SECTION 00 31 32

GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. Soil-boring data for Project, obtained by Duffield Associates, dated December 17, 2013, is available for viewing as appended to this Document.

C. Related Requirements:

1. Section 00 21 13 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.

END OF SECTION

DUFFIELD
ASSOCIATES

5400 Limestone Road
Wilmington, DE 19808
Phone: 302.239.6634
Fax: 302.239.8485
duffnet.com

December 17, 2013

Ring Lardner, P.E.
Davis, Bowen & Friedel, Inc.
23 North Walnut Street
Milford, DE 19963

RE: Project No. 5448.GY
Geotechnical Evaluation Report
Proposed Pavement Improvements
DEARNG Governor Bacon Facility
Delaware City, Delaware

Dear Mr. Lardner:

In accordance with our agreement, dated October 1, 2013, Duffield Associates, Inc. (Duffield Associates) has prepared this geotechnical evaluation report to provide a summary of our field observations, conclusions, and recommendations regarding the pavement evaluation for the parking lots at the Delaware National Guard (DEARNG) facility at the Governor Bacon site in New Castle, Delaware.

Introduction

Based on our understanding of the proposed project, rehabilitation of the four parking lots at the site is proposed. The purpose of our evaluation was to evaluate the existing pavement and subsurface conditions and make recommendations for the proposed pavement rehabilitation. A sketch was provided by your office (included as an attachment to this report), which designated the four parking areas as follows:

- Military Parking Lot (for parking of Military vehicles, such as HUM-Vs);
- POV Lot 1 (for parking of passenger cars);
- POV Lot 2 (for parking of passenger cars); and
- POV Lot 3 (for parking of passenger cars).

Site Reconnaissance

On November 22, 2013, a representative of Duffield Associates visited the site to visually review the pavement conditions and to observe performance of several test borings. Based on the site

reconnaissance, a majority of the pavement appeared in fair condition with some long cracking throughout the parking areas with grass growing through the cracks. Isolated areas were in poor condition with extensive cracking. The areas where the most traffic appeared to be occurring, included in the entrance drive to the parking areas and to the parking area designated as the "Military Parking Lot" on the sketch provided by your office, which is to the rear of the existing building. Photographs providing a sampling of the observations are included as an attachment to this report.

Geotechnical Field Program

As part of our geotechnical evaluation, eight Standard Penetration Test (SPT) borings were performed on November 22, 2013. The test borings were performed by CGC Geoservices, LLC as a subcontractor to Duffield Associates. Upon completion of the test borings, the boreholes were backfilled with the soil cuttings and patched at the ground surface with bituminous concrete "cold patch". Test boring logs and a Test Boring Location Sketch are included as attachments to this report.

It is noted that some settlement of the SPT boring locations may occur over time requiring additional maintenance, which was beyond our scope of services. Some future maintenance may be required to address settlement if this occurs.

Summary of Subsurface Conditions

Based on the test borings, the subsurface conditions, encountered beneath a pavement section consisting of a layer of bituminous concrete (approximately 2- to 3-inches thick), included a relatively thin layer of previously placed fill material generally consisting of a thin layer of sandy round gravel and/or sand soils to a maximum depth of 2 feet below the existing pavement surface. Beneath the fill layer, a stratum of soft sandy silt was observed, which was generally 1- to 4-feet thick. This stratum was underlain by medium dense sands.

Groundwater was generally observed between 4 to 5 feet below the existing ground surface at the site. A summary of groundwater observations is included on the individual test boring logs.

Discussion

The silt soils and soils containing significant amounts of fine-grained materials generally correspond to American Association of State Highway and Transportation Officials (AASHTO) classification A-4, which are classified as "fair to poor" subgrade and, typically, require a deeper paving section to provide drainage and reduce frost susceptibility than predominantly granular subgrade soils. There are risks associated with placing site pavements over poor subgrade

materials. These risks include increased potential for localized yielding resulting in possible pavement cracking and increased maintenance costs. Given the size of the site, the observed depth of the silt soils, it will most likely be considered impractical to remove and replace these with compacted, granular structural fill. However, it is considered practical to construct the site pavements over these soils with the appropriate subgrade preparation.

Development of pavement section recommendations considered construction of a bituminous concrete pavement section with a graded aggregate base coarse constructed over the existing sand fill or silt subgrade soils. It is anticipated that some stabilization (i.e., undercutting and backfill with structural fill) of located yielding subgrade areas may be required prior to pavement section construction.

Based on Duffield Associates' previous experience with similar silt soils in the project area, we have estimated a design California Bearing Ratio (CBR) value on the order of 4 for the silt subgrade soils.

In addition to the subgrade soil bearing conditions, the design of site pavements is dependent on the vehicle loading. To develop a pavement section recommendation, Duffield Associates utilized Unified Facilities Criteria (UFC) "UFC 3-250-01FA, Pavement Design for Roads, Streets, Walks, and Open Storage Areas," and "UFC 3-230-18FA, General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas," dated January 16, 2004.

Based on the information provided by your office, it is assumed that the type of vehicles using the paved areas will generally consist of passenger cars and lightly loaded military vehicles, with occasional heavier truck traffic. The proposed frequency of anticipated vehicle traffic was not provided. Based on the information provided, assumptions were made for the design of site pavements. Recommendations for light-duty pavement sections were based on Traffic Category I (traffic composed primarily of passenger cars, panel and pickup trucks, that may contain as much as 1% two-axle trucks, and not containing trucks having three or more axles) and Road Classification E (road with 10 to 149 Equivalent Passenger Cars per Hour). Specific paving section recommendations are provided in the conclusions and recommendations section of this report.

The use of an underdrain system, located along roadways and in topographic low areas of the proposed parking lots and discharging to the area storm sewer system, should be evaluated during the construction phase of the project, if significant portions of the exposed subgrade appear to consist of fine-grained soils (silt/clay) or if wet conditions are encountered. Use of an underdrain system to facilitate drainage typically extends the design life of a pavement and decreases the future maintenance costs.

Conclusions and Recommendations

The following conclusions and recommendations are provided.

1. **Existing Pavement.** The existing bituminous concrete pavement thickness was observed in the eight test borings to vary between 2 to 3 inches over a rounded gravel or sand soil base coarse. Based on visual observations, the existing pavement appears to be in fair to poor condition, which appeared to correlate with frequency of loading (i.e., higher traffic areas such as the entrance driveway to the parking areas were extensively cracked).

2. **Pavement Design.** Based on the subsurface conditions encountered, the results of the field and laboratory testing programs, and UFC Traffic Categories I (light-duty) and III (heavy-duty) and Road Classification E, the pavement sections below are recommended assuming the subgrade is prepared as recommended herein.

Light-duty (Traffic Category I) Bituminous Concrete Section

1½ inches	Surface Course, Bituminous Concrete, Delaware Type C
2½ inches	Base Course, Bituminous Concrete, Delaware Type B
8 inches	Subbase Graded Aggregate, Delaware Type B
	Geotextile Fabric, Geotex 315ST or equivalent
12 inches	Total Depth

Although not indicated, if heavy duty traffic or high traffic loading is expected in the future at the site, the following pavement section is recommended.

Heavy-duty (Traffic Category III) Bituminous Concrete Section

2 inches	Surface Course, Bituminous Concrete, Delaware Type C
3 inches	Base Course, Bituminous Concrete, Delaware Type B
12 inches	Subbase Graded Aggregate, Delaware Type B
	Geotextile Fabric, Geotex 315ST or equivalent
17 inches	Total Depth

A layer of geotextile fabric (e.g., Geotex 315ST or equivalent) should be placed directly over the carefully prepared and reviewed subgrade. Adjacent rows of fabric should be overlapped a minimum of 24 inches. The fabric should be placed in a stretched (no wrinkles) state. The geotextile will act as a separator between the base course aggregate and the fine-grained subgrade, helping to maintain the integrity of the base course.

All pavement materials and construction should be in accordance with Delaware Department of Transportation's "Standard Specifications for Construction and Materials," August 2001 (revised May 11, 2010 or most recent revision). The use of an underdrain system, located

along roadways and in topographic low areas of the proposed parking lots and discharging to the area storm sewer system, should be evaluated during the construction phase of the project if significant portions of the exposed subgrade appear poorly drained. An underdrain typically consists of a 4-inch-diameter corrugated, perforated pipe bedded in AASHTO SP-57 stone and wrapped in a nonwoven geotextile. Use of an underdrain system to facilitate drainage typically extends the design life of pavement and decreases the likelihood of future maintenance.

3. **Pavement Areas.** At the start of construction, the proposed pavement areas should be stripped of all topsoil and existing pavement materials and rough excavated. Following rough grading and prior to placement of fill, it is recommended that the exposed subgrade in the proposed pavement areas be proofrolled using a minimum 10-ton static roller.

   Proofrolling should be monitored by a qualified technician under the supervision of a geotechnical engineer familiar with this report. Yielding, or otherwise unsuitable subgrade conditions encountered, should be undercut to firm subgrade conditions and backfilled with compacted structural fill in accordance with the recommendations of this report. Scarification and recompaction could also be performed in lieu of undercutting. The geotechnical engineer's representative should also confirm the consistency and texture of the exposed soils with the conditions encountered by this evaluation, as described herein, since localized loose and yielding subgrade conditions may be encountered.

4. **Compaction Requirements.** Structural fill in pavement areas should be compacted to at least 95% of the maximum dry density as determined by the Standard Proctor test (ASTM D 698). The placement and compaction of structural fill should be monitored on a full-time basis by a qualified technician under the supervision of a geotechnical engineer.

5. **Protection of Subgrade Soils.** The shallow layer of silt or clay soils at the site is considered moisture sensitive. Exposure of these soils to precipitation and construction traffic will likely weaken the soils and result in yielding subgrade conditions. Subgrade soils disturbed by precipitation and construction traffic should be either scarified and recompacted, or undercut and replaced with structural fill, as previously discussed.

6. **Subsurface Data.** All contractors interested in bidding on phases of this work, which involve subsurface conditions, should be given full access to this report so that they can develop their own interpretations of the available data.

These conclusions and recommendations have been prepared according to generally accepted soil and foundation engineering standards, and are based on the conditions encountered by the test borings performed at the site. It is noted that, although soil quality has been inferred from the interpolation of the sampling data, subsurface conditions beyond the test borings are, in fact, unknown. As a result, the recommendations may require modifications based on the conditions encountered and exposed during construction. Should any conditions encountered during

DUFFIELD ASSOCIATES

construction differ from those described in this report, this office should be notified immediately in order to review and possibly modify these recommendations. The cost for this construction review is not part of the existing agreement. This report applies solely to the size, type, and location of the structure described herein. In the event that changes are proposed, this report will not be considered valid unless the changes have been reviewed and the recommendations of this report modified and reapproved in writing by Duffield Associates, Inc.

We have appreciated the opportunity to be of continued assistance to you on this important project. If you have any questions, please feel free to contact us.

Very truly yours,

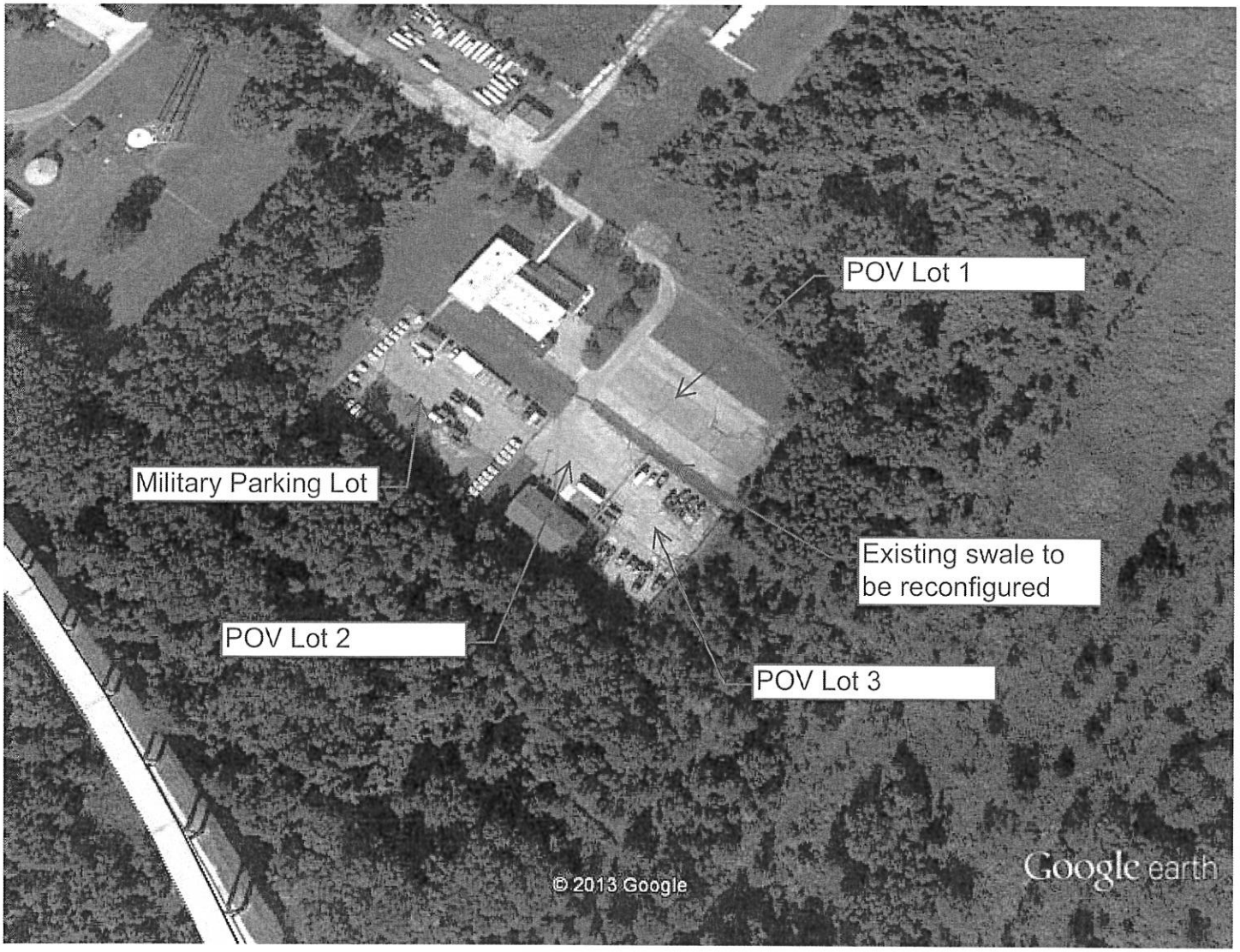
DUFFIELD ASSOCIATES, INC.

Peter G. Kearney, P.E.
Senior Geotechnical Engineer

PGK/JFC:bac
WORD\5448GY.1213-DEARNG GOV BACON PAVEMENT.RPT

Enclosures: Sketch Provided by Davis, Bowen, & Friedel
Site Photographs
Test Boring Location Sketch
Test Boring Logs

SKETCH PROVIDED BY DAVIS, BOWEN, & FRIEDEL



Google earth

feet 700
meters 200

SITE PHOTOGRAPHS

Photo #1: POV lot 1 looking towards existing building.

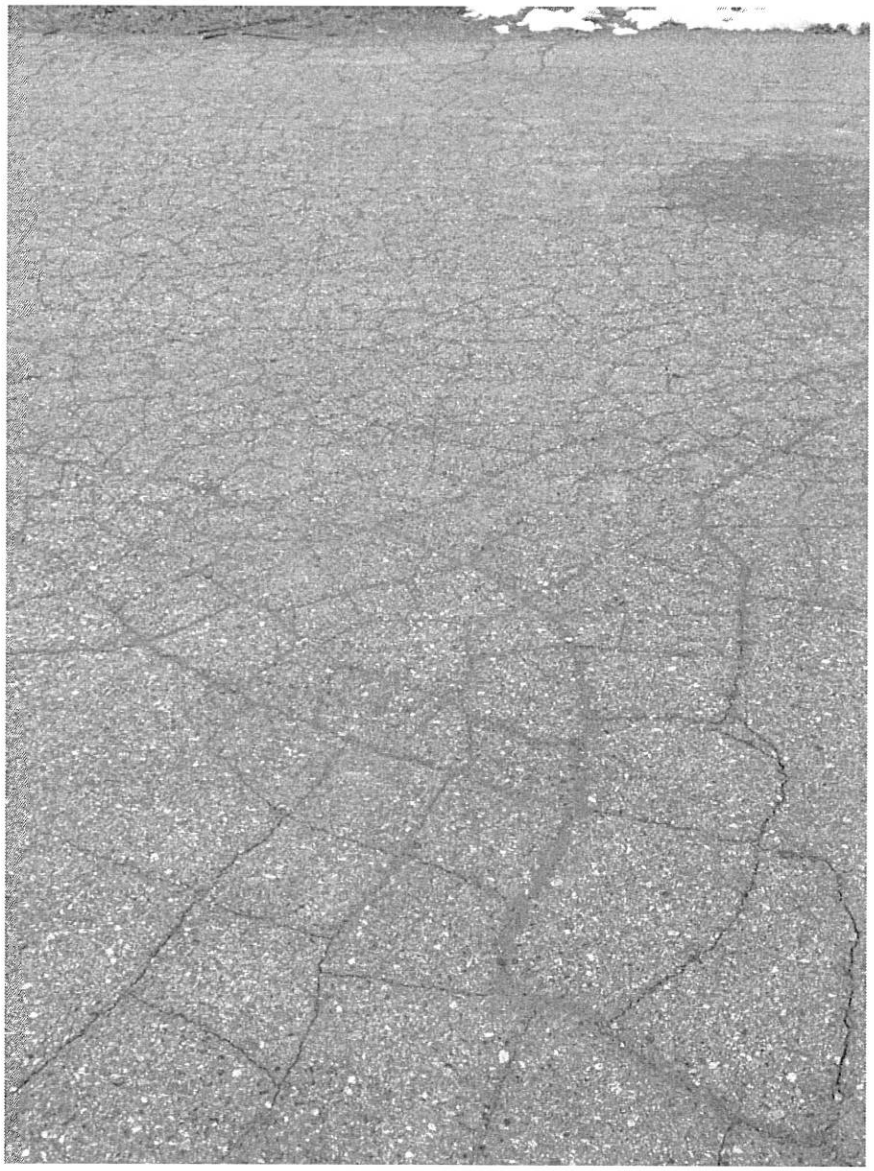


Photo #2: Entrance drive adjacent to existing building and POV lot 1.

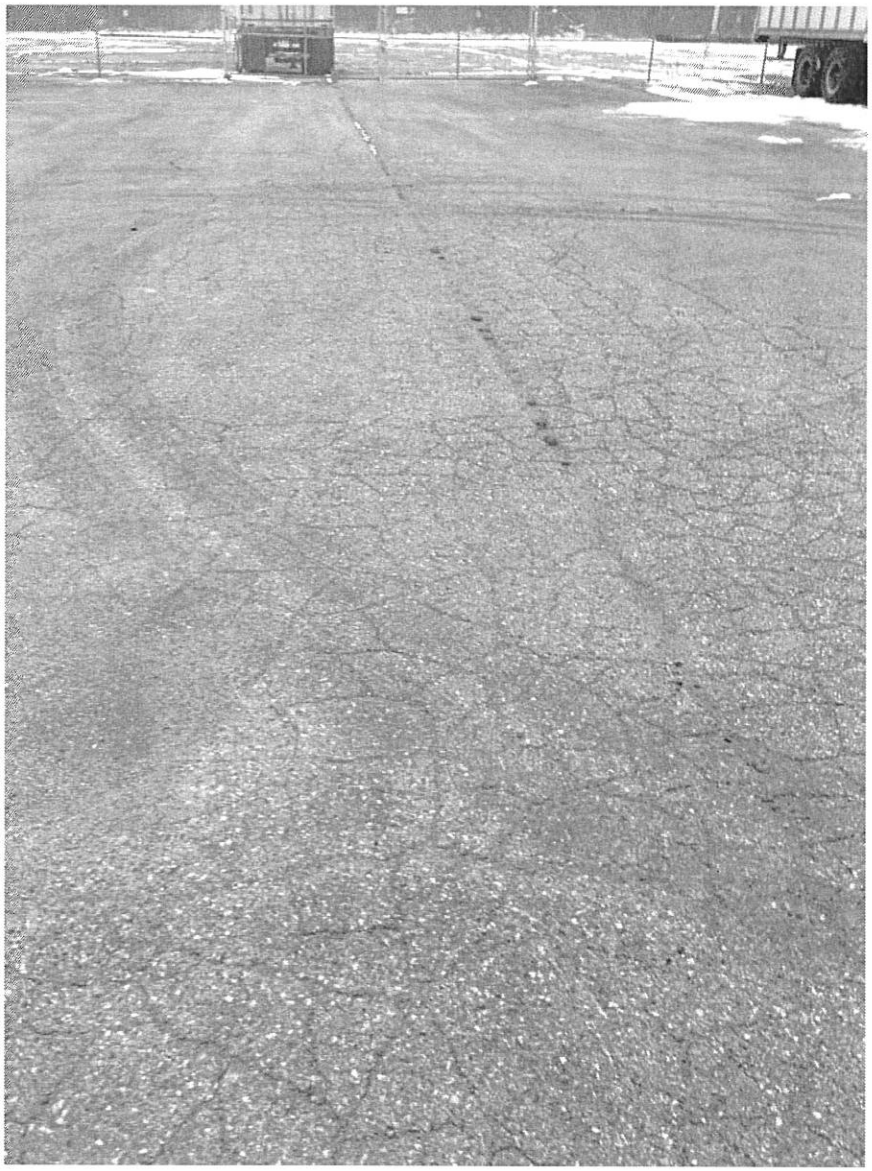


Photo #3: POV lot 2 looking towards POV lot 3.

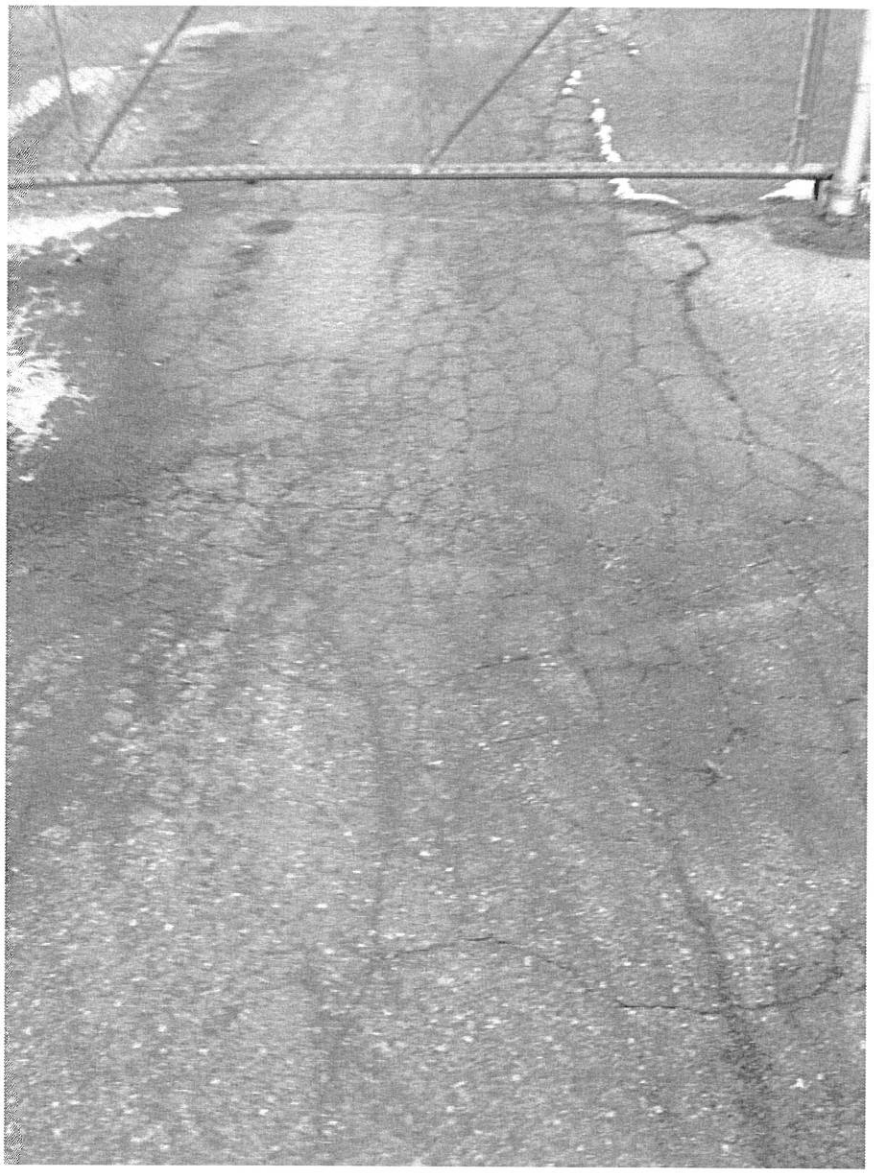


Photo #4: Entrance to Military parking lot.

TEST BORING LOCATION SKETCH

Notes:
1. 2012 aerial photograph obtained from the State of Delaware Environmental Monitoring and Analysis Center (DEMAC) Web Mapping Service through ArcGIS.
2. This figure is part of a geotechnical evaluation for Proposed Pavement Improvements, DEARNG Governor Bacon Facility, Delaware City, New Castle County, Delaware, prepared by Duffield Associates and should only be viewed in that context.

Date: 12/2013	TEST BORING LOCATION SKETCH	DESIGNED BY: ADK	DUFFIELD ASSOCIATES Soil, Water & the Environment
SCALE: AS SHOWN	**GEOTECHNICAL EVALUATION PROPOSED PAVEMENT IMPROVEMENTS DEARNG GOVERNOR BACON FACILITY**	DRAWN BY: ADK	5400 LIMESTONE ROAD WILMINGTON, DE 19808-1232 TEL. (302)239-6634 FAX (302)239-8485
PROJECT NO. 5448.GY		CHECKED BY: PGK	OFFICES IN PENNSYLVANIA, SOUTHERN DELAWARE, MARYLAND AND NEW JERSEY
SHEET: 1 OF 1	DELAWARE CITY~NEW CASTLE COUNTY~DELAWARE	FILE: 5448GY_TBLocSketch.mxd	EMAIL: DUFFIELD@DUFFNET.COM

TEST BORING LOGS

DUFFIELD ASSOCIATES

TEST BORING TB-1

Geotechnical Evaluation
DEARNG Governor Bacon Facility
Delaware City, New Castle County, Delaware
Project No. 5448.GY

Date Started : November 22, 2013
Date Completed : November 22, 2013
Logged by : RRN
Weather : Clouds, Int. rain
Driller/Agency : J. Feldmann/CGCG

Drilling Equipment : Truck-Mounted Diedrich D-50
Drilling Methods : HSA (SPT, ASTM D 1586)

Sample Condition: Remolded

Water Levels: During Drilling; At completion

Depth in feet	Layer Depth feet	GRAPHIC	USCS	DESCRIPTION	SAMPLES	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	WATER LEVEL
0	0.2			ASPHALT (±2")							
	0.4			FILL: Gray rounded gravel, some sand, little silt (moist)							
				FILL: Orange medium sand (moist)							
	1.0		SM	Gray medium SAND (0.1' lense of gray SILT) (moist)		S-1A	7-6-4-2	1.2			
2	2.0			Gray SILT, little clay (moist)		S-1B					
			ML	Gray SILT and medium SAND (in lenses), trace clay throughout (moist)		S-2	1-2-1-3	0.4			▼
	5.0		SM	Gray, orange-brown (in lenses) medium SAND, some silt, trace clay (moist to wet)		S-3A	WOH-7-20-23	1.5			
6	6.0		SW	Gray, brown (in lenses) medium to coarse SAND, some fine rounded gravel (wet)		S-3B					
	7.5		SP	Gray, brown medium sand, trace rounded grave, trace silt (wet)		S-4	8-9-10-10	1.8			
8											
10	10.0										
12											
14											

NOTES:
1. Hole located in southeast lot, approximately 27 feet from east end and 47 feet from south end.
2. Test boring terminated at ± 10.0 feet below existing ground surface (b.e.g.s.).
3. Wet-on-spoon conditions observed at ± 5.0 feet b.e.g.s. in sample S-3.
4. Water level observed at ± 4.5 feet b.e.g.s. with augers at ± 5.0 feet b.e.g.s.
5. Hole caved at ±5.0 feet b.e.g.s at completion with water level observed at ±4.5 feet b.e.g.s.
6. S-2: 3" spoon used for add'l sample retrieval

DUFFIELD ASSOCIATES

TEST BORING TB-2

Geotechnical Evaluation
DEARNG Governor Bacon Facility
Delaware City, New Castle County, Delaware
Project No. 5448.GY

Date Started : November 22, 2013
Date Completed : November 22, 2013
Logged by : RRN
Weather : Clouds, Int. rain
Driller/Agency : J. Feldmann/CGCG

Drilling Equipment : Truck-Mounted Diedrich D-50
Drilling Methods : HSA (SPT, ASTM D 1586)

Sample Condition: Remolded

Water Levels: During Drilling; At completion

Depth in feet	Layer Depth feet	GRAPHIC	USCS	DESCRIPTION	SAMPLES	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	WATER LEVEL
0	0.1			ASPHALT (±2")							
				FILL: Gray fine to coarse rounded gravel and medium sand							
	0.8			FILL: Orange medium sand (moist)							
				FILL: Orange medium sand (moist)		S-1A	4-4-3-3	1.2			
	1.8										
2				Gray SILT, little medium sand, trace clay, trace round gravel (moist)		S-1B					
			ML								
4				Gray SILT, some medium sand, trace clay, trace round gravel (moist)		S-2	1-1-1-3	2.0			▼
	5.2										
6				Gray to brown medium SAND, some to little rounded gravel, trace silt		S-3	5-7-7-5	1.5			
			SW								
8				Gray to brown medium SAND, little to trace rounded gravel, trace silt		S-4	4-5-5-5				
10	10.0										
12											
14											

NOTES:
1. Hole located in southeast lot, approximately 38 feet from west edge and 85 feet from north end.
2. Test boring terminated at ± 10.0 feet below existing ground surface (b.e.g.s.).
3. Wet-on-spoon conditions observed at ± 6.0 feet b.e.g.s. in sample S-3.
4. Water level observed at ± 5.0 feet b.e.g.s. with augers at ± 8.0 feet b.e.g.s.
5. Hole caved at ±5.5 feet b.e.g.s at completion with water level observed at ±5.0 feet b.e.g.s.

DUFFIELD ASSOCIATES

TEST BORING TB-3

Geotechnical Evaluation
DEARNG Governor Bacon Facility
Delaware City, New Castle County, Delaware
Project No. 5448.GY

Date Started : November 22, 2013
Date Completed : November 22, 2013
Logged by : RRN
Weather : Clouds, Int. rain
Driller/Agency : J. Feldmann/CGCG

Drilling Equipment : Truck-Mounted Diedrich D-50
Drilling Methods : HSA (SPT, ASTM D 1586)

Sample Condition: Remolded

Water Levels: During Drilling; At completion

Depth in feet	Layer Depth feet	GRAPHIC	USCS	DESCRIPTION	SAMPLES	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	WATER LEVEL
0	0.2			ASPHALT (±2.5")							
	0.6			FILL: Gray fine to coarse rounded gravel and medium sand							
	1.1			FILL: Orange medium sand (moist)							
2			ML	Gray to brownish gray SILT, trace fine sand, trace clay (moist)		S-1	3-3-2-2	2.0			
4	4.5		ML	Gray to brownish gray SILT, little to some fine sand, trace clay (moist) (increase in sand with depth)		S-2	2-1-3-5	1.5			▼
6	7.5		SW	Gray to gray-brown medium to coarse SAND, littl fine rounded to sub-angular gravel (wet)		S-3	2-4-8-8	1.6			
8			SP	Brown medium SAND, little coarse sand, trace silt (wet)		S-4	5-4-5-4	1.2			
10	10.0										
12											
14											

NOTES:
1. Hole located in southwest, gated lot, approximately 26 feet from west edge of pavement and 36 feet from north fence.
2. Test boring terminated at ± 10.0 feet below existing ground surface (b.e.g.s.).
3. Wet-on-spoon conditions observed at ± 4.5 feet b.e.g.s. in sample S-3.
4. Water level observed at ± 4.5 feet b.e.g.s. with augers at ± 5.0 feet b.e.g.s.
5. Hole caved at ±4.5 feet b.e.g.s at completion with water level observed at ±4.5 feet b.e.g.s.

DUFFIELD ASSOCIATES

TEST BORING TB-4

Geotechnical Evaluation
DEARNG Governor Bacon Facility
Delaware City, New Castle County, Delaware
Project No. 5448.GY

Date Started	: November 22, 2013	Drilling Equipment	: Truck-Mounted Diedrich D-50
Date Completed	: November 22, 2013	Drilling Methods	: HSA (SPT, ASTM D 1586)
Logged by	: RRN		
Weather	: Clouds, Int. rain		
Driller/Agency	: J. Feldmann/CGCG		

Sample Condition: Remolded

Water Levels: During Drilling; At completion

Depth in feet	Layer Depth feet	GRAPHIC	USCS	DESCRIPTION	SAMPLES	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	WATER LEVEL
0	0.3			ASPHALT (±3")							
	0.8			FILL: Gray fine to coarse rounded gravel and medium sand							
				FILL: Orange medium sand (moist)							
				FILL: Orange medium sand (moist)		S-1A	4-3-2-1	2.0			
	1.6										
2				Gray, tan, orange-brown SILT, little to trace fine sand, trace clay (moist to wet)		S-1B					
			ML	Gray, tan, orange-brown SILT, little to trace fine sand, trace clay, some brown medium sand in lenses, little gray clay in lenses (moist to wet)							
4						S-2	1-1-2-3	1.9			▽ ▼
	5.5			Gray, tan, orange-brown SILT, some to and gray clay in lenses, some brown medium sand in lenses, little to trace fine sand throughout (moist to wet)		S-3A	6-10-15-15	2.0			
6				Gray to brown stained medium to coarse varicolored SAND, little to trace gravel, trace silt (wet)		S-3B					
			SW								
8				Gray to brown stained medium varicolored SAND, little coarse sand, little to trace gravel, trace silt (wet)		S-4	6-10-13-14				
10	10.0										
12											
14											

NOTES:
1. Hole located in southwest, gated lot, approximately 33 feet from south end and 29 feet from east end.
2. Test boring terminated at ± 10.0 feet below existing ground surface (b.e.g.s.).
3. Wet-on-spoon conditions observed at ± 4.5 feet b.e.g.s. in sample S-4.
4. Water level observed at ± 4.5 feet b.e.g.s. with augers at ± 8.0 feet b.e.g.s.
5. Hole caved at ±4.8 feet b.e.g.s at completion with water level observed at ±4.0 feet b.e.g.s.

DUFFIELD ASSOCIATES

TEST BORING TB-5

Geotechnical Evaluation
DEARNG Governor Bacon Facility
Delaware City, New Castle County, Delaware
Project No. 5448.GY

Date Started : November 22, 2013
Date Completed : November 22, 2013
Logged by : RRN
Weather : Clouds, Int. rain
Driller/Agency : J. Feldmann/CGCG

Drilling Equipment : Truck-Mounted Diedrich D-50
Drilling Methods : HSA (SPT, ASTM D 1586)

Sample Condition: Remolded
Water Levels: ▼ During Drilling

Depth in feet	Layer Depth feet	GRAPHIC	USCS	DESCRIPTION	SAMPLES	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	WATER LEVEL
0	0.2			ASPHALT (±2")							
	0.7			FILL: Gray fine to coarse rounded gravel and medium sand							
	1.0			FILL: Orange medium sand (moist)							
2			SM	Orange-brown to gray medium SAND, little to some silt, trace clay (moist)		S-1	3-4-7-4	0.8			
	2.8										
			ML	Gray SILT, trace medium sand, trace to little clay (moist)		S-2A	3-3-6-5	1.4			
4	3.9										
				Brown, varicolored medium to coarse SAND, some fine rounded gravel (wet)		S-2B					▼
			SW								
6				Brown stained, varicolored medium to coarse SAND, some fine rounded gravel (wet)		S-3	5-8-10-9	2.0			
	7.0										
8			SP								
				Brown stained medium sand, trace fine rounded gravel, trace silt		S-4	5-6-6-6	1.8			
10	10.0										
12											
14											

NOTES:
1. Hole located in west lot, approximately 24 feet from south fence and 26 feet from east end.
2. Test boring terminated at ± 10.0 feet below existing ground surface (b.e.g.s.).
3. S-1: 3" spoon used for add'l sample retrieval
4. Wet-on-spoon conditions observed at ± 6.0 feet b.e.g.s. in sample S-4.
5. Water level observed at ± 4.6 feet b.e.g.s. with augers at ± 8.0 feet b.e.g.s.

DUFFIELD ASSOCIATES

TEST BORING TB-6

Geotechnical Evaluation
DEARNG Governor Bacon Facility
Delaware City, New Castle County, Delaware
Project No. 5448.GY

Date Started : November 22, 2013
Date Completed : November 22, 2013
Logged by : RRN
Weather : Clouds, Int. rain
Driller/Agency : J. Feldmann/CGCG

Drilling Equipment : Truck-Mounted Diedrich D-50
Drilling Methods : HSA (SPT, ASTM D 1586)

Sample Condition: Remolded

Water Levels: During Drilling; At completion

Depth in feet	Layer Depth feet	GRAPHIC	USCS	DESCRIPTION	SAMPLES	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	WATER LEVEL
0	0.2			ASPHALT (±2.5")							
	1.2			FILL: Gray fine to coarse rounded gravel and medium sand							
2			ML	Gray SILT, orange lensing, trace to little clay in lenses, slight mottling (moist)		S-1	5-2-2-3	2.0			
4	5.1		ML	Gray SILT, orange lensing, some medium sand in lenses, trace to little clay in lenses, slight mottling (moist)		S-2	1-1-2-10	1.0			▼
6			SP	Brown stained varicolored medium to coarse SAND, trace fine rounded gravel, trace silt (wet)		S-3	8-10-14-14	1.2			
8			SP	Brown stained varicolored medium SAND, trace fine rounded gravel, trace silt (wet)		S-4	7-7-7-8	1.0			
10	10.0										
12											
14											

NOTES:
1. Hole located in west lot, approximately 25 feet from north fence and 29 feet from west end of lot.
2. Test boring terminated at ± 10.0 feet below existing ground surface (b.e.g.s.).
3. Wet-on-spoon conditions observed at ± 5.0 feet b.e.g.s. in sample S-4.
4. Water level observed at ± 5.0 feet b.e.g.s. with augers at ± 8.0 feet b.e.g.s.
5. Hole caved at ±5.0 feet b.e.g.s at completion with water level observed at ±5.0 feet b.e.g.s.

DUFFIELD ASSOCIATES

TEST BORING TB-7

Geotechnical Evaluation
DEARNG Governor Bacon Facility
Delaware City, New Castle County, Delaware
Project No. 5448.GY

Date Started : November 22, 2013
Date Completed : November 22, 2013
Logged by : RRN
Weather : Clouds, Int. rain
Driller/Agency : J. Feldmann/CGCG

Drilling Equipment : Truck-Mounted Diedrich D-50
Drilling Methods : HSA (SPT, ASTM D 1586)

Sample Condition: Remolded
Water Levels: During Drilling

Depth in feet	Layer Depth feet	GRAPHIC	USCS	DESCRIPTION	SAMPLES	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	WATER LEVEL
0	0.2			ASPHALT (±2")							
	0.9			FILL: Gray fine to coarse rounded gravel and medium sand							
	1.0			FILL: Orange medium sand (moist)							
2			ML	Gray SILT, little clay, trace sand, slight mottling (moist)		S-1	2-1-1-2	2.0			
4				Gray to brown SILT, little clay, little to some sand increasing with depth, trace medium sand, slight mottling (moist)		S-2	1-2-5-4	2.0			
	4.8										
6			SW	Gray-brown stained, varicolored medium to coarse sand, little to some fine round gravel, trace silt (wet)		S-3	8-15-18-19	1.6			▼
	7.5										
8			SP	Orange, dark tan stained, varicolored medium sand, little coarse sand (wet)		S-4	4-4-9-10	2.0			
10	10.0										
12											
14											

NOTES:
1. Hole located in north lot, approximately 26 feet from east end and 44 feet from south fence.
2. Test boring terminated at ± 10.0 feet below existing ground surface (b.e.g.s.).
3. Wet-on-spoon conditions observed at ± 6.7 feet b.e.g.s. in sample S-3.
4. Water level observed at ± 5.8 feet b.e.g.s. with augers at ± 8.0 feet b.e.g.s.
5. Hole caved at ±5.0 feet b.e.g.s at completion with no water level observed.

DUFFIELD ASSOCIATES

TEST BORING TB-8

Geotechnical Evaluation
DEARNG Governor Bacon Facility
Delaware City, New Castle County, Delaware
Project No. 5448.GY

Date Started : November 22, 2013
Date Completed : November 22, 2013
Logged by : RRN
Weather : Clouds, Int. rain
Driller/Agency : J. Feldmann/CGCG

Drilling Equipment : Truck-Mounted Diedrich D-50
Drilling Methods : HSA (SPT, ASTM D 1586)

Sample Condition: Remolded

Water Levels: During Drilling; At completion

Depth in feet	Layer Depth feet	GRAPHIC	USCS	DESCRIPTION	SAMPLES	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	WATER LEVEL
0	0.2			ASPHALT (±2")							
	0.7			FILL: Gray fine to coarse rounded gravel and medium sand							
	1.0			FILL: Orange medium sand (moist)							
2			ML	Gray-brown SILT, trace fine sand, slight mottling (moist)		S-1	2-2-1-2	1.8			
	3.2										
4			SM	Brown to orange-brown fine to medium sand, little silt in lenses (moist)		S-2	3-2-2-4	1.2			
6				Orange-brown to gray fine to medium sand, little silt in lenses (moist)		S-3	8-12-15-19	0.9			▽ ▼
	6.8										
8			SW	Brown stained, varicolored medium to coarse SAND, little fine rounded gravel (wet)		S-4	10-12-13-14	1.5			
10	10.0										
12											
14											

NOTES:
1. Hole located in north lot, approximately 22 feet from north end and 7 feet east of light pole "line".
2. Test boring terminated at ± 10.0 feet below existing ground surface (b.e.g.s.).
3. Wet-on-spoon conditions observed at ± 5.5 feet b.e.g.s. in sample S-4.
4. Water level observed at ± 6.2 feet b.e.g.s. with augers at ± 8.0 feet b.e.g.s.
5. Hole caved at ±5.5 feet b.e.g.s at completion with water level observed at ±5.5 feet b.e.g.s.