State of Delaware
Department of Transportation
P.O.Box 778
DOVER, DELAWARE 19903

Carolann Wicks, P.E.
Secretary

TO:	**Jason Hastings, P.E.** Project Engineer Bridge Design
FROM:	**Hany Fekry, P.E.** Geotechnical Engineer Material & Research
DATE	**: January 14, 2011**
ROJECT NUMBER	**: T201107306**
PROJECT NAME	**: BR3-368 on Sycamore Road over Elliotts Pond Branch**
SUBJECT	**: Geotechnical Report**

---

1. Introduction

The Delaware Department of Transportation (DelDOT), with Walton Corporation and Geo-Technology Associates, Inc. (GTA), has completed a supplemental subsurface exploration for this project. Included in the field exploration were 2 - Standard Penetration Test borings that were scheduled to depths of 50 feet below the existing ground surface. Limited laboratory testing was performed on split spoon samples and the tube recovered from the borings to characterize general subsurface conditions. The results of the field and laboratory are detailed herein.

2. Project Description

The subsurface investigation was completed at the Sycamore Road north west the intersection of the Sycamore Road and Elliotts Dam Road, Laurel Delaware.

3. Area Geology Background

Using the Geology map from the Delaware Geological Survey Geologic Map of Southern Delaware by Kelvin W. Ramsey and William S. Schenck June 1990 . According to Geologic Map the both Borings it is under Category BEAVERDAM Formation and the soil descriptions is White- greenish gray medium Sand with scattered beds of coarse Sand, gravelly sand Silty Clay.

4. Ground Water Background

According to The Water Table, surface- Drainage, and Engineering Soil Map of The Laurel Area Delaware by Durward H. Boggess, and John K. Adams 1965 Atlas HA-123.
The groundwater has historically been measured between 1950 to 1962 from 5 to 9 feet below the existing grades.

5. Hydrologic Background

According to Delaware Geological Survey Geohydrology of the Sussex County Delaware; Map Series, No. 12, by A. Scott Andres June 2003 the recharge ground water it is under Good Category and the Hydraulic Conductivity (K) 10 to 25 (ft/day) feet per day.

6. Field Exploration

6.1 Field Equipment

The subsurface exploration for this Task was completed on December 13, 2010. Walton Corporation of Newark, Delaware drilled the borings. Walton Corporation subcontracted Geo-Technology Associates, INC (GTA) to provide full-time supervision of the subsurface exploration activities. Walton Corporation, in accordance with their open-end contract with DelDOT, provided the following drilling equipment and hammer type:

- Rig Track Mounted CME 55 with Safety Hammer.

6.2 Survey Control

Borings were drilled at locations selected by the designer. The boring was located in the field by GTA Engineering using a GPS unit.

6.3 SPT Borings

Standard Penetration Testing (SPT) was performed on the borings, with soil samples obtained continuously in the boring. Standard Penetration Testing involves driving a 2-inch O.D. sleeve to collect soil samples for a total of 24 inches with a 140-pound hammer free falling 30 inches. The number of blows (n) required to drive the sampler was recorded in intervals of 6 inches or maximum (n=50). Uncorrected SPT blow counts (N) have been calculated from the borings logs. The total number SPT “N” value blow counts the sum of the “n” value for the second and third record number to drive the split spoon from the 6 to18-inch interval. Split spoon samples retrieved from the test borings were delivered to DelDOT's laboratory.

7. Groundcover

The existing surface was Asphalt pavement 6” to 10” inches thickness and Base course 10” to 12” inches thickness for the both boring locations.

8. Groundwater

The depth to groundwater was noted during the drilling operations and the groundwater levels were measured at the completion of drilling. The groundwater was encountered during the borings about 7.6 to 8.0 feet from the surface elevation. This reading and actual levels are likely not Higher.

9. Laboratory Testing

9.1 Index Testing

Index testing was performed on the samples obtained from the borings to classify the soils. The laboratory testing included the grain size distribution, the natural moisture content, and Atterberg Limits if any of the soil were collected from the split spoon.

9.2 Bearing Capacity

The allowable bearing capacity for this soil is estimated to be approximately 3500 (psf) pound per square foot at 10 feet below the existing surface.

9.3 Sub Grade Modulus

The sub grade modulus for this soil is estimated to be approximately 200/300 (psi/in) pound per square inch

10. Borrow Type

According to the test data analysis form the lab. The soil meet the borrow requirement from the 2 to 10 feet below the existing surface are tabulated below.

Borrow Type	A	C	E	D	B
Percentage %	90	90	88	55	48

11. Recommendation

Our findings indicate that the subsurface condition at this site in general is in a good condition.
In addition, the N- Value indicated the subsurface consolidation it is increasing according to the overburden pressure.
In addition the material indicated Type “A”, and “C” for the borrow user.

12. Limitation

The boring indicates the soil condition only at specific location and weather conditions and only to the depth penetrated; these samples do not reflect the strata variation that may exist between the test locations.

This report has been prepared for the exclusive use of DelDOT in according with generally accepted engineering practice. No warranty, express or implied, is made.

This Report is part of the Boring Log and the soil Description.

APPENDIX A

- GPS Boring Plan (2- sheets)

APPENDIX B

- AASHTO Soil Classification System AND Boring Log Data(8- sheets)

APPENDIX C

- Grain Size Distribution Result(7- sheets)

APPENDIX D

- Summary of the Borings(1- sheet)

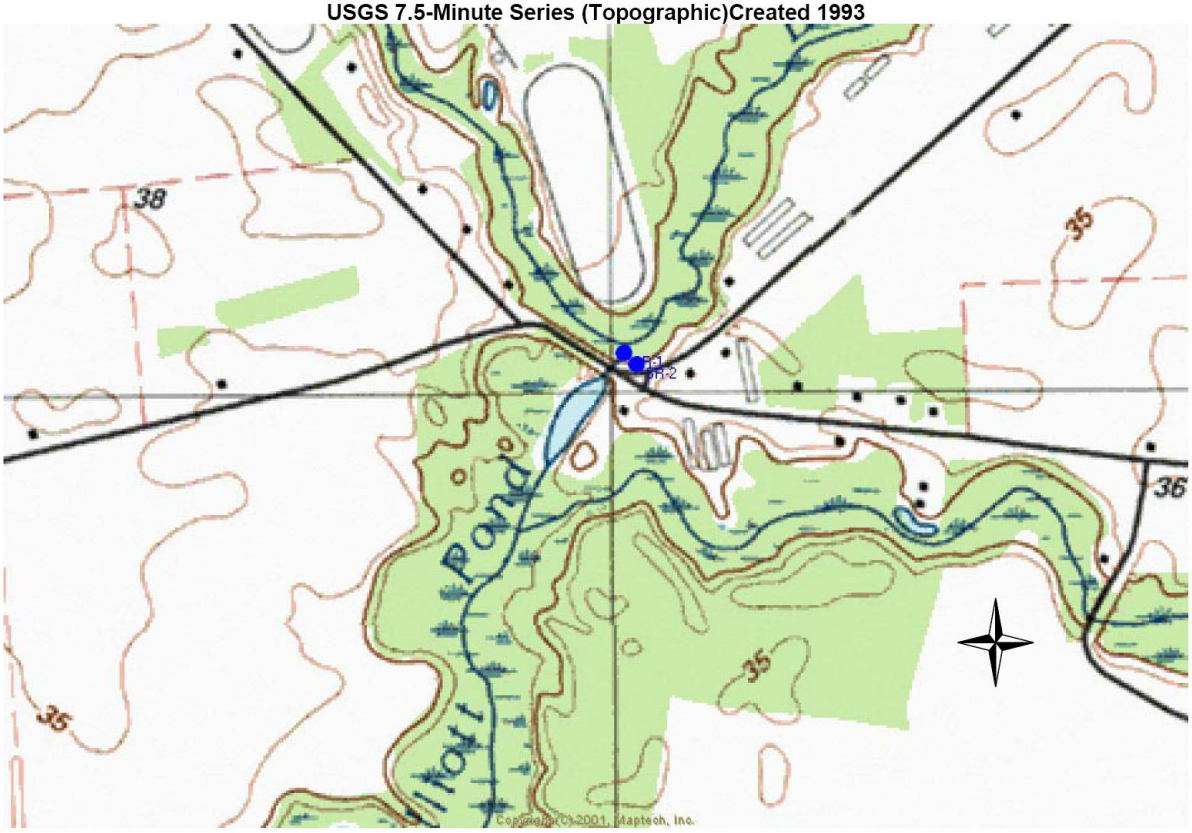
APPENDIX E

- Figures and Chart(1- sheet)

APPENDIX A

- GPS Boring Plan

Base map obtained from MAPTECH Inc. Terrain Navigator 2001
From LAUREL (Delaware) Quadrangle
USGS 7.5-Minute Series (Topographic)Created 1993



BR3-368 on Sycamore Road over Elliots Pond Branch
Task# 73, T201107306

Reference	State Plane, NAD83 0700-Delaware, U.S. Feet		Geographic, NAD83	
	Northing	Easting	Latitude	Longitude
SR-1	210396.94	624277.24	38 34 39.65	75 31 41.56
SR-2	210345.25	624343.95	38 34 39.14	75 31 40.72

APPENDIX B

- AASHTO Soil Classification System AND Boring Log Data

• Table B-1 AASHTO SOIL CLASSIFICATION SYSTEM

The American Association of State Highway and Transportation Officials developed the AASHTO Soil Classification System, and it is used as a guide for the classification of soils and soil-aggregate mixtures for highway construction purposes. AASHTO M-57-2, M-145-7											
General Classification	Granular Materials (35% or less passing the 0.075 mm sieve)							Silt-Clay Materials (>35% passing the 0.075 mm sieve)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6 Note 1
Sieve Analysis, % passing											
2.00 mm (No. 10)	50 max	…	…	…	…	…	…	…	…	…	…
0.425 (No. 40)	30 max	50 max	51 min	…	…	…	…	…	…	…	…
0.075 (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid Limit	…		…	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity Index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min[1]
Usual types of significant constituent materials	stone fragments, gravel and sand		fine sand	silty or clayey gravel and sand				silty soils		clayey soils	
General rating as a subgrade	excellent to good							fair to poor			

Note (1): Plasticity index of A-7-5 subgroup is equal to or less than the LL - 30. Plasticity index of A-7-6 subgroup is greater than LL – 30

Note (2): The AASHTO classification include the Group Index (GI) need to be lees 20, more than 20

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH

BORING SR # 1

Project Name: Bridge 3-368 on Sycamore Road over Elliot Pond Branch **Location:**
State Contract #: T201107306 **Federal Contract #:**
Station/Offset: **Northing:** 210396.94 **Easting:** 624277.24
Boring Surface Elev.: **Reference:**
Date Started: 12/13/2010 **Date Completed:** 12/13/2010

Wt. of Sample Hammer: 140 **Lbs.** **Average Fall:** 30 **IN.**
Type of: **D-Sampler:** Split-Barrel **O.D.** **O.D. of Sampler:** 2 **IN.**
S-Sampler: **O.D.** **O.D. of Samp. Tube:** **IN.**
U-Sampler: **O.D.** **O.D. of Samp. Tube:** **IN.**
Core Bit: **O.D.** **O.D. of Rock Core:** **IN.**

Hollow Stem Auger Diameter: 3 1/4" **Inches** **From Depth of:** 0.0' **To:** 14.0'
Mud Rotary: **From Depth of:** 14.0' **To:** 53.0'

Water Level Readings

Date	Depth to Water (ft)	Caved Depth (ft)
12/13/2010	8.0'	
12/13/2010	Dry	7.0'

Boring Contractor: Walton Corporation **Equipment/Rig Type:** Truck CME 55
Driller: Gary Truver **Logged By:** GTA - J. Lafferty

Depth (ft.)	Water Level	No.	Sample Depth	Blows/6"	Sample Description	AASHTO Class.	Remarks
		1	0.0' 2.0'		No Sampling 0" RECOVERY		Asphalt - 10". Crushed Stone - 10".
2.53		2	2.0' 4.0'	7 10 9 9	Moist medium dense tan fine to coarse sand w/ some silt. 20" RECOVERY	A-2-4(0)	Fill
5.06		3	4.0' 6.0'	3 4 3 3	Moist loose tan fine to coarse sand w/some silt, trace of fine gravel. 17" RECOVERY	A-2-4(0)	Fill
7.59		4	6.0' 8.0'	3 1 2 2	Wet very loose tan fine sand w/some coarse sand and silt, trace of fine gravel. 16" RECOVERY	A-2-4(0)	
10.12	▽	5	8.0' 10.0'	4 8 10 8	Wet medium dense gray coarse to fine sand w/ trace of fine gravel and silt. 17" RECOVERY	A-1-b	
		6	10.0' 12.0'	5 5 6 5	Wet medium dense tan fine to coarse sand w/ trace of silt and fine gravel. 17" RECOVERY	A-3	
12.65		7	12.0' 14.0'	2 2 2 2	Wet very loose brownish gray fine to coarse sand w/some silt, trace of fine gravel. 18" RECOVERY	A-2-4(0)	

Remarks:

Reviewed By: Hany Fekry **Soils Supervisor:** Randy Ferguson

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH

Project Name: Bridge 3-368 on Sycamore Road over Elliot Pond Branch **Boring No.:** SR # 1
State Contract:

Depth (ft.)	Water Level	No.	Sample Depth	Blows/6"	Sample Description	AASHTO Class.	Remarks
15.18		8	14.0' 16.0'	1 3 5 9	Wet loose brown fine to coarse sand w/some fine gravel and silt. 20" RECOVERY	A-2-4(0)	Mud Rotary @ 14.0'.
17.71		9	16.0' 18.0'	5 5 7 8	Wet medium dense brownish orange coarse to fine sand w/some silt, trace of fine gravel. 19" RECOVERY	A-1-b	
20.24 22.77		10	18.0' 20.0'	5 6 7 6	Wet medium dense brownish orange fine to coarse sand w/some silt, trace of fine gravel. 22" RECOVERY	A-2-4(0)	
25.3 27.83		11	23.0' 25.0'	7 11 8 14	Wet medium dense orange fine to coarse sand w/some silt, trace of fine gravel. 21" RECOVERY	A-2-4(0)	
30.36 32.89		12	28.0' 30.0'	6 7 17 22	Wet medium dense orange fine to coarse sand w/some fine gravel, trace of silt. 19" RECOVERY	A-1-b	
35.42 37.95		13	33.0' 35.0'	20 17 11 14	Wet medium dense orange coarse to fine sand w/some fine gravel, trace of silt. 20" RECOVERY	A-1-b	

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH

Project Name: Bridge 3-368 on Sycamore Road over Elliot Pond Branch **Boring No.:** SR # 1
State Contract:

Depth (ft.)	Water Level	No.	Sample Depth	Blows/6"	Sample Description	AASHTO Class.	Remarks
		14	38.0' 40.0'	13 12 13 20	Wet medium dense orange coarse sand w/some fine sand and fine gravel, trace of silt. 19" RECOVERY	A-1-b	
40.48							
43.01		15	43.0' 45.0'	2 3 4 5	Saturated firm gray clayey fine sandy fine gravelly silt w/trace of coarse sand. 22" RECOVERY	A-4(0)	
45.54							
48.07		16	48.0' 50.0'	5 6 7 6	Saturated stiff gray fine sandy silt w/some clay, trace of coarse sand and fine gravel. 19" RECOVERY	A-4(0)	
50.6							
53.13		17	53.0' 55.0'	13 22 21 23	Saturated dense gray fine sand w/some silt, trace of fine gravel. 17" RECOVERY	A-2-4(0)	
55.66					End of Boring		
58.19							
60.72							

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH

BORING SR # 2

Project Name: Bridge 3-368 on Sycamore Road over Elliot Pond Branch **Location:**
State Contract #: T201107306 **Federal Contract #:**
Station/Offset: **Northing:** 210345.25 **Easting:** 624343.95
Boring Surface Elev.: **Reference:**
Date Started: 12/13/2010 **Date Completed:** 12/13/2010

Wt. of Sample Hammer: 140 **Lbs.** **Average Fall:** 30 **IN.**
Type of: **D-Sampler:** Split-Barrel **O.D.** **O.D. of Sampler:** 2 **IN.**
S-Sampler: **O.D.** **O.D. of Samp. Tube:** **IN.**
U-Sampler: **O.D.** **O.D. of Samp. Tube:** **IN.**
Core Bit: **O.D.** **O.D. of Rock Core:** **IN.**

Hollow Stem Auger Diameter: 3 1/4" **Inches** **From Depth of:** 0.0' **To:** 48.0'
Mud Rotary: **From Depth of:** **To:**

Water Level Readings

Date	Depth to Water (ft)	Caved Depth (ft)
12/13/2010	7.6'	
12/13/2010	Dry	7.0'

Boring Contractor: Walton Corporation **Equipment/Rig Type:** Truck CME 55
Driller: Dave Burt **Logged By:** GTA - T. Kane

Depth (ft.)	Water Level	No.	Sample Depth	Blows/6"	Sample Description	AASHTO Class.	Remarks
			0.0'		No Sampling		Asphalt - 6". Crushed Stone - 12".
			2.0'		0" RECOVERY		
2.53		1	2.0'	10 14 10 9	Moist medium dense brown fine to coarse sand w/some silt, trace of fine gravel.	A-2-4(0)	Fill
			4.0'		23" RECOVERY		
5.06		2	4.0'	2 2 2 3	Moist very loose brown fine to coarse sand w/ some silt, trace of fine gravel.	A-2-4(0)	Fill
			6.0'		20" RECOVERY		
7.59	▽	3	6.0'	4 5 5 7	Wet loose gray fine to coarse sand w/trace silt and fine gravel.	A-3	
			8.0'		21" RECOVERY		
10.12		4	8.0'	8 10 10 16	Wet medium dense gray fine to coarse sand w/ some fine gravel, trace of silt.	A-3	
			10.0'		23" RECOVERY		
		5	10.0'	9 12 10 11	Wet medium dense gray fine gravelly coarse sand w/some fine sand, trace of silt.	A-1-b	
			12.0'		22" RECOVERY		
12.65		6	12.0'	3 5 8 6	Wet medium dense brown coarse to fine sand w/some fine gravel, trace of silt.	A-1-b	
			14.0'		14" RECOVERY		

Remarks:

Reviewed By: Hany Fekry **Soils Supervisor:** Randy Ferguson

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH

Project Name: Bridge 3-368 on Sycamore Road over Elliot Pond Branch **Boring No.:** SR # 2
State Contract:

Depth (ft.)	Water Level	No.	Sample Depth	Blows/6"	Sample Description	AASHTO Class.	Remarks
15.18		7	14.0' 16.0'	13 8 5 7	Wet medium dense brown fine to coarse sand w/some silt, trace of fine gravel. 13" RECOVERY	A-2-4(0)	
17.71		8	16.0' 18.0'	5 7 7 5	Wet medium dense brown fine to coarse sand w/trace silt and fine gravel. 20" RECOVERY	A-3	
20.24		9	18.0' 20.0'	4 8 10 9	Wet medium dense brownish green coarse sand w/some fine sand, trace of silt and fine gravel. 6" RECOVERY	A-1-b	
22.77							
25.3		10	23.0' 25.0'	7 7 7 9	Wet medium dense orange coarse to fine sand w/trace fine gravel and silt. 18" RECOVERY	A-1-b	
27.83							
30.36		11	28.0' 30.0'	7 7 7 13	Wet medium dense orange fine to coarse sand w/some fine gravel, trace of silt. 16" RECOVERY	A-3	
32.89							
35.42		12	33.0' 35.0'	12 12 12 14	Wet medium dense orange coarse sand w/some fine sand and fine gravel, trace of silt. 16" RECOVERY	A-1-b	
37.95							

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH

Project Name: Bridge 3-368 on Sycamore Road over Elliot Pond Branch **Boring No.:** SR # 2
State Contract:

Depth (ft.)	Water Level	No.	Sample Depth	Blows/6"	Sample Description	AASHTO Class.	Remarks
		13	38.0'	20 23 31 30	Wet very dense brown fine gravelly coarse sand w/some fine sand, trace of silt.	A-1-b	
			40.0'		17" RECOVERY		
40.48							
43.01							
		14	43.0'	19 21 16 12	Wet dense gray fine gravelly fine sand w/some coarse sand, trace of silt.	A-3	
			45.0'		8" RECOVERY		
45.54							
48.07							
		15	48.0'	6 7 10 14	Wet very stiff gray clayey fine sandy silt w/ some fine gravel, trace of coarse sand.	A-4(2)	
			50.0'		23" RECOVERY		
50.6					End of Boring		
53.13							
55.66							
58.19							
60.72							

KEY TO SYMBOLS

Symbol Description

Strata symbols

Poorly graded, silty or clayey sands and gravel

Clean sand & gravelly sand

Well graded gravels and sands

Silty soils

Misc. Symbols

Water table during drilling.

Notes:

1. These logs are subject to the limitations, conclusions, and recommendations in this report.

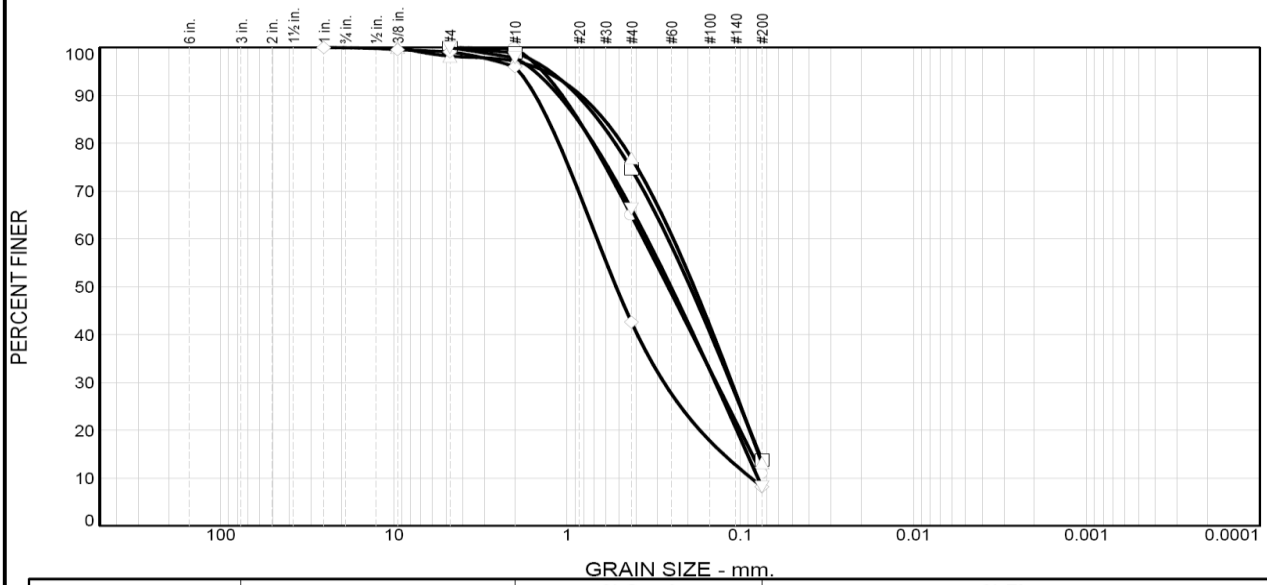
2. Results of tests conducted on samples recovered are reported on the logs.

3. All blow counts are uncorrected.

APPENDIX C

- Grain Size Distribution Result

Particle Size Distribution Report



	% +3"	% Gravel	% Sand Coarse	% Sand Fine	% Fines Silt	% Fines Clay
○	0.0	0.3	34.8	54.1	10.8	
□	0.0	1.1	24.3	60.9	13.7	
△	0.0	2.9	20.2	63.7	13.2	
◇	0.0	4.0	53.4	34.4	8.2	
▽	0.0	2.1	31.6	58.2	8.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NV	NP	0.8635	0.3617	0.2612	0.1376	0.0855			
□	NV	NP	0.6630	0.2609	0.1947	0.1138	0.0775			
△	NV	NP	0.6130	0.2435	0.1848	0.1119	0.0783			
◇	NV	NP	1.2917	0.6712	0.5212	0.2761	0.1251	0.0866	1.31	7.75
▽	NV	NP	0.8738	0.3448	0.2515	0.1392	0.0910	0.0790	0.71	4.36

	Material Description	USCS	AASHTO
○	Moist medium dense tan fine to coarse sand w/some silt.	SP-SM	A-2-4(0)
□	Moist loose tan fine to coarse sand w/some silt, trace of fine gravel.	SM	A-2-4(0)
△	Wet very loose tan fine sand w/some coarse sand and silt, trace of fine gravel.	SM	A-2-4(0)
◇	Wet medium dense gray coarse to fine sand w/trace of fine gravel and silt.	SW-SM	A-1-b
▽	Wet medium dense tan fine to coarse sand w/trace of silt and fine gravel.	SP-SM	A-3

Project No. **Client:**

Project: Bridge 3-368 on Sycamore Road over Elliot Pond Branch

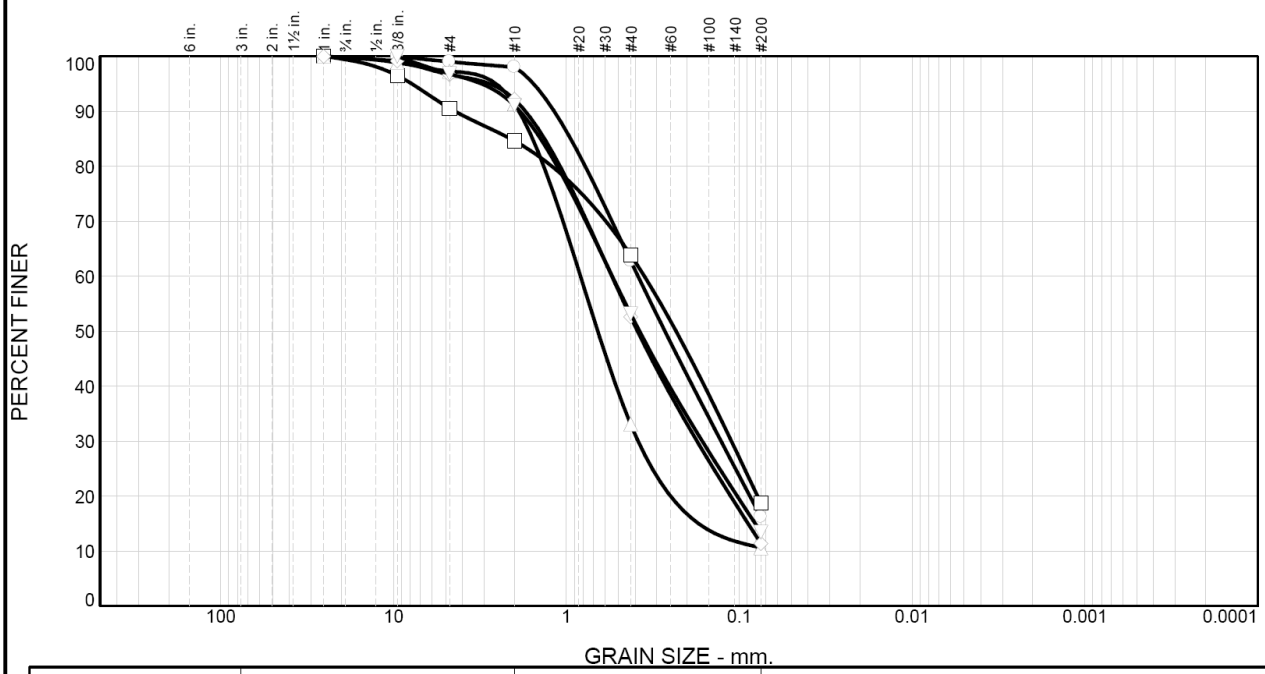
○ **Source of Sample:** SR # 1 **Depth:** 2.0 **Sample Number:** 2
□ **Source of Sample:** SR # 1 **Depth:** 4.0 **Sample Number:** 3
△ **Source of Sample:** SR # 1 **Depth:** 6.0 **Sample Number:** 4
◇ **Source of Sample:** SR # 1 **Depth:** 8.0 **Sample Number:** 5
▽ **Source of Sample:** SR # 1 **Depth:** 10.0 **Sample Number:** 6

Remarks:

Delaware Department of Transportation
Materials and Research Laboratory

Figure C-1

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	2.0	35.2	46.6	16.2	
□	0.0	15.4	20.8	45.1	18.7	
△	0.0	8.7	58.2	22.5	10.6	
◇	0.0	7.8	39.6	41.2	11.4	
▽	0.0	8.9	37.9	39.8	13.4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NV	NP	0.9463	0.3855	0.2694	0.1275				
□	NV	NP	2.1044	0.3542	0.2322	0.1111				
△	NV	NP	1.5691	0.8296	0.6588	0.3852	0.1723			
◇	NV	NP	1.3384	0.5463	0.3879	0.1757	0.0890			
▽	NV	NP	1.4106	0.5434	0.3777	0.1639	0.0809			

	Material Description	USCS	AASHTO
○	Wet very loose brownish gray fine to coarse sand w/some silt, trace of fine gravel.	SM	A-2-4(0)
□	Wet loose brown fine to coarse sand w/some fine gravel and silt.	SM	A-2-4(0)
△	Wet medium dense brownish orange coarse to fine sand w/some silt, trace of fine gravel.	SP-SM	A-1-b
◇	Wet medium dense brownish orange fine to coarse sand w/some silt, trace of fine gravel.	SP-SM	A-2-4(0)
▽	Wet medium dense orange fine to coarse sand w/some silt, trace of fine gravel.	SM	A-2-4(0)

Project No. **Client:**

Project: Bridge 3-368 on Sycamore Road over Elliot Pond Branch

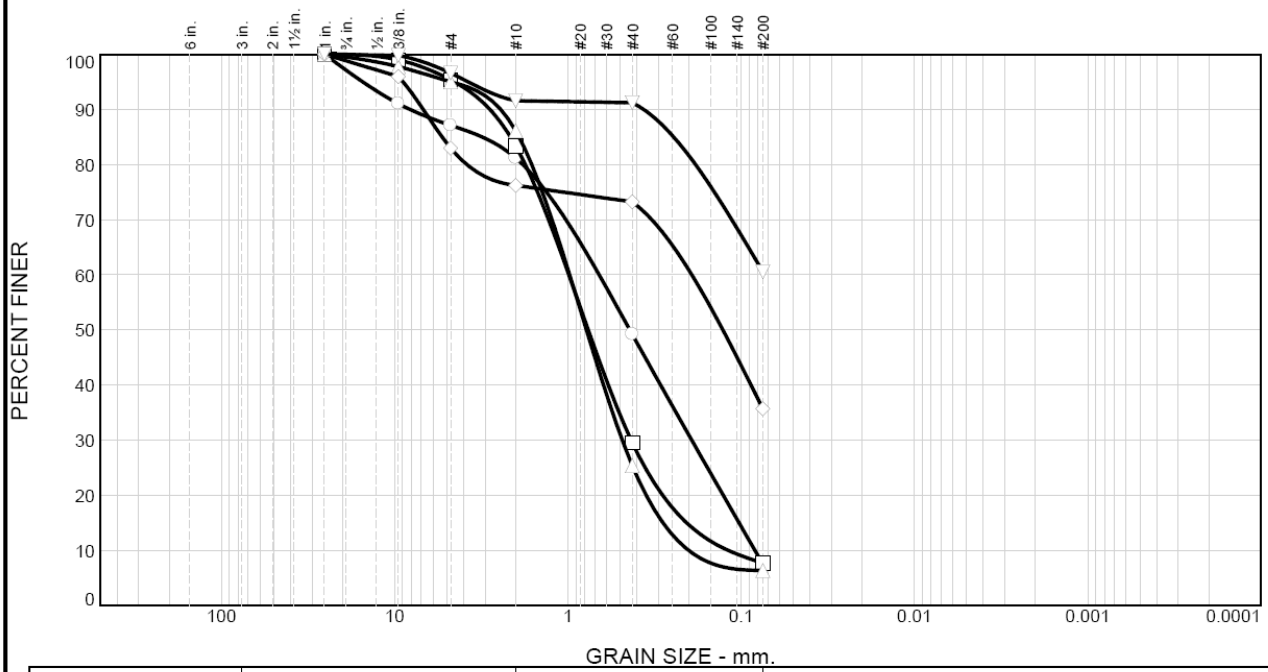
○ **Source of Sample:** SR # 1 **Depth:** 12.0 **Sample Number:** 7
□ **Source of Sample:** SR # 1 **Depth:** 14.0 **Sample Number:** 8
△ **Source of Sample:** SR # 1 **Depth:** 16.0 **Sample Number:** 9
◇ **Source of Sample:** SR # 1 **Depth:** 18.0 **Sample Number:** 10
▽ **Source of Sample:** SR # 1 **Depth:** 23.0 **Sample Number:** 11

Remarks:

Delaware Department of Transportation
Materials and Research Laboratory

Figure C-2

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	18.8	32.0	41.7	7.5	
□	0.0	16.6	53.9	21.8	7.7	
△	0.0	13.9	60.7	19.0	6.4	
◇	0.0	23.8	3.0	37.5	35.7	
▽	0.0	8.4	0.4	30.6	60.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NV	NP	3.1278	0.6605	0.4391	0.1928	0.1028	0.0833	0.68	7.93
□	NV	NP	2.1436	0.9879	0.7633	0.4317	0.2064	0.1185	1.59	8.33
△	NV	NP	1.9143	0.9776	0.7820	0.4853	0.2827	0.2009	1.20	4.87
◇	22.4	16.4	5.3259	0.1928	0.1276					
▽	22.4	18.3	0.2454							

	Material Description	USCS	AASHTO
○	Wet medium dense orange fine to coarse sand w/some fine gravel, trace of silt.	SP-SM	A-1-b
□	Wet medium dense orange coarse to fine sand w/some fine gravel, trace of silt.	SW-SM	A-1-b
△	Wet medium dense orange coarse sand w/some fine sand and fine gravel, trace of silt.	SP-SM	A-1-b
◇	Saturated firm gray clayey fine sandy fine gravelly silt w/trace of coarse sand.	SC-SM	A-4(0)
▽	Saturated stiff gray fine sandy silt w/some clay, trace of coarse sand and fine gravel.	CL-ML	A-4(0)

Project No. **Client:**

Project: Bridge 3-368 on Sycamore Road over Elliot Pond Branch

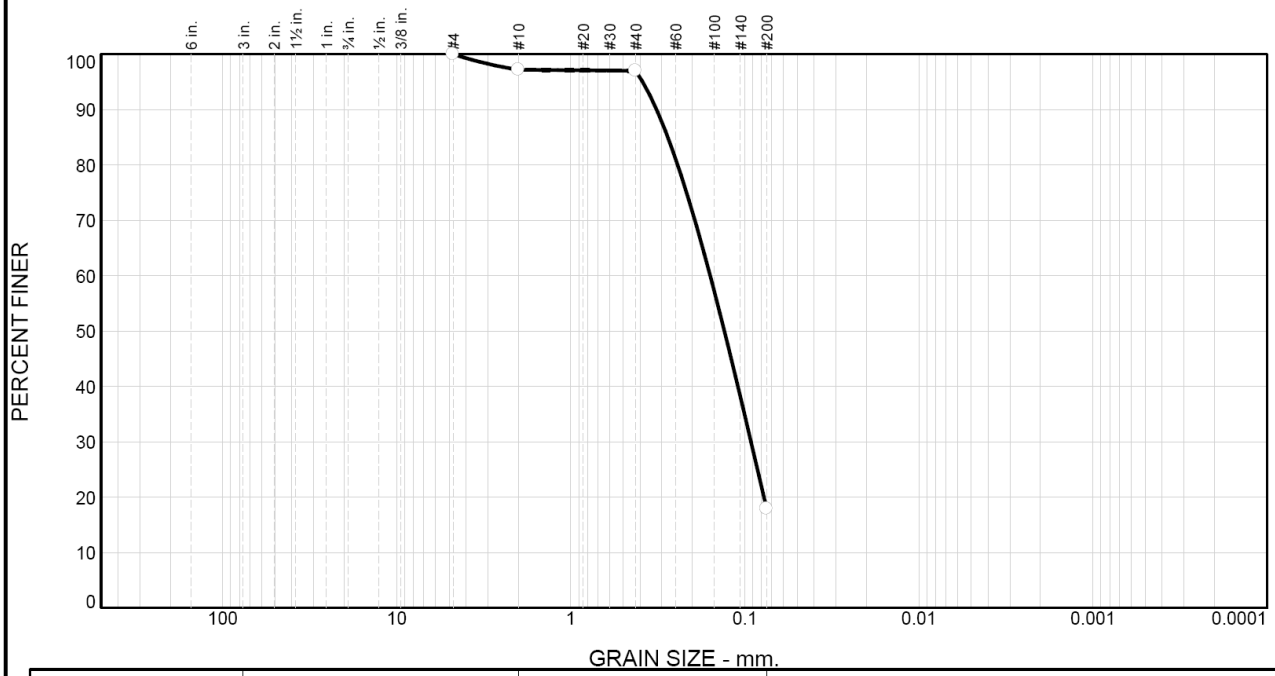
○ **Source of Sample:** SR # 1 **Depth:** 28.0 **Sample Number:** 12
□ **Source of Sample:** SR # 1 **Depth:** 33.0 **Sample Number:** 13
△ **Source of Sample:** SR # 1 **Depth:** 38.0 **Sample Number:** 14
◇ **Source of Sample:** SR # 1 **Depth:** 43.0 **Sample Number:** 15
▽ **Source of Sample:** SR # 1 **Depth:** 48.0 **Sample Number:** 16

Remarks:

Delaware Department of Transportation
Materials and Research Laboratory

Figure C-3

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	2.8	0.2	79.1	17.9	

LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
NV	NP	0.2770	0.1581	0.1310	0.0921				

Material Description	USCS	AASHTO
Saturated dense gray fine sand w/some silt, trace of fine gravel.	SM	A-2-4(0)

Project No. **Client:**

Project: Bridge 3-368 on Sycamore Road over Elliot Pond Branch

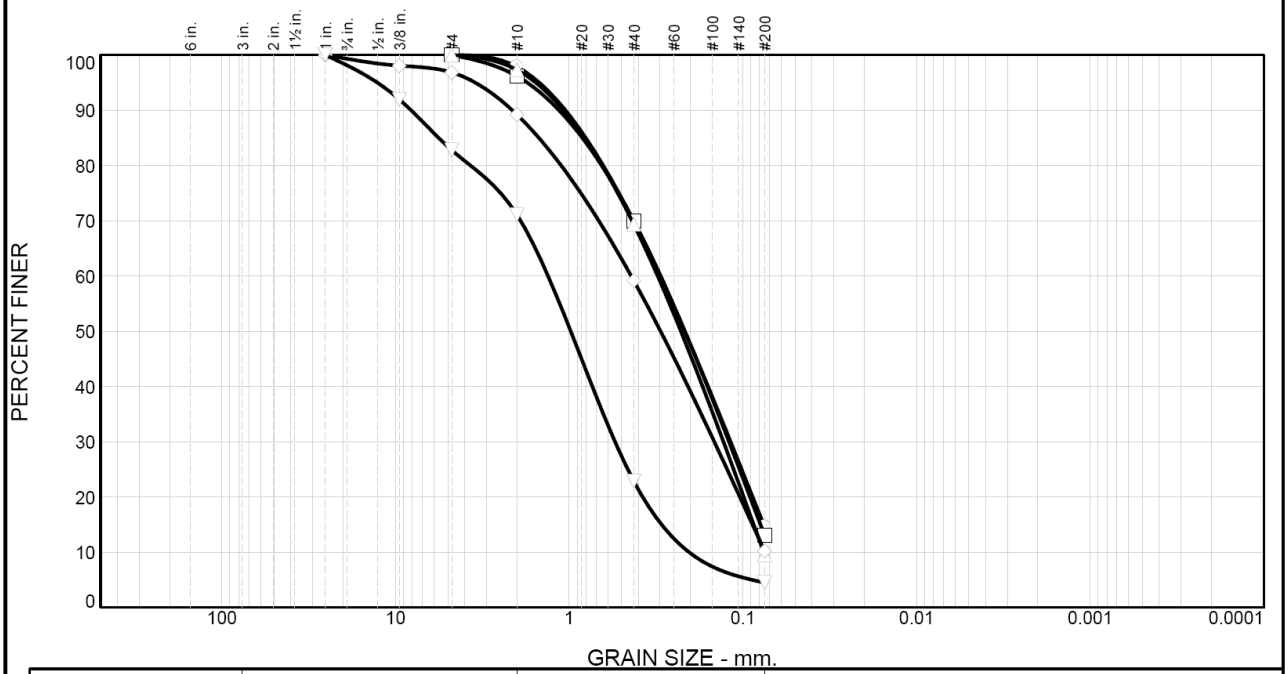
Source of Sample: SR # 1 **Depth:** 53.0 **Sample Number:** 17

Remarks:

Delaware Department of Transportation
Materials and Research Laboratory

Figure C-4

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	2.1	28.0	55.3	14.6	
□	0.0	3.8	26.2	57.0	13.0	
△	0.0	2.7	27.9	59.8	9.6	
◇	0.0	10.8	30.0	49.0	10.2	
▽	0.0	28.9	48.2	18.4	4.5	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NV	NP	0.8035	0.2996	0.2161	0.1177	0.0760			
□	NV	NP	0.8401	0.2974	0.2158	0.1202	0.0792			
△	NV	NP	0.8171	0.3095	0.2275	0.1294	0.0866	0.0759	0.71	4.08
◇	NV	NP	1.4943	0.4397	0.2979	0.1461	0.0880			
▽	NV	NP	5.6514	1.3238	0.9805	0.5450	0.2942	0.2043	1.10	6.48

	Material Description	USCS	AASHTO
○	Moist medium dense brown fine to coarse sand w/some silt, trace of fine gravel.	SM	A-2-4(0)
□	Moist very loose brown fine to coarse sand w/some silt, trace of fine gravel.	SM	A-2-4(0)
△	Wet loose gray fine to coarse sand w/trace silt and fine gravel.	SP-SM	A-3
◇	Wet medium dense gray fine to coarse sand w/some fine gravel, trace of silt.	SP-SM	A-3
▽	Wet medium dense gray fine gravelly coarse sand w/some fine sand, trace of silt.	SW	A-1-b

Project No. **Client:**

Project: Bridge 3-368 on Sycamore Road over Elliot Pond Branch

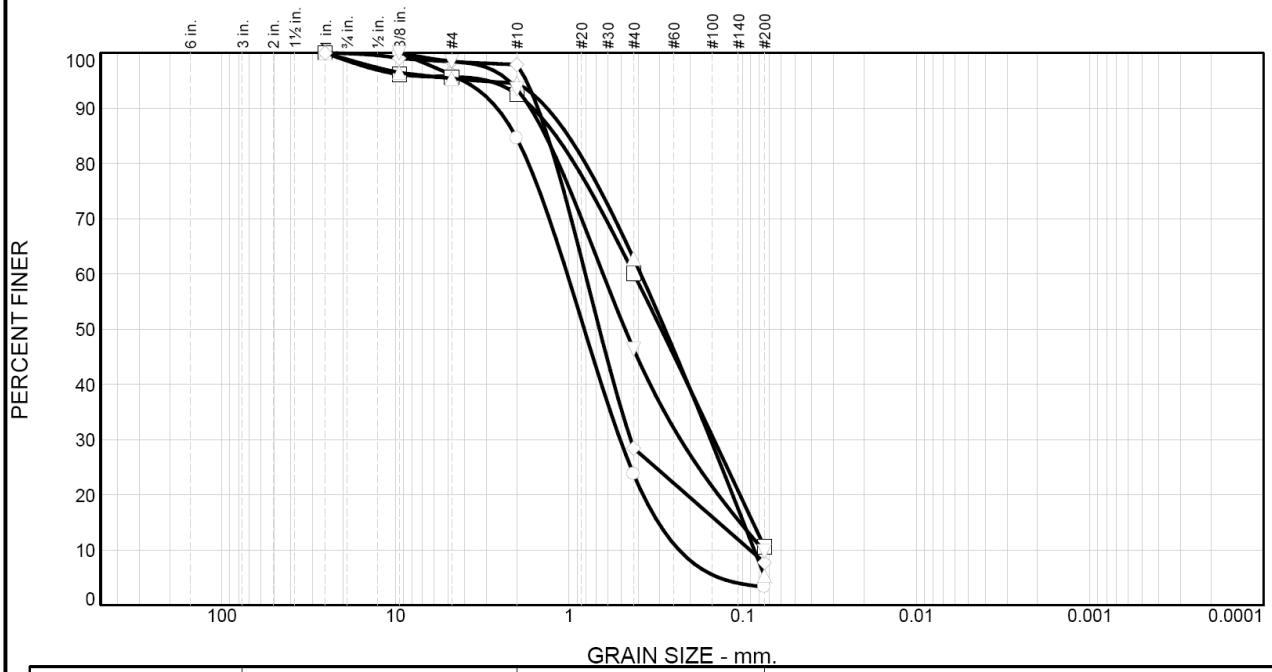
○ **Source of Sample:** SR # 2 **Depth:** 2.0 **Sample Number:** 1
□ **Source of Sample:** SR # 2 **Depth:** 4.0 **Sample Number:** 2
△ **Source of Sample:** SR # 2 **Depth:** 6.0 **Sample Number:** 3
◇ **Source of Sample:** SR # 2 **Depth:** 8.0 **Sample Number:** 4
▽ **Source of Sample:** SR # 2 **Depth:** 10.0 **Sample Number:** 5

Remarks:

Delaware Department of Transportation
Materials and Research Laboratory

Figure C-5

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	15.5	60.8	20.4	3.3	
□	0.0	7.5	32.4	49.5	10.6	
△	0.0	5.5	31.7	57.5	5.3	
◇	0.0	2.1	69.5	20.7	7.7	
▽	0.0	6.6	47.0	36.7	9.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NV	NP	2.0373	1.0258	0.8182	0.5083	0.3069	0.2328	1.08	4.41
□	NV	NP	1.1912	0.4237	0.2953	0.1464	0.0874			
△	NV	NP	1.0116	0.3873	0.2806	0.1531	0.0990	0.0857	0.71	4.52
◇	NV	NP	1.3319	0.8062	0.6689	0.4418	0.1380	0.0908	2.67	8.88
▽	NV	NP	1.3638	0.6380	0.4761	0.2282	0.1036	0.0764	1.07	8.35

Material Description	USCS	AASHTO
○ Wet medium dense brown coarse to fine sand w/some fine gravel, trace of silt.	SP	A-1-b
□ Wet medium dense brown fine to coarse sand w/some silt, trace of fine gravel.	SP-SM	A-2-4(0)
△ Wet medium dense brown fine to coarse sand w/trace silt and fine gravel.	SP-SM	A-3
◇ Wet medium dense brownish green coarse sand w/some fine sand, trace of silt and fine gravel.	SW-SM	A-1-b
▽ Wet medium dense orange coarse to fine sand w/trace fine gravel and silt.	SW-SM	A-1-b

Project No. **Client:**

Project: Bridge 3-368 on Sycamore Road over Elliot Pond Branch

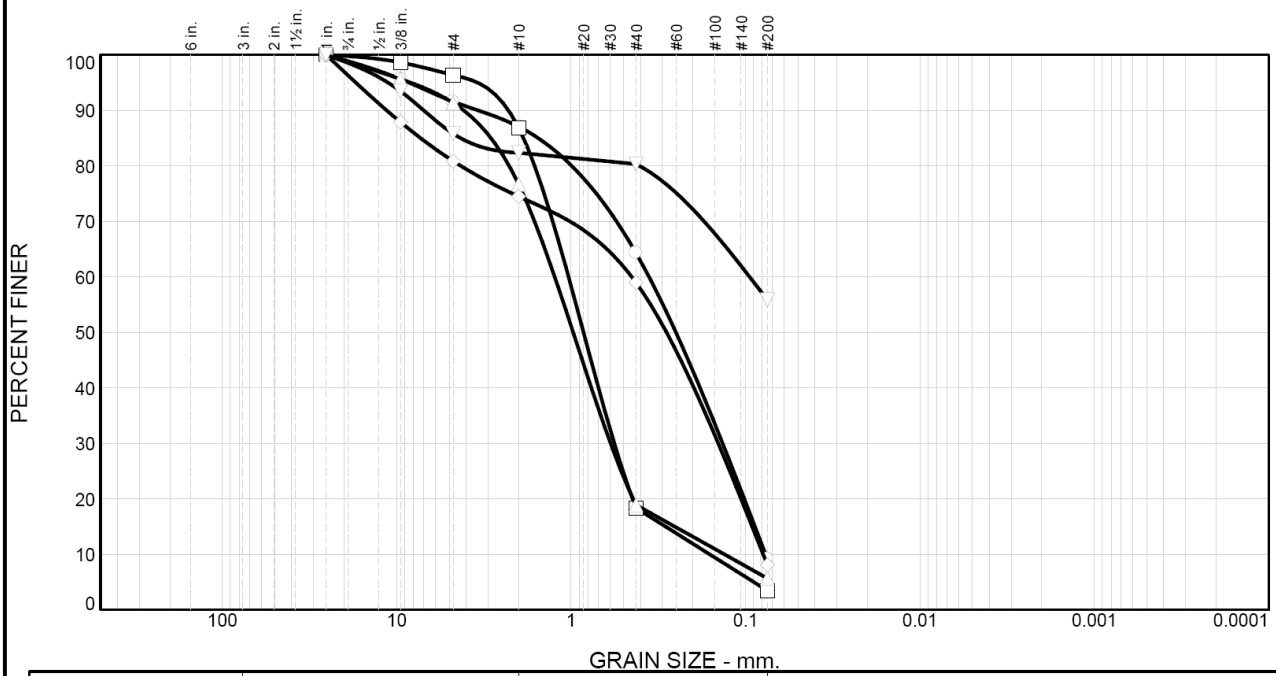
○ **Source of Sample:** SR # 2 **Depth:** 12.0 **Sample Number:** 6
□ **Source of Sample:** SR # 2 **Depth:** 14.0 **Sample Number:** 7
△ **Source of Sample:** SR # 2 **Depth:** 16.0 **Sample Number:** 8
◇ **Source of Sample:** SR # 2 **Depth:** 18.0 **Sample Number:** 9
▽ **Source of Sample:** SR # 2 **Depth:** 23.0 **Sample Number:** 10

Remarks:

Delaware Department of Transportation
Materials and Research Laboratory

Figure C-6

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	12.9	22.8	55.1	9.2	
□	0.0	13.1	68.6	14.8	3.5	
△	0.0	23.3	57.8	13.2	5.7	
◇	0.0	25.5	15.5	50.9	8.1	
▽	0.0	17.6	2.1	24.5	55.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NV	NP	1.5461	0.3578	0.2508	0.1354	0.0883	0.0768	0.67	4.66
□	NV	NP	1.8751	1.0352	0.8497	0.5658	0.2880	0.1608	1.92	6.44
△	NV	NP	2.8804	1.2427	0.9742	0.5944	0.2552	0.1324	2.15	9.38
◇	NV	NP	7.3065	0.4494	0.2840	0.1434	0.0917	0.0793	0.58	5.67
▽	26.7	17.5	4.3117	0.0948						

	Material Description	USCS	AASHTO
○	Wet medium dense orange fine to coarse sand w/some fine gravel, trace of silt.	SP-SM	A-3
□	Wet medium dense orange coarse sand w/some fine sand and fine gravel, trace of silt.	SW	A-1-b
△	Wet very dense brown fine gravelly coarse sand w/some fine sand, trace of silt.	SW-SM	A-1-b
◇	Wet dense gray fine gravelly fine sand w/some coarse sand, trace of silt.	SP-SM	A-3
▽	Wet very stiff gray clayey fine sandy silt w/some fine gravel, trace of coarse sand.	CL	A-4(2)

Project No. **Client:**

Project: Bridge 3-368 on Sycamore Road over Elliot Pond Branch

○ **Source of Sample:** SR # 2 **Depth:** 28.0 **Sample Number:** 11
□ **Source of Sample:** SR # 2 **Depth:** 33.0 **Sample Number:** 12
△ **Source of Sample:** SR # 2 **Depth:** 38.0 **Sample Number:** 13
◇ **Source of Sample:** SR # 2 **Depth:** 43.0 **Sample Number:** 14
▽ **Source of Sample:** SR # 2 **Depth:** 48.0 **Sample Number:** 15

Remarks:

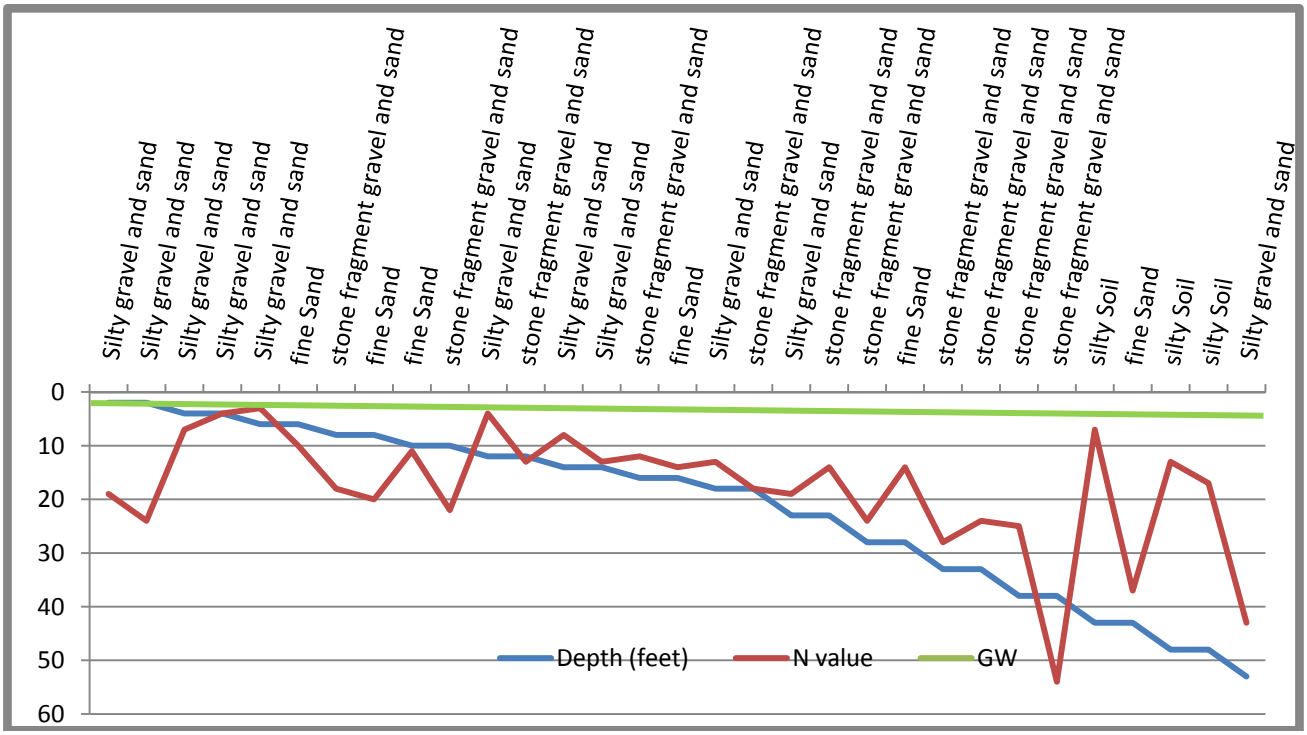
Delaware Department of Transportation
Materials and Research Laboratory

Figure C-7

APPENDIX D

- Summary of the Borings

Boring Number	Sample Number	Depth (feet)	Material description	AASHTO classification	USCS	Liquid limit	Plastic limit	Plasticity index	Percent less than the #4 sieve	Percent less than the #10 sieve	Percent less than the #200 sieve	Natural moisture %
SR # 1												
	1	0	No Sampling									
	2	2	Moist medium dense tan fine to coarse sand w/some silt.	A-2-4(0)	SP-SM	NV	NP	NP	100	99.7	10.8	3.2
	3	4	Moist loose tan fine to coarse sand w/some silt, trace of fine gravel.	A-2-4(0)	SM	NV	NP	NP	100	98.9	13.7	8.8
	4	6	Wet very loose tan fine sand w/some coarse sand and silt, trace of fine gravel.	A-2-4(0)	SM	NV	NP	NP	98.2	97.1	13.2	20.7
	5	8	Wet medium dense gray coarse to fine sand w/trace of fine gravel and silt.	A-1-b	SW-SM	NV	NP	NP	99.1	96	8.2	17.8
	6	10	Wet medium dense tan fine to coarse sand w/trace of silt and fine gravel.	A-3	SP-SM	NV	NP	NP	100	97.9	8.1	19.1
	7	12	Wet very loose brownish gray fine to coarse sand w/some silt, trace of fine gravel.	A-2-4(0)	SM	NV	NP	NP	99	98	16.2	21.9
	8	14	Wet loose brown fine to coarse sand w/some fine gravel and silt.	A-2-4(0)	SM	NV	NP	NP	90.6	84.6	18.7	20.2
	9	16	Wet medium dense brownish orange coarse to fine sand w/some silt, trace of fine gravel.	A-1-b	SP-SM	NV	NP	NP	97.3	91.3	10.6	22.1
	10	18	Wet medium dense brownish orange fine to coarse sand w/some silt, trace of fine gravel.	A-2-4(0)	SP-SM	NV	NP	NP	96.7	92.2	11.4	24.6
	11	23	Wet medium dense orange fine to coarse sand w/some silt, trace of fine gravel.	A-2-4(0)	SM	NV	NP	NP	96.8	91.1	13.4	22.2
	12	28	Wet medium dense orange fine to coarse sand w/some fine gravel, trace of silt.	A-1-b	SP-SM	NV	NP	NP	87.1	81.2	7.5	18.2
	13	33	Wet medium dense orange coarse to fine sand w/some fine gravel, trace of silt.	A-1-b	SW-SM	NV	NP	NP	95.3	83.4	7.7	18.9
	14	38	Wet medium dense orange coarse sand w/some fine sand and fine gravel, trace of silt.	A-1-b	SP-SM	NV	NP	NP	95	86.1	6.4	17.7
	15	43	Saturated firm gray clayey fine sandy fine gravelly silt w/trace of coarse sand.	A-4(0)	SC-SM	22.4	16.4	6	83	76.2	35.7	33.8
	16	48	Saturated stiff gray fine sandy silt w/some clay, trace of coarse sand and fine gravel.	A-4(0)	CL-ML	22.4	18.3	4.1	96.6	91.6	60.6	24.1
	17	53	Saturated dense gray fine sand w/some silt, trace of fine gravel.	A-2-4(0)	SM	NV	NP	NP	100	97.2	17.9	21.7
		55	End of Boring									
SR # 2												
		0	No Sampling									
	1	2	Moist medium dense brown fine to coarse sand w/some silt, trace of fine gravel.	A-2-4(0)	SM	NV	NP	NP	100	97.9	14.6	4.1
	2	4	Moist very loose brown fine to coarse sand w/some silt, trace of fine gravel.	A-2-4(0)	SM	NV	NP	NP	100	96.2	13	5.7
	3	6	Wet loose gray fine to coarse sand w/trace silt and fine gravel.	A-3	SP-SM	NV	NP	NP	100	97.3	9.6	17.8
	4	8	Wet medium dense gray fine to coarse sand w/some fine gravel, trace of silt.	A-3	SP-SM	NV	NP	NP	96.9	89.2	10.2	18.5
	5	10	Wet medium dense gray fine gravelly coarse sand w/some fine sand, trace of silt.	A-1-b	SW	NV	NP	NP	82.8	71.1	4.5	13.7
	6	12	Wet medium dense brown coarse to fine sand w/some fine gravel, trace of silt.	A-1-b	SP	NV	NP	NP	96	84.5	3.3	18.1
	7	14	Wet medium dense brown fine to coarse sand w/some silt, trace of fine gravel.	A-2-4(0)	SP-SM	NV	NP	NP	95.7	92.5	10.6	21.3
	8	16	Wet medium dense brown fine to coarse sand w/trace silt and fine gravel.	A-3	SP-SM	NV	NP	NP	95.4	94.5	5.3	22.9
	9	18	Wet medium dense brownish green coarse sand w/some fine sand, trace of silt and fine gravel.	A-1-b	SW-SM	NV	NP	NP	98.4	97.9	7.7	22
	10	23	Wet medium dense orange coarse to fine sand w/trace fine gravel and silt.	A-1-b	SW-SM	NV	NP	NP	98.5	93.4	9.7	21.8
	11	28	Wet medium dense orange fine to coarse sand w/some fine gravel, trace of silt.	A-3	SP-SM	NV	NP	NP	91.6	87.1	9.2	19.8
	12	33	Wet medium dense orange coarse sand w/some fine sand and fine gravel, trace of silt.	A-1-b	SW	NV	NP	NP	96.4	86.9	3.5	20.5
	13	38	Wet very dense brown fine gravelly coarse sand w/some fine sand, trace of silt.	A-1-b	SW-SM	NV	NP	NP	91.3	76.7	5.7	15.6
	14	43	Wet dense gray fine gravelly fine sand w/some coarse sand, trace of silt.	A-3	SP-SM	NV	NP	NP	80.9	74.5	8.1	17.4
	15	48	Wet very stiff gray clayey fine sandy silt w/some fine gravel, trace of coarse sand.	A-4(2)	CL	26.7	17.5	9.2	85.8	82.4	55.8	19.9
		50	End of Boring									

APPENDIX E

- Figures and Chart