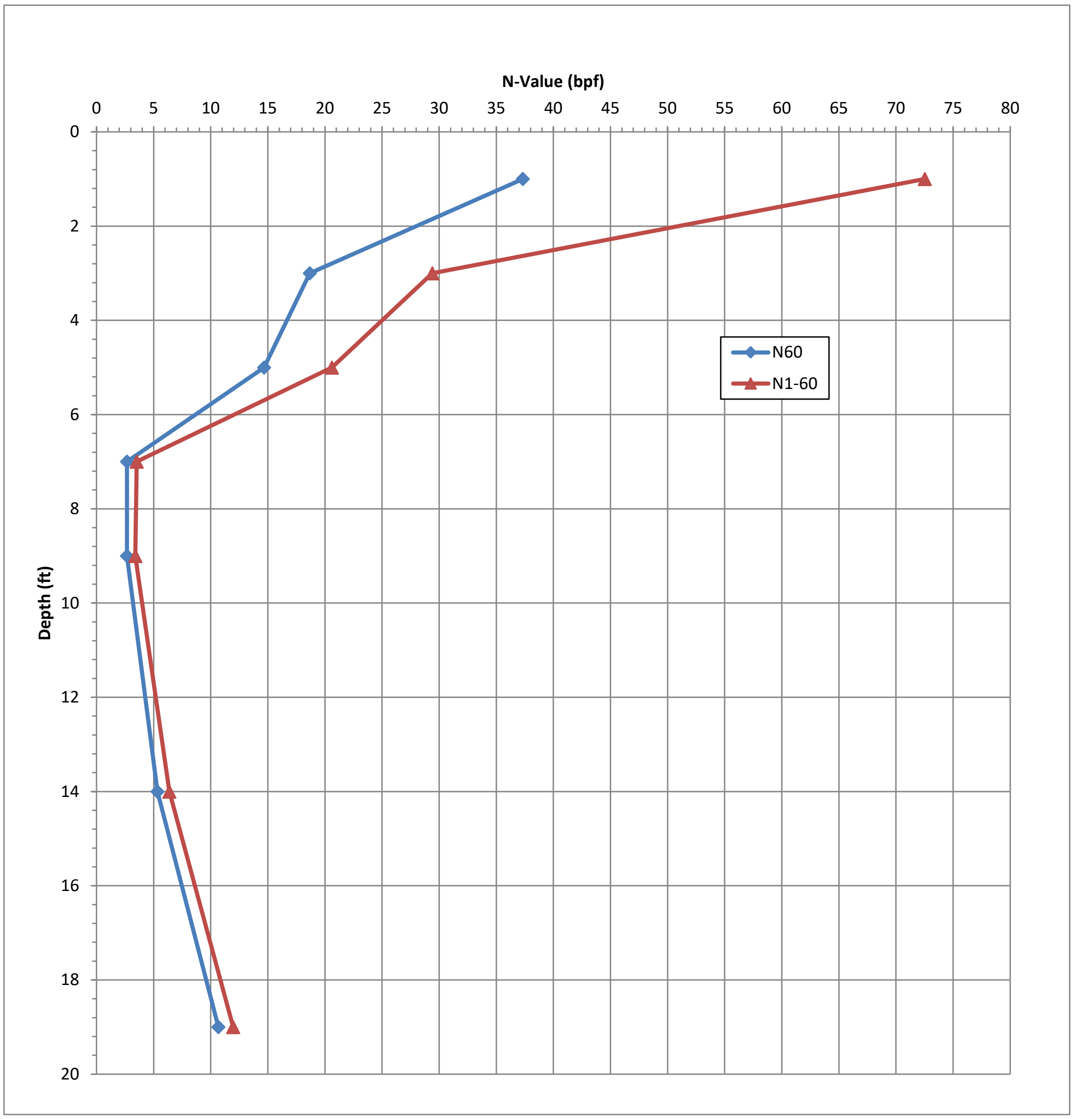
NORMALIZED N VALUES

Balzano Terminal Security Barrier
Camden, NJ

Boring No.	B-1
Elevation, ft	0
Groundwater Depth, ft	6
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6) σ' = σt - u CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf N160 = N60*CN

Sample Number	Sample Depth	N-value Recored			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	28	37	120	0.12	0.00	0.12	1.94	73
2	2 - 4	3	-3	14	19	120	0.36	0.00	0.36	1.58	29
3	4 - 6	5	-5	11	15	120	0.60	0.00	0.60	1.40	21
4	6 - 8	7	-7	2	3	120	0.84	0.06	0.78	1.32	4
5	8 - 10	9	-9	2	3	120	1.08	0.19	0.89	1.27	3
6	13 - 15	14	-14	4	5	110	1.63	0.51	1.12	1.20	6
7	18 - 20	19	-19	8	11	120	2.23	0.83	1.40	1.12	12



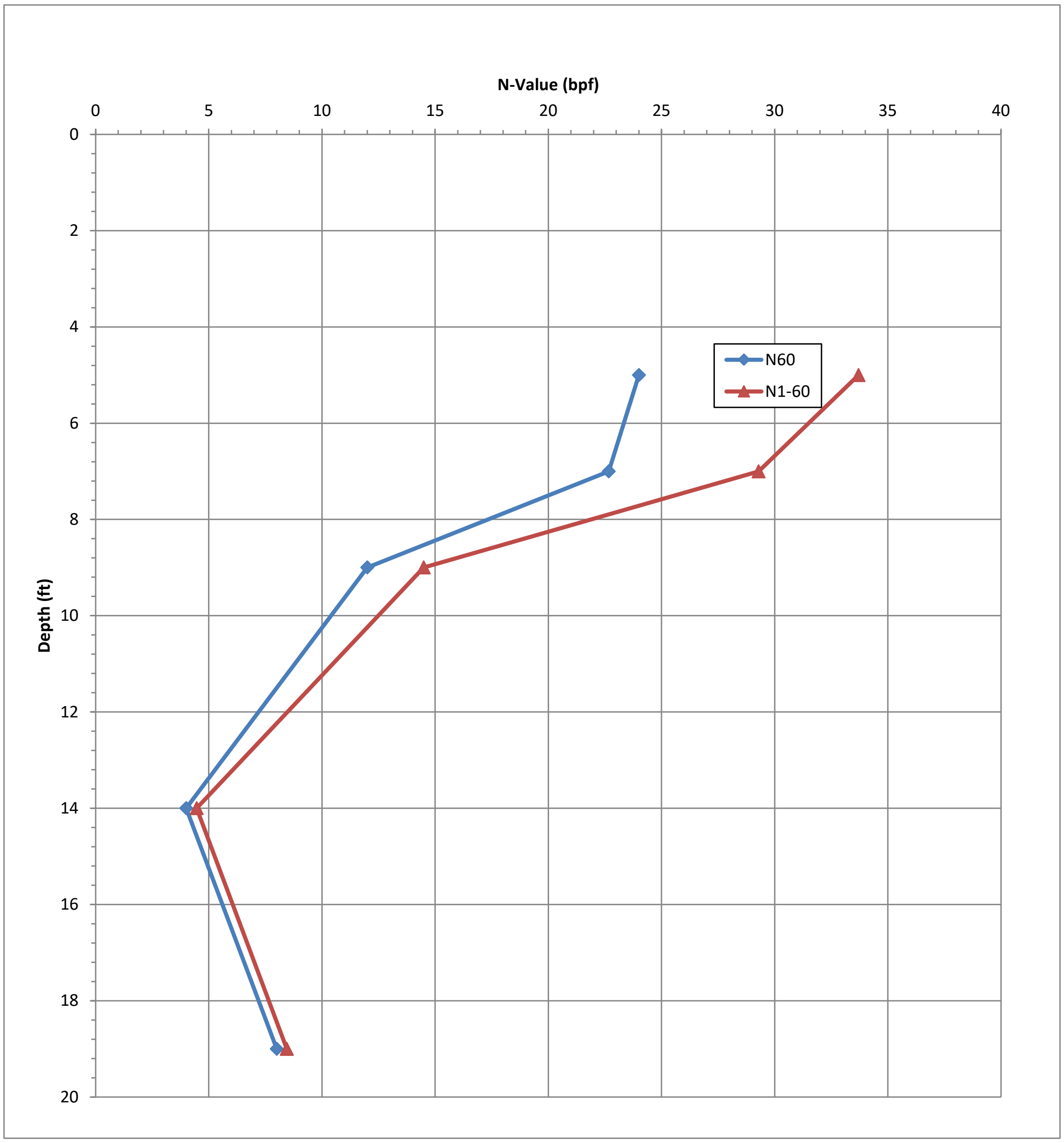
NORMALIZED N VALUES

Balzano Terminal Security Barrier
Camden, NJ

Boring No.	B-2
Elevation, ft	0
Groundwater Depth, ft	10
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)		
	σ' = σt - u		
	CN = .77log(40/σ')	CN < 2	Only valid for σ' ≥ 0.5 ksf
	N160 = N60*CN		

Sample Number	Sample Depth	N-value Recored			N_{60}	γ pcf	σt ksf	u ksf	σ' ksf	CN	N160
		Depth	Elev.	Value							
1	4 - 6	5	-5	18	24	120	0.60	0.00	0.60	1.40	34
2	6 - 8	7	-7	17	23	120	0.84	0.00	0.84	1.29	29
3	8 - 10	9	-9	9	12	120	1.08	0.00	1.08	1.21	14
4	13 - 15	14	-14	3	4	120	1.68	0.26	1.42	1.12	4
5	18 - 20	19	-19	6	8	120	2.28	0.58	1.70	1.06	8



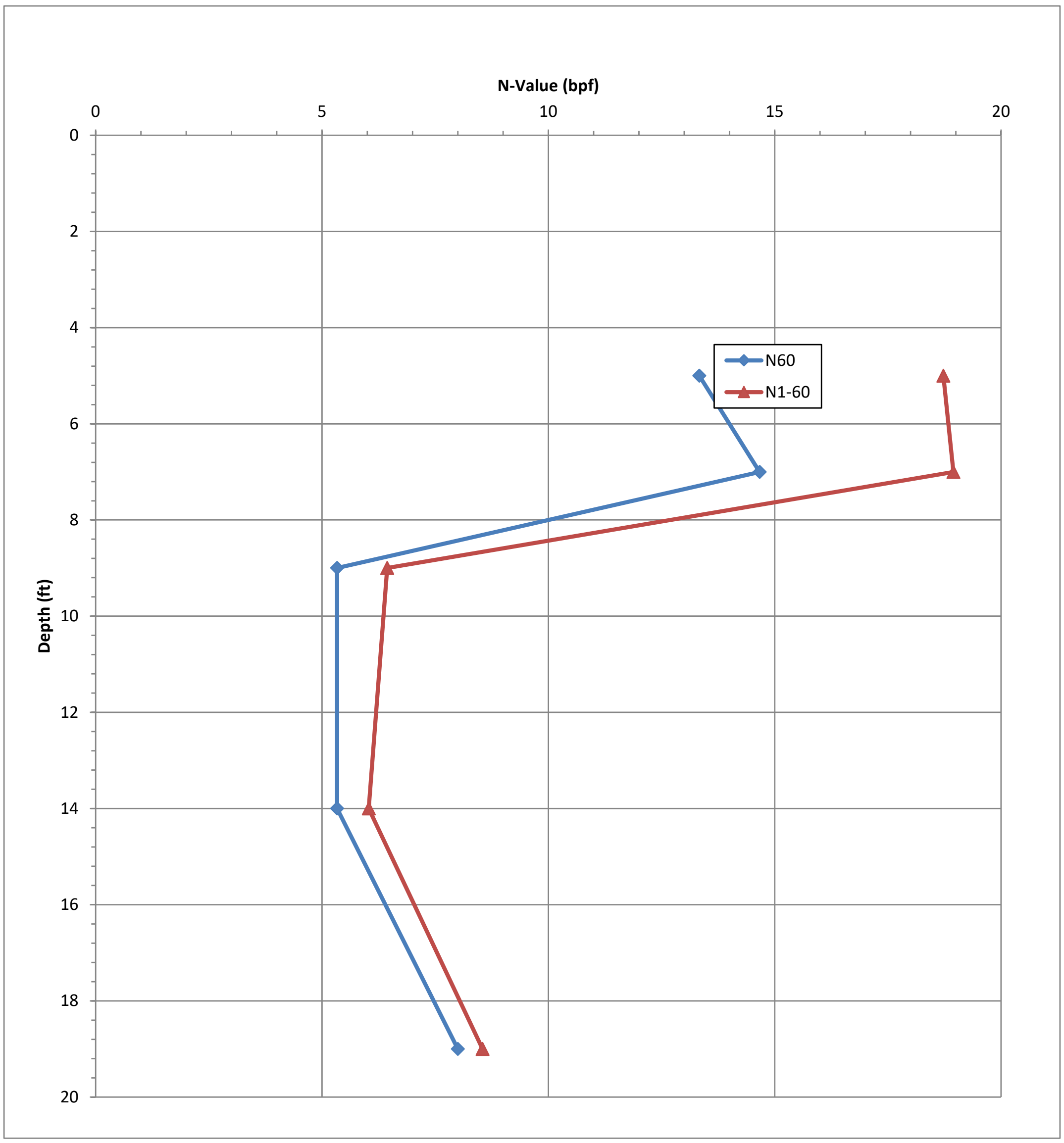
NORMALIZED N VALUES

Balzano Terminal Security Barrier
Camden, NJ

Boring No.	B-3
Elevation, ft	0
Groundwater Depth, ft	9
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)		
	σ' = σt - u		
	CN = .77log(40/σ')	CN < 2	Only valid for σ' ≥ 0.5 ksf
	N160 = N60*CN		

Sample Number	Sample Depth	N-value Recored			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	4 - 6	5	-5	10	13	120	0.60	0.00	0.60	1.40	19
2	6 - 8	7	-7	11	15	120	0.84	0.00	0.84	1.29	19
3	8 - 10	9	-9	4	5	120	1.08	0.00	1.08	1.21	6
4	13 - 15	14	-14	4	5	120	1.68	0.32	1.36	1.13	6
5	18 - 20	19	-19	6	8	120	2.28	0.64	1.64	1.07	9



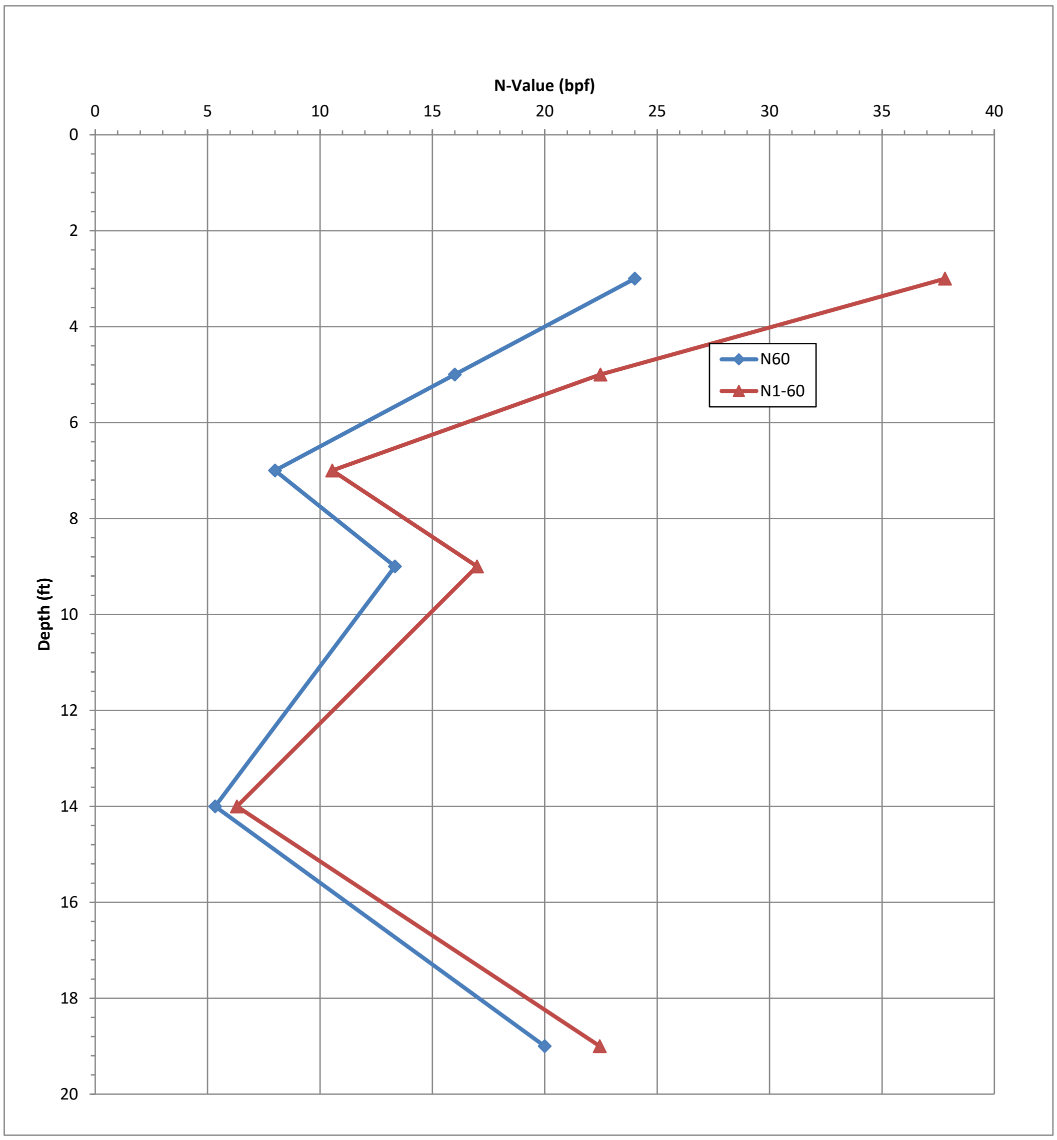
NORMALIZED N VALUES

Balzano Terminal Security Barrier
Camden, NJ

Boring No.	B-4
Elevation, ft	0
Groundwater Depth, ft	6
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6) σ' = σt - u CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf N160 = N60*CN

Sample Number	Sample Depth	N-value Recored			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	2 - 4	3	-3	18	24	120	0.36	0.00	0.36	1.58	38
2	4 - 6	5	-5	12	16	120	0.60	0.00	0.60	1.40	22
3	6 - 8	7	-7	6	8	120	0.84	0.06	0.78	1.32	11
4	8 - 10	9	-9	10	13	120	1.08	0.19	0.89	1.27	17
5	13 - 15	14	-14	4	5	120	1.68	0.51	1.17	1.18	6
6	18 - 20	19	-19	15	20	110	2.23	0.83	1.40	1.12	22



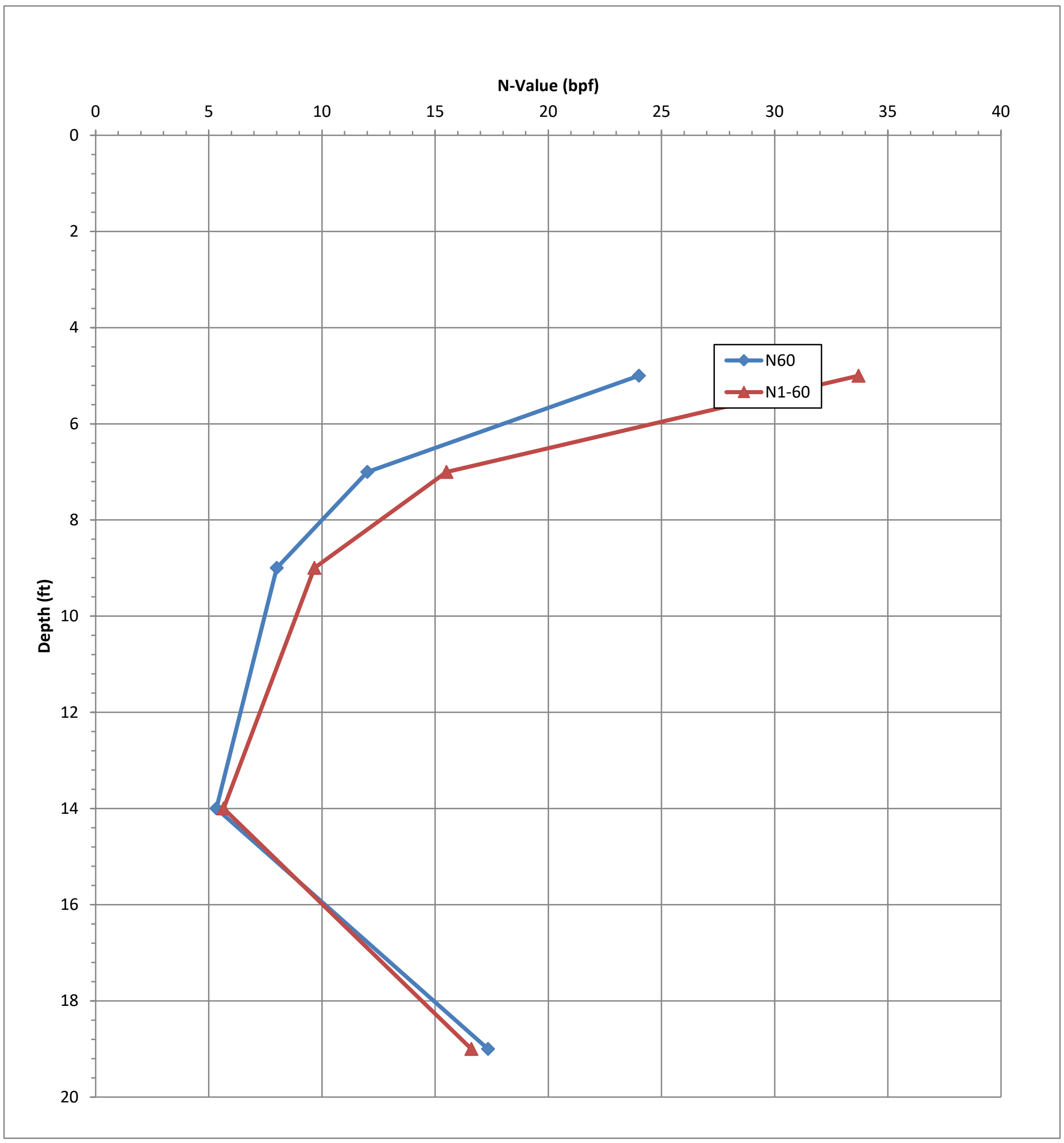
NORMALIZED N VALUES

Balzano Terminal Security Barrier
Camden, NJ

Boring No.	B-5
Elevation, ft	0
Groundwater Depth, ft	None
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)		
	σ' = σt - u		
	CN = .77log(40/σ')	CN < 2	Only valid for σ' ≥ 0.5 ksf
	N160 = N60*CN		

Sample Number	Sample Depth	N-value Recored			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	4 - 6	5	-5	18	24	120	0.60	0.00	0.60	1.40	34
2	6 - 8	7	-7	9	12	120	0.84	0.00	0.84	1.29	16
3	8 - 10	9	-9	6	8	120	1.08	0.00	1.08	1.21	10
4	13 - 15	14	-14	4	5	120	1.68	0.00	1.68	1.06	6
5	18 - 20	19	-19	13	17	120	2.28	0.00	2.28	0.96	17



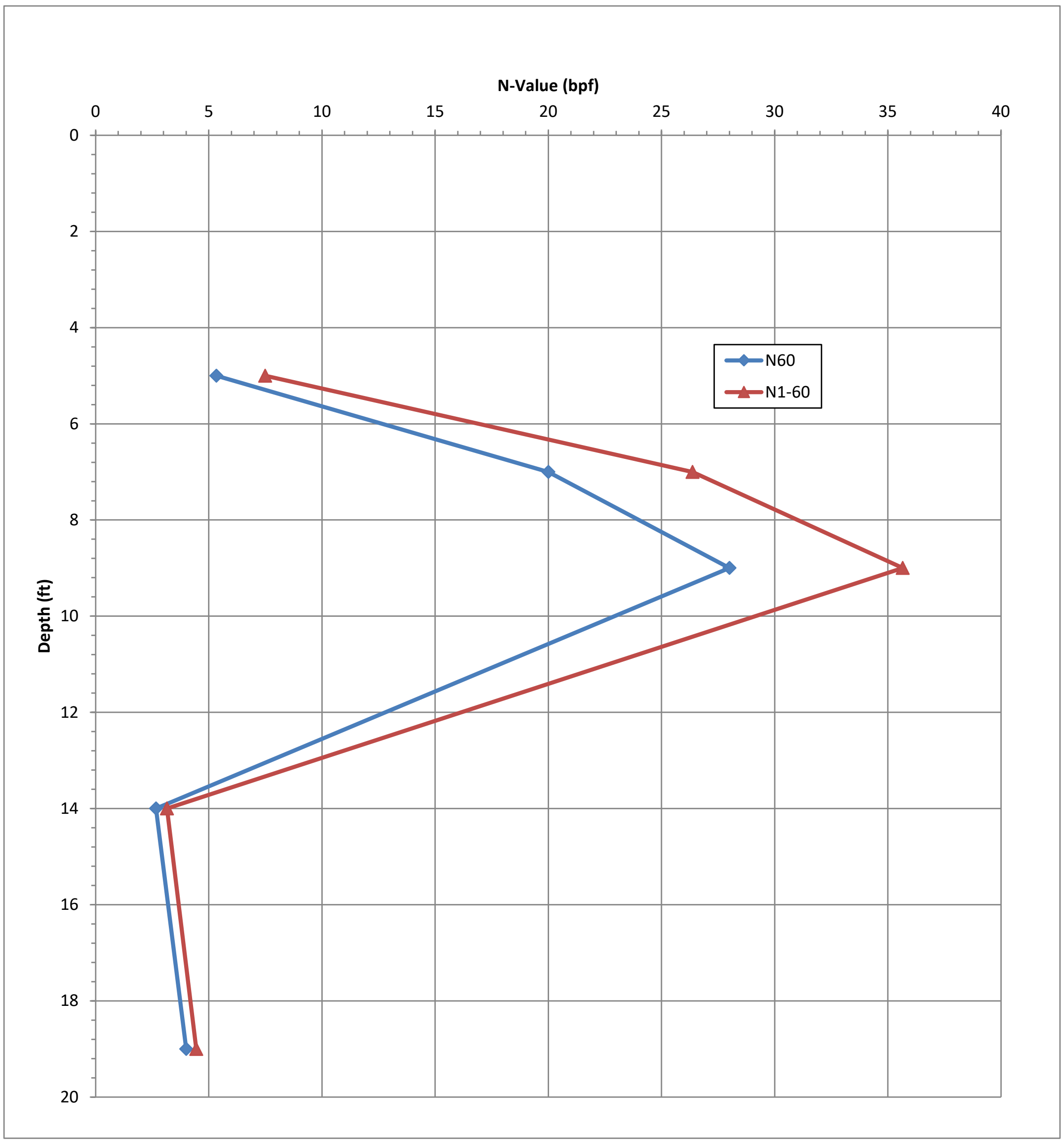
NORMALIZED N VALUES

Balzano Terminal Security Barrier
Camden, NJ

Boring No.	B-6
Elevation, ft	0
Groundwater Depth, ft	6
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)
	σ' = σt - u
	CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf
	N160 = N60*CN

Sample Number	Sample Depth	N-value Recored			N_{60}	γ pcf	σt ksf	u ksf	σ' ksf	CN	N160
		Depth	Elev.	Value							
1	4 - 6	5	-5	4	5	120	0.60	0.00	0.60	1.40	7
2	6 - 8	7	-7	15	20	120	0.84	0.06	0.78	1.32	26
3	8 - 10	9	-9	21	28	120	1.08	0.19	0.89	1.27	36
4	13 - 15	14	-14	2	3	120	1.68	0.51	1.17	1.18	3
5	18 - 20	19	-19	3	4	120	2.28	0.83	1.45	1.11	4



NORMALIZED N VALUES

Balzano Terminal Security Barrier
Camden, NJ