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A	Site Plan Permitting	12/21/22	KNW	LRM	

Change Log		
Ørsted Revision	**Location**	**Brief description of change**
A		Site Plan Permitting

Table of Contents

RDS-PP: #OCW01=X11UBA&CDD; #OCW01=X19UBA&CDD

Stormwater Management Report

prepared for

Ocean Wind 1, an Orsted & PSEG Project

BLW01 Offshore Wind Farm Substation
900 North Shore Road
Upper Township, New Jersey

Project No. 142147

Revision A
12/21/2022

prepared by

Burns & McDonnell Engineering Company, Inc.
Morristown, New Jersey

INDEX AND CERTIFICATION

Ocean Wind 1, an Orsted & PSEG Project
Stormwater Management Report
Project No. 142147

Report Index

Certification

I hereby certify, as a Professional Engineer in the State of New Jersey, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by the Ocean Wind 1, an Orsted & PSEG Project or others without specific verification or adaptation by the Engineer.

Kevin N. Warrender, P.E.
License # 24GE04640900

Date: ____________________

Additional reference information provided by others and not certified by the above sealing Engineer.

Section Number	Section Title
Appendix D	FEMA Flood Insurance Rate Map
Appendix E	Web Soil Survey Report
Appendix F	NJ-GeoWeb Data
Appendix H	Geotechnical Engineering Report

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LIST OF ABBREVIATIONS

Abbreviation	**Term/Phrase/Name**
AC	Acres
BMP	Best Management Practice
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
CFS	Cubic Feet per Second
CN	Curve Number
DRC	Dynamic Reactive Compensation
EDA	Existing Drainage Area
FIRM	Flood Insurance Rate Map
FT	Feet
GRV	Groundwater Recharge Volume
HUC	Hydrologic Unit Code
LOD	Limit of Disturbance
LF	Linear Feet
MTD	Manufactured Treatment Device
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
PDA	Proposed Drainage Area
SESC	Soil Erosion and Sediment Control
SF	Square Feet
SWM	Stormwater Management
TSS	Total Suspended Solids

Abbreviation	**Term/Phrase/Name**
AC	Acres
BMP	Best Management Practice
USACE	United States Army Corps of Engineers
USDA/NRCS	United States Department of Agriculture / National Resources Conservation Service
USGS	United States Geological Survey
WQ	Water Quality

1.0 PROJECT OVERVIEW

1.1 Location and Project Summary

The intent of this project is to construct a new substation at the BL England Substation facility to accommodate the 1.1 gigawatt (GW) offshore wind farm located off the coast of Atlantic City, New Jersey. The proposed substation improvements will collect wind turbine partial outputs from the offshore wind farm using sub-sea cables. The generated wind turbine power will then be transferred to the existing Atlantic City Energy substation located northeast of the proposed improvements. The Project Site (Site) is located at 900 North Shore Road in Upper Township, Cape May County, New Jersey. Refer to Figure 1-1: USGS General Vicinity Map.

The site is surrounded by wetlands on the west and south of the project location and by an existing substation facility on the north. Existing railroad tracks to remain are to the east of the site. An existing golf course is located to the southeast. The site is located adjacent to the Great Egg Harbor Bay and is subject to tidal flooding.

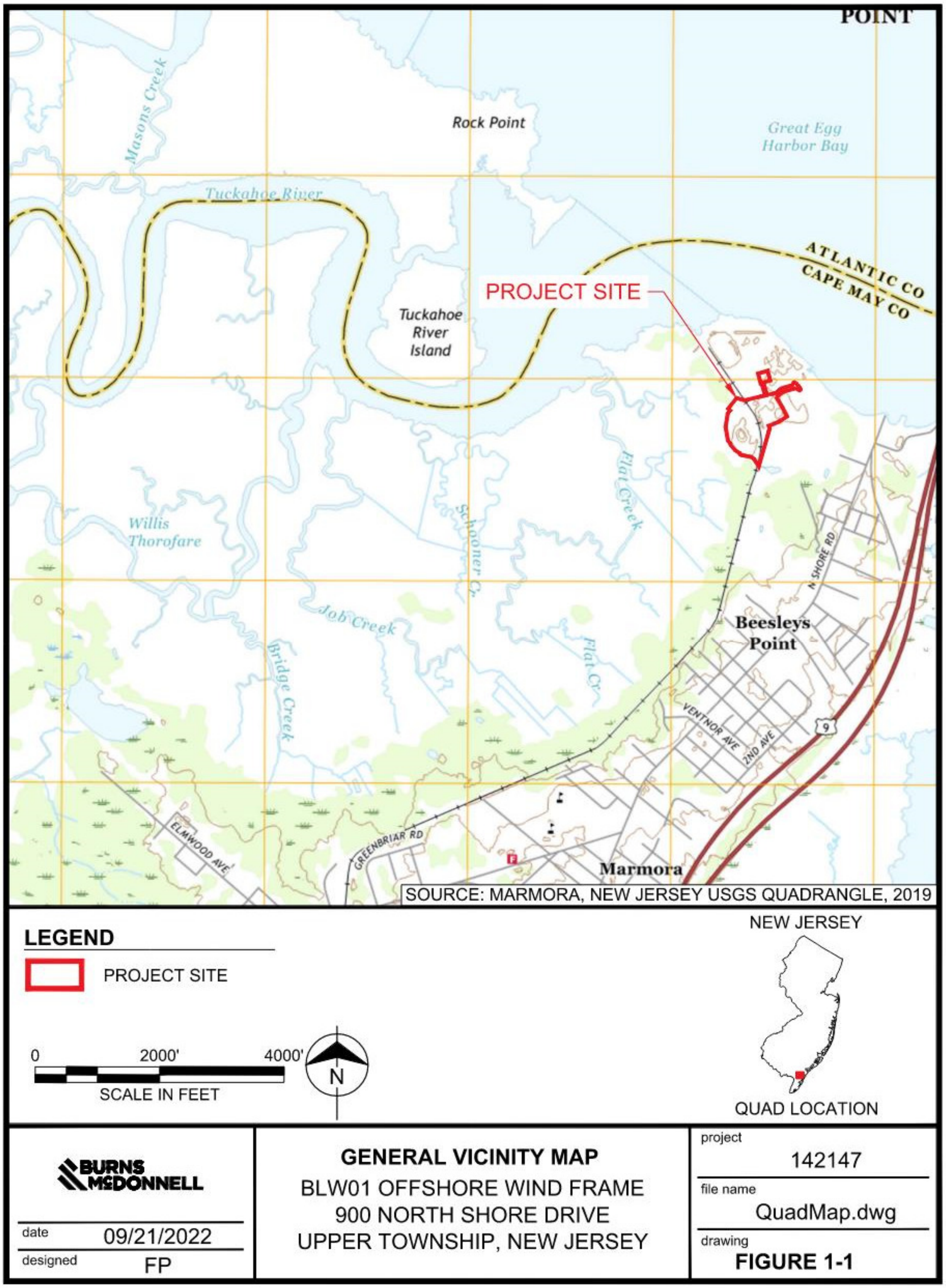
Stormwater runoff in existing conditions is collected by a perimeter trench wall and pumped to a water treatment facility or is collected by inlets located along the existing rail tracks. The pre-existing condition of the site was a coal farm and has been modeled in our report and calculations as impervious.

Post-development conditions include a 5,665 SF Dynamic Reactive Compensation (DRC) building and a 7,100 SF control house building, paved roadways, a gravel substation yard, transformers, various electrical equipment, and grass swales for conveyance. The post-development improvements will result in a decrease of impervious surface. In accordance with NJDEP Stormwater Management Rules (N.J.A.C. 7:8), a site with a decrease in impervious surface complies with the requirements for groundwater recharge. Furthermore, a site located within a tidal area is not subject water quantity reduction by providing an analysis showing that overall flows have been decreased. However, because the site is adding a regulated motor vehicle surface greater than 0.25 acres, water quality must be provided in accordance with the Stormwater Management Rules.

A hydrologic model was developed to evaluate the pre- and post-development drainage conditions of the Site for the 2-, 10-, and 100-year design frequency storm events. The results of the analysis indicate that there is no increase in peak discharge rates in post-development conditions from pre-development conditions. The analyses summary, results, and model output are located in further sections.

The limit of disturbance (LOD) area is approximately 16.82 acres and covers the existing site as well as a section of the existing substation facility as well as the temporary laydown area. There are 16.04 acres of existing impervious surfaces and 15.28 acres of proposed impervious surfaces including gravel areas; therefore, there is a total decrease of 0.76 acres of impervious surface associated with the project.

Figure 1-1: General Vicinity Map



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1.2 Existing Conditions Survey Information

An existing conditions survey was performed by PSE&G Services Corporation – Surveys and Mapping in June 2022. The survey was used as a base throughout the analysis and design of the site plans and this Stormwater Management Report. The Site's horizontal and vertical datum are as follows:

- Horizontal datum: NAD83 NJ83F
- Vertical Datum: NAVD88

1.3 Soils

A desktop review of the Natural Resources Conservation Service (NRCS) Web Soil Survey revealed four soil types present on site as listed below in table 1.1. The Web Soil Survey information gathered from the desktop review is provided in Appendix F.

Table 1-1: NRCS Web Soil Survey Data

Map Unit Symbol	Map Unit Name	Hydrologic Soil Group	Percent of Site
BEXAS	Berryland and Mullica soils, 0 to 2 percent slopes, occasionally flooded	A/D	0.3%
PdwAv	Pawcatucks – Transquaking complex, 0 to 1 percent slopes, very frequently flooded	D	3.0%
UdrB	Udorthents, refuse substratum, 0 to 8 percent slopes	B	35.2%
UR	Urban Land	-	61.5%

1.4 Floodplain

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), Map No. 34009C0067F, the Project Site is located in Zone 'AE' and Zone 'X'. Zone 'AE' is identified as Special Flood Zone Area with a base flood elevation (BFE) between 8 feet and 9 feet. Zone 'X' is identified as an area with 0.2% annual chance flood hazards, areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile. With the removal of part of the existing trench wall, we have designed the new substation area as if it were located in Zone 'AE'. The FIRMETTE can be found in Appendix D.

1.5 Wetlands

Wetlands are identified on the drawings delineated by HDR and are located along the southern and western boundaries of the project site. They are identified as Saline Marsh (low marsh) on the NJ-GeoWeb Data Server. A map showing this information is provided in Appendix G.

1.6 Watercourses and Receiving Surface Waters

The site is located in the Great Egg Harbor Watershed, HUC 14: 02040302070120. The east portion of the site is part of the Patcong Creek / Great Egg Harbor Bay Watershed, HUC 11: 02040302060, while the west portion of the site is part of the Tuckahoe River Watershed, HUC 11: 02040302070. The east portion drains directly into the Great Egg Harbor Bay. The west portion drains to the Tuckahoe River prior to reaching the Great Egg Harbor Bay, which ties into the Atlantic Ocean. A map was generated using the NJ-GeoWeb Data Server showing water courses, receiving waters, and HUC limits and is provided in Appendix G.

2.0 HYDROLOGY AND HYDRAULICS

2.1 Design Criteria

The site was analyzed for compliance with the New Jersey Stormwater Management Rules N.J.A.C. 7:8, the New Jersey Department of Environmental Protection (NJDEP) Stormwater Best Management Practice Manual, 2004 (BMP Manual); Section 19-7.7: Stormwater Control Ordinance for Township of Upper; and the Standards for Soil Erosion and Sediment Control in New Jersey Manual, 2017 (SESC Manual). The development of the Site and compliance with the stormwater rules results in a decrease in impervious surface and a reduction of flows for the site.

N.J.A.C. 7:8-1.6 requires that all major developments comply with the New Jersey Stormwater Management Regulations. A Major Development is defined as a development which ultimately disturbs one or more acres of land or creates one-quarter of an acre or more of regulated impervious surface and/or regulated motor vehicle surface.

The proposed construction will decrease overall impervious cover by more than one-quarter of an acre but will create more than one acre of land disturbance and therefore is considered a major development. In addition it will add more than ¼ acre of regulated motor vehicle surface area which will require compliance with Water Quality provisions. The proposed activity will require a Request for Authorization (RFA) for coverage under New Jersey’s Stormwater Management Discharge General Permit NJ0088323, due to the disturbance of more than one (1) acre. The RFA is issued by NJDEP and coordinated with the Cape Atlantic Soil Conservation District.

2.1.1 Water Quantity

The stormwater runoff quantity standards per N.J.A.C 7:8-5.6 require reductions for the 2-year, 10-year and 100-year storm events. The post-development peak runoff rates for the 2-yr, 10-yr, and 100-yr storm events shall not exceed 50%, 75%, and 80%, respectively, of the pre-development peak runoff rates for the area of the site proposed for improvement. However, in a tidal flood hazard area, stormwater runoff quantity requirements can be waived when the hydrologic and hydraulic analysis demonstrates the site improvements will not result in additional flood damage below the point of discharge. The project will reduce overall stormwater runoff and peak rates and therefore will not increase flood damage potential below the point of discharge. This is achieved by reducing overall site impervious areas and using grass swales to convey stormwater. See Section 2.3 for detailed calculations on how N.J.A.C. 7:8-5.6 is met by reducing pre- to post-development runoff.

2.1.2 Water Quality

The stormwater runoff quality standards per N.J.A.C 7:8-5.5 require the reduction in post-development load of total suspended solids (TSS) in stormwater runoff generated from the water quality storm event. It is required to reduce TSS by 80% of the net increase of motor vehicle surface generated by the water quality storm event: 1.25 inches of rainfall in two-hours. Water quality will be provided in the form of grass swales collecting the runoff from the impervious surfaces of the Site and conveying them to one of four (4) separate Water Quality manufactured treatment devices (MTS) located at the ends of each swale. These devices will used to treat the impervious and motor vehicle surface areas of the main substation.

The grassed areas outside of the substation will be graded to drain into the swales which will carry the stormwater to the water quality devices.

2.1.3 Groundwater Recharge

The Ground Water Recharge standards per N.J.A.C. 7:8-5.4 indicate that groundwater recharge volume (GRV) is determined based on the increase of stormwater runoff volume from pre-construction to post-construction for the 2-year storm event. The proposed development will decrease impervious surface and reduce runoff during the 2-year storm event, as such groundwater recharge requirements are met.

2.2 Methodology and Design Data

2.2.1 Rainfall Data

The Region C rainfall depths provided in Table 2-3 are referenced from the NOAA Atlas 14 National Weather Service Hydrometeorological Design Studies Center, Precipitation Frequency Data Server. These values are used for calculating runoff for the corresponding storm event.

Table 2-1: 24-Hour Rainfall Depths

Storm Event (Year)	Rainfall (Inch)
2	3.37
10	5.25
25	6.58
100	9.06

2.2.2 Runoff Data

The stormwater runoff calculations were completed using the USDA NRCS/SCS TR-20 runoff curve method in HydroCAD modeling software. Pervious and impervious surfaces were split into separate hydrographs as required in the NJ BMP Manual. The input values that were used in the HydroCAD model are provided in the tables below.

Times of Concentration (Tc) calculations produced times less than the minimum 10 minutes; therefore, the minimum 10 min Tc will be used for all sub-drainage area runoff calculations.

Table 2-2 provides the Runoff Curve Numbers, CN for the SCS method for the various surface conditions present and proposed on the site. As mentioned previously, the soils present on site vary between Hydrologic Soil Group B, D, A/D, and Urban Land where a type D is assumed for the purpose of these calculations. The CN values are referenced from TR-55, Table 2-2a & 2-2c.

Table 2-2: Runoff Curve Number (CN) for SCS Method

Land Use	CN
Open Space, Lawn, Good Condition (B)	61
Wooded Land, Good Condition (B)	55
Wooded Land, Good Condition (D)	77
Gravel	85
Impervious: Pavement, Roof	98

The following tables provide the surface area conditions used to analyze the site. Table 2-3 provides the surface area conditions of the pre-developed site and Table 2-4 provides the post-development conditions.

Table 2-3: Pre-Development Areas

Subarea	Area (ac)	Curve Number*	Time of Concentration (Minutes)
EDA-1 (Impervious)	6.83	98	10
EDA-1 (Pervious)	0.29	63	10
EDA-2 (Impervious)	7.40	98	10

*Curve numbers are weighted in HydroCAD based on surface type and soil type

Table 2-4: Post-Development Areas

Subarea	Area (ac)	Curve Number*	Time of Concentration (Minutes)
PDA-1A (Impervious)	1.25	88	10
PDA-1A (New Drivable Impervious)	0.59	98	10
PDA-1A (Pervious)	0.16	61	10
PDA-1B (Impervious)	0.99	86	10
PDA-1B (New Drivable Impervious)	0.15	98	10
PDA-1B (Pervious)	0.31	61	10
PDA-1C (Impervious)	1.23	86	10
PDA-1 (New Drivable Impervious)	0.16	98	10
PDA-1C (Pervious)	0.07	61	10
PDA-1D (Impervious)	0.75	85	10
PDA-1D (New Drivable Impervious)	0.22	98	10
PDA-1D (Pervious)	0.20	61	10
PDA-2A (Impervious)	0.12	98	10
PDA-2A (Pervious)	0.37	65	10
PDA-2B (Impervious)	0.07	98	10
PDA-2B (Pervious)	0.29	58	10
PDA-3 (Impervious)	7.59	98	10

*Curve numbers are weighted in HydroCAD based on surface type and soil type

Stormwater Management Plans delineating these areas are provided in Appendix A and Hydrograph reports are provided in Appendix B.

2.3 Runoff Quantity Calculations

Runoff quantity calculations were prepared to demonstrate the reduction in runoff for all storm events resulting from the decrease in impervious surface.

A summary of the peak runoff results is provided in Table 2-5. The full HydroCAD report is provided in Appendix B.

Table 2-5: Total Site Runoff Summary

Storm Event (Yrs)	Pre-Development Runoff (CFS)	Post-Development Runoff (CFS)	Runoff Reduction (Pre – Post) (CFS)
2	43.54	37.52	6.02
10	68.57	62.36	6.21
100	119.31	113.36	5.95

2.4 Grass Swales

Proposed drainage areas PDA-1A, -1B, -1C and -1D will sheet flow into grass swales and convey runoff from the new gravel areas to new Water Quality MTDs located at the downstream ends of each swale.

Swales were size using AutoCADD Hydraflow Express, Trapezoidal Channels. Each swale has a 2 feet wide flat bottom and is 1.5 feet in height with 3:1 side slopes. The maximum allowable velocity in the grass channel is referenced from the SESC Manual, *Table 11-1: Allowable Velocity for Various Soil Textures.* For loam soils, the maximum allowable velocity is 3.0 fps. Calculations are provided in Appendix C.

Table 2-6: Grass Swales

	25-YR Design Storm			**100-YR Design Storm**		
Swale ID	Q CFS	Velocity FT/S	Depth FT	Q CFS	Velocity FT/S	Depth FT
Swale 1	5.66	1.97	0.7	8.03	2.15	0.83
Swale 2	6.5	2.17	0.72	9.47	2.4	0.86
Swale 3	8.61	2.11	0.88	12.42	2.3	1.05
Swale 4	5.73	1.83	0.74	8.45	2.03	0.89

2.5 Manufactured Treatment Devices (MTD)

To provide 80% TSS reduction from the new regulated motor vehicle surfaces, Water Quality MTDs will be installed at the downstream ends of each swale. The basis of design manufactured treatment devices will be Aqua-Ponic Biofiltration Systems as manufactured by AquaShield, Inc. The Aqua-Ponic Biofiltration System has been certified by the NJDEP for its TSS removal and sized for the drainage areas that each will provide treatment for.

Table 2-7: Water Quality Flows and Drainage Areas

Drainage Area ID	**MTD ID**	**Required WQ Flow (CFS)**	**Treated WQ Flow (CFS)**	**Contributing Drainage Area (AC)**	**Aqua-Ponic Device**
PDA-1A	MTD-1	1.52	2.07	2.00	AP-13
PDA-1B	MTD-2	0.39	1.21	1.45	AP-11
PDA-1C	MTD-3	0.41	1.72	1.45	AP-12
PDA-1D	MTD-4	0.57	1.11	1.16	AP-10

2.6 Pipe Conveyance

Pipes will be used to convey runoff from the overflow inlet located downstream of each WQ device. The MTDs are designed to collect and treat the WQ volume and bypass greater storm events over the top of the MTD structure to the bypass inlets. The discharge pipes from the MTD are standard sized by the manufacturer and tie into the overflow structure. The overflow structures convey to the two (2) outlet points that discharge to the wetlands. PDA-1 discharges to the north and PDA-2, -3 and -4 discharge to the south. Both outlet points are protected with riprap outlet protection as noted below. Pipe calculations are provided in Appendix C.

2.7 Outlet Protection

New outfall will be constructed to discharge collected runoff to the existing wetlands. Riprap outlet protection will be installed to prevent erosion from the concentrated discharge from the pipes. The outlet protection has been sized in accordance with the NJDEP Erosion and Sediment Control Manual, current edition. Sizing calculations are provided in Appendix C.

3.0 BEST MANAGEMENT PRACTICES

The proposed Stormwater Management System contains Best Management Practices (BMPs) that will, if maintained properly, provide treatment of site generated stormwater runoff. The proposed BMPs are described below. An Operation and Maintenance Plan for post-development site conditions is provided in Appendix G.

3.1 Erosion Control Measures

During construction the contractor will follow the Erosion and Sediment Control Plan for temporary erosion control measures, which are detailed on the E&S plan. These measures will protect existing drainage features and vegetation during construction:

- Stabilized Construction Entrance
- Inlet Protection
- Silt Fence
- Stabilized Stockpile
- Temporary Seeding and Stabilization

Erosion control measures will be designed and constructed in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey. Permanent erosion control measures will be necessary upon the completion of construction and the site will be stabilized by one or more of the following measures:

3.1.1 Permanent Seeding

Any disturbed area not proposed as an impervious or gravel surface will be restored to natural grass vegetation over 4” of topsoil. Planting and mulching of permanent seed will occur as soon as practical after final grading, placement of topsoil, and soil preparation has been completed. Seeding will occur during the growing season. Slopes will be protected with an erosion control blanket to enhance the slopes performance against erosion.

3.2 Manufactured Treatment Devices (MTD)

The MTDs shall require maintenance in accordance with the manufacturer’s Inspection and Maintenance Manual provided as part of the Operation and Maintenance Plan in Appendix G.

3.3 Grass Swales

Grass swales will be used for conveying runoff to the MTDs. They are not designed to provide treatment, however, they do discharge directly to the MTDs and care shall be taken to maintain the swales to function properly.

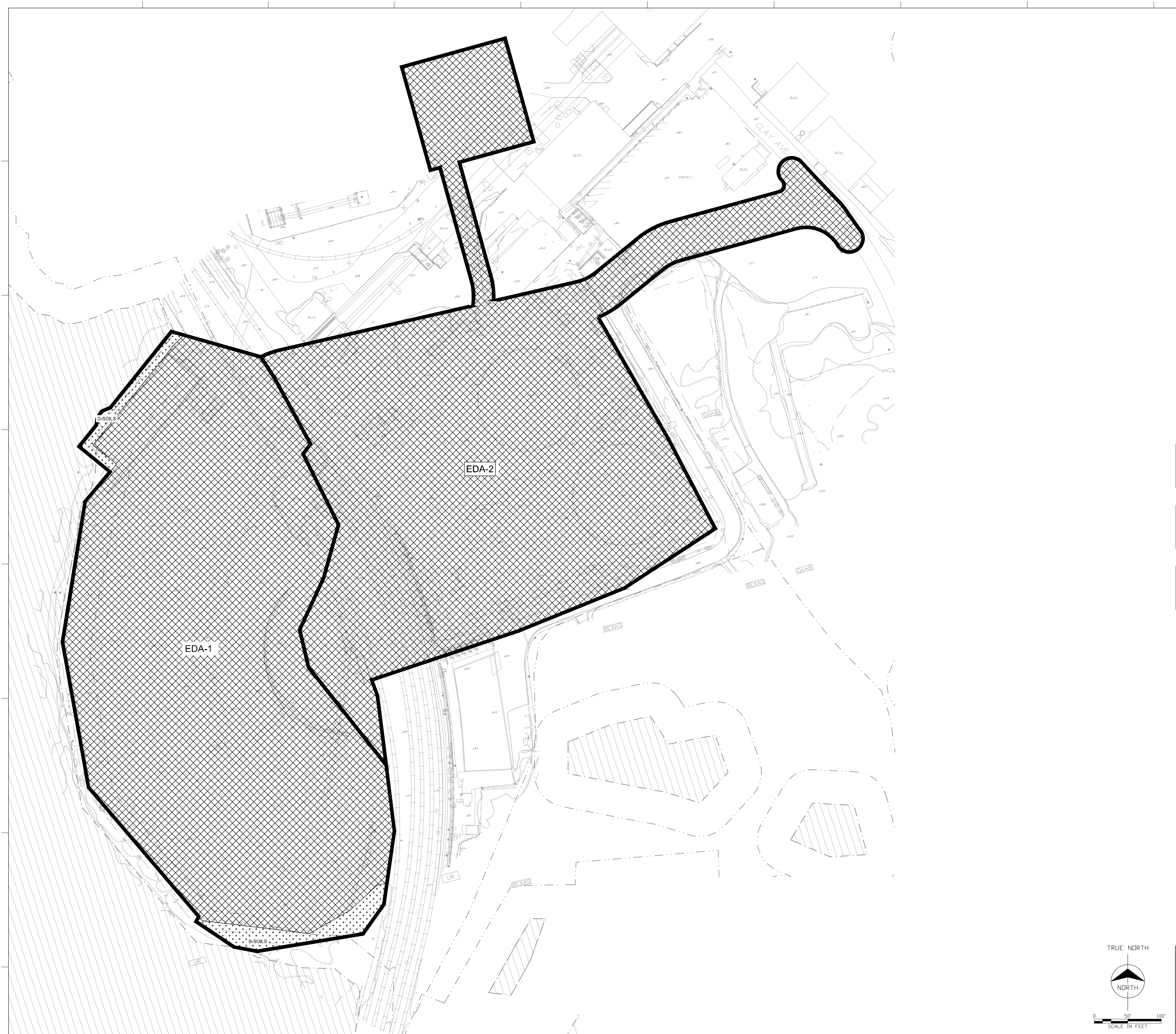
3.4 Riprap Outlet Protection

The pipe outlets will implement a riprap apron designed and sized in accordance with NJDEP Erosion and Sediment Control Manual, current edition. The outlet protection apron is detailed on the plans. The use of the apron protects from erosion and scouring at this location.

4.0 CONCLUSION

The proposed development project does not increase stormwater flows to existing site features due to the decrease in impervious surface at the site. Additionally, the project is located within a tidal flood hazard zone. Lastly, stormwater flows from the new regulated motor vehicle surface areas will be collected and treated with new manufactured treatment devices. As a result of these characteristics, the project meets the criteria for addressing groundwater recharge, water quantity, and water quality respectively per the NJDEP Stormwater BMP Manual and Stormwater Management Rules NJAC 7:8.

APPENDIX A - STORWMATER MANAGEMENT PLANS



LEGEND

EDA-1	DRAINAGE AREA ID
▨	ASPHALT
⁘	WOODS

Pre-Development Areas

EDA-1

Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious	297,438	6.83	98
Wodded (B)	8,104	0.19	55
Wooded (D)	4,246	0.10	77
Total	309,788	7.11	

EDA-2

Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious	322,237	7.40	98
Wodded (B)	0	0.00	55
Wooded (D)	0	0.00	77
Total	322,237	7.40	

TOTAL

Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious	619,675	14.23	98
Wodded (B)	8,104	0.19	55
Wooded (D)	4,246	0.10	77
Total	632,025	14.51	

BURNS McDONNELL

THE REGISTRANT OF THE NEWLY APPLIED SEAL ASSUMES RESPONSIBILITY FOR THE CHANGES AS INDICATED BY THE FOLLOWING REVISION NUMBER C.

KEVIN N. WARRENDER
N.J. PROFESSIONAL ENGINEER
LIC. NO. 24GE04640900
C.O.A. NO. 24GA28066400

Rev.	Date	Accep.	Appr.	Description
C	02DEC2022	LMG	KNW	NJDEP SUBMITTAL

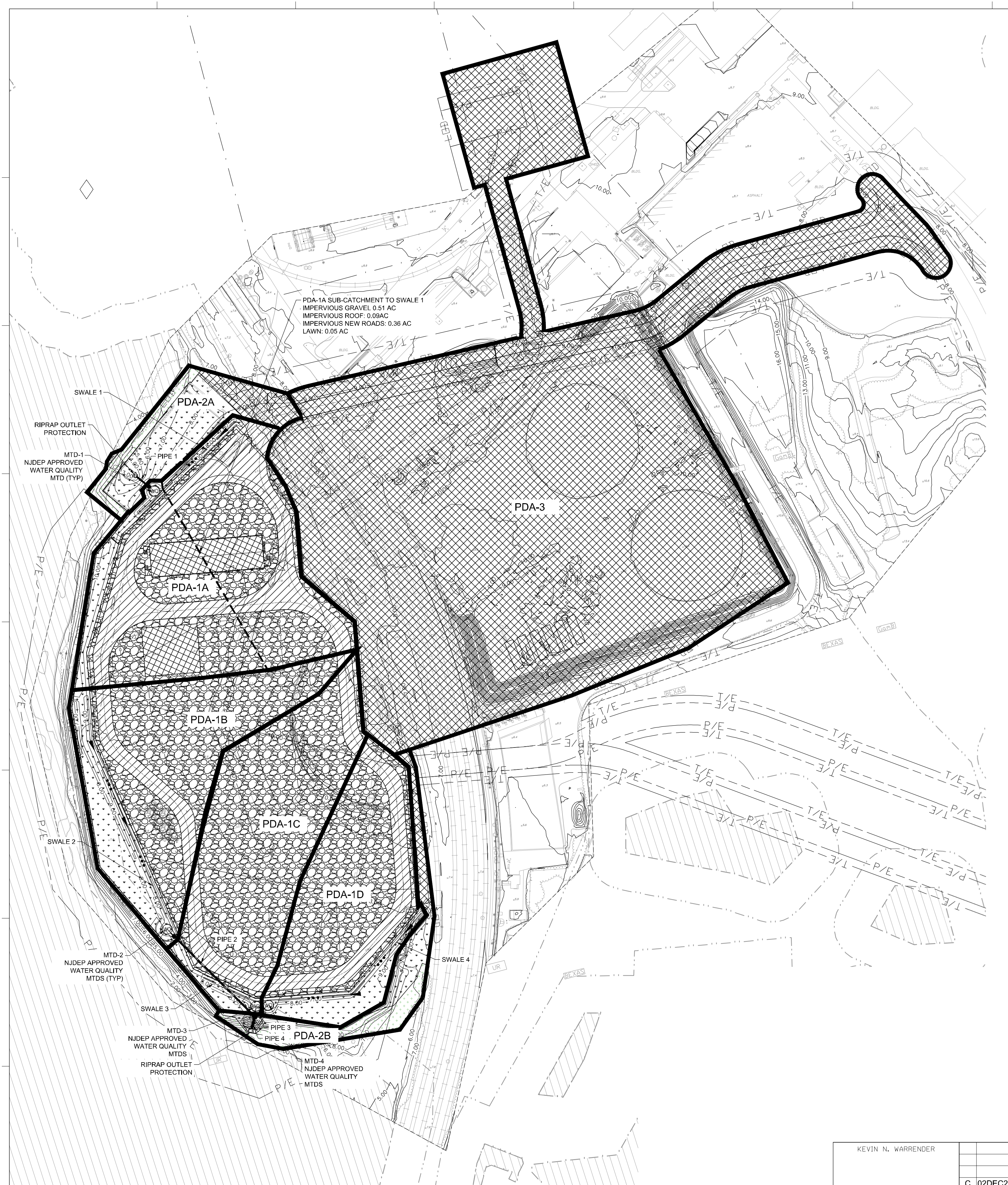
OCW01 OFFSHORE WIND FARM - BL ENGLAND
PRE-DEVELOPMENT STORMWATER MANAGEMENT PLAN

CIVIL

Ocean Wind 1
An Ørsted & PSEG project

Drawn by 02-DEC-2022 SMC	Accepted 02-DEC-2022 KNW	Approved 02-DEC-2022 LRM
Scale 1" = 50'	Size 34X44	Ørsted Document No. 07845287 Rev.:

Supplier
Supplier Document No. & Rev.
PSEG Dwg No.
Rev.: C
RDS-PP code



Post-Development Areas

PDA-1A

Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious-Gravel (B)	41,174	0.95	85
Impervious-Roofs & Unchanged	13,271	0.30	98
Impervious-New Roads	25,643	0.59	98
Wodded (B)	0	0.00	55
Wodded (D)	0	0.00	77
Lawn (B)	7,070	0.16	61
Total	87,158	2.00	

PDA-1B

Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious-Gravel (B)	41,390	0.95	85
Impervious-Roofs & Unchanged	1,541	0.04	98
Impervious-New Roads	6,491	0.15	98
Wodded (B)	0	0.00	55
Wodded (D)	0	0.00	77
Lawn (B)	13,665	0.31	61
Total	63,087	1.45	

PDA-1C

Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious-Gravel (B)	52,971	1.22	85
Impervious-Roofs & Unchanged	430	0.01	98
Impervious-New Roads	6,880	0.16	98
Wodded (B)	0	0.00	55
Wodded (D)	0	0.00	77
Lawn (B)	3,040	0.07	61
Total	63,321	1.45	

PDA-1D

Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious-Gravel (B)	32,779	0.75	85
Impervious-Roofs & Unchanged	0	0.00	98
Impervious-New Roads	9,431	0.22	98
Wodded (B)	0	0.00	55
Wodded (D)	0	0.00	77
Lawn (B)	8,516	0.20	61
Total	50,726	1.16	

PDA-2A

Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious-Gravel (B)	0	0.00	85
Impervious-Roofs & Unchanged	5,119	0.12	98
Impervious-New Roads	0	0.00	98
Wodded (B)	0	0.00	55
Wodded (D)	4,067	0.09	77
Lawn (B)	12,013	0.28	61
Total	21,199	0.49	

PDA-2B

Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious-Gravel (B)	0	0.00	85
Impervious-Roofs & Unchanged	3,085	0.07	98
Impervious-New Roads	0	0.00	98
Wodded (B)	7,020	0.16	55
Wodded (D)	0	0.00	77
Lawn (B)	5,835	0.13	61
Total	15,940	0.37	

PDA-3

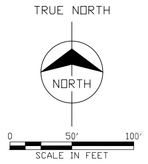
Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious-Gravel (B)	0	0.00	85
Impervious-Roofs & Unchanged	330,591	7.59	98
Impervious-New Roads	0	0.00	98
Wodded (B)	0	0.00	55
Wodded (D)	0	0.00	77
Lawn (B)	0	0.00	61
Total	330,591	7.59	

TOTAL

Surface Cover	**Area (SF)**	**Area (AC)**	**CN**
Impervious-Gravel (B)	168,314	3.86	85
Impervious-Roofs & Unchanged	354,037	8.13	98
Impervious-New Roads	48,445	1.11	98
Wodded (B)	7,020	0.16	55
Lawn (B)	4,067	0.09	61
Total	632,022	14.51	

LEGEND

PDA-1A	DRAINAGE AREA ID
▨	NEW ROADS
▩	IMPERVIOUS
▦	GRAVEL
⋯	LAWN
+	WOODS



OCW01 OFFSHORE WIND FARM - BL ENGLAND
POST DEVELOPMENT STORMWATER MANAGEMENT PLAN

CIVIL

Ocean Wind 1
An Ørsted & PSEG project

Drawn by	Accepted	Approved
02-DEC-2022 SMC	02-DEC-2022 KNW	02-DEC-2022 LRM

Scale	Size	Ørsted Document No.	Rev.:
1" = 50'	34X44	07845287	C

Supplier
Supplier Document No. & Rev.
PSEG Dwg No.
Rev.:
RDS-PP code

Rev.	Date	Accep.	Appr.	Description
C	02DEC2022	LMG	KNW	NJDEP SUBMITTAL

KEVIN N. WARRENDER

N.J. PROFESSIONAL ENGINEER
LIC. NO. 24GE04640900
C.O.A. NO. 24GA28066400

BURNS McDONNELL

THE REGISTRANT OF THE NEWLY APPLIED SEAL ASSUMES RESPONSIBILITY FOR THE CHANGES AS INDICATED BY THE FOLLOWING REVISION NUMBER C.

APPENDIX B – HYDROLOGY MODELS

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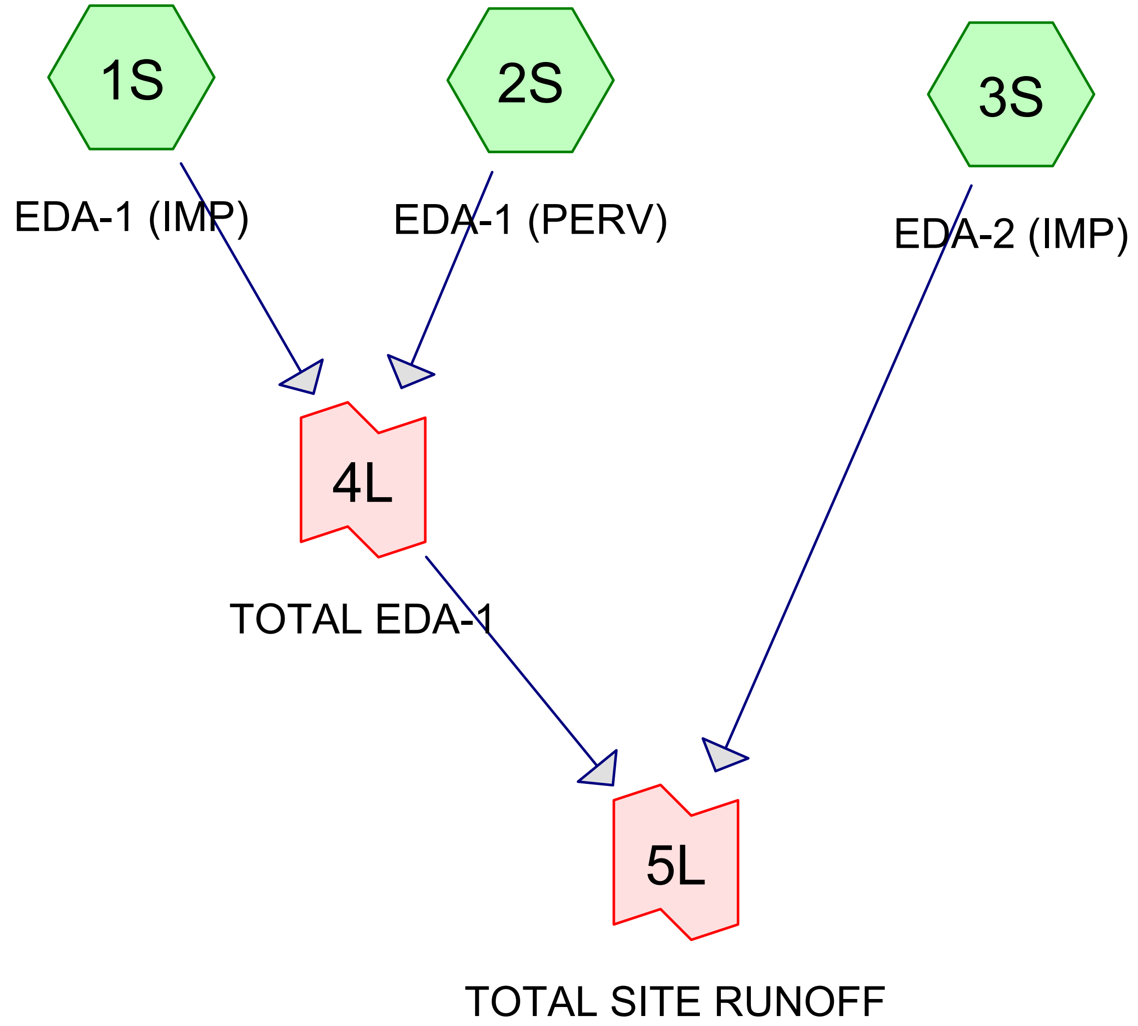
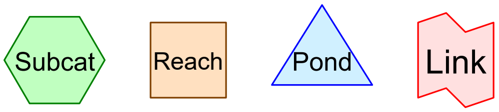




Routing Diagram for Pre-Development Conditions
Prepared by Burns and McDonnell, Printed 12/8/2022
HydroCAD® 10.10-6a s/n 08510 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-YR	NOAA 24-hr	C	Default	24.00	1	3.37	2
2	10-YR	NOAA 24-hr	C	Default	24.00	1	5.25	2
3	100-YR	NOAA 24-hr	C	Default	24.00	1	9.06	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
14.230	98	Existing Impervious (1S, 3S)
0.190	55	Wooded (B) (2S)
0.100	77	Wooded (D) (2S)
14.520	**97**	**TOTAL AREA**

Time span=2.00-24.00 hrs, dt=0.05 hrs, 441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1S: EDA-1 (IMP) Runoff Area=6.830 ac 100.00% Impervious Runoff Depth>3.13"
Tc=10.0 min CN=98 Runoff=20.83 cfs 1.780 af

Subcatchment2S: EDA-1 (PERV) Runoff Area=0.290 ac 0.00% Impervious Runoff Depth>0.59"
Tc=10.0 min CN=63 Runoff=0.15 cfs 0.014 af

Subcatchment3S: EDA-2 (IMP) Runoff Area=7.400 ac 100.00% Impervious Runoff Depth>3.13"
Tc=10.0 min CN=98 Runoff=22.57 cfs 1.929 af

Link 4L: TOTAL EDA-1 Inflow=20.97 cfs 1.795 af
Primary=20.97 cfs 1.795 af

Link 5L: TOTAL SITE RUNOFF Inflow=43.54 cfs 3.724 af
Primary=43.54 cfs 3.724 af

Total Runoff Area = 14.520 ac Runoff Volume = 3.724 af Average Runoff Depth = 3.08"
2.00% Pervious = 0.290 ac 98.00% Impervious = 14.230 ac

Summary for Subcatchment 1S: EDA-1 (IMP)

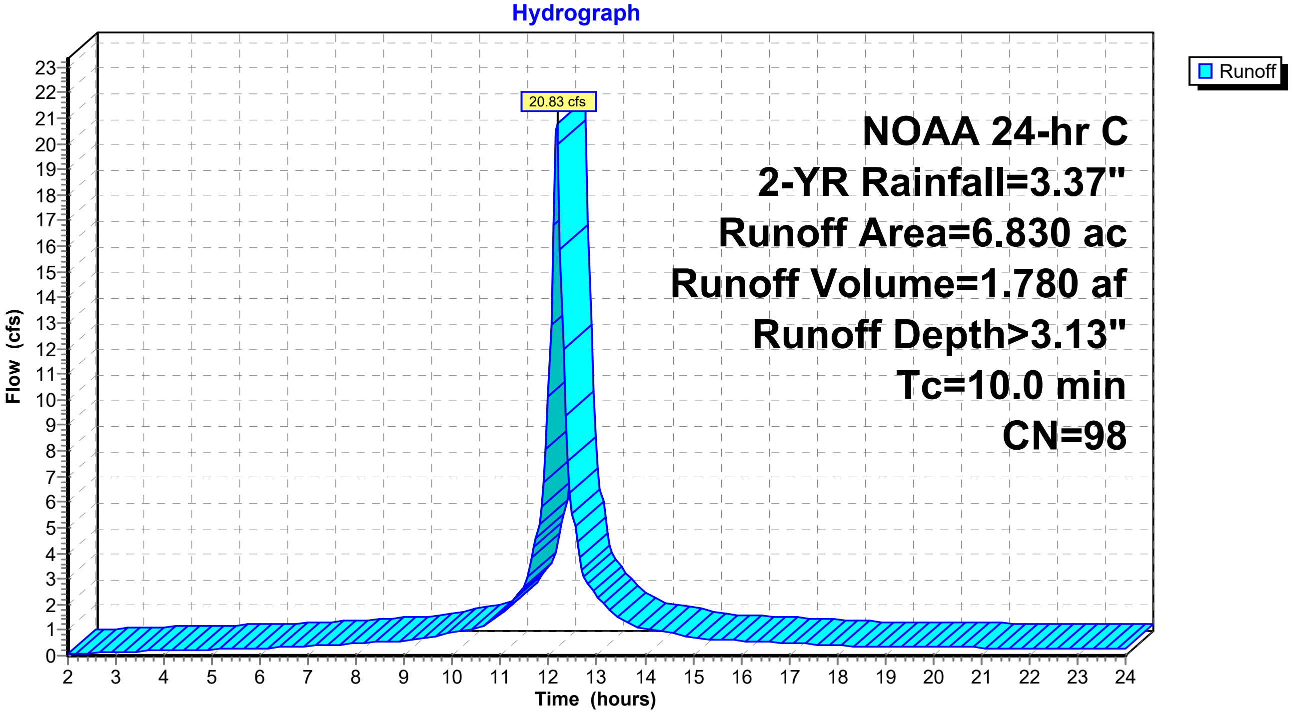
Runoff = 20.83 cfs @ 12.17 hrs, Volume= 1.780 af, Depth> 3.13"
Routed to Link 4L : TOTAL EDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	6.830	98	Existing Impervious
	6.830		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 1S: EDA-1 (IMP)



Summary for Subcatchment 2S: EDA-1 (PERV)

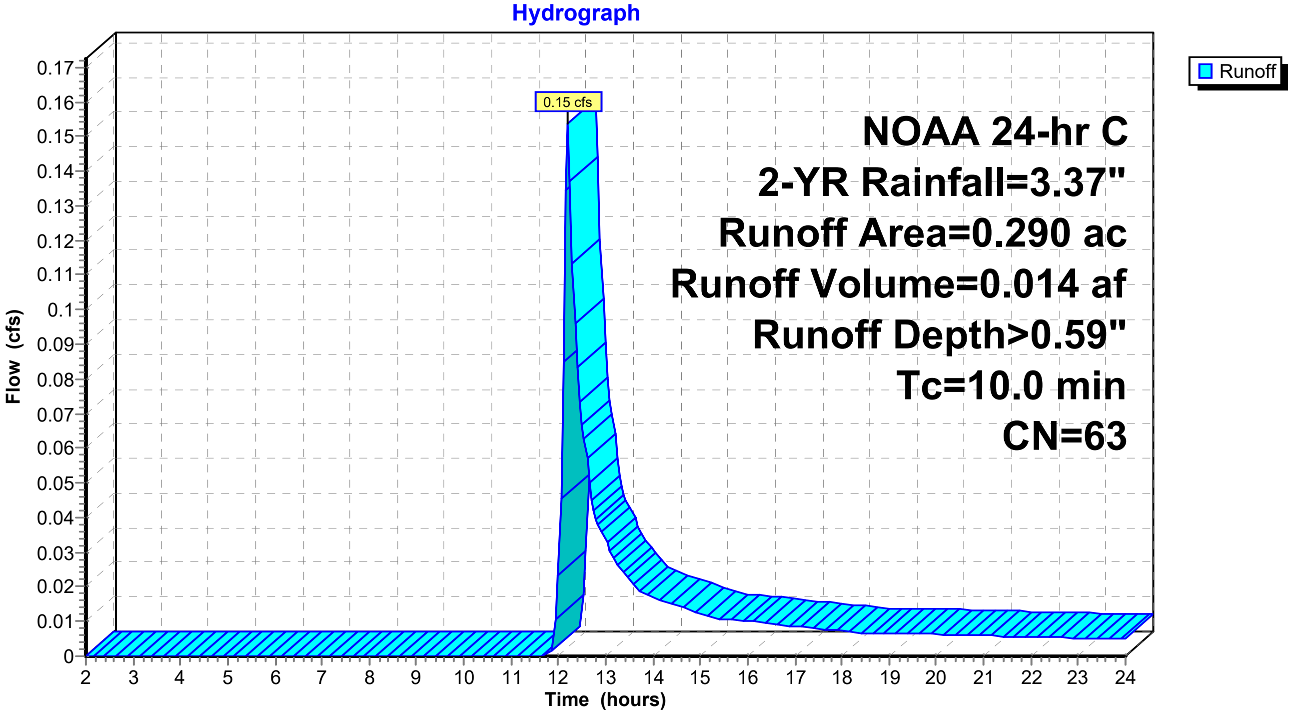
Runoff = 0.15 cfs @ 12.20 hrs, Volume= 0.014 af, Depth> 0.59"
Routed to Link 4L : TOTAL EDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.190	55	Wooded (B)
*	0.100	77	Wooded (D)
	0.290	63	Weighted Average
	0.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 2S: EDA-1 (PERV)



Summary for Subcatchment 3S: EDA-2 (IMP)

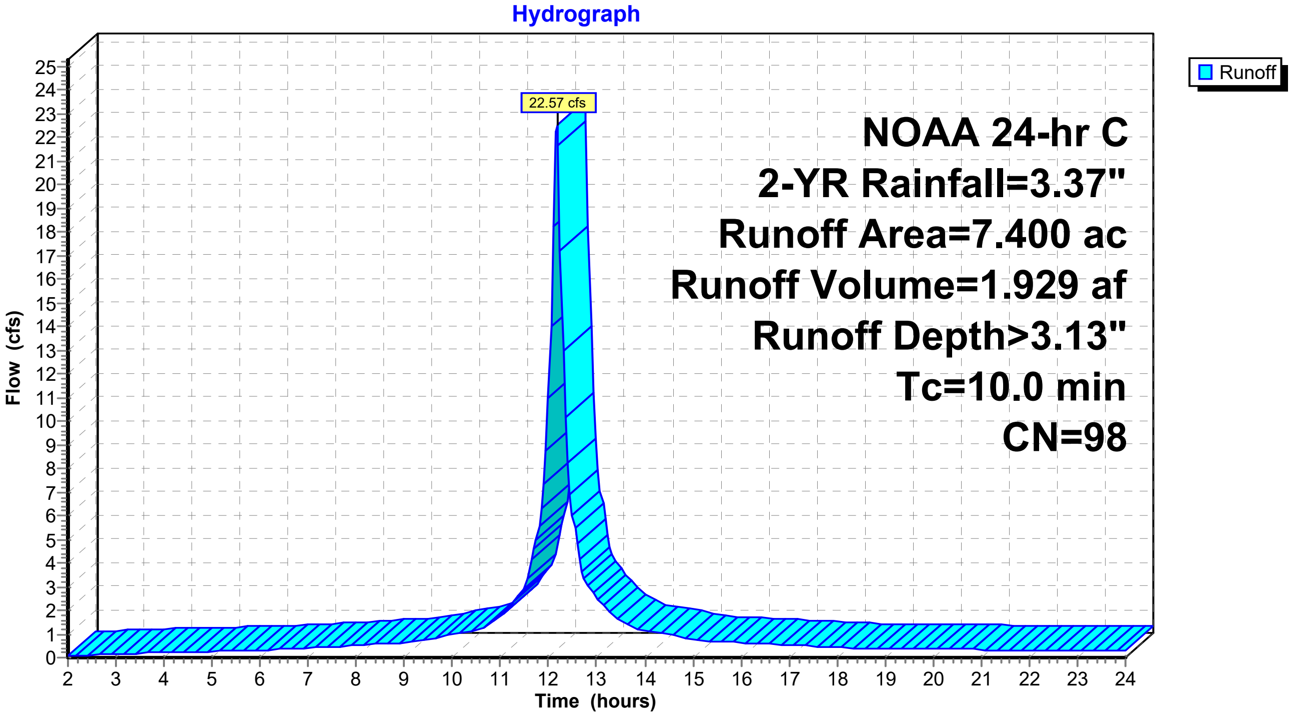
Runoff = 22.57 cfs @ 12.17 hrs, Volume= 1.929 af, Depth> 3.13"
Routed to Link 5L : TOTAL SITE RUNOFF

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	7.400	98	Existing Impervious
	7.400		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 3S: EDA-2 (IMP)



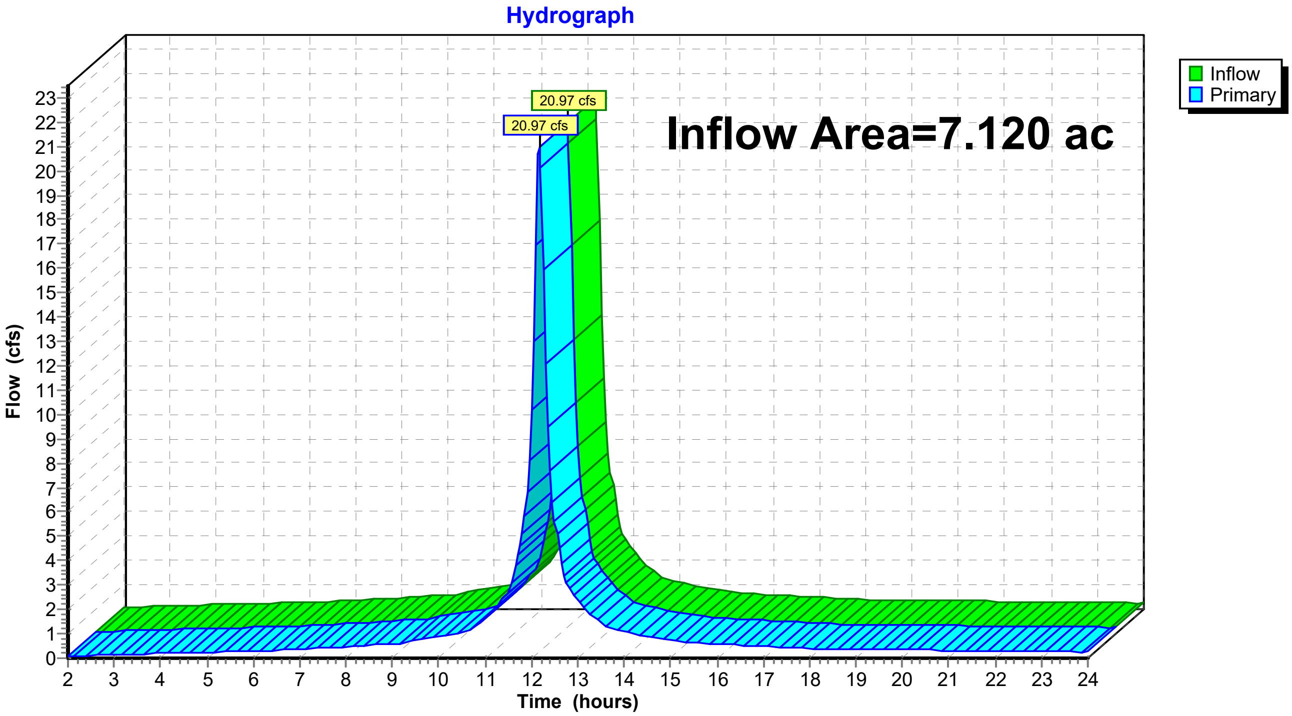
Summary for Link 4L: TOTAL EDA-1

Inflow Area =	7.120 ac,	95.93% Impervious,	Inflow Depth > 3.03"	for 2-YR event	
Inflow =	20.97 cfs @	12.17 hrs,	Volume=	1.795 af	
Primary =	20.97 cfs @	12.17 hrs,	Volume=	1.795 af,	Atten= 0%, Lag= 0.0 min

Routed to Link 5L : TOTAL SITE RUNOFF

Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs

Link 4L: TOTAL EDA-1

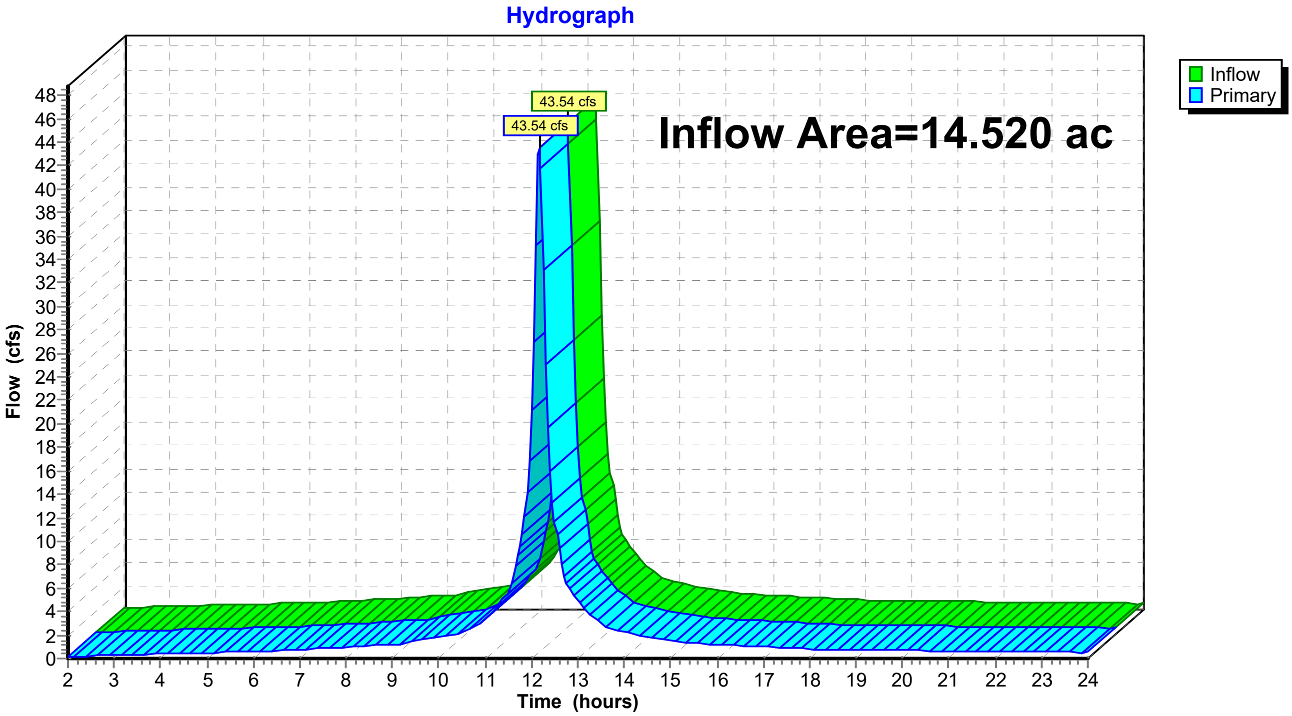


Summary for Link 5L: TOTAL SITE RUNOFF

```
Inflow Area =       14.520 ac, 98.00% Impervious, Inflow Depth >   3.08"    for  2-YR event
Inflow      =       43.54 cfs @   12.17 hrs,  Volume=           3.724 af
Primary     =       43.54 cfs @   12.17 hrs,  Volume=           3.724 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs

Link 5L: TOTAL SITE RUNOFF



```
                     Time span=2.00-24.00 hrs, dt=0.05 hrs, 441 points
                        Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
              Reach routing by Stor-Ind method  -  Pond routing by Stor-Ind method

Subcatchment1S: EDA-1 (IMP)        Runoff Area=6.830 ac  100.00% Impervious  Runoff Depth>4.99"
                                                Tc=10.0 min   CN=98  Runoff=32.67 cfs  2.839 af

Subcatchment2S: EDA-1 (PERV)         Runoff Area=0.290 ac  0.00% Impervious  Runoff Depth>1.66"
                                                 Tc=10.0 min   CN=63  Runoff=0.52 cfs  0.040 af

Subcatchment3S: EDA-2 (IMP)        Runoff Area=7.400 ac  100.00% Impervious  Runoff Depth>4.99"
                                                Tc=10.0 min   CN=98  Runoff=35.39 cfs  3.076 af

Link 4L: TOTAL EDA-1                                                   Inflow=33.18 cfs  2.879 af
                                                                      Primary=33.18 cfs  2.879 af

Link 5L: TOTAL SITE RUNOFF                                             Inflow=68.57 cfs  5.955 af
                                                                      Primary=68.57 cfs  5.955 af

         Total Runoff Area = 14.520 ac   Runoff Volume = 5.955 af   Average Runoff Depth = 4.92"
                                   2.00% Pervious = 0.290 ac     98.00% Impervious = 14.230 ac
```

Summary for Subcatchment 1S: EDA-1 (IMP)

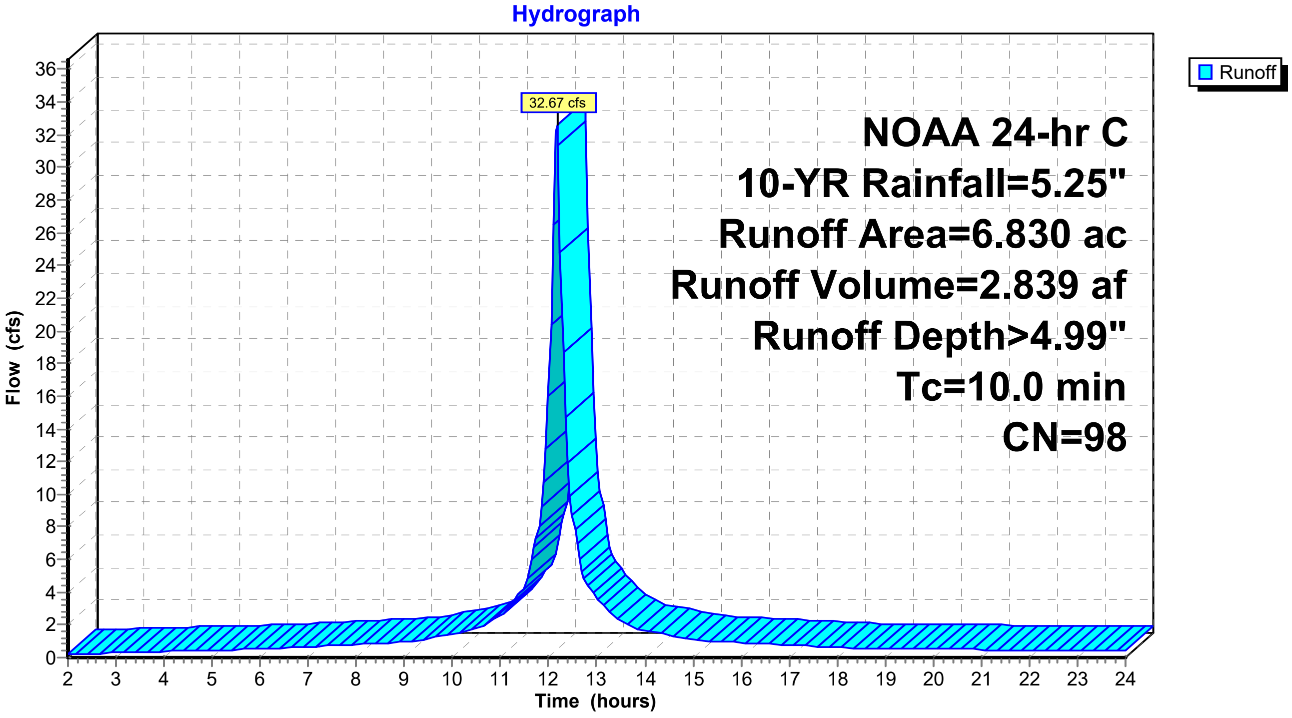
Runoff = 32.67 cfs @ 12.17 hrs, Volume= 2.839 af, Depth> 4.99"
Routed to Link 4L : TOTAL EDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	6.830	98	Existing Impervious
	6.830		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 1S: EDA-1 (IMP)



Summary for Subcatchment 2S: EDA-1 (PERV)

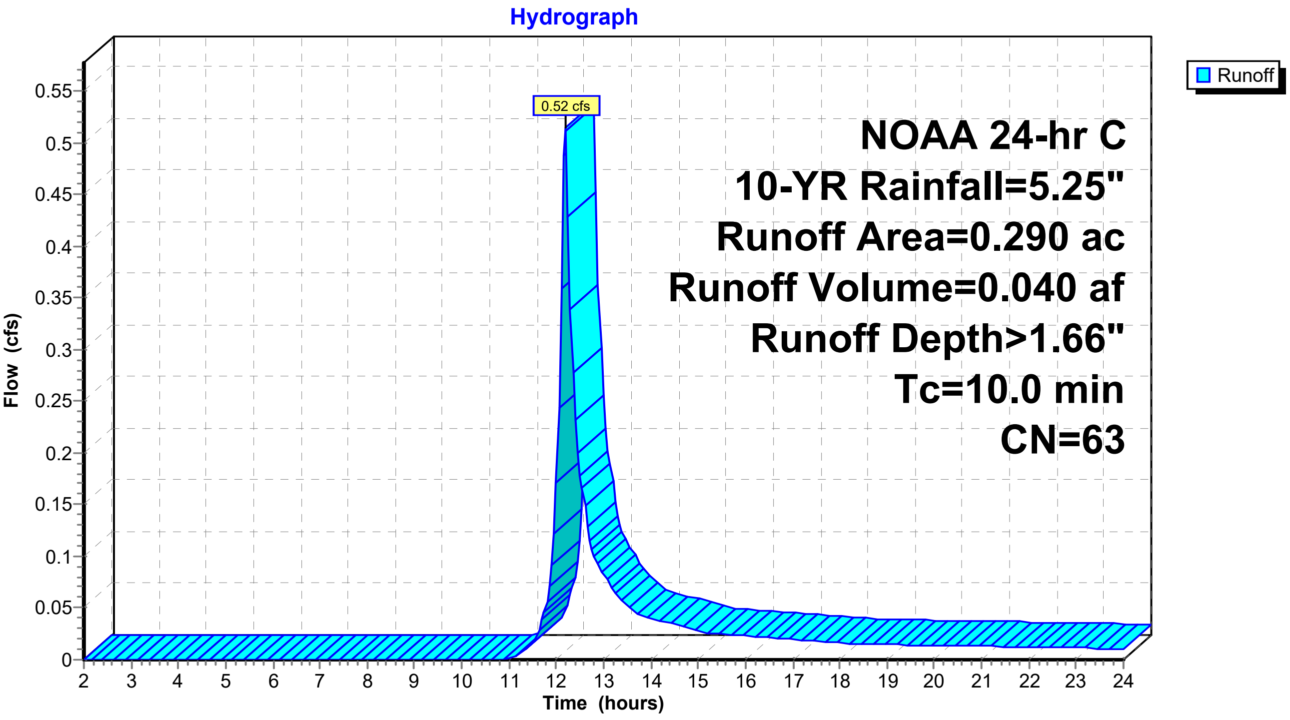
Runoff = 0.52 cfs @ 12.19 hrs, Volume= 0.040 af, Depth> 1.66"
Routed to Link 4L : TOTAL EDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.190	55	Wooded (B)
*	0.100	77	Wooded (D)
	0.290	63	Weighted Average
	0.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 2S: EDA-1 (PERV)



Summary for Subcatchment 3S: EDA-2 (IMP)

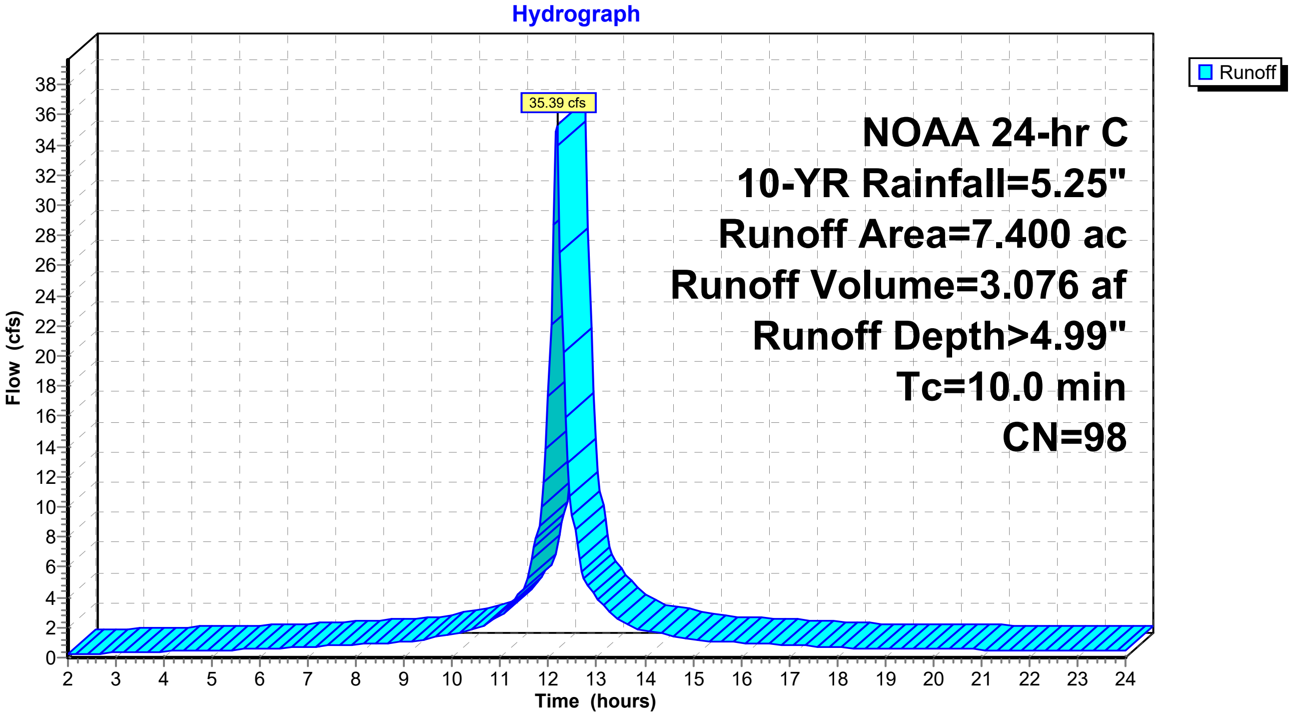
Runoff = 35.39 cfs @ 12.17 hrs, Volume= 3.076 af, Depth> 4.99"
Routed to Link 5L : TOTAL SITE RUNOFF

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	7.400	98	Existing Impervious
	7.400		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 3S: EDA-2 (IMP)

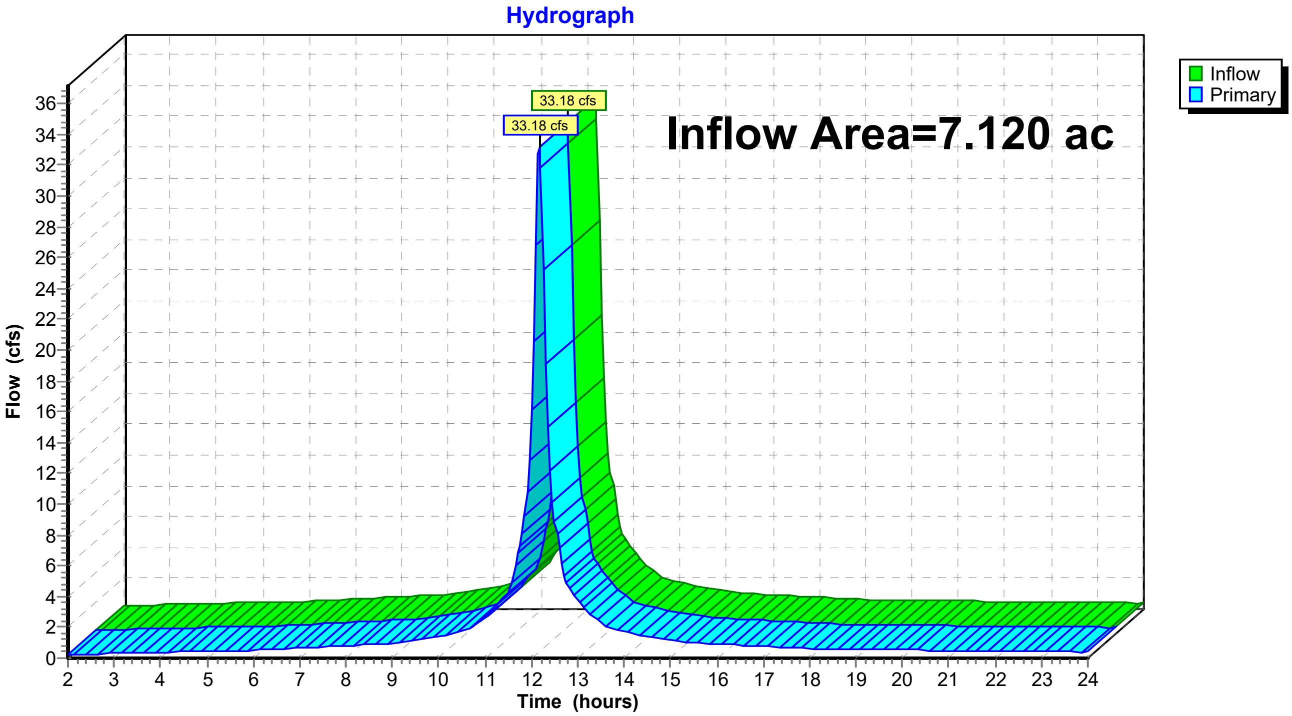


Summary for Link 4L: TOTAL EDA-1

Inflow Area = 7.120 ac, 95.93% Impervious, Inflow Depth > 4.85" for 10-YR event
Inflow = 33.18 cfs @ 12.17 hrs, Volume= 2.879 af
Primary = 33.18 cfs @ 12.17 hrs, Volume= 2.879 af, Atten= 0%, Lag= 0.0 min
Routed to Link 5L : TOTAL SITE RUNOFF

Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs

Link 4L: TOTAL EDA-1

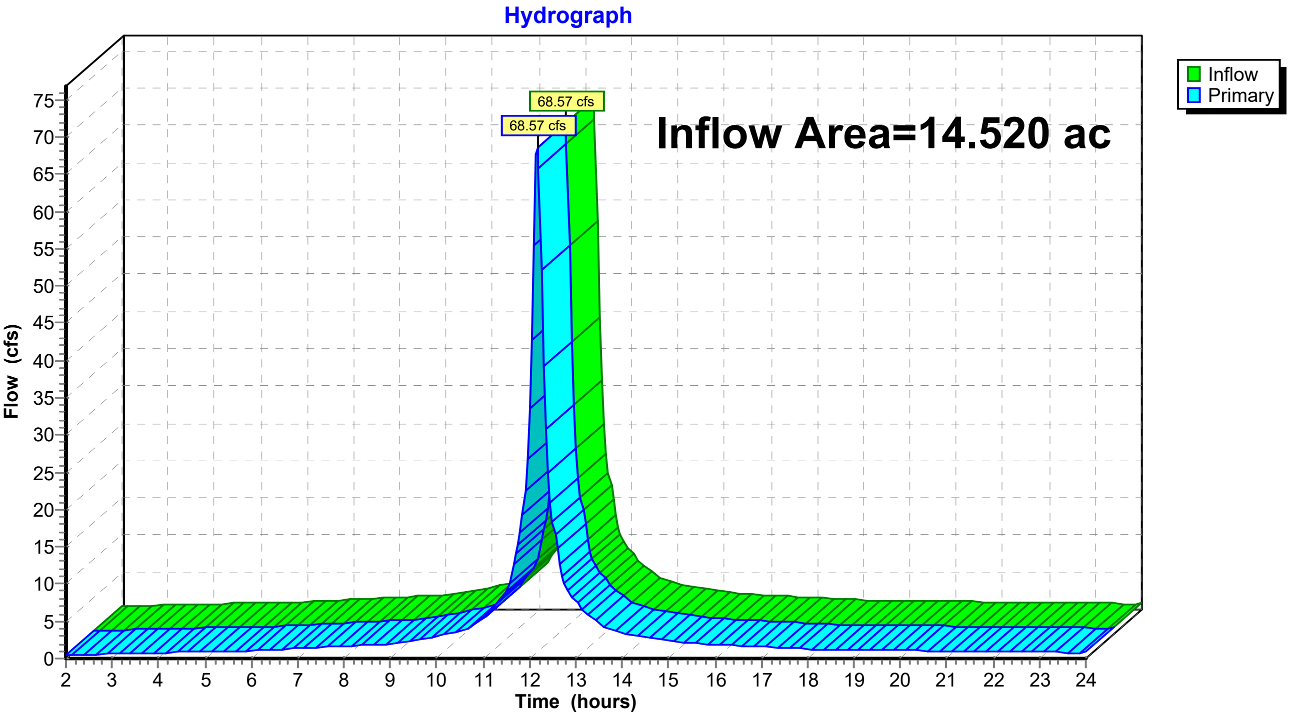


Summary for Link 5L: TOTAL SITE RUNOFF

```
Inflow Area =      14.520 ac,  98.00% Impervious,  Inflow Depth >   4.92"    for  10-YR event
Inflow      =      68.57 cfs @   12.17 hrs,  Volume=           5.955 af
Primary     =      68.57 cfs @   12.17 hrs,  Volume=           5.955 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs

Link 5L: TOTAL SITE RUNOFF



Time span=2.00-24.00 hrs, dt=0.05 hrs, 441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1S: EDA-1 (IMP) Runoff Area=6.830 ac 100.00% Impervious Runoff Depth>8.75"
Tc=10.0 min CN=98 Runoff=56.57 cfs 4.978 af

Subcatchment2S: EDA-1 (PERV) Runoff Area=0.290 ac 0.00% Impervious Runoff Depth>4.51"
Tc=10.0 min CN=63 Runoff=1.45 cfs 0.109 af

Subcatchment3S: EDA-2 (IMP) Runoff Area=7.400 ac 100.00% Impervious Runoff Depth>8.75"
Tc=10.0 min CN=98 Runoff=61.29 cfs 5.393 af

Link 4L: TOTAL EDA-1 Inflow=58.02 cfs 5.087 af
Primary=58.02 cfs 5.087 af

Link 5L: TOTAL SITE RUNOFF Inflow=119.31 cfs 10.480 af
Primary=119.31 cfs 10.480 af

Total Runoff Area = 14.520 ac Runoff Volume = 10.480 af Average Runoff Depth = 8.66"
2.00% Pervious = 0.290 ac 98.00% Impervious = 14.230 ac

Summary for Subcatchment 1S: EDA-1 (IMP)

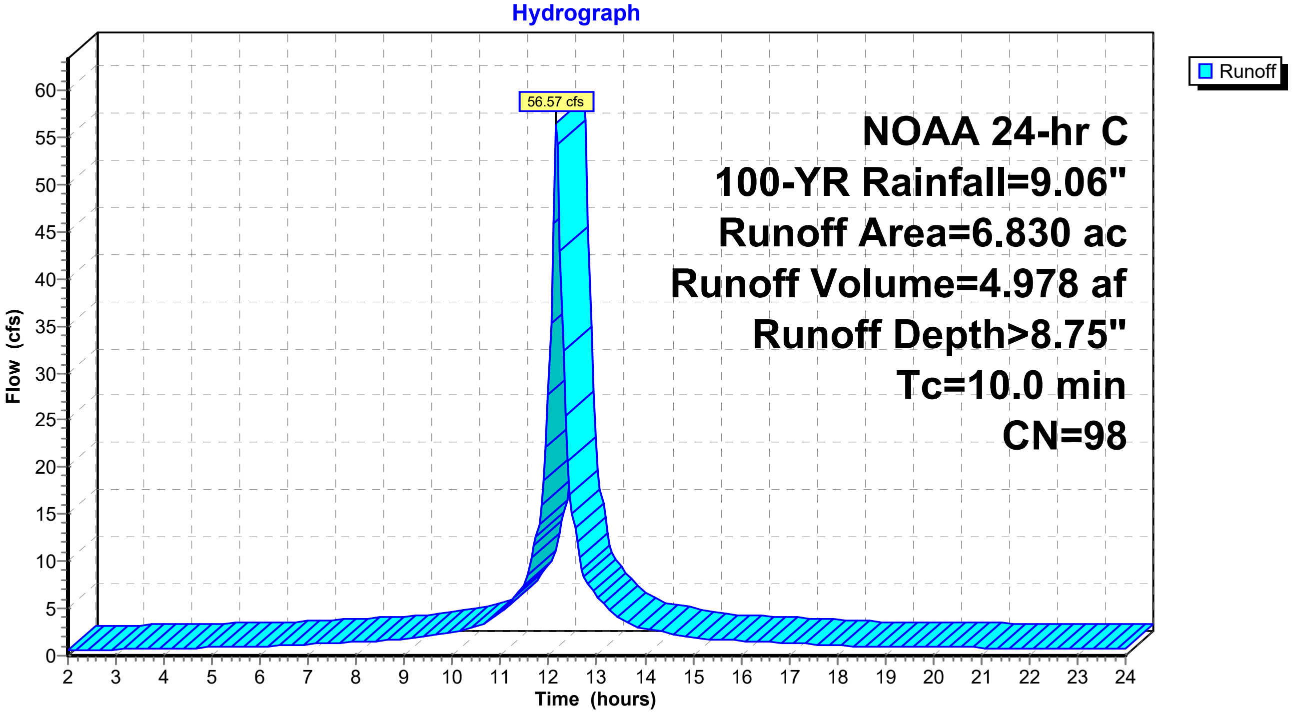
Runoff = 56.57 cfs @ 12.17 hrs, Volume= 4.978 af, Depth> 8.75"
Routed to Link 4L : TOTAL EDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	6.830	98	Existing Impervious
	6.830		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 1S: EDA-1 (IMP)



Summary for Subcatchment 2S: EDA-1 (PERV)

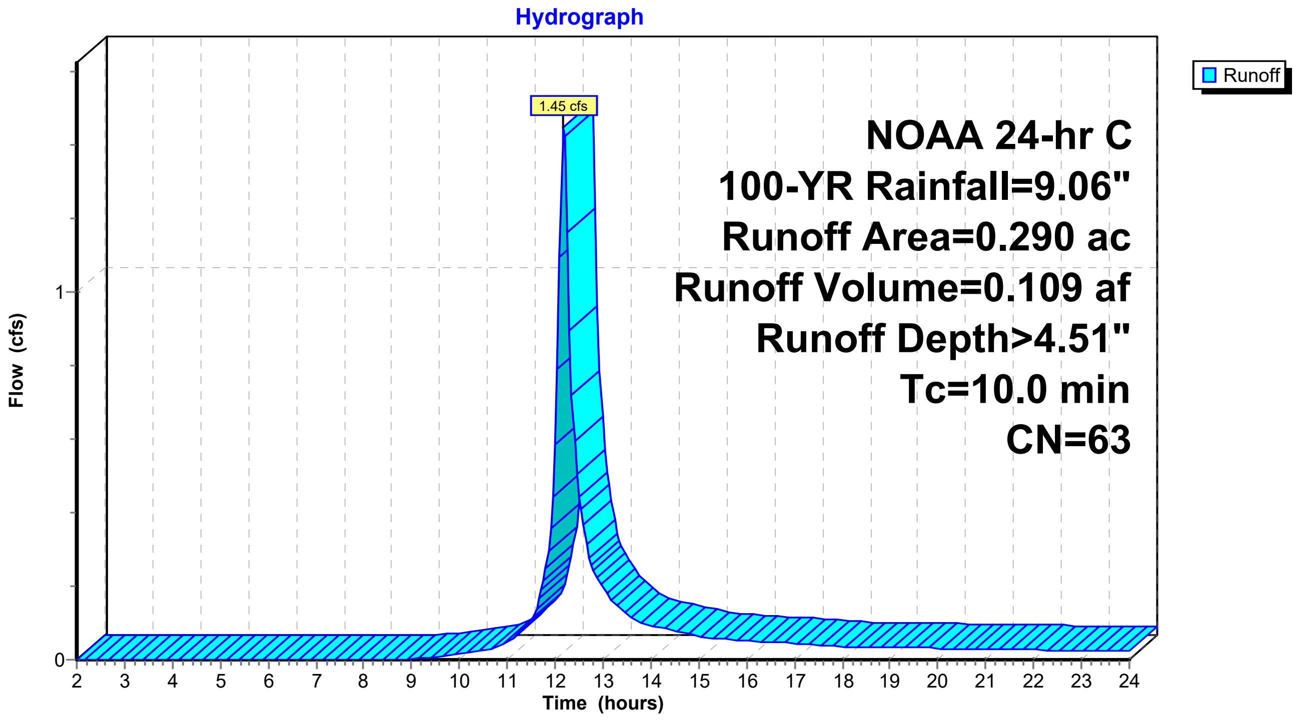
Runoff = 1.45 cfs @ 12.18 hrs, Volume= 0.109 af, Depth> 4.51"
Routed to Link 4L : TOTAL EDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.190	55	Wooded (B)
*	0.100	77	Wooded (D)
	0.290	63	Weighted Average
	0.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 2S: EDA-1 (PERV)



Summary for Subcatchment 3S: EDA-2 (IMP)

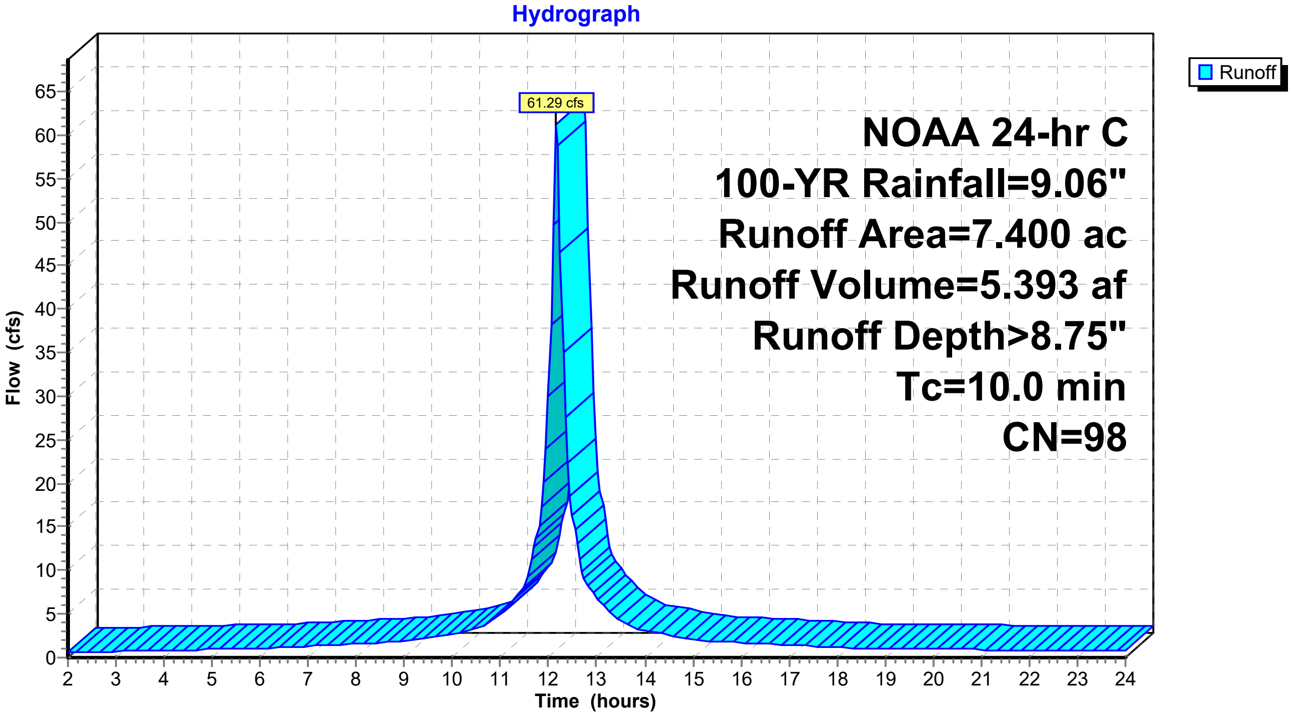
Runoff = 61.29 cfs @ 12.17 hrs, Volume= 5.393 af, Depth> 8.75"
Routed to Link 5L : TOTAL SITE RUNOFF

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	7.400	98	Existing Impervious
	7.400		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 3S: EDA-2 (IMP)

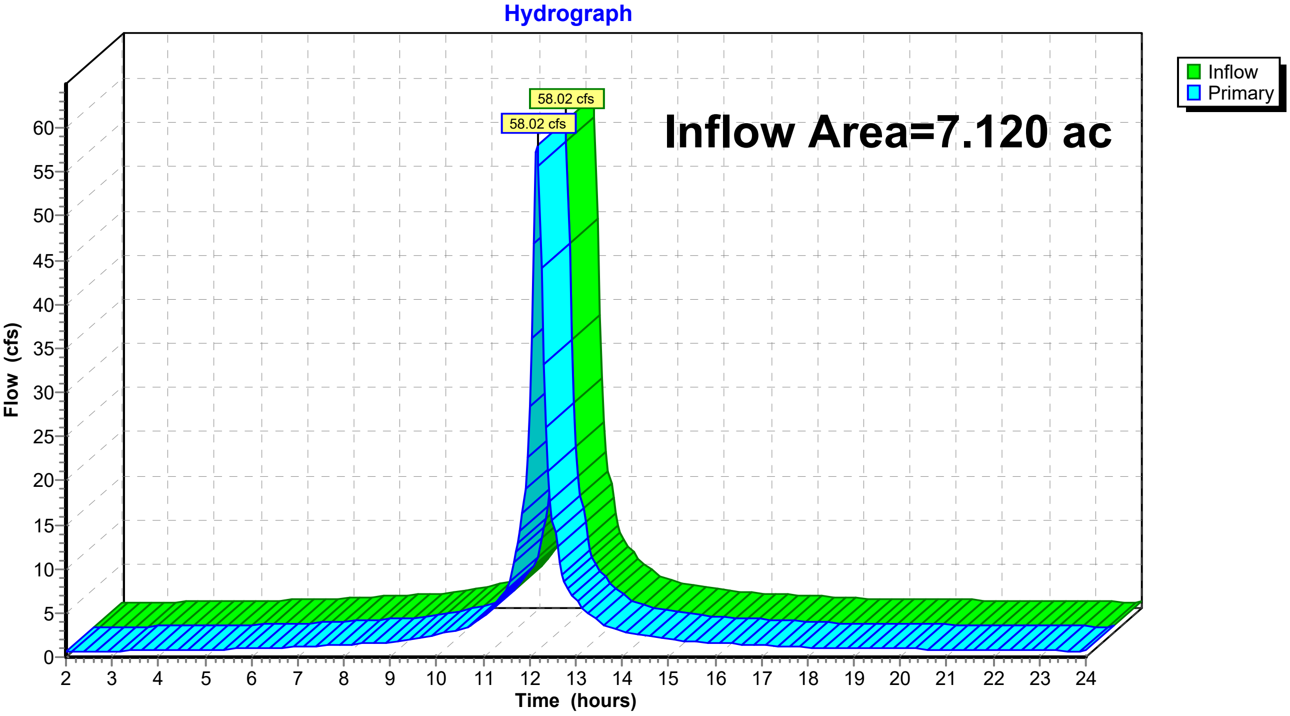


Summary for Link 4L: TOTAL EDA-1

Inflow Area = 7.120 ac, 95.93% Impervious, Inflow Depth > 8.57" for 100-YR event
Inflow = 58.02 cfs @ 12.17 hrs, Volume= 5.087 af
Primary = 58.02 cfs @ 12.17 hrs, Volume= 5.087 af, Atten= 0%, Lag= 0.0 min
Routed to Link 5L : TOTAL SITE RUNOFF

Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs

Link 4L: TOTAL EDA-1

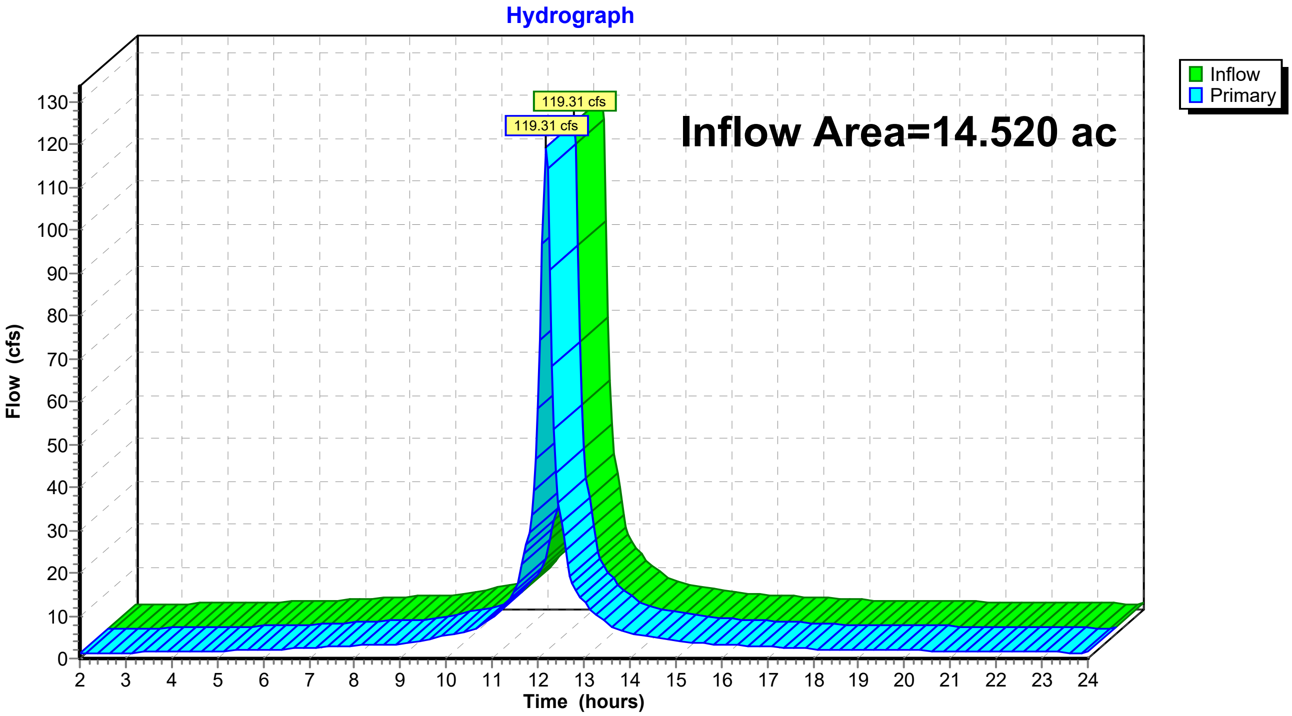


Summary for Link 5L: TOTAL SITE RUNOFF

Inflow Area = 14.520 ac, 98.00% Impervious, Inflow Depth > 8.66" for 100-YR event
Inflow = 119.31 cfs @ 12.17 hrs, Volume= 10.480 af
Primary = 119.31 cfs @ 12.17 hrs, Volume= 10.480 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.05 hrs

Link 5L: TOTAL SITE RUNOFF



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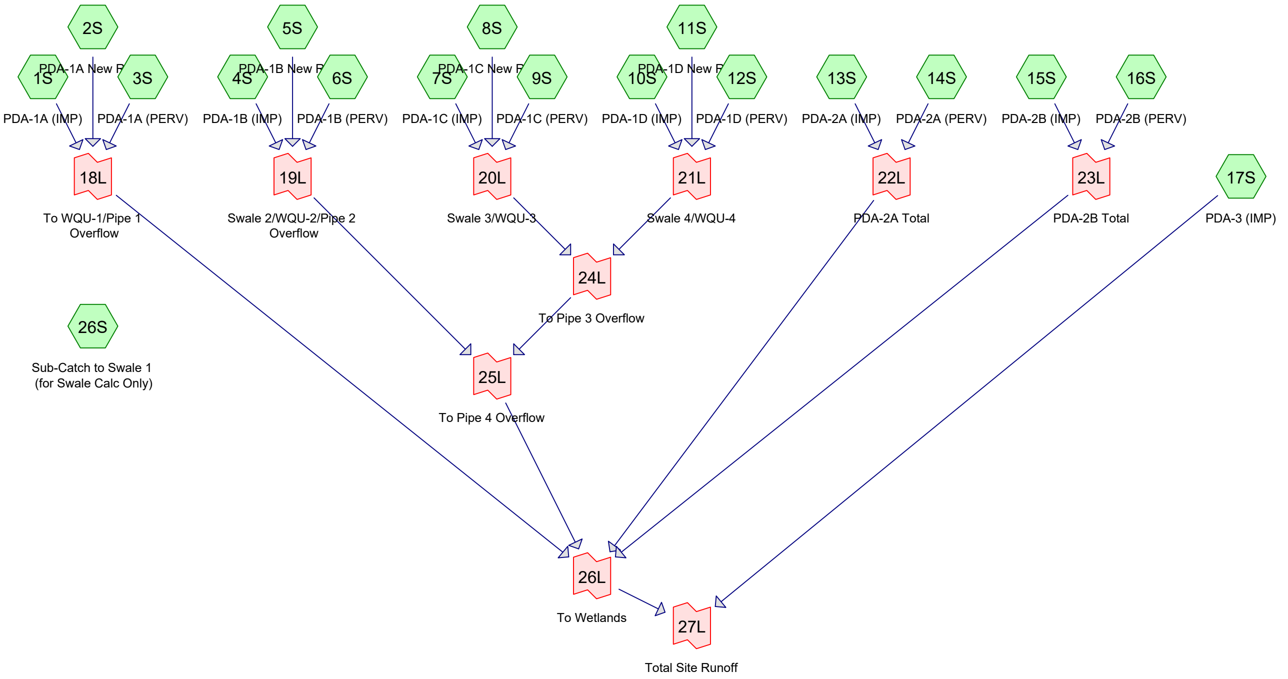
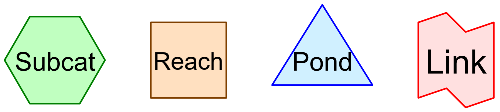
Project Reports

WQ Event

2-YR Event





Routing Diagram for Post-Development Conditions
Prepared by Burns and McDonnell, Printed 12/8/2022
HydroCAD® 10.10-6a s/n 08510 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	WQ	NJ DEP 2-hr		Default	2.00	1	1.25	2
2	2-YR	NOAA 24-hr	C	Default	24.00	1	3.37	2
3	10-YR	NOAA 24-hr	C	Default	24.00	1	5.25	2
4	25-YR	NOAA 24-hr	C	Default	24.00	1	6.58	2
5	100-YR	NOAA 24-hr	C	Default	24.00	1	9.06	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.510	85	Gravel (26S)
3.870	85	Gravel (B) (1S, 4S, 7S, 10S)
8.580	98	Impervious (1S, 4S, 7S, 13S, 15S, 17S, 26S)
1.200	61	Lawn (B) (3S, 6S, 9S, 12S, 14S, 16S, 26S)
1.120	98	New Road (2S, 5S, 8S, 11S)
0.160	98	New Roads (7S)
0.160	55	Wooded (B) (16S)
0.090	77	Wooded (D) (14S)
15.690	**91**	**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1S: PDA-1A (IMP) Runoff Area=1.250 ac 24.00% Impervious Runoff Depth=0.41"
Tc=10.0 min CN=88 Runoff=1.31 cfs 0.042 af

Subcatchment2S: PDA-1A New Road Runoff Area=0.590 ac 100.00% Impervious Runoff Depth=1.03"
Tc=10.0 min CN=98 Runoff=1.52 cfs 0.051 af

Subcatchment3S: PDA-1A (PERV) Runoff Area=0.160 ac 0.00% Impervious Runoff Depth=0.00"
Tc=10.0 min CN=61 Runoff=0.00 cfs 0.000 af

Subcatchment4S: PDA-1B (IMP) Runoff Area=0.990 ac 4.04% Impervious Runoff Depth=0.33"
Tc=10.0 min CN=86 Runoff=0.83 cfs 0.028 af

Subcatchment5S: PDA-1B New Road Runoff Area=0.150 ac 100.00% Impervious Runoff Depth=1.03"
Tc=10.0 min CN=98 Runoff=0.39 cfs 0.013 af

Subcatchment6S: PDA-1B (PERV) Runoff Area=0.310 ac 0.00% Impervious Runoff Depth=0.00"
Tc=0.0 min CN=61 Runoff=0.00 cfs 0.000 af

Subcatchment7S: PDA-1C (IMP) Runoff Area=1.390 ac 12.23% Impervious Runoff Depth=0.37"
Tc=10.0 min CN=87 Runoff=1.31 cfs 0.043 af

Subcatchment8S: PDA-1C New Road Runoff Area=0.160 ac 100.00% Impervious Runoff Depth=1.03"
Tc=10.0 min CN=98 Runoff=0.41 cfs 0.014 af

Subcatchment9S: PDA-1C (PERV) Runoff Area=0.070 ac 0.00% Impervious Runoff Depth=0.00"
Tc=10.0 min CN=61 Runoff=0.00 cfs 0.000 af

Subcatchment10S: PDA-1D (IMP) Runoff Area=0.750 ac 0.00% Impervious Runoff Depth=0.30"
Tc=10.0 min CN=85 Runoff=0.56 cfs 0.019 af

Subcatchment11S: PDA-1D New Road Runoff Area=0.220 ac 100.00% Impervious Runoff Depth=1.03"
Tc=10.0 min CN=98 Runoff=0.57 cfs 0.019 af

Subcatchment12S: PDA-1D (PERV) Runoff Area=0.200 ac 0.00% Impervious Runoff Depth=0.00"
Tc=10.0 min CN=61 Runoff=0.00 cfs 0.000 af

Subcatchment13S: PDA-2A (IMP) Runoff Area=0.120 ac 100.00% Impervious Runoff Depth=1.03"
Tc=10.0 min CN=98 Runoff=0.31 cfs 0.010 af

Subcatchment14S: PDA-2A (PERV) Runoff Area=0.370 ac 0.00% Impervious Runoff Depth=0.01"
Tc=10.0 min CN=65 Runoff=0.00 cfs 0.000 af

Subcatchment15S: PDA-2B (IMP) Runoff Area=0.070 ac 100.00% Impervious Runoff Depth=1.03"
Tc=10.0 min CN=98 Runoff=0.18 cfs 0.006 af

Subcatchment16S: PDA-2B (PERV) Runoff Area=0.290 ac 0.00% Impervious Runoff Depth=0.00"
Tc=10.0 min CN=58 Runoff=0.00 cfs 0.000 af

Subcatchment 17S: PDA-3 (IMP) Runoff Area=7.590 ac 100.00% Impervious Runoff Depth=1.03"
Tc=10.0 min CN=98 Runoff=19.55 cfs 0.654 af

Subcatchment 26S: Sub-Catch to Swale 1 Runoff Area=1.010 ac 44.55% Impervious Runoff Depth=0.49"
Tc=10.0 min CN=90 Runoff=1.31 cfs 0.042 af

Link 18L: To WQU-1/Pipe 1 Overflow Inflow=2.81 cfs 0.093 af
Primary=2.81 cfs 0.093 af

Link 19L: Swale 2/WQU-2/Pipe 2 Overflow Inflow=1.21 cfs 0.041 af
Primary=1.21 cfs 0.041 af

Link 20L: Swale 3/WQU-3 Inflow=1.72 cfs 0.057 af
Primary=1.72 cfs 0.057 af

Link 21L: Swale 4/WQU-4 Inflow=1.11 cfs 0.038 af
Primary=1.11 cfs 0.038 af

Link 22L: PDA-2A Total Inflow=0.31 cfs 0.011 af
Primary=0.31 cfs 0.011 af

Link 23L: PDA-2B Total Inflow=0.18 cfs 0.006 af
Primary=0.18 cfs 0.006 af

Link 24L: To Pipe 3 Overflow Inflow=2.83 cfs 0.095 af
Primary=2.83 cfs 0.095 af

Link 25L: To Pipe 4 Overflow Inflow=4.04 cfs 0.135 af
Primary=4.04 cfs 0.135 af

Link 26L: To Wetlands Inflow=7.32 cfs 0.245 af
Primary=7.32 cfs 0.245 af

Link 27L: Total Site Runoff Inflow=26.78 cfs 0.899 af
Primary=26.78 cfs 0.899 af

Total Runoff Area = 15.690 ac Runoff Volume = 0.941 af Average Runoff Depth = 0.72"
37.16% Pervious = 5.830 ac 62.84% Impervious = 9.860 ac

Summary for Subcatchment 1S: PDA-1A (IMP)

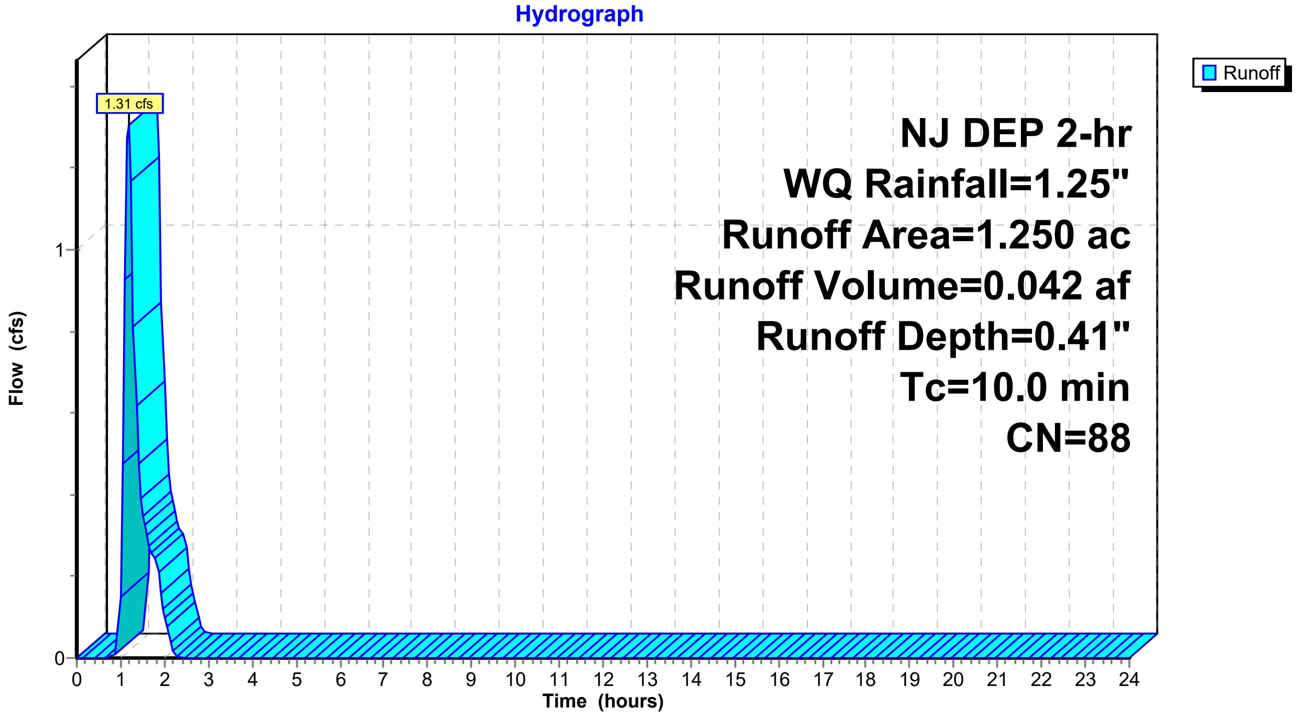
Runoff = 1.31 cfs @ 1.18 hrs, Volume= 0.042 af, Depth= 0.41"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.950	85	Gravel (B)
*	0.300	98	Impervious
	1.250	88	Weighted Average
	0.950		76.00% Pervious Area
	0.300		24.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 1S: PDA-1A (IMP)



Summary for Subcatchment 2S: PDA-1A New Road

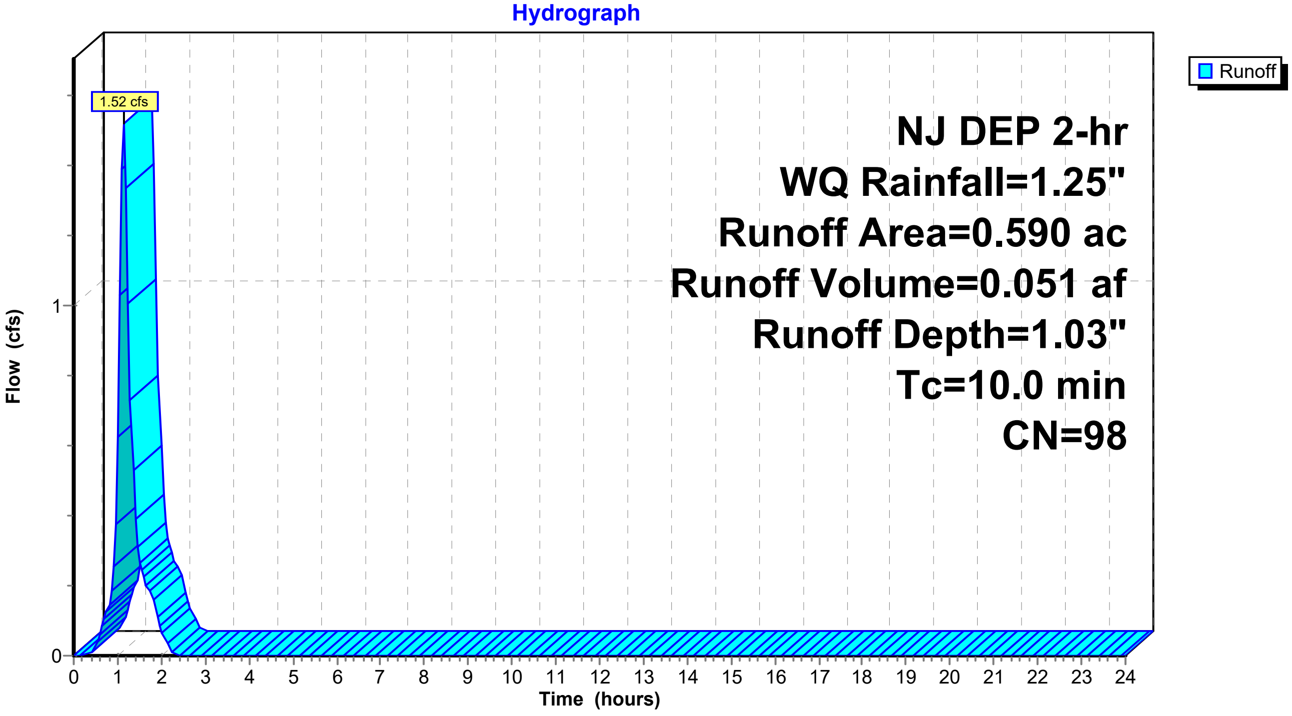
Runoff = 1.52 cfs @ 1.15 hrs, Volume= 0.051 af, Depth= 1.03"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.590	98	New Road
	0.590		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 2S: PDA-1A New Road



Summary for Subcatchment 3S: PDA-1A (PERV)

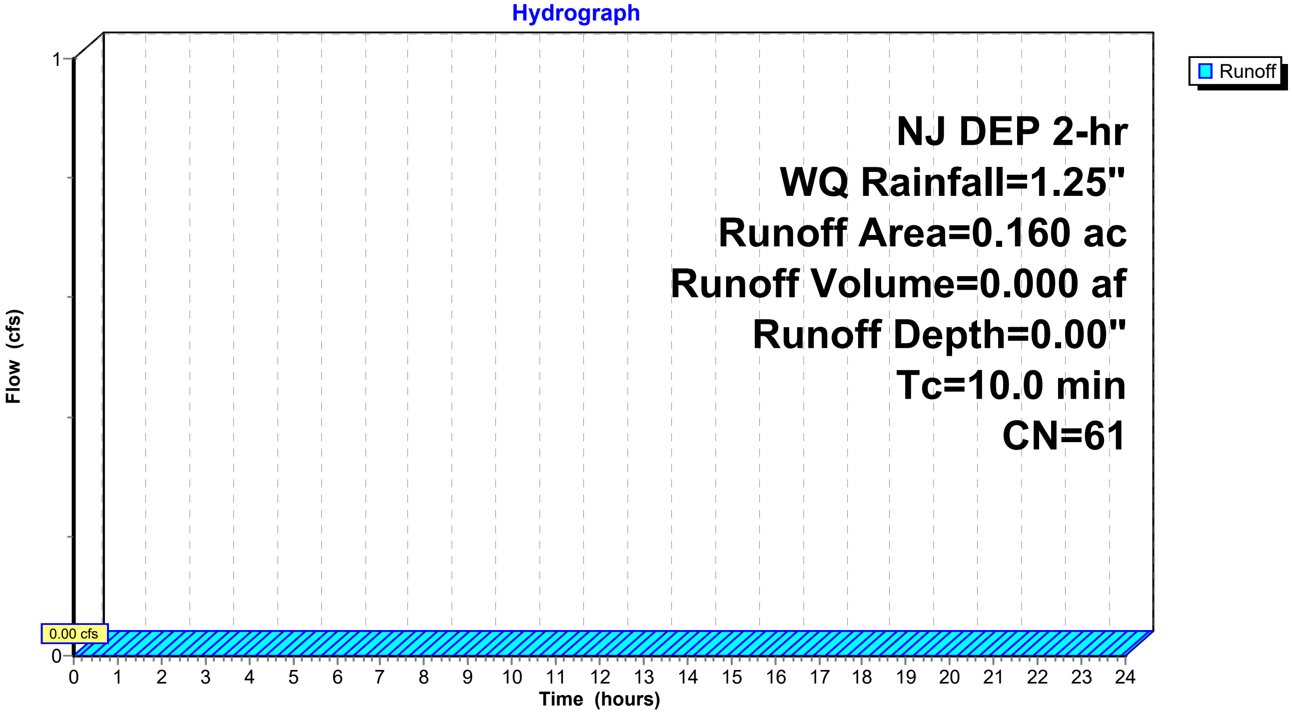
```
Runoff      =        0.00 cfs @     0.00 hrs,  Volume=           0.000 af,  Depth=  0.00"
    Routed to Link 18L : To WQU-1/Pipe 1 Overflow
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.160	61	Lawn (B)
	0.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 3S: PDA-1A (PERV)



Summary for Subcatchment 4S: PDA-1B (IMP)

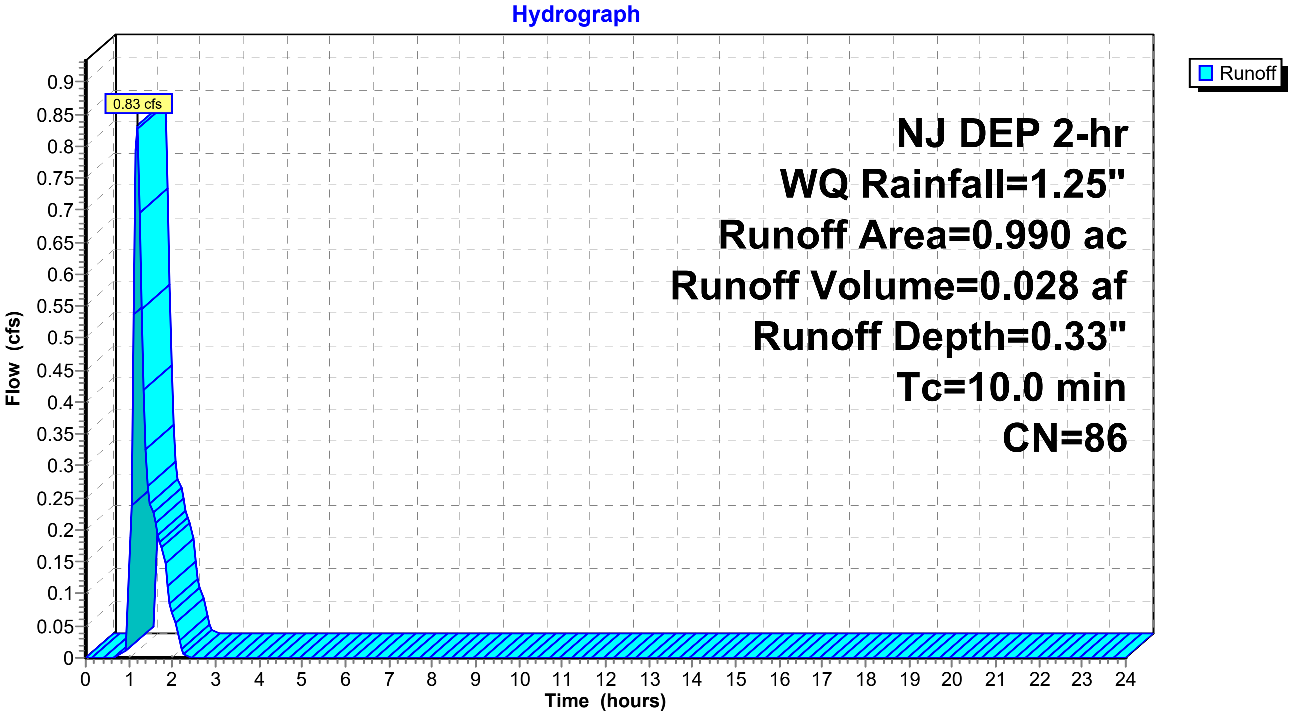
Runoff = 0.83 cfs @ 1.18 hrs, Volume= 0.028 af, Depth= 0.33"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.950	85	Gravel (B)
*	0.040	98	Impervious
	0.990	86	Weighted Average
	0.950		95.96% Pervious Area
	0.040		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 4S: PDA-1B (IMP)



Summary for Subcatchment 5S: PDA-1B New Road

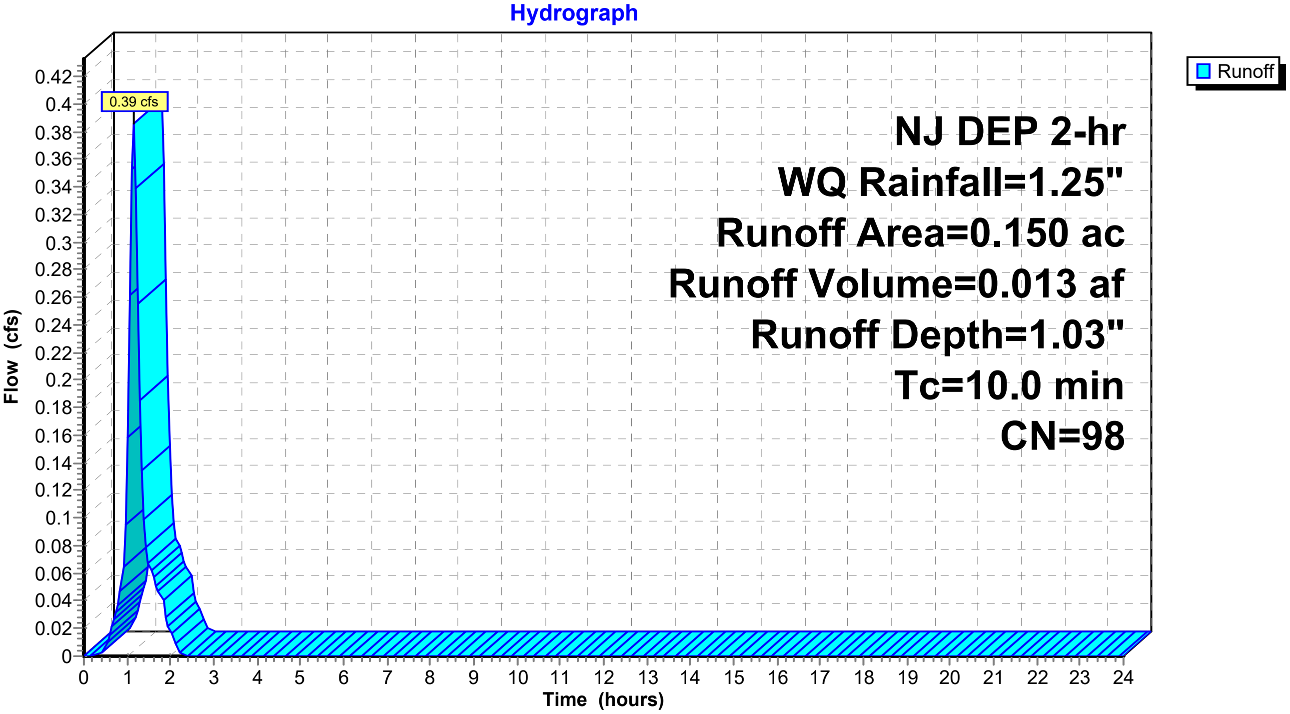
Runoff = 0.39 cfs @ 1.15 hrs, Volume= 0.013 af, Depth= 1.03"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.150	98	New Road
	0.150		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 5S: PDA-1B New Road



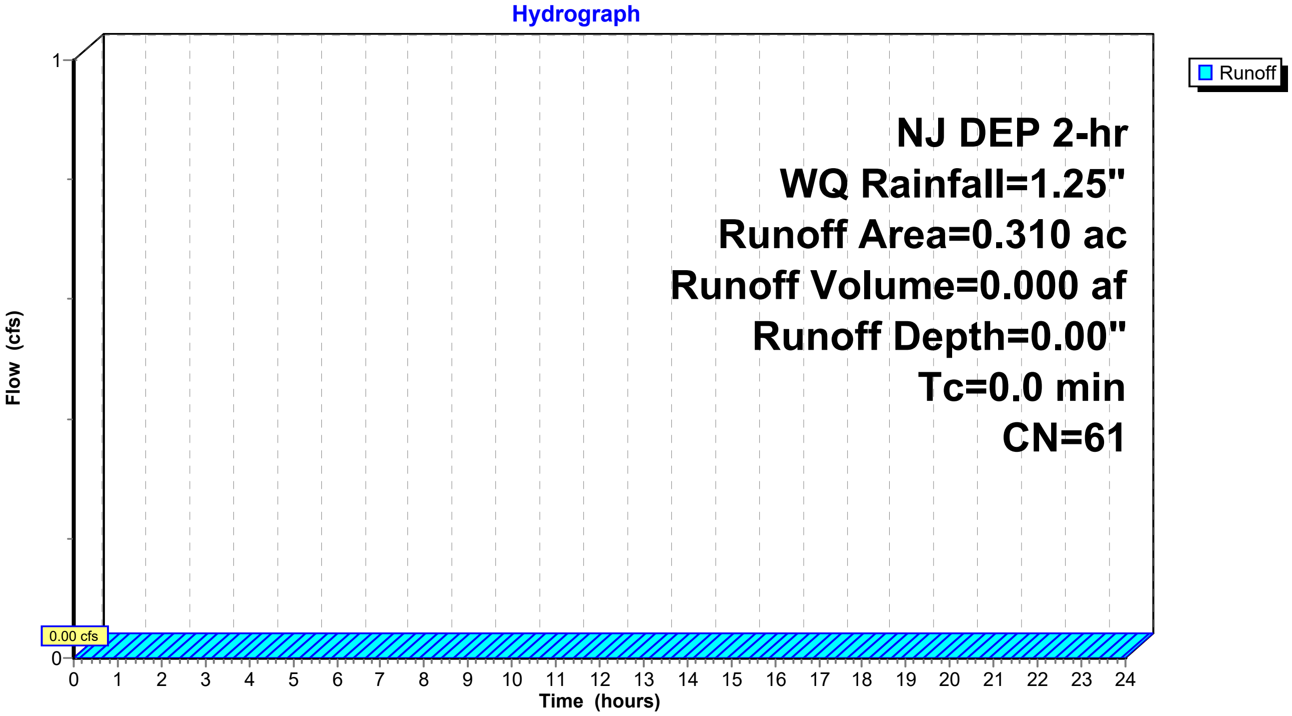
Summary for Subcatchment 6S: PDA-1B (PERV)

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.310	61	Lawn (B)
	0.310		100.00% Pervious Area

Subcatchment 6S: PDA-1B (PERV)



Summary for Subcatchment 7S: PDA-1C (IMP)

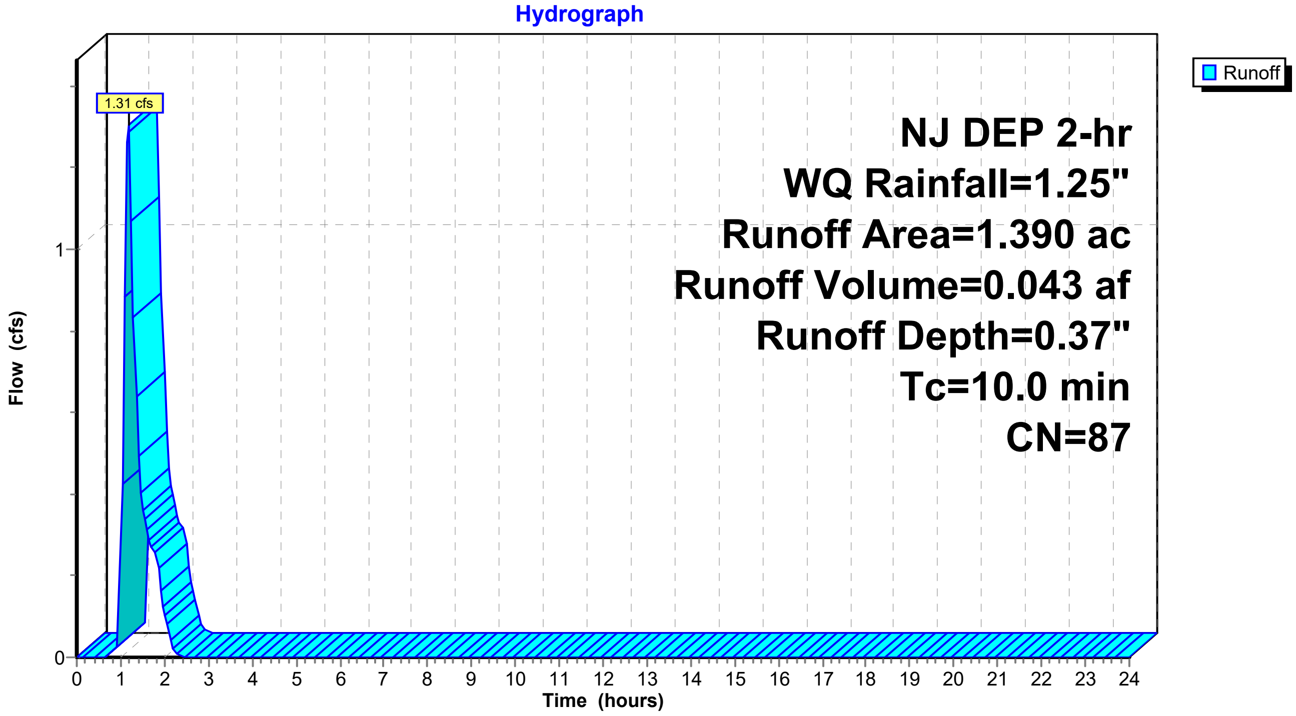
Runoff = 1.31 cfs @ 1.18 hrs, Volume= 0.043 af, Depth= 0.37"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	1.220	85	Gravel (B)
*	0.010	98	Impervious
*	0.160	98	New Roads
	1.390	87	Weighted Average
	1.220		87.77% Pervious Area
	0.170		12.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 7S: PDA-1C (IMP)



Summary for Subcatchment 8S: PDA-1C New Road

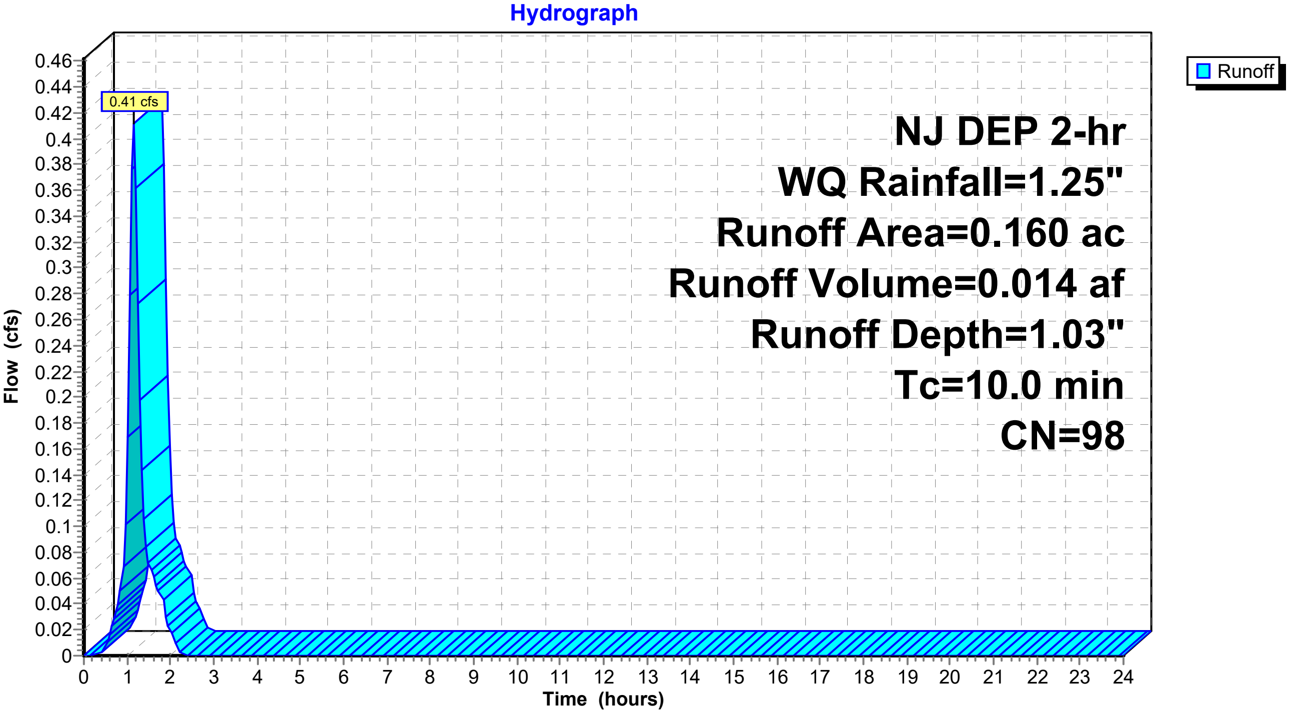
Runoff = 0.41 cfs @ 1.15 hrs, Volume= 0.014 af, Depth= 1.03"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.160	98	New Road
	0.160		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 8S: PDA-1C New Road



Summary for Subcatchment 9S: PDA-1C (PERV)

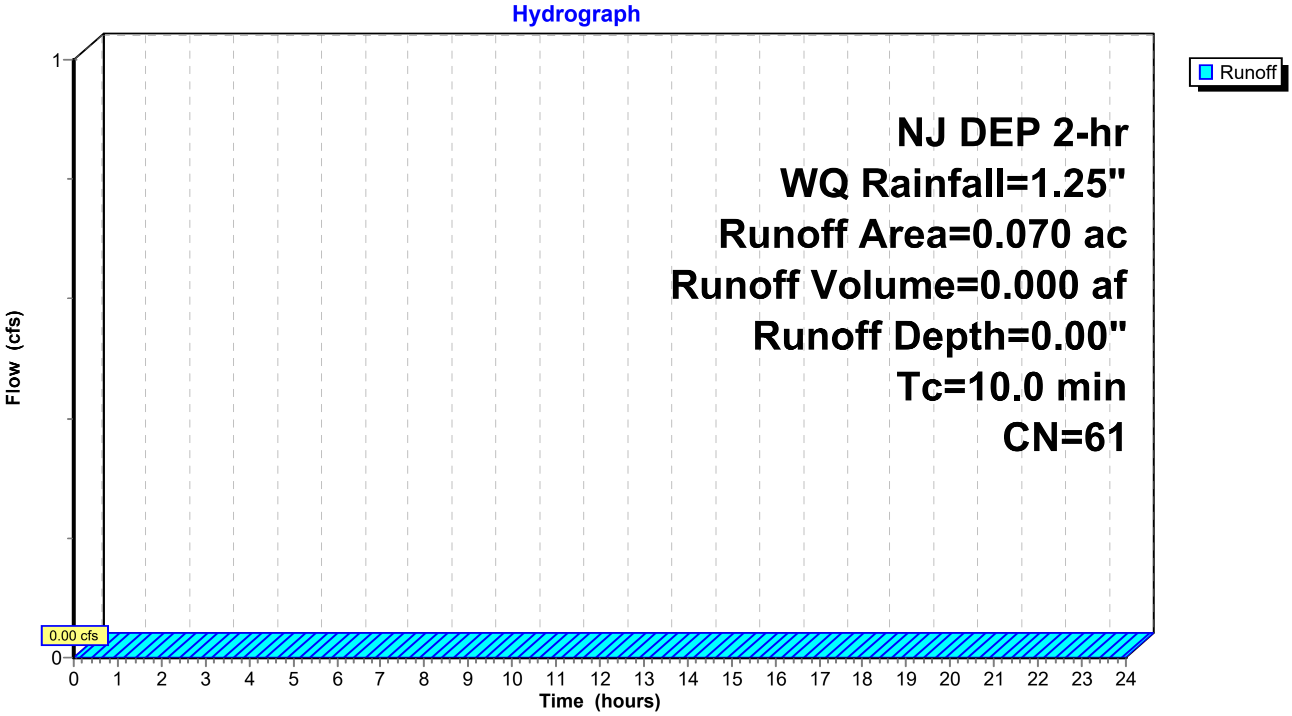
```
Runoff       =          0.00 cfs @     0.00 hrs,  Volume=           0.000 af,  Depth=  0.00"
    Routed to Link 20L : Swale 3/WQU-3
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.070	61	Lawn (B)
	0.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 9S: PDA-1C (PERV)



Summary for Subcatchment 10S: PDA-1D (IMP)

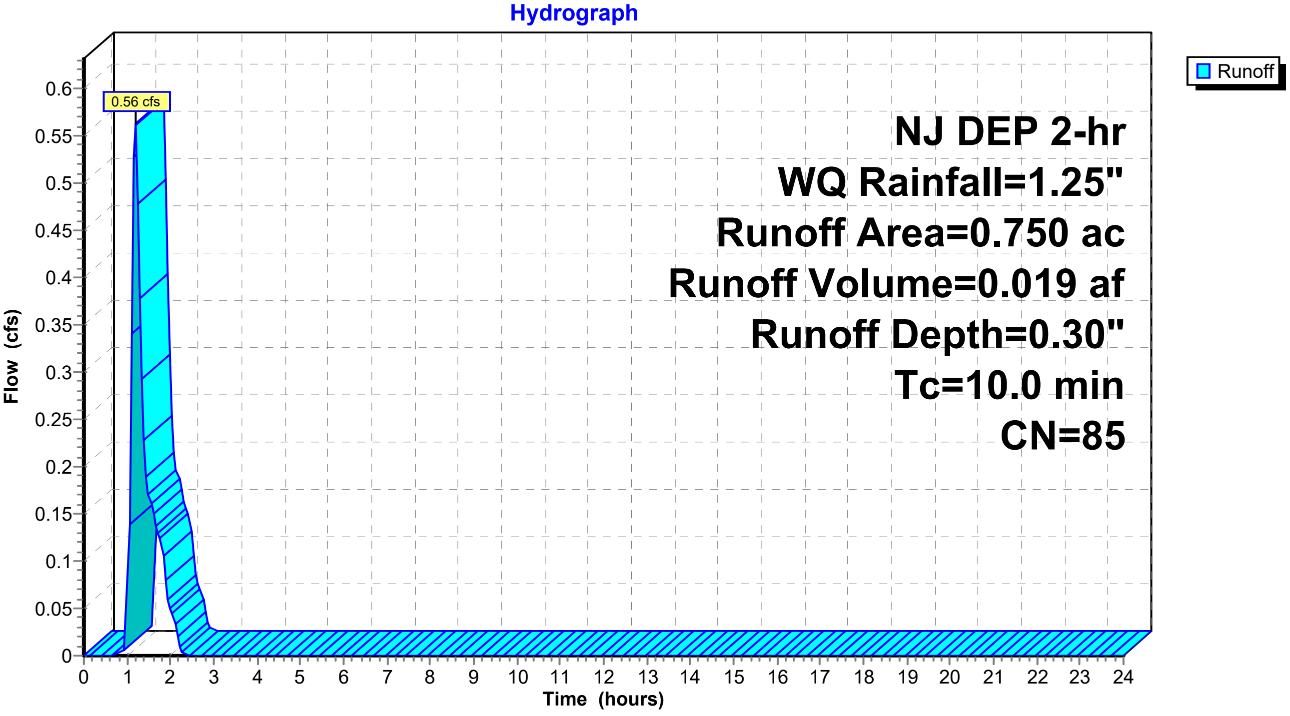
Runoff = 0.56 cfs @ 1.19 hrs, Volume= 0.019 af, Depth= 0.30"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.750	85	Gravel (B)
	0.750		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 10S: PDA-1D (IMP)



Summary for Subcatchment 11S: PDA-1D New Road

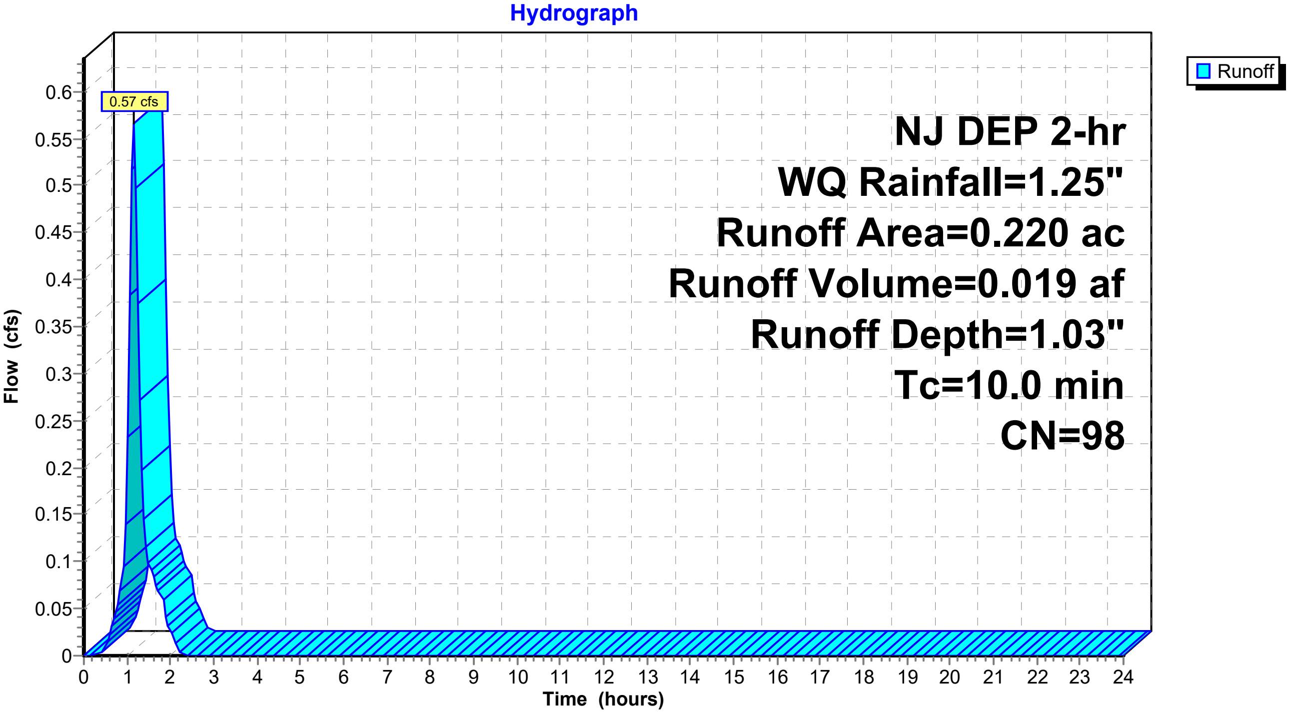
Runoff = 0.57 cfs @ 1.15 hrs, Volume= 0.019 af, Depth= 1.03"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.220	98	New Road
	0.220		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 11S: PDA-1D New Road



Summary for Subcatchment 12S: PDA-1D (PERV)

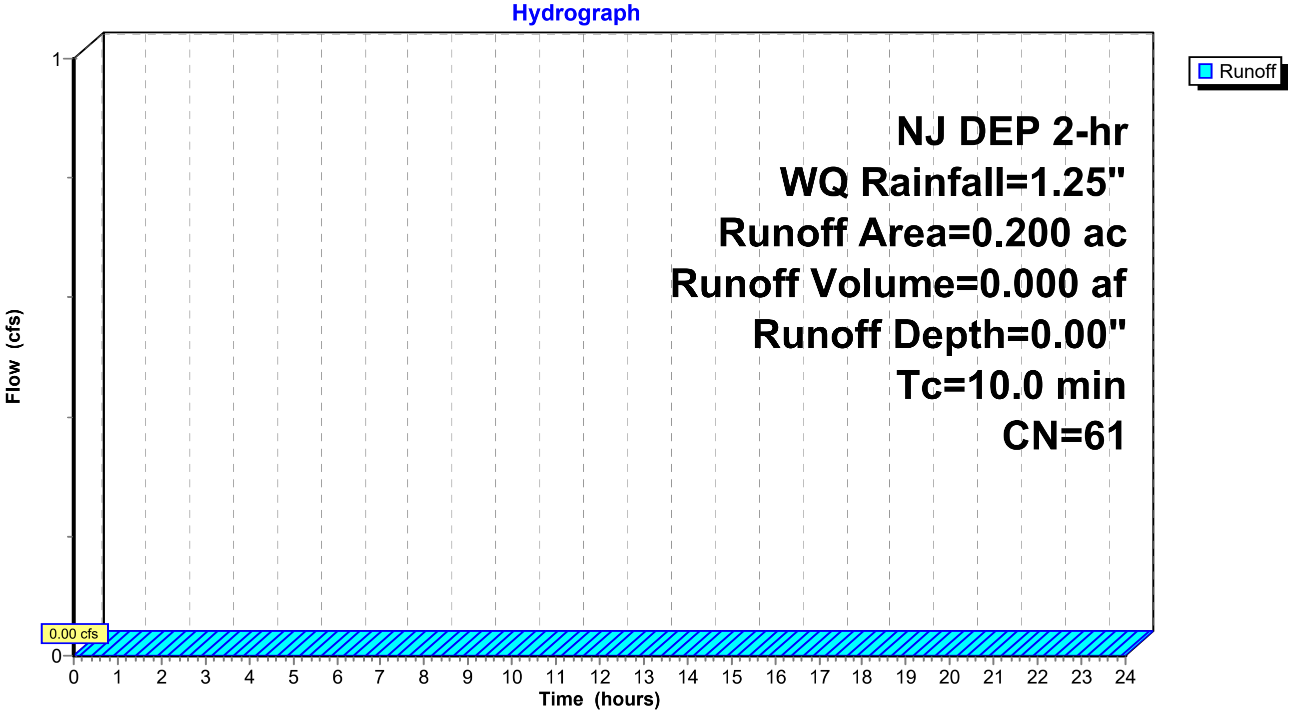
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.200	61	Lawn (B)
	0.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 12S: PDA-1D (PERV)



Summary for Subcatchment 13S: PDA-2A (IMP)

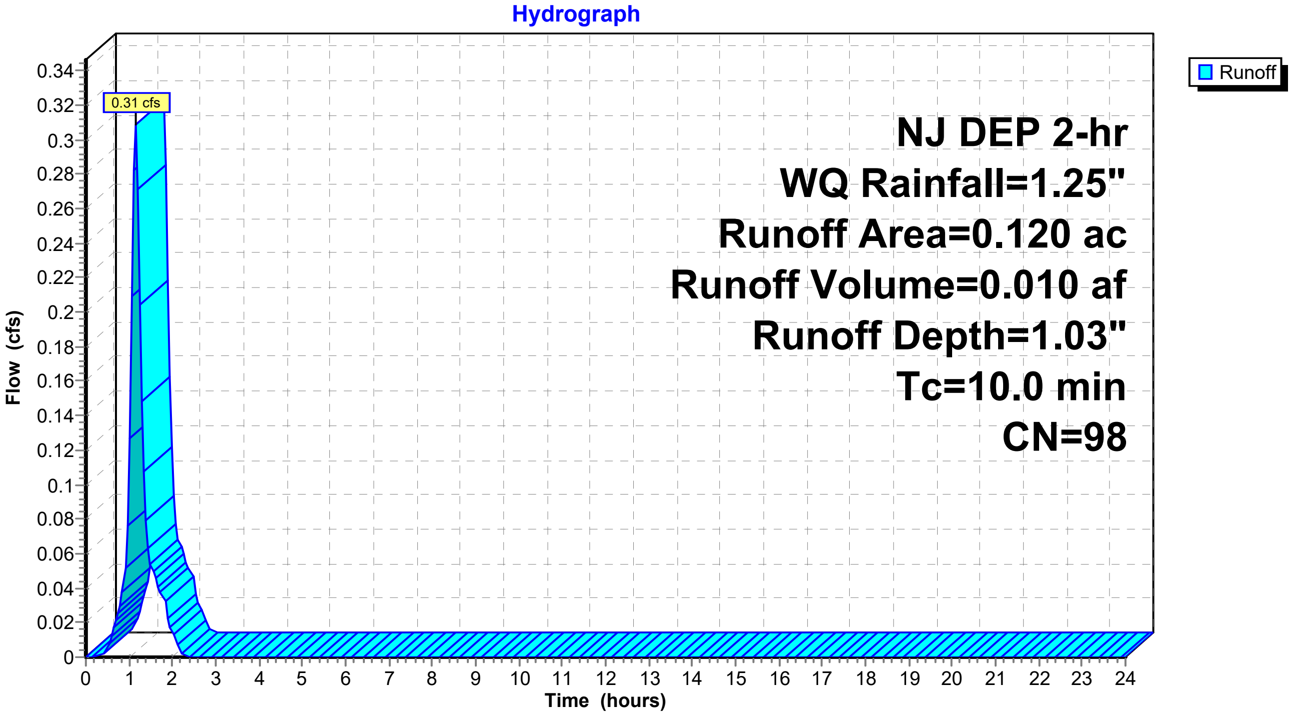
Runoff = 0.31 cfs @ 1.15 hrs, Volume= 0.010 af, Depth= 1.03"
Routed to Link 22L : PDA-2A Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.120	98	Impervious
	0.120		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 13S: PDA-2A (IMP)



Summary for Subcatchment 14S: PDA-2A (PERV)

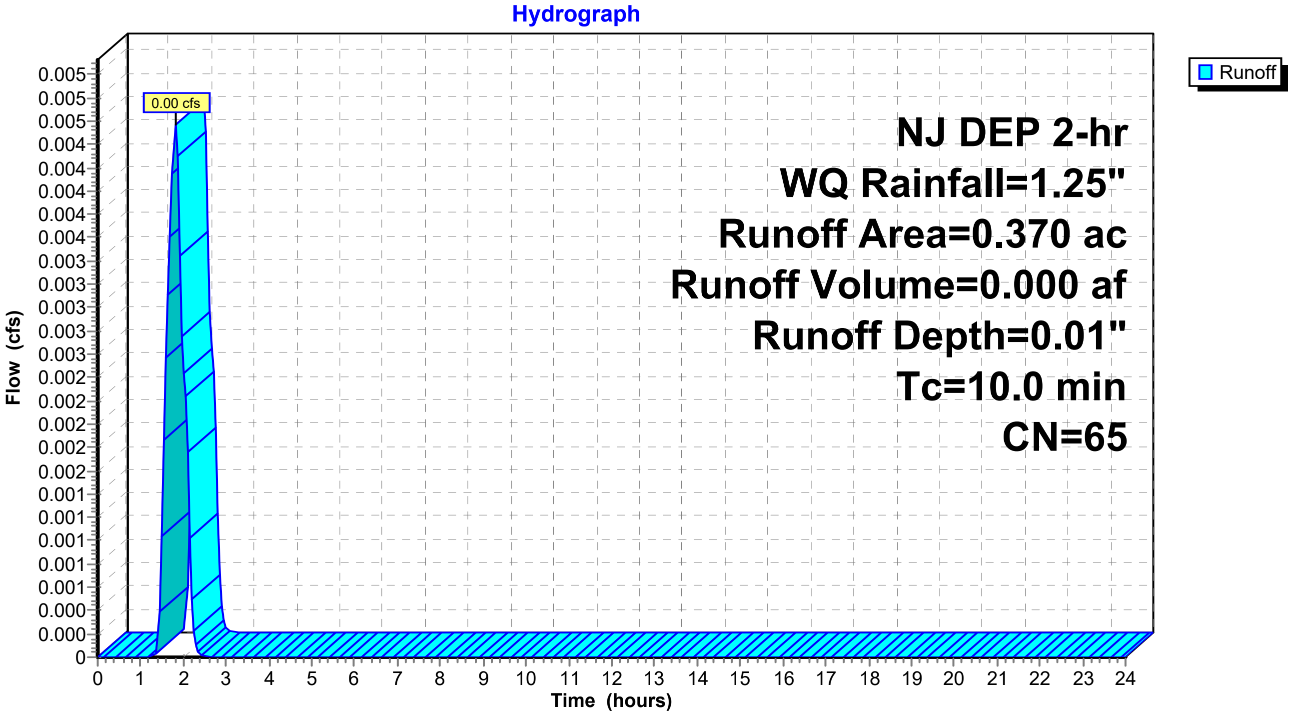
Runoff = 0.00 cfs @ 1.81 hrs, Volume= 0.000 af, Depth= 0.01"
Routed to Link 22L : PDA-2A Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.090	77	Wooded (D)
*	0.280	61	Lawn (B)
	0.370	65	Weighted Average
	0.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 14S: PDA-2A (PERV)



Summary for Subcatchment 15S: PDA-2B (IMP)

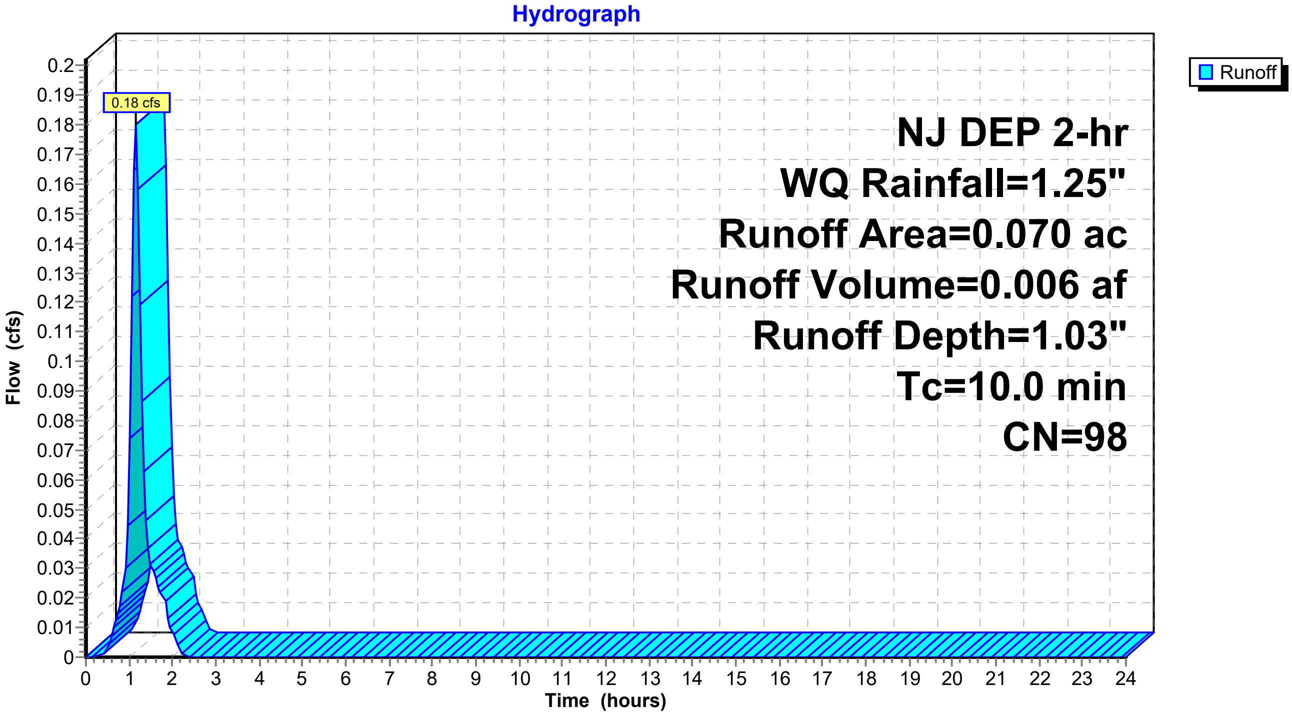
Runoff = 0.18 cfs @ 1.15 hrs, Volume= 0.006 af, Depth= 1.03"
Routed to Link 23L : PDA-2B Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.070	98	Impervious
	0.070		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 15S: PDA-2B (IMP)



Summary for Subcatchment 16S: PDA-2B (PERV)

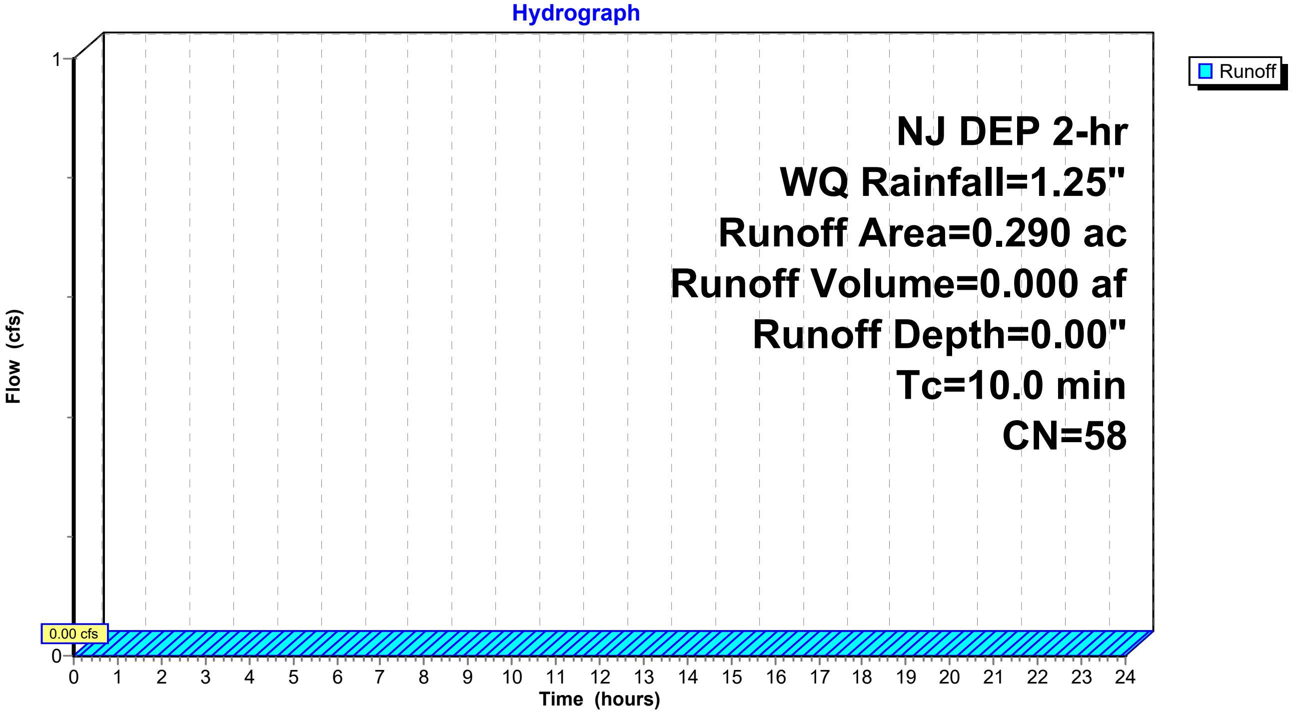
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link 23L : PDA-2B Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.160	55	Wooded (B)
*	0.130	61	Lawn (B)
	0.290	58	Weighted Average
	0.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 16S: PDA-2B (PERV)



Summary for Subcatchment 17S: PDA-3 (IMP)

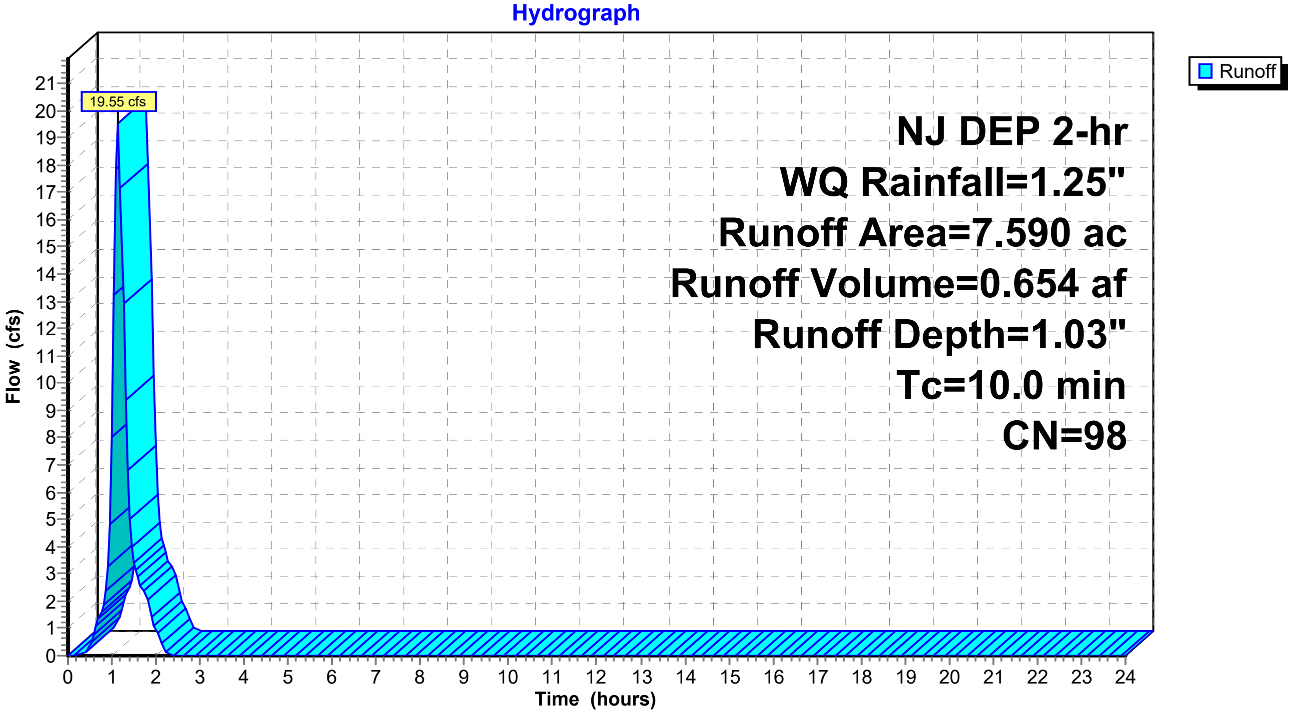
Runoff = 19.55 cfs @ 1.15 hrs, Volume= 0.654 af, Depth= 1.03"
Routed to Link 27L : Total Site Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	7.590	98	Impervious
	7.590		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 17S: PDA-3 (IMP)



Summary for Subcatchment 26S: Sub-Catch to Swale 1 (for Swale Calc Only)

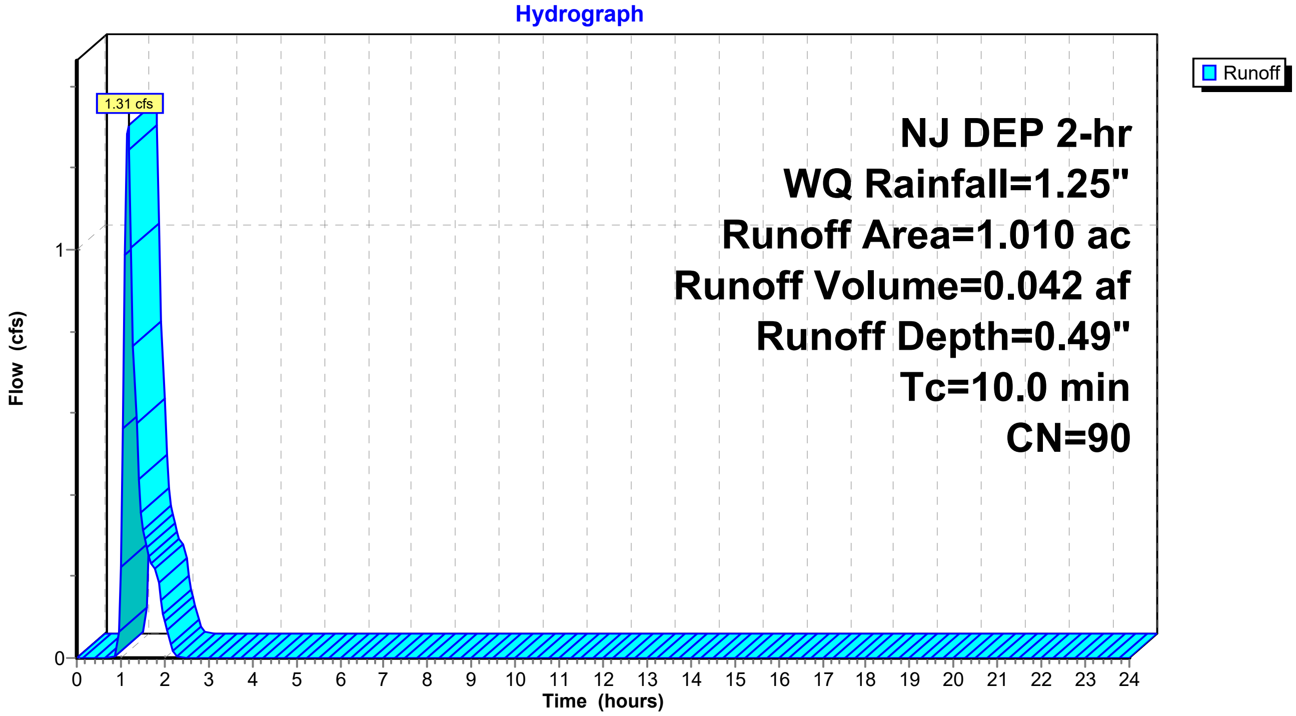
Runoff = 1.31 cfs @ 1.17 hrs, Volume= 0.042 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQ Rainfall=1.25"

	Area (ac)	CN	Description
*	0.510	85	Gravel
*	0.450	98	Impervious
*	0.050	61	Lawn (B)
	1.010	90	Weighted Average
	0.560		55.45% Pervious Area
	0.450		44.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 26S: Sub-Catch to Swale 1 (for Swale Calc Only)

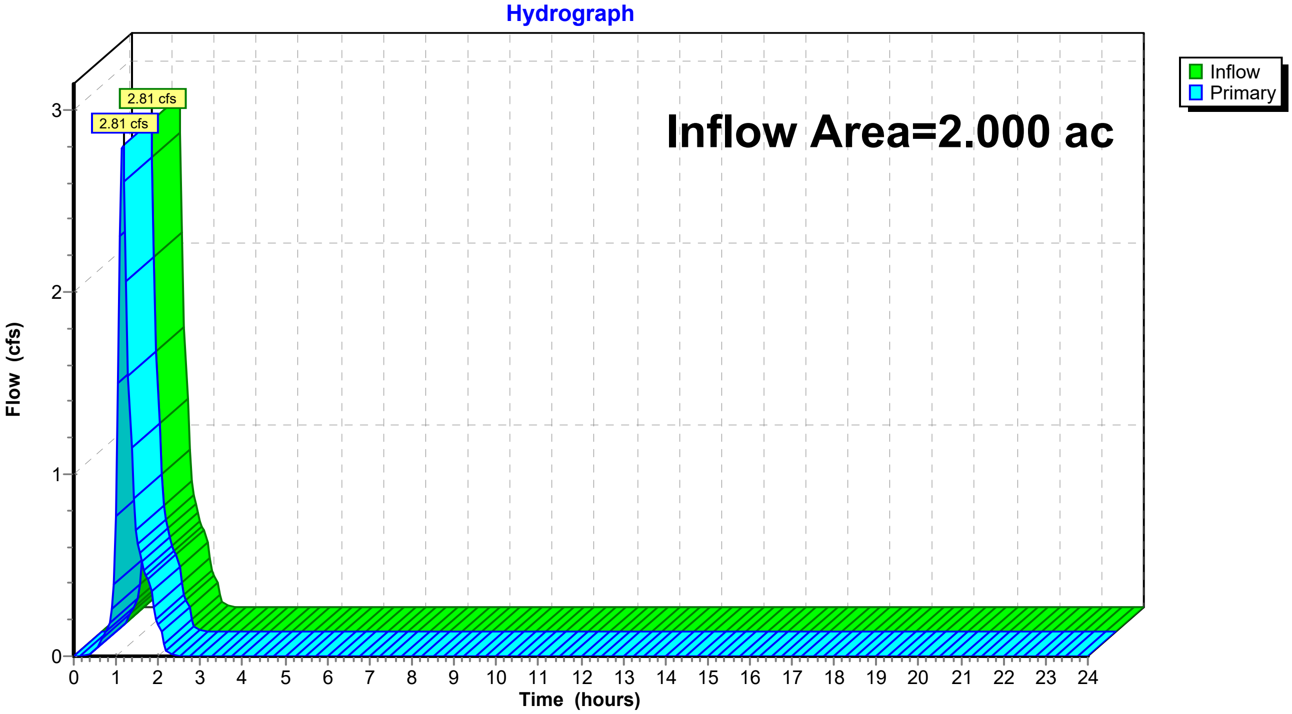


Summary for Link 18L: To WQU-1/Pipe 1 Overflow

```
Inflow Area =       2.000 ac,  44.50% Impervious,  Inflow Depth =   0.56"    for  WQ event
Inflow      =       2.81 cfs @     1.16 hrs,  Volume=           0.093 af
Primary     =       2.81 cfs @     1.16 hrs,  Volume=           0.093 af,  Atten= 0%,  Lag= 0.0 min
    Routed to Link 26L : To Wetlands
```

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 18L: To WQU-1/Pipe 1 Overflow

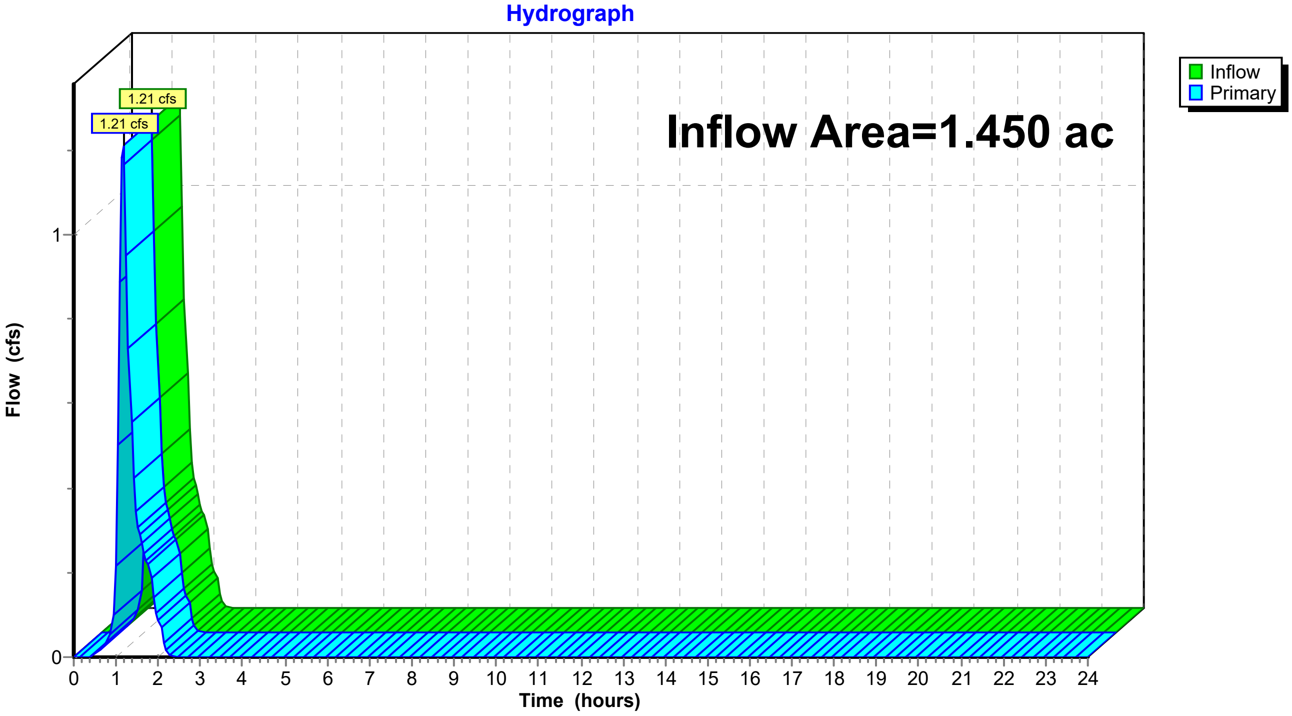


Summary for Link 19L: Swale 2/WQU-2/Pipe 2 Overflow

```
Inflow Area =     1.450 ac, 13.10% Impervious, Inflow Depth =  0.34"   for  WQ event
Inflow      =     1.21 cfs @    1.17 hrs,  Volume=          0.041 af
Primary     =     1.21 cfs @    1.17 hrs,  Volume=          0.041 af,  Atten= 0%,  Lag= 0.0 min
    Routed to Link 25L : To Pipe 4 Overflow
```

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 19L: Swale 2/WQU-2/Pipe 2 Overflow

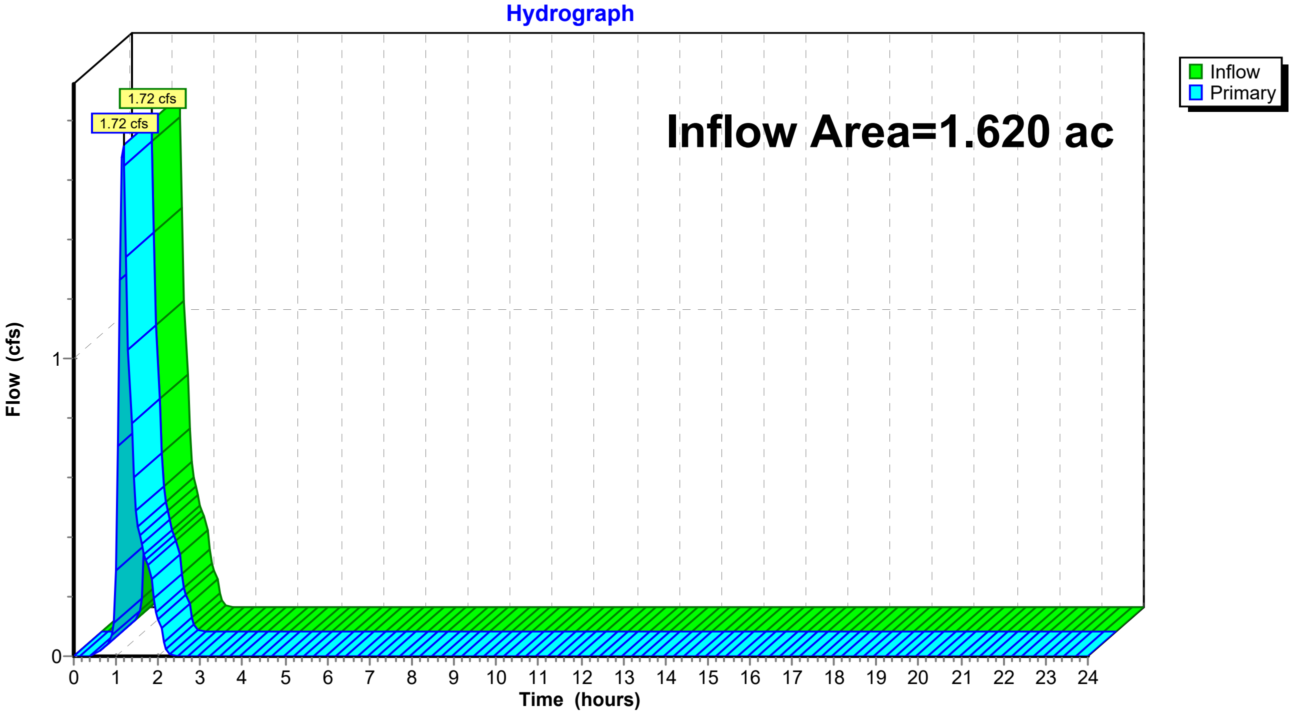


Summary for Link 20L: Swale 3/WQU-3

Inflow Area = 1.620 ac, 20.37% Impervious, Inflow Depth = 0.42" for WQ event
Inflow = 1.72 cfs @ 1.17 hrs, Volume= 0.057 af
Primary = 1.72 cfs @ 1.17 hrs, Volume= 0.057 af, Atten= 0%, Lag= 0.0 min
Routed to Link 24L : To Pipe 3 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 20L: Swale 3/WQU-3

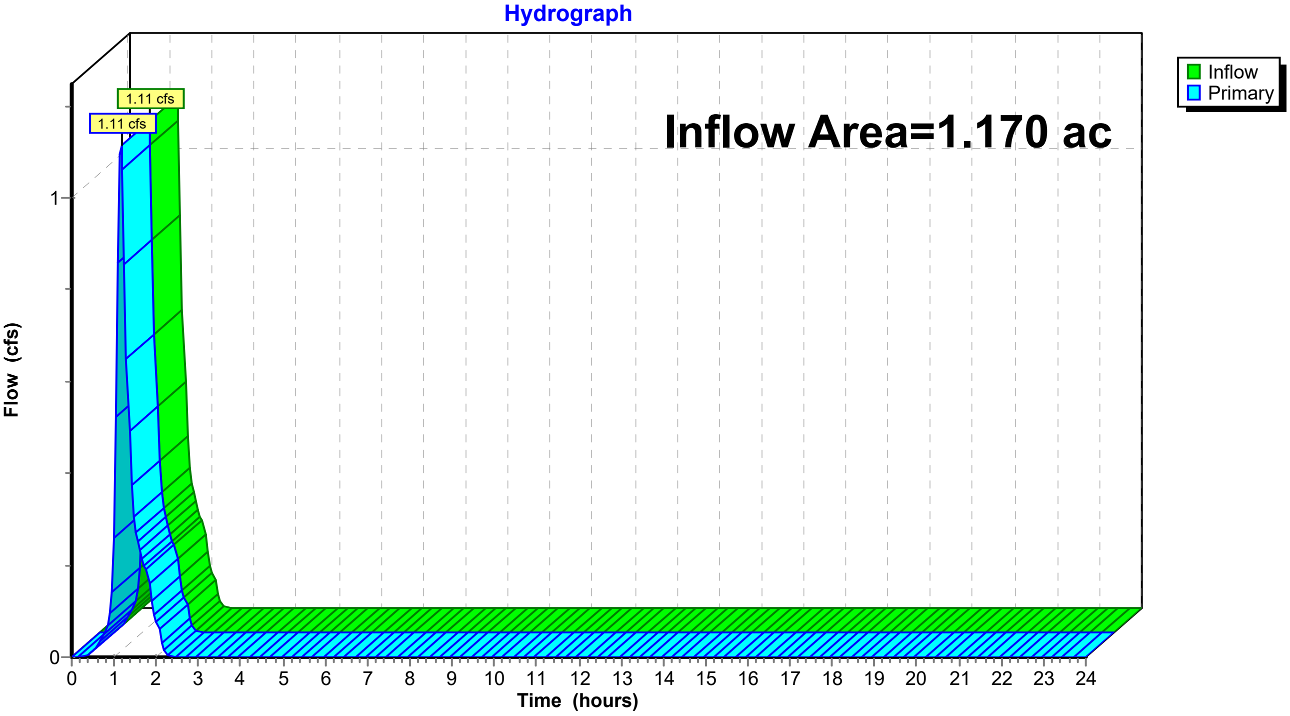


Summary for Link 21L: Swale 4/WQU-4

Inflow Area = 1.170 ac, 18.80% Impervious, Inflow Depth = 0.39" for WQ event
Inflow = 1.11 cfs @ 1.17 hrs, Volume= 0.038 af
Primary = 1.11 cfs @ 1.17 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min
Routed to Link 24L : To Pipe 3 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

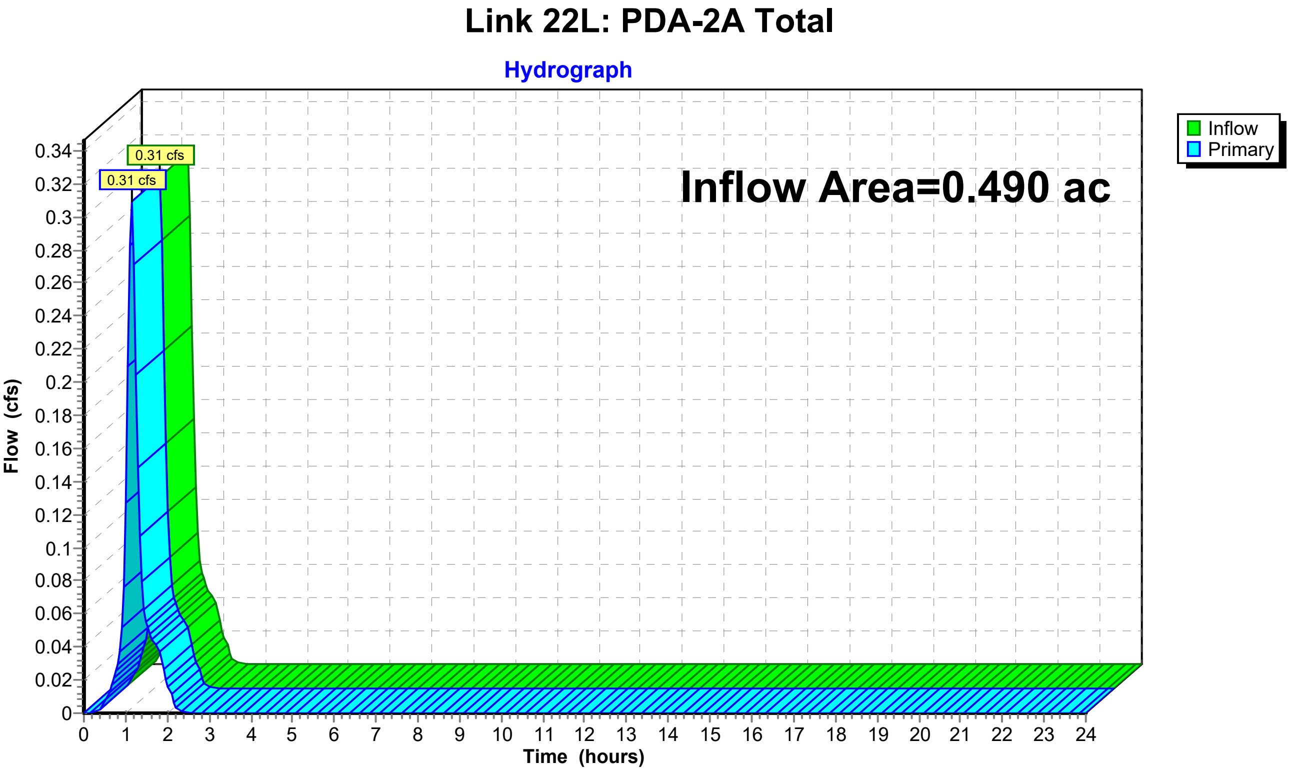
Link 21L: Swale 4/WQU-4



Summary for Link 22L: PDA-2A Total

Inflow Area = 0.490 ac, 24.49% Impervious, Inflow Depth = 0.26" for WQ event
Inflow = 0.31 cfs @ 1.15 hrs, Volume= 0.011 af
Primary = 0.31 cfs @ 1.15 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

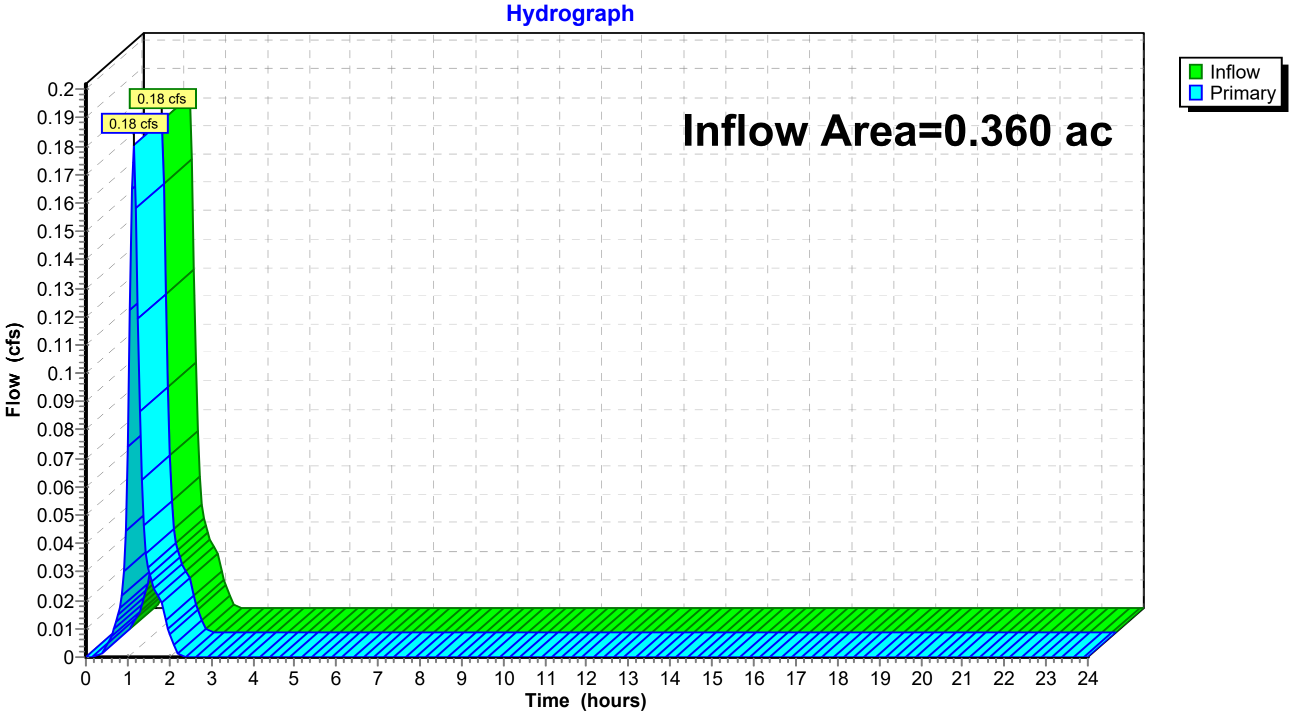


Summary for Link 23L: PDA-2B Total

Inflow Area = 0.360 ac, 19.44% Impervious, Inflow Depth = 0.20" for WQ event
Inflow = 0.18 cfs @ 1.15 hrs, Volume= 0.006 af
Primary = 0.18 cfs @ 1.15 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 23L: PDA-2B Total

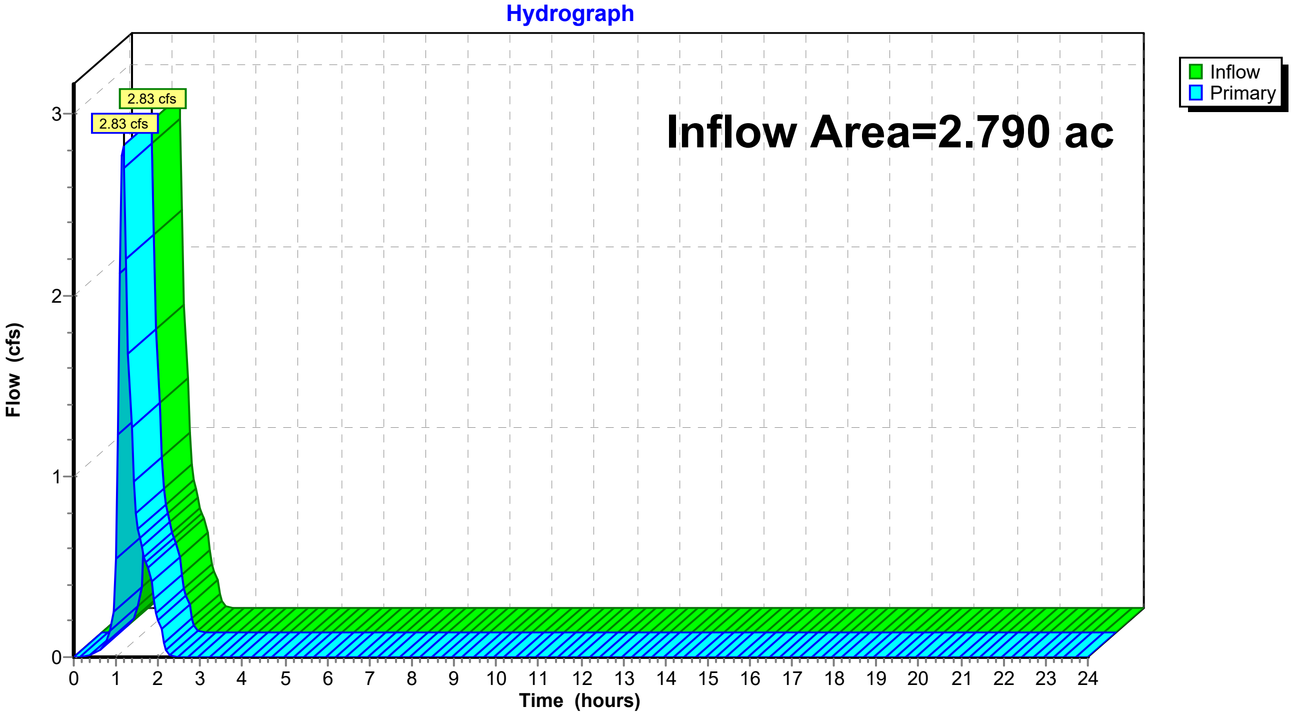


Summary for Link 24L: To Pipe 3 Overflow

Inflow Area = 2.790 ac, 19.71% Impervious, Inflow Depth = 0.41" for WQ event
Inflow = 2.83 cfs @ 1.17 hrs, Volume= 0.095 af
Primary = 2.83 cfs @ 1.17 hrs, Volume= 0.095 af, Atten= 0%, Lag= 0.0 min
Routed to Link 25L : To Pipe 4 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 24L: To Pipe 3 Overflow

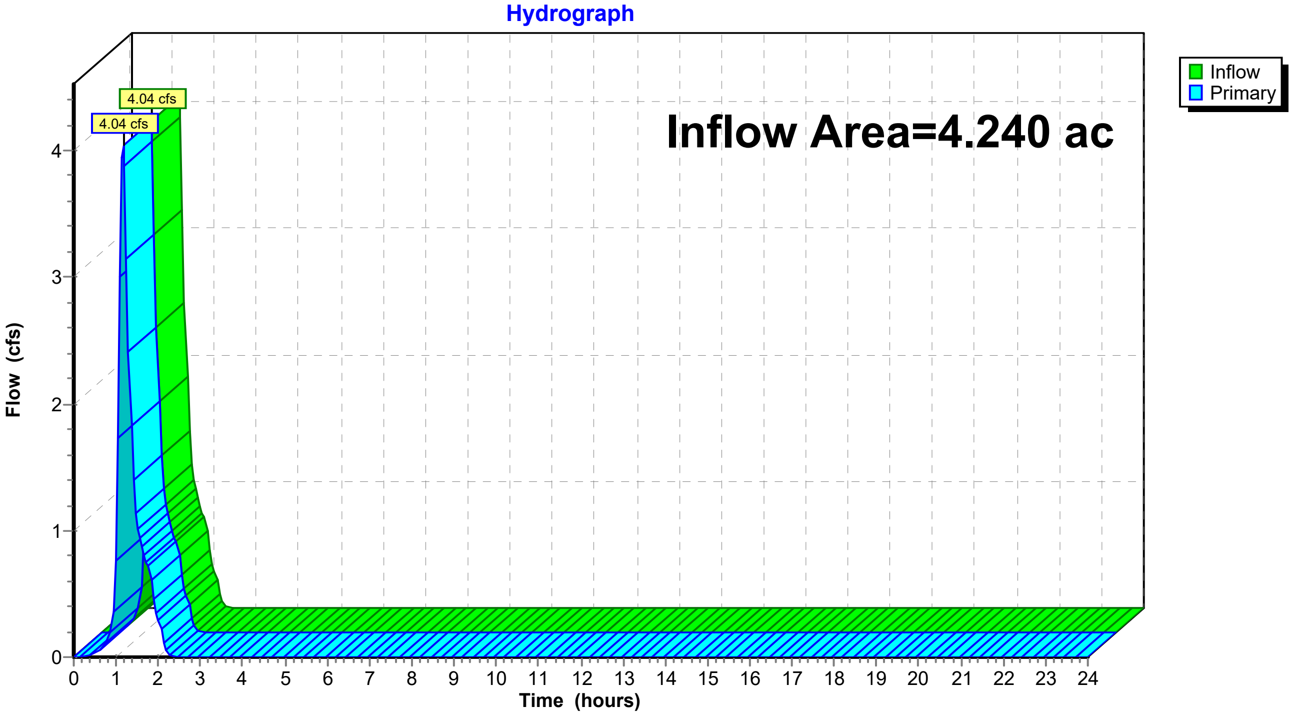


Summary for Link 25L: To Pipe 4 Overflow

Inflow Area = 4.240 ac, 17.45% Impervious, Inflow Depth = 0.38" for WQ event
Inflow = 4.04 cfs @ 1.17 hrs, Volume= 0.135 af
Primary = 4.04 cfs @ 1.17 hrs, Volume= 0.135 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 25L: To Pipe 4 Overflow

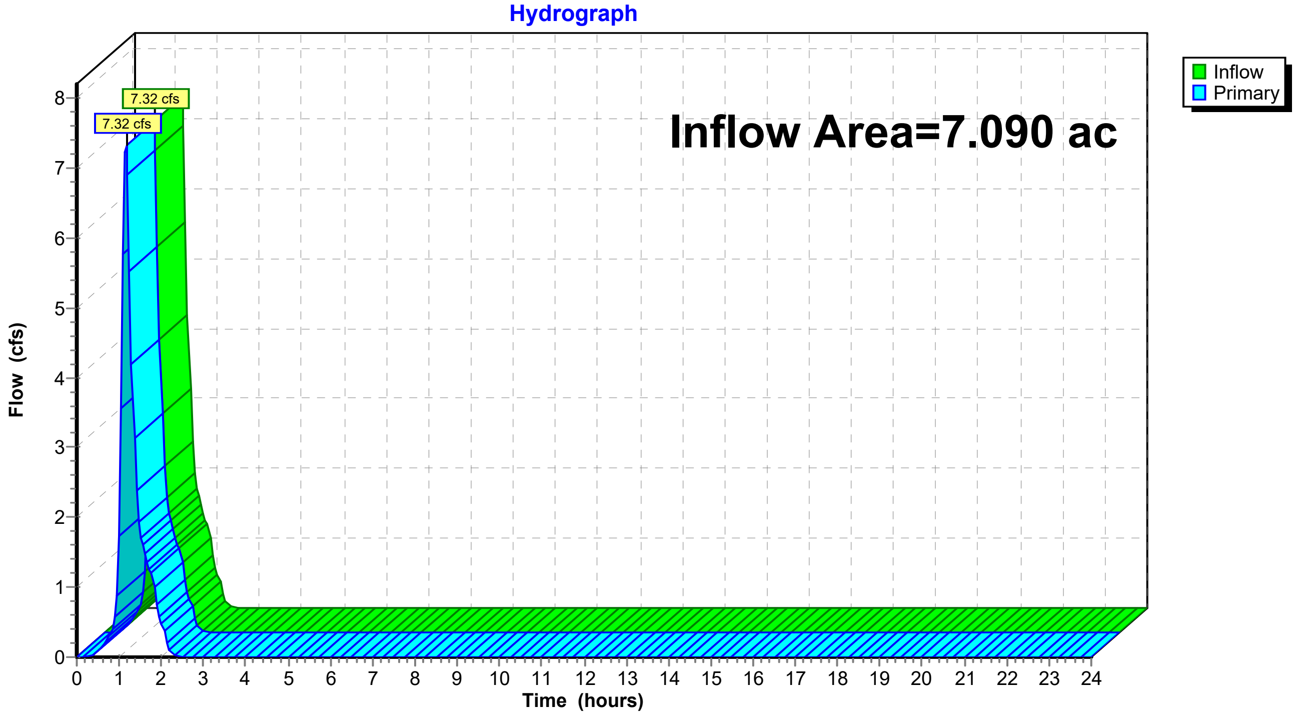


Summary for Link 26L: To Wetlands

Inflow Area = 7.090 ac, 25.67% Impervious, Inflow Depth = 0.41" for WQ event
Inflow = 7.32 cfs @ 1.17 hrs, Volume= 0.245 af
Primary = 7.32 cfs @ 1.17 hrs, Volume= 0.245 af, Atten= 0%, Lag= 0.0 min
Routed to Link 27L : Total Site Runoff

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 26L: To Wetlands

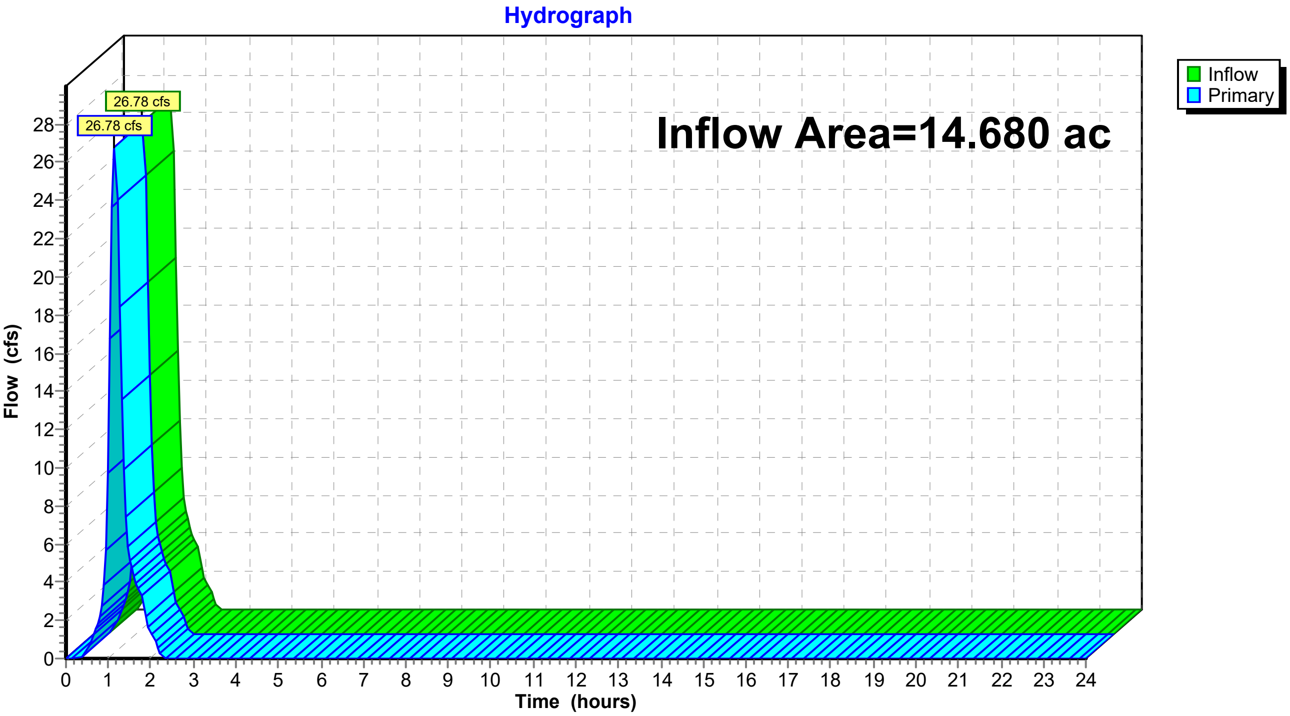


Summary for Link 27L: Total Site Runoff

```
Inflow Area =       14.680 ac,  64.10% Impervious,  Inflow Depth =   0.74"    for  WQ event
Inflow      =      26.78 cfs @     1.15 hrs,  Volume=           0.899 af
Primary     =      26.78 cfs @     1.15 hrs,  Volume=           0.899 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 27L: Total Site Runoff



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1S: PDA-1A (IMP) Runoff Area=1.250 ac 24.00% Impervious Runoff Depth>2.15"
Tc=10.0 min CN=88 Runoff=2.95 cfs 0.224 af

Subcatchment2S: PDA-1A New Road Runoff Area=0.590 ac 100.00% Impervious Runoff Depth>3.13"
Tc=10.0 min CN=98 Runoff=1.80 cfs 0.154 af

Subcatchment3S: PDA-1A (PERV) Runoff Area=0.160 ac 0.00% Impervious Runoff Depth>0.51"
Tc=10.0 min CN=61 Runoff=0.07 cfs 0.007 af

Subcatchment4S: PDA-1B (IMP) Runoff Area=0.990 ac 4.04% Impervious Runoff Depth>1.98"
Tc=10.0 min CN=86 Runoff=2.17 cfs 0.163 af

Subcatchment5S: PDA-1B New Road Runoff Area=0.150 ac 100.00% Impervious Runoff Depth>3.13"
Tc=10.0 min CN=98 Runoff=0.46 cfs 0.039 af

Subcatchment6S: PDA-1B (PERV) Runoff Area=0.310 ac 0.00% Impervious Runoff Depth>0.52"
Tc=0.0 min CN=61 Runoff=0.18 cfs 0.013 af

Subcatchment7S: PDA-1C (IMP) Runoff Area=1.390 ac 12.23% Impervious Runoff Depth>2.06"
Tc=10.0 min CN=87 Runoff=3.16 cfs 0.239 af

Subcatchment8S: PDA-1C New Road Runoff Area=0.160 ac 100.00% Impervious Runoff Depth>3.13"
Tc=10.0 min CN=98 Runoff=0.49 cfs 0.042 af

Subcatchment9S: PDA-1C (PERV) Runoff Area=0.070 ac 0.00% Impervious Runoff Depth>0.51"
Tc=10.0 min CN=61 Runoff=0.03 cfs 0.003 af

Subcatchment10S: PDA-1D (IMP) Runoff Area=0.750 ac 0.00% Impervious Runoff Depth>1.90"
Tc=10.0 min CN=85 Runoff=1.57 cfs 0.119 af

Subcatchment11S: PDA-1D New Road Runoff Area=0.220 ac 100.00% Impervious Runoff Depth>3.13"
Tc=10.0 min CN=98 Runoff=0.67 cfs 0.057 af

Subcatchment12S: PDA-1D (PERV) Runoff Area=0.200 ac 0.00% Impervious Runoff Depth>0.51"
Tc=10.0 min CN=61 Runoff=0.08 cfs 0.009 af

Subcatchment13S: PDA-2A (IMP) Runoff Area=0.120 ac 100.00% Impervious Runoff Depth>3.13"
Tc=10.0 min CN=98 Runoff=0.37 cfs 0.031 af

Subcatchment14S: PDA-2A (PERV) Runoff Area=0.370 ac 0.00% Impervious Runoff Depth>0.68"
Tc=10.0 min CN=65 Runoff=0.24 cfs 0.021 af

Subcatchment15S: PDA-2B (IMP) Runoff Area=0.070 ac 100.00% Impervious Runoff Depth>3.13"
Tc=10.0 min CN=98 Runoff=0.21 cfs 0.018 af

Subcatchment16S: PDA-2B (PERV) Runoff Area=0.290 ac 0.00% Impervious Runoff Depth>0.40"
Tc=10.0 min CN=58 Runoff=0.08 cfs 0.010 af

```
Subcatchment17S: PDA-3 (IMP)             Runoff Area=7.590 ac  100.00% Impervious  Runoff Depth>3.13"
                                                  Tc=10.0 min  CN=98  Runoff=23.15 cfs  1.981 af

Subcatchment26S: Sub-Catch to Swale 1    Runoff Area=1.010 ac  44.55% Impervious  Runoff Depth>2.32"
                                                  Tc=10.0 min  CN=90  Runoff=2.55 cfs  0.195 af

Link 18L: To WQU-1/Pipe 1 Overflow                                     Inflow=4.81 cfs  0.384 af
                                                                      Primary=4.81 cfs  0.384 af

Link 19L: Swale 2/WQU-2/Pipe 2 Overflow                                Inflow=2.70 cfs  0.216 af
                                                                      Primary=2.70 cfs  0.216 af

Link 20L: Swale 3/WQU-3                                                Inflow=3.67 cfs  0.284 af
                                                                      Primary=3.67 cfs  0.284 af

Link 21L: Swale 4/WQU-4                                                Inflow=2.33 cfs  0.185 af
                                                                      Primary=2.33 cfs  0.185 af

Link 22L: PDA-2A Total                                                 Inflow=0.60 cfs  0.052 af
                                                                      Primary=0.60 cfs  0.052 af

Link 23L: PDA-2B Total                                                 Inflow=0.28 cfs  0.028 af
                                                                      Primary=0.28 cfs  0.028 af

Link 24L: To Pipe 3 Overflow                                           Inflow=6.00 cfs  0.468 af
                                                                      Primary=6.00 cfs  0.468 af

Link 25L: To Pipe 4 Overflow                                           Inflow=8.70 cfs  0.684 af
                                                                      Primary=8.70 cfs  0.684 af

Link 26L: To Wetlands                                                 Inflow=14.38 cfs  1.149 af
                                                                     Primary=14.38 cfs  1.149 af

Link 27L: Total Site Runoff                                           Inflow=37.52 cfs  3.129 af
                                                                     Primary=37.52 cfs  3.129 af

        Total Runoff Area = 15.690 ac   Runoff Volume = 3.325 af   Average Runoff Depth = 2.54"
                                    37.16% Pervious = 5.830 ac     62.84% Impervious = 9.860 ac
```

Summary for Subcatchment 1S: PDA-1A (IMP)

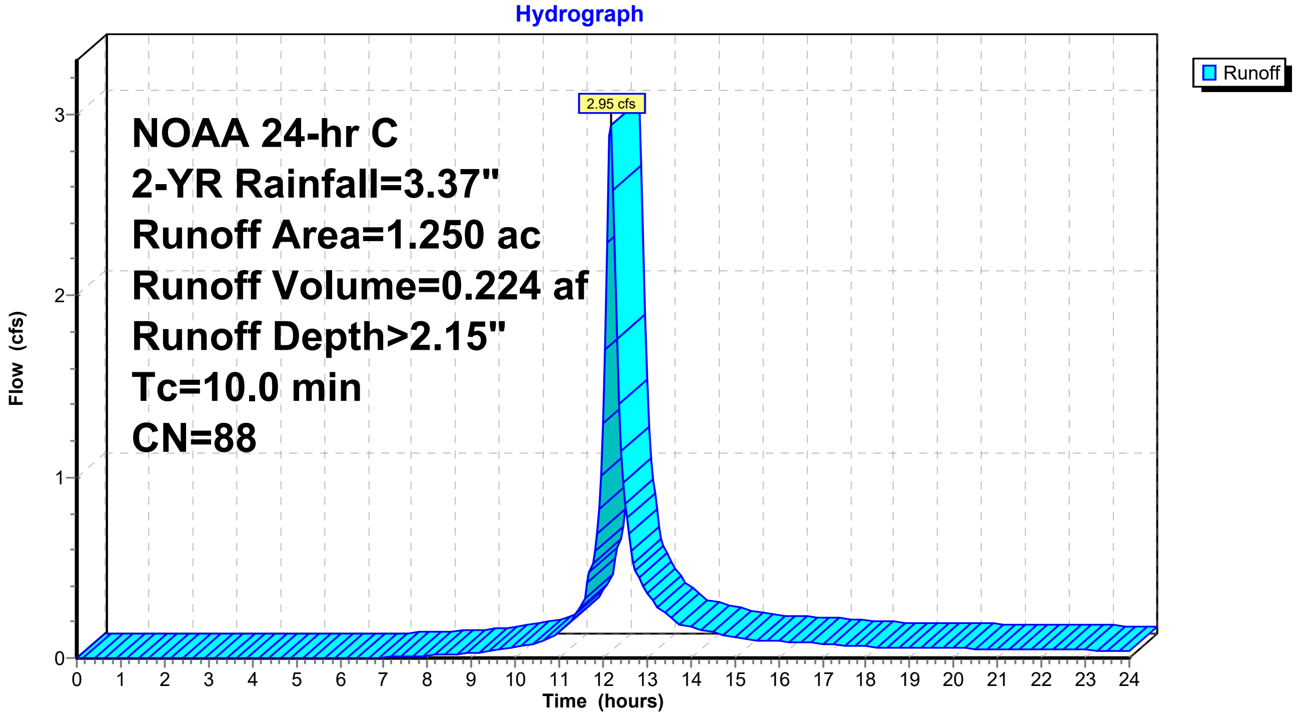
Runoff = 2.95 cfs @ 12.17 hrs, Volume= 0.224 af, Depth> 2.15"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.950	85	Gravel (B)
*	0.300	98	Impervious
	1.250	88	Weighted Average
	0.950		76.00% Pervious Area
	0.300		24.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 1S: PDA-1A (IMP)



Summary for Subcatchment 2S: PDA-1A New Road

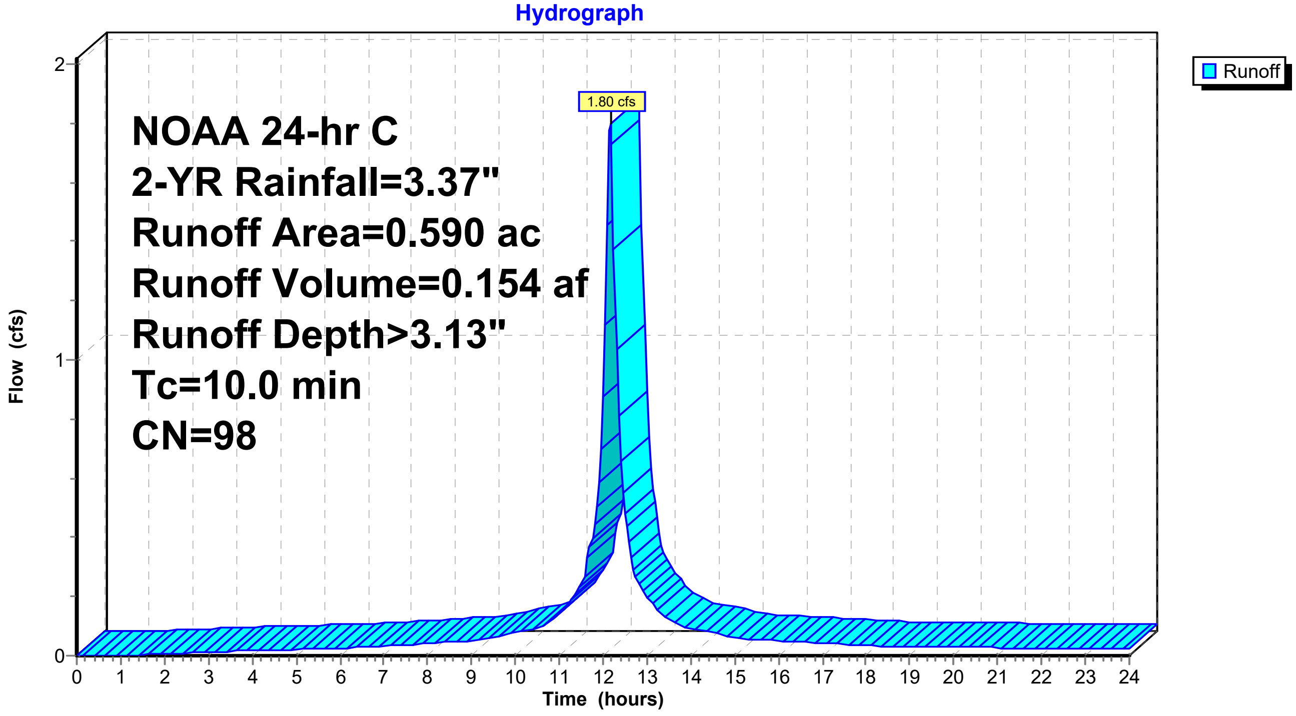
Runoff = 1.80 cfs @ 12.17 hrs, Volume= 0.154 af, Depth> 3.13"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.590	98	New Road
	0.590		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 2S: PDA-1A New Road



Summary for Subcatchment 3S: PDA-1A (PERV)

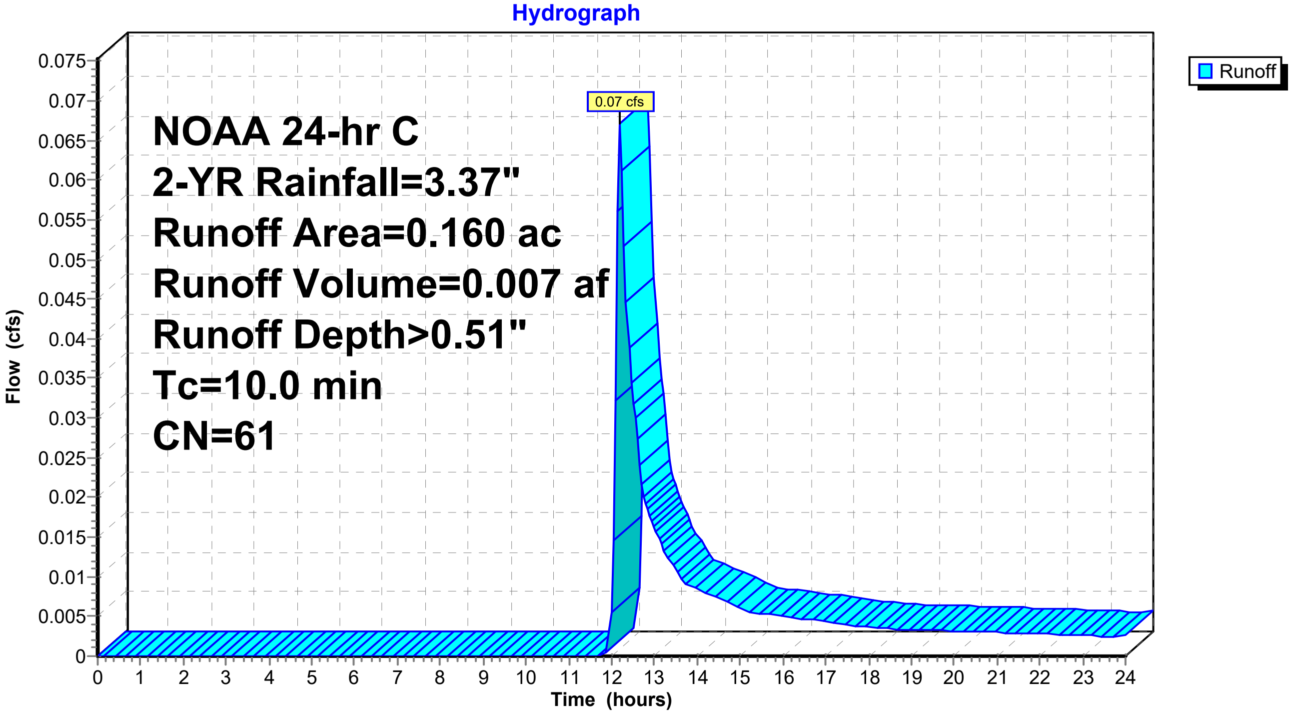
```
Runoff      =        0.07 cfs @   12.21 hrs,  Volume=          0.007 af,  Depth>  0.51"
   Routed to Link 18L : To WQU-1/Pipe 1 Overflow
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.160	61	Lawn (B)
	0.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 3S: PDA-1A (PERV)



Summary for Subcatchment 4S: PDA-1B (IMP)

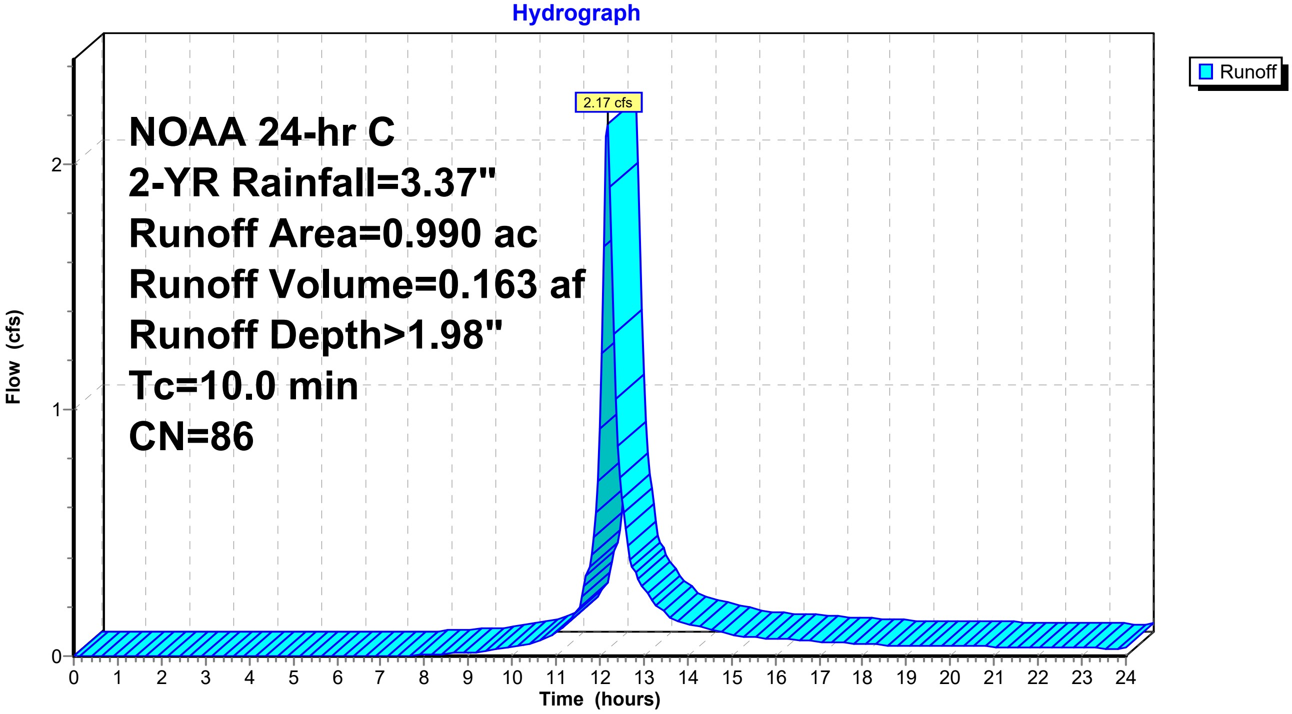
Runoff = 2.17 cfs @ 12.17 hrs, Volume= 0.163 af, Depth> 1.98"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.950	85	Gravel (B)
*	0.040	98	Impervious
	0.990	86	Weighted Average
	0.950		95.96% Pervious Area
	0.040		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 4S: PDA-1B (IMP)



Summary for Subcatchment 5S: PDA-1B New Road

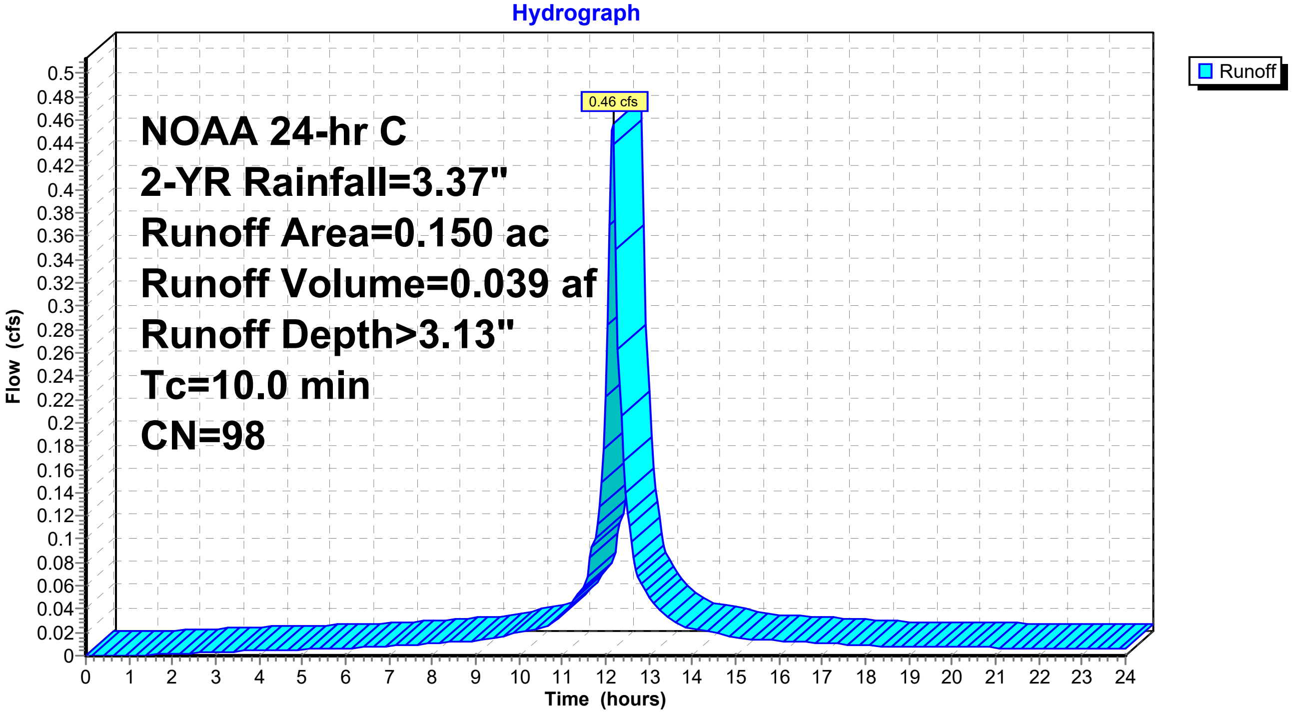
Runoff = 0.46 cfs @ 12.17 hrs, Volume= 0.039 af, Depth> 3.13"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.150	98	New Road
	0.150		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 5S: PDA-1B New Road



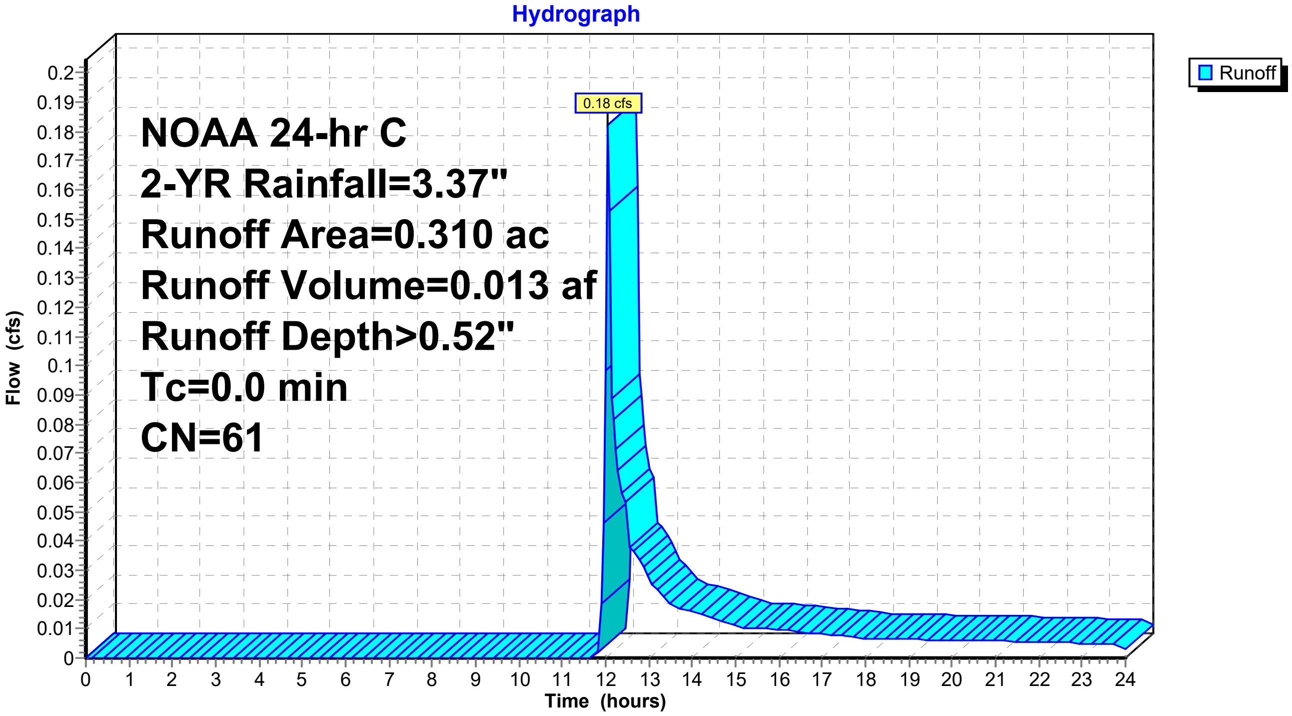
Summary for Subcatchment 6S: PDA-1B (PERV)

Runoff = 0.18 cfs @ 12.06 hrs, Volume= 0.013 af, Depth> 0.52"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.310	61	Lawn (B)
	0.310		100.00% Pervious Area

Subcatchment 6S: PDA-1B (PERV)



Summary for Subcatchment 7S: PDA-1C (IMP)

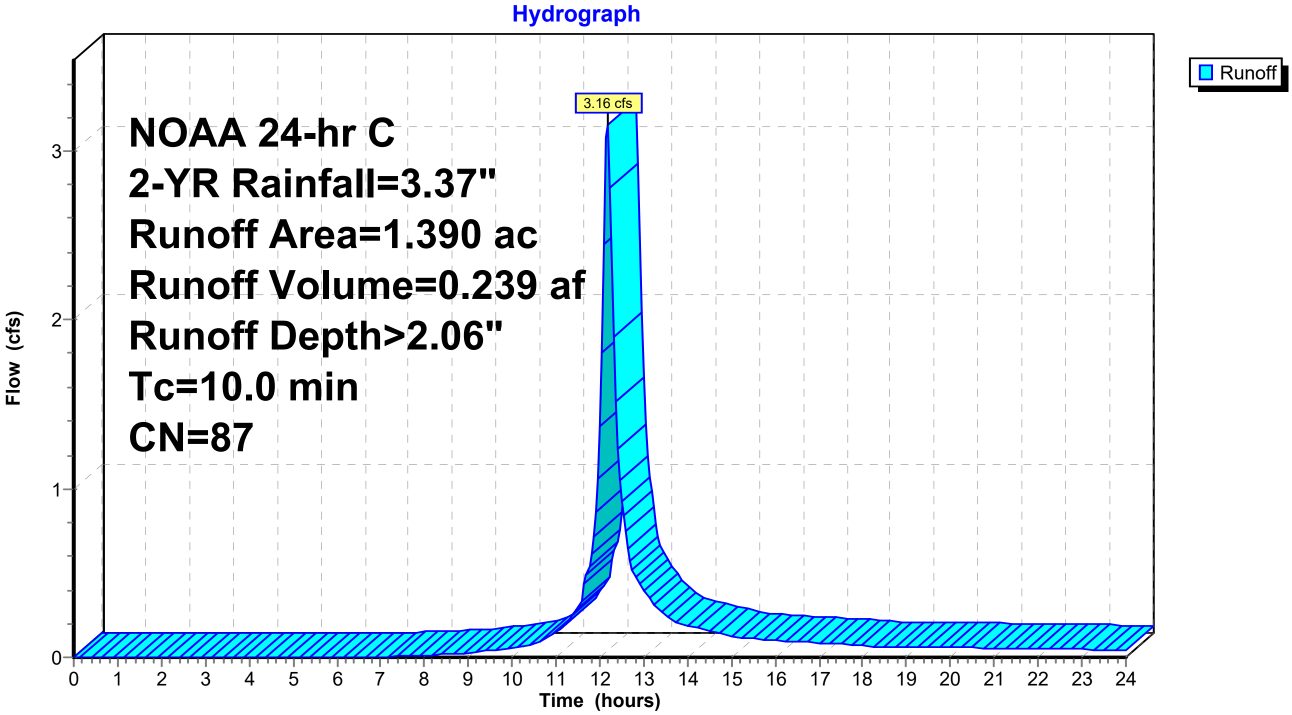
Runoff = 3.16 cfs @ 12.17 hrs, Volume= 0.239 af, Depth> 2.06"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	1.220	85	Gravel (B)
*	0.010	98	Impervious
*	0.160	98	New Roads
	1.390	87	Weighted Average
	1.220		87.77% Pervious Area
	0.170		12.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 7S: PDA-1C (IMP)



Summary for Subcatchment 8S: PDA-1C New Road

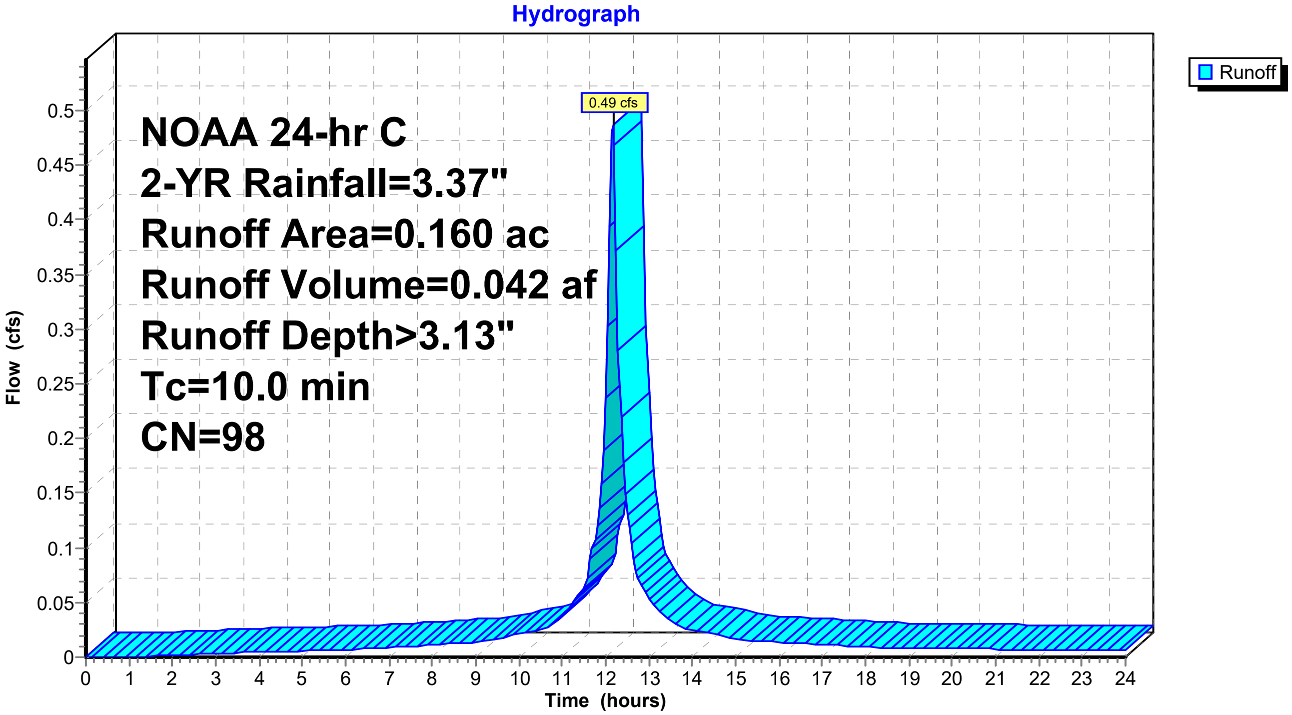
```
Runoff      =        0.49 cfs @   12.17 hrs,  Volume=          0.042 af,  Depth>  3.13"
    Routed to Link 20L : Swale 3/WQU-3
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.160	98	New Road
	0.160		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 8S: PDA-1C New Road



Summary for Subcatchment 9S: PDA-1C (PERV)

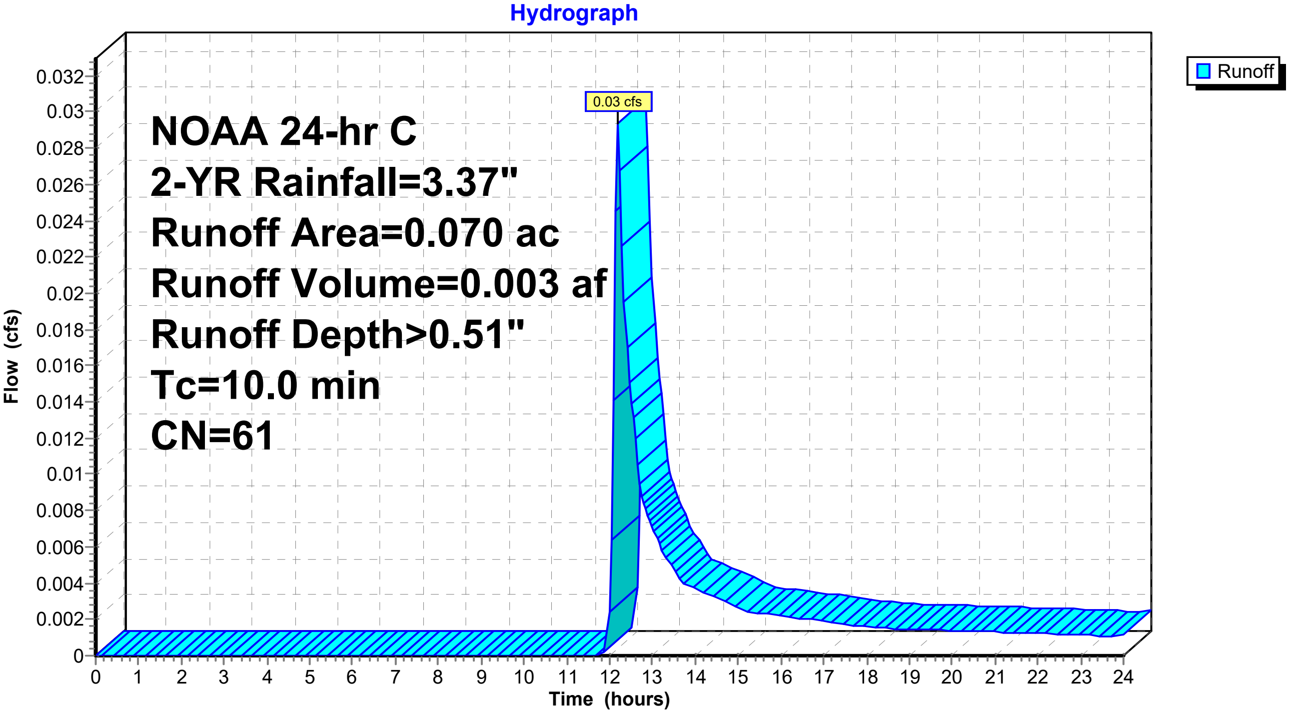
Runoff = 0.03 cfs @ 12.21 hrs, Volume= 0.003 af, Depth> 0.51"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.070	61	Lawn (B)
	0.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 9S: PDA-1C (PERV)



Summary for Subcatchment 10S: PDA-1D (IMP)

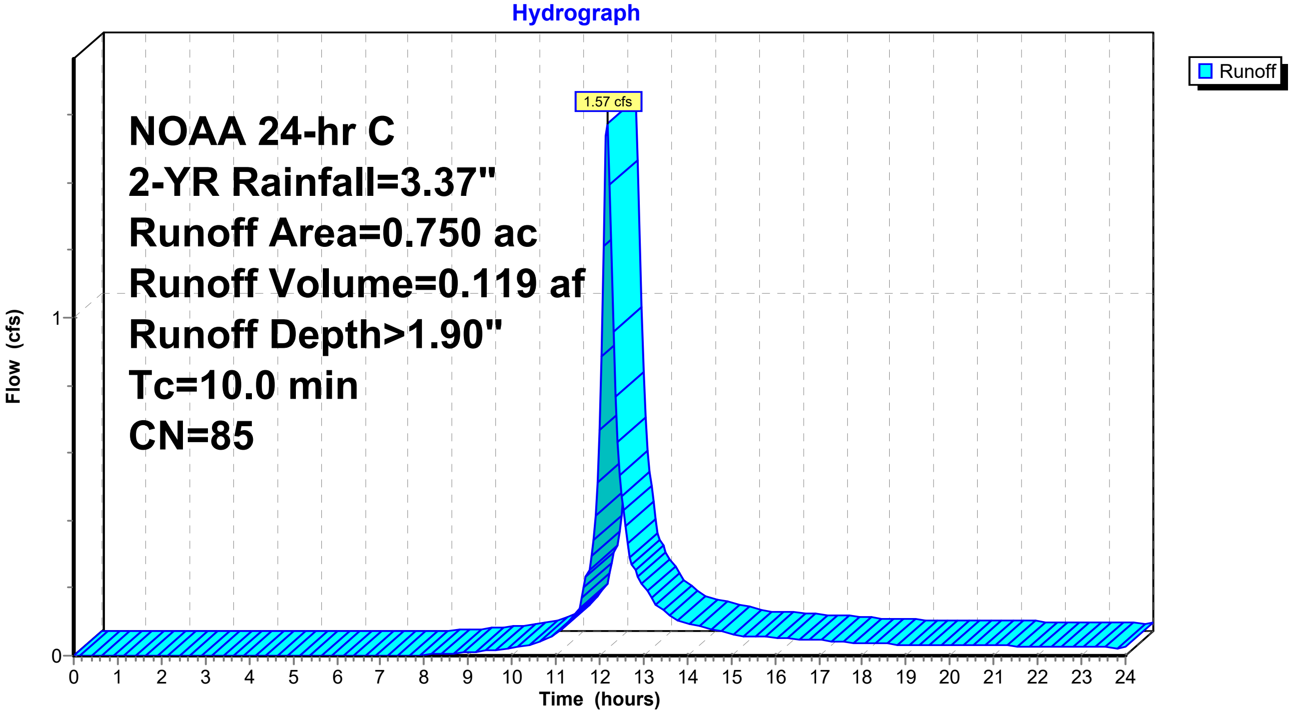
Runoff = 1.57 cfs @ 12.18 hrs, Volume= 0.119 af, Depth> 1.90"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.750	85	Gravel (B)
	0.750		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 10S: PDA-1D (IMP)



Summary for Subcatchment 11S: PDA-1D New Road

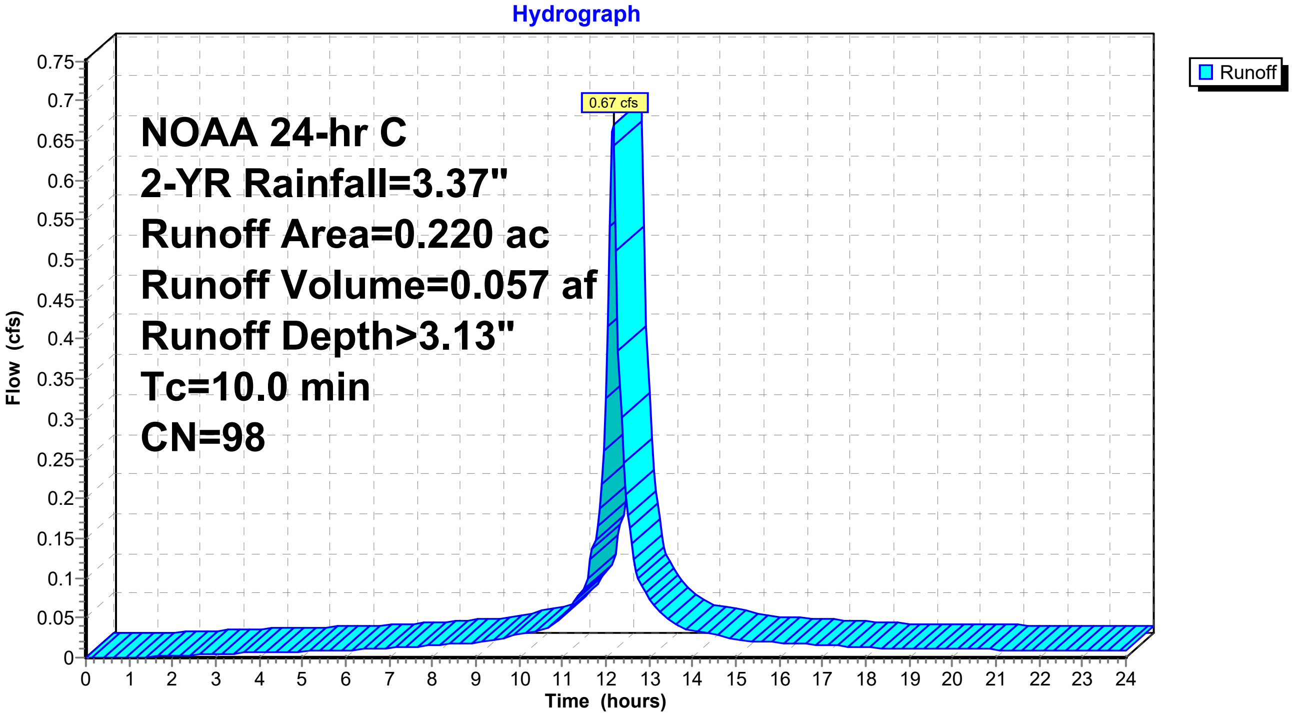
Runoff = 0.67 cfs @ 12.17 hrs, Volume= 0.057 af, Depth> 3.13"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.220	98	New Road
	0.220		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 11S: PDA-1D New Road



Summary for Subcatchment 12S: PDA-1D (PERV)

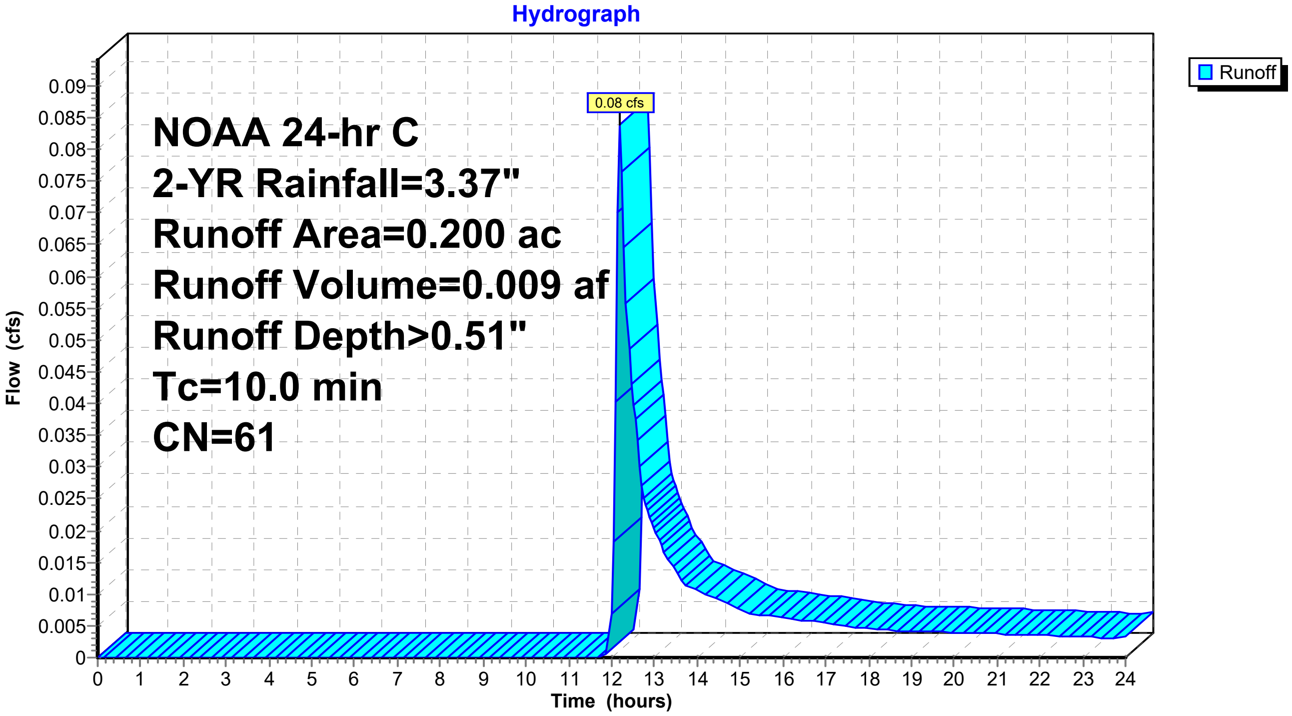
Runoff = 0.08 cfs @ 12.21 hrs, Volume= 0.009 af, Depth> 0.51"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.200	61	Lawn (B)
	0.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 12S: PDA-1D (PERV)



Summary for Subcatchment 13S: PDA-2A (IMP)

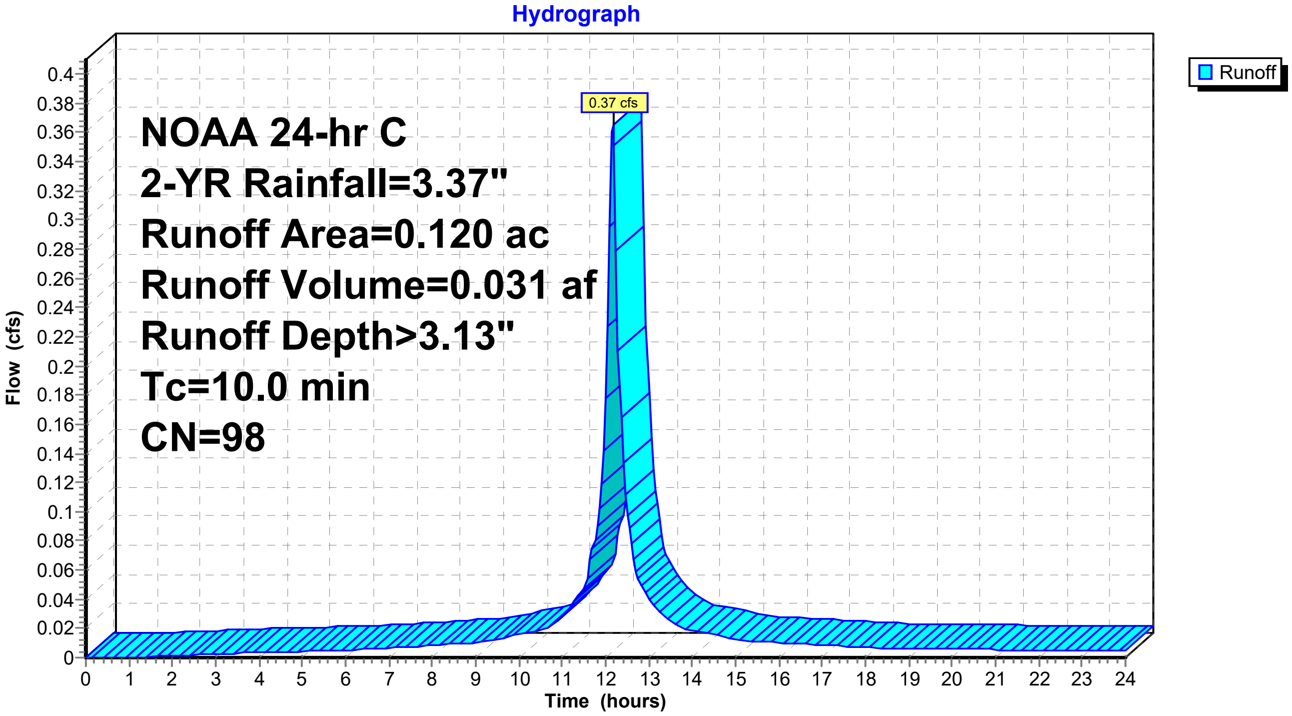
Runoff = 0.37 cfs @ 12.17 hrs, Volume= 0.031 af, Depth> 3.13"
Routed to Link 22L : PDA-2A Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.120	98	Impervious
	0.120		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 13S: PDA-2A (IMP)



Summary for Subcatchment 14S: PDA-2A (PERV)

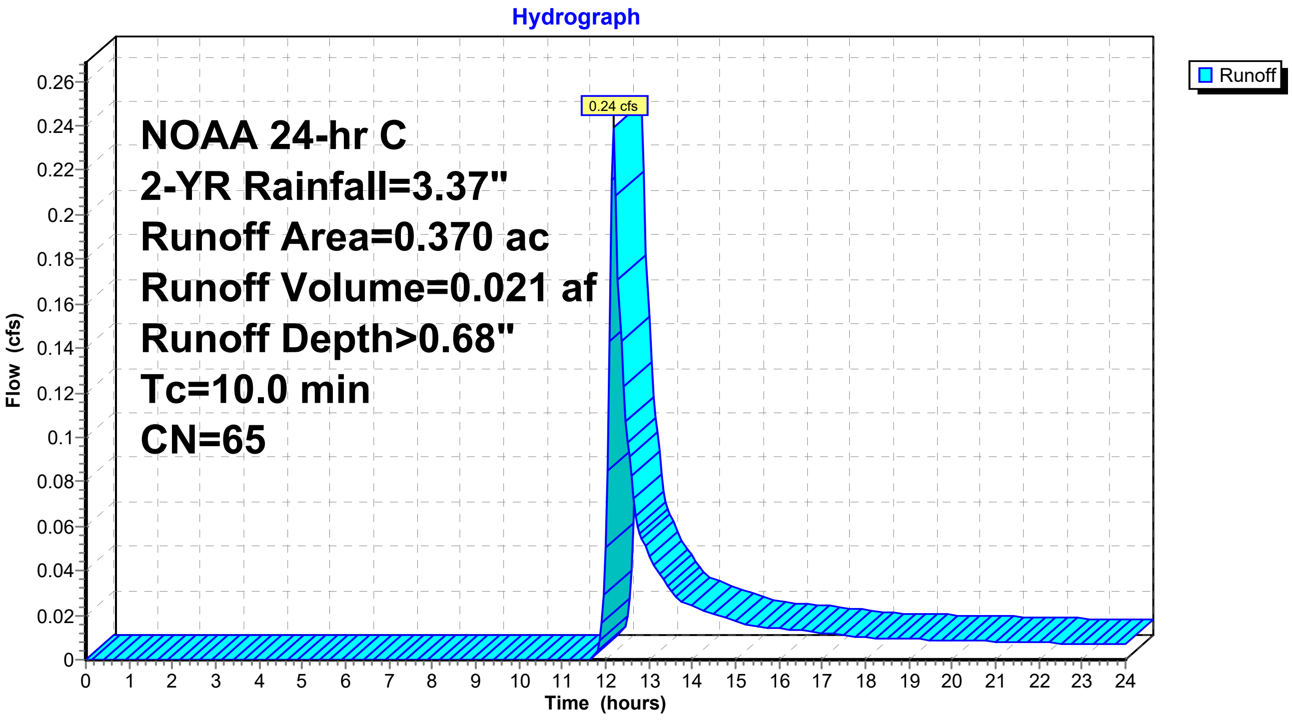
Runoff = 0.24 cfs @ 12.20 hrs, Volume= 0.021 af, Depth> 0.68"
Routed to Link 22L : PDA-2A Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.090	77	Wooded (D)
*	0.280	61	Lawn (B)
	0.370	65	Weighted Average
	0.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 14S: PDA-2A (PERV)



Summary for Subcatchment 15S: PDA-2B (IMP)

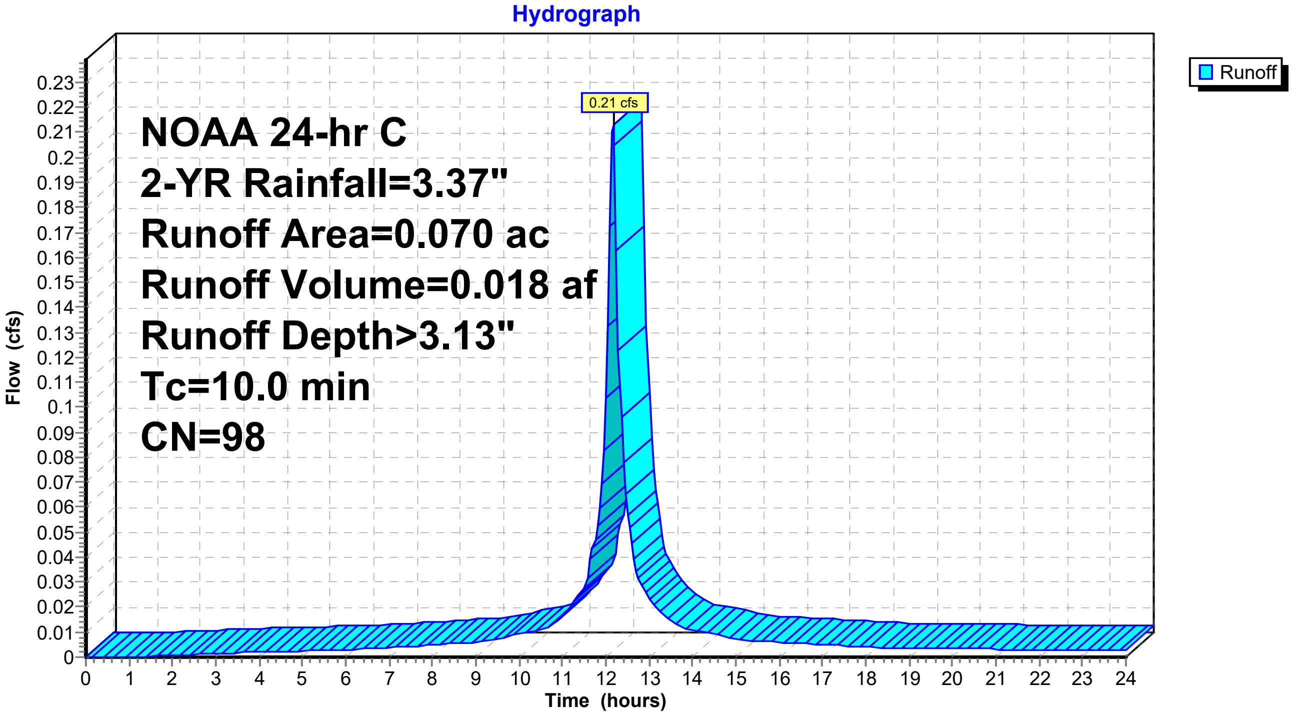
Runoff = 0.21 cfs @ 12.17 hrs, Volume= 0.018 af, Depth> 3.13"
Routed to Link 23L : PDA-2B Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.070	98	Impervious
	0.070		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 15S: PDA-2B (IMP)



Summary for Subcatchment 16S: PDA-2B (PERV)

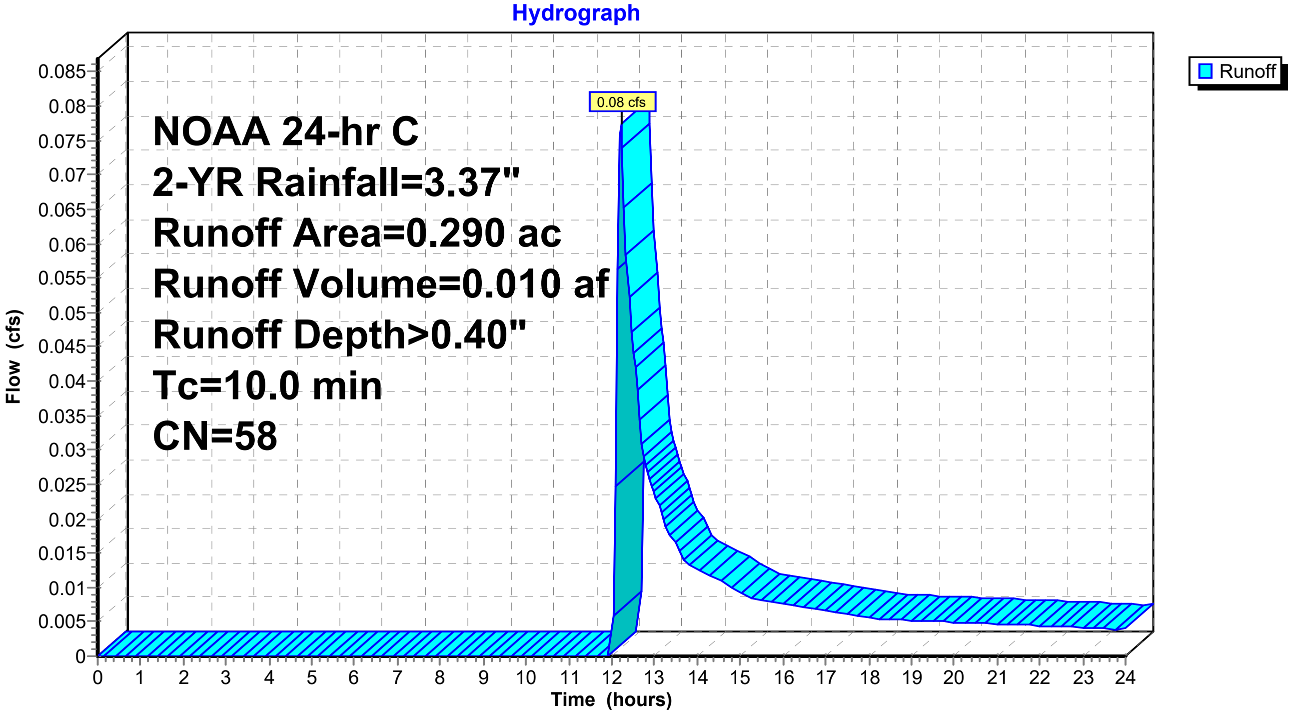
Runoff = 0.08 cfs @ 12.22 hrs, Volume= 0.010 af, Depth> 0.40"
Routed to Link 23L : PDA-2B Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.160	55	Wooded (B)
*	0.130	61	Lawn (B)
	0.290	58	Weighted Average
	0.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 16S: PDA-2B (PERV)



Summary for Subcatchment 17S: PDA-3 (IMP)

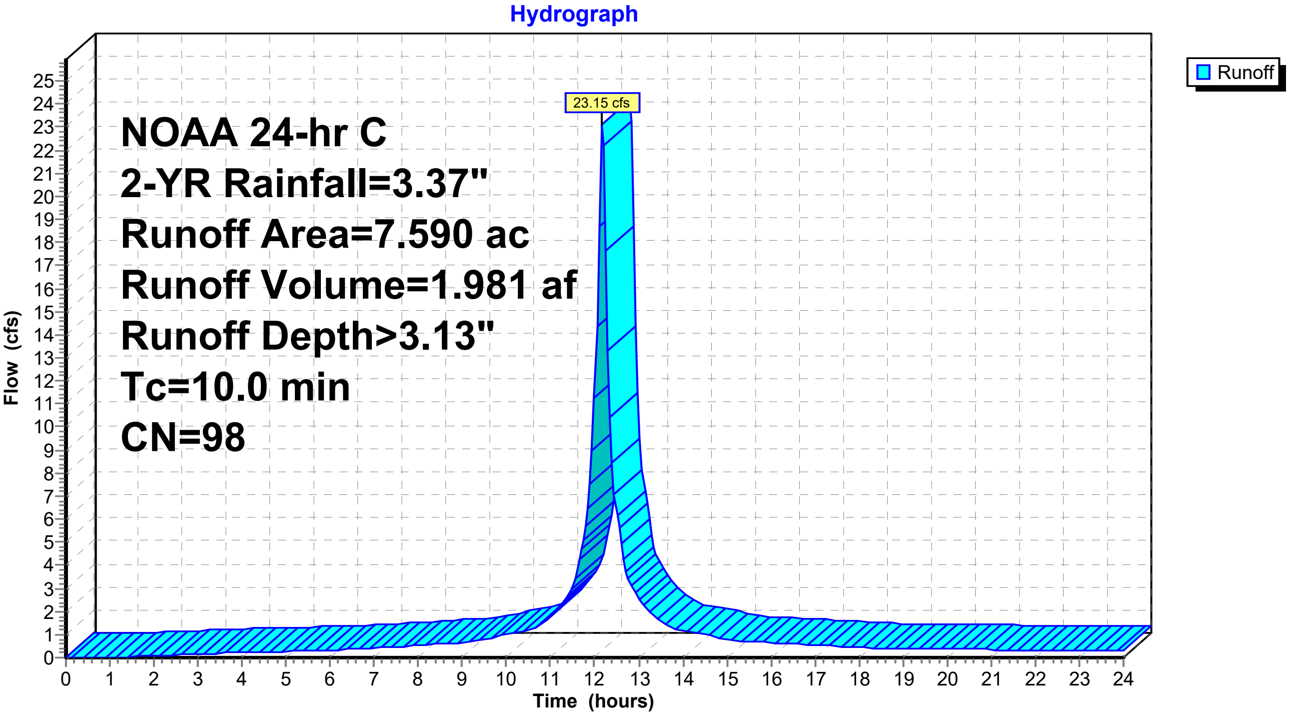
Runoff = 23.15 cfs @ 12.17 hrs, Volume= 1.981 af, Depth> 3.13"
Routed to Link 27L : Total Site Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	7.590	98	Impervious
	7.590		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 17S: PDA-3 (IMP)



Summary for Subcatchment 26S: Sub-Catch to Swale 1 (for Swale Calc Only)

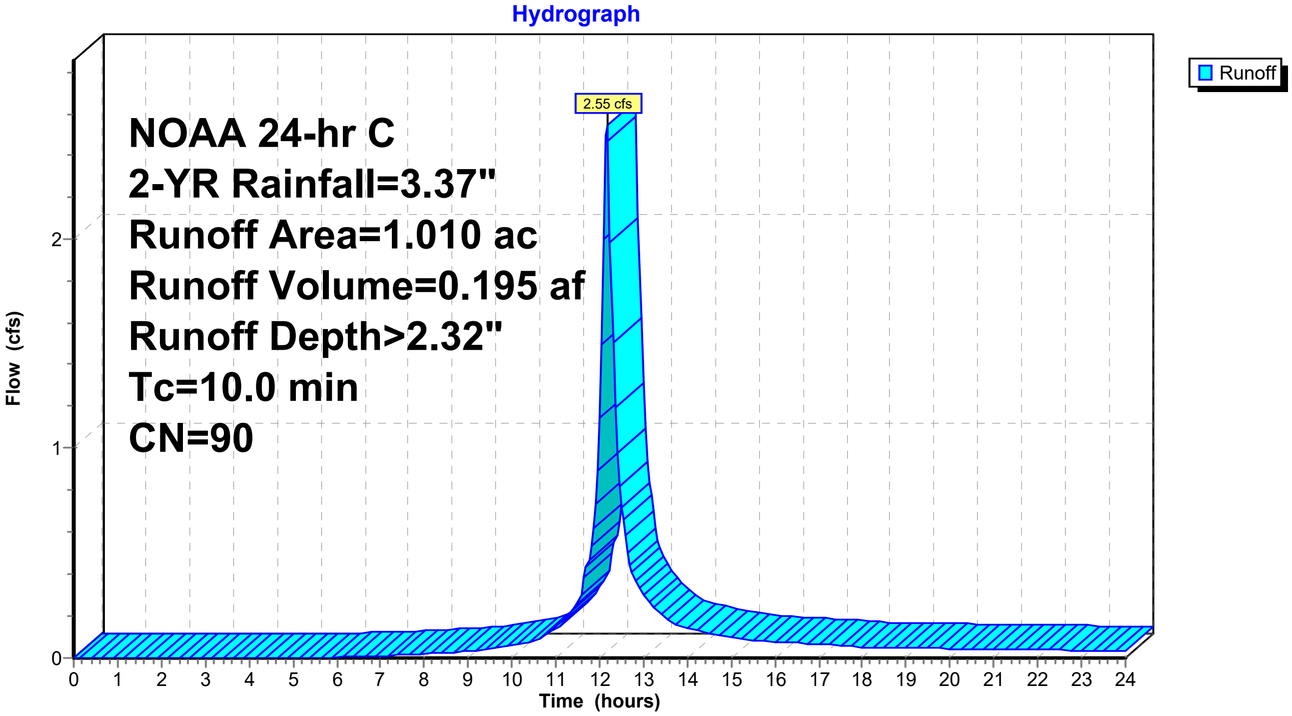
Runoff = 2.55 cfs @ 12.17 hrs, Volume= 0.195 af, Depth> 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-YR Rainfall=3.37"

	Area (ac)	CN	Description
*	0.510	85	Gravel
*	0.450	98	Impervious
*	0.050	61	Lawn (B)
	1.010	90	Weighted Average
	0.560		55.45% Pervious Area
	0.450		44.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 26S: Sub-Catch to Swale 1 (for Swale Calc Only)

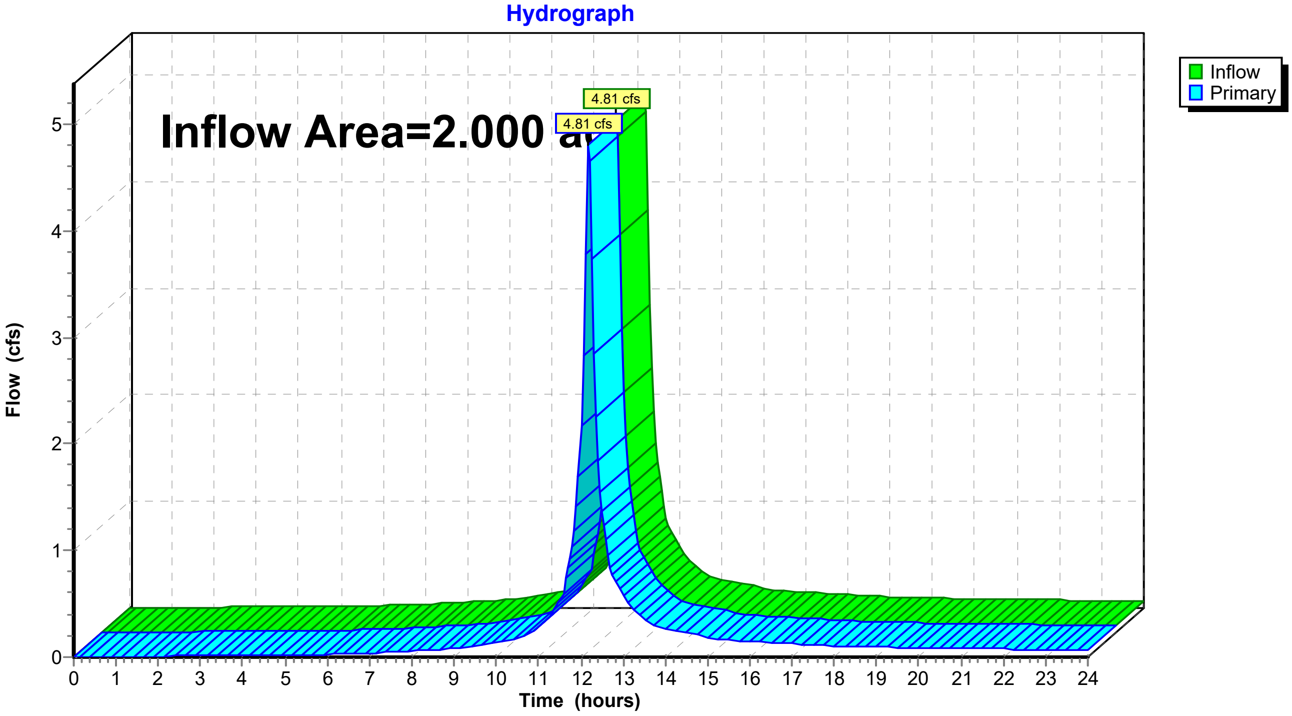


Summary for Link 18L: To WQU-1/Pipe 1 Overflow

Inflow Area = 2.000 ac, 44.50% Impervious, Inflow Depth > 2.31" for 2-YR event
Inflow = 4.81 cfs @ 12.17 hrs, Volume= 0.384 af
Primary = 4.81 cfs @ 12.17 hrs, Volume= 0.384 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 18L: To WQU-1/Pipe 1 Overflow

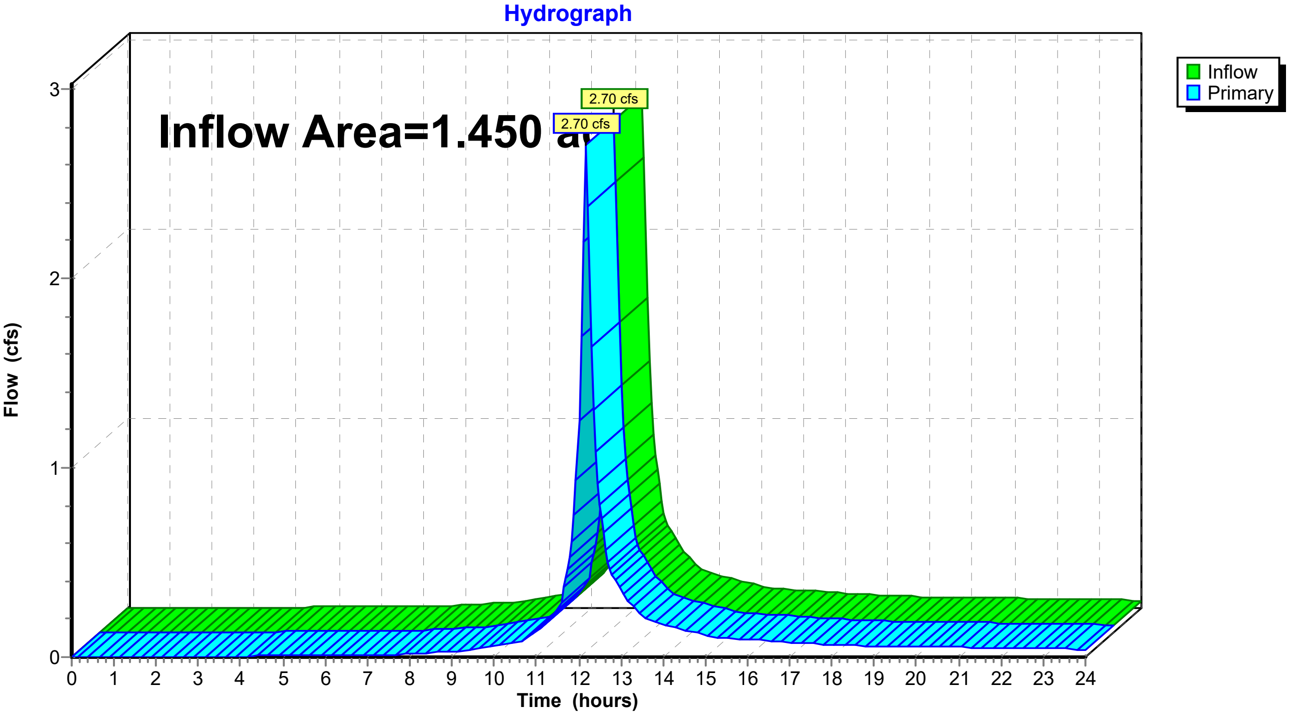


Summary for Link 19L: Swale 2/WQU-2/Pipe 2 Overflow

Inflow Area = 1.450 ac, 13.10% Impervious, Inflow Depth > 1.79" for 2-YR event
Inflow = 2.70 cfs @ 12.17 hrs, Volume= 0.216 af
Primary = 2.70 cfs @ 12.17 hrs, Volume= 0.216 af, Atten= 0%, Lag= 0.0 min
Routed to Link 25L : To Pipe 4 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 19L: Swale 2/WQU-2/Pipe 2 Overflow

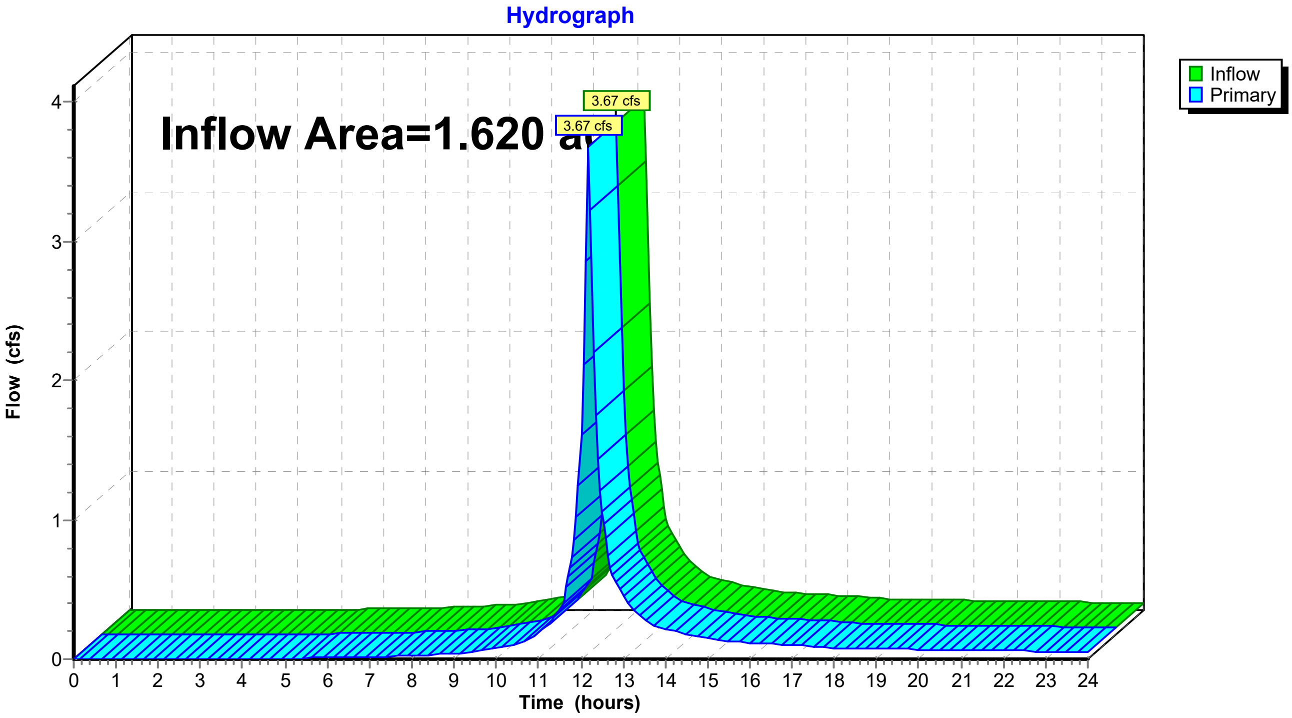


Summary for Link 20L: Swale 3/WQU-3

Inflow Area = 1.620 ac, 20.37% Impervious, Inflow Depth > 2.10" for 2-YR event
Inflow = 3.67 cfs @ 12.17 hrs, Volume= 0.284 af
Primary = 3.67 cfs @ 12.17 hrs, Volume= 0.284 af, Atten= 0%, Lag= 0.0 min
Routed to Link 24L : To Pipe 3 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 20L: Swale 3/WQU-3



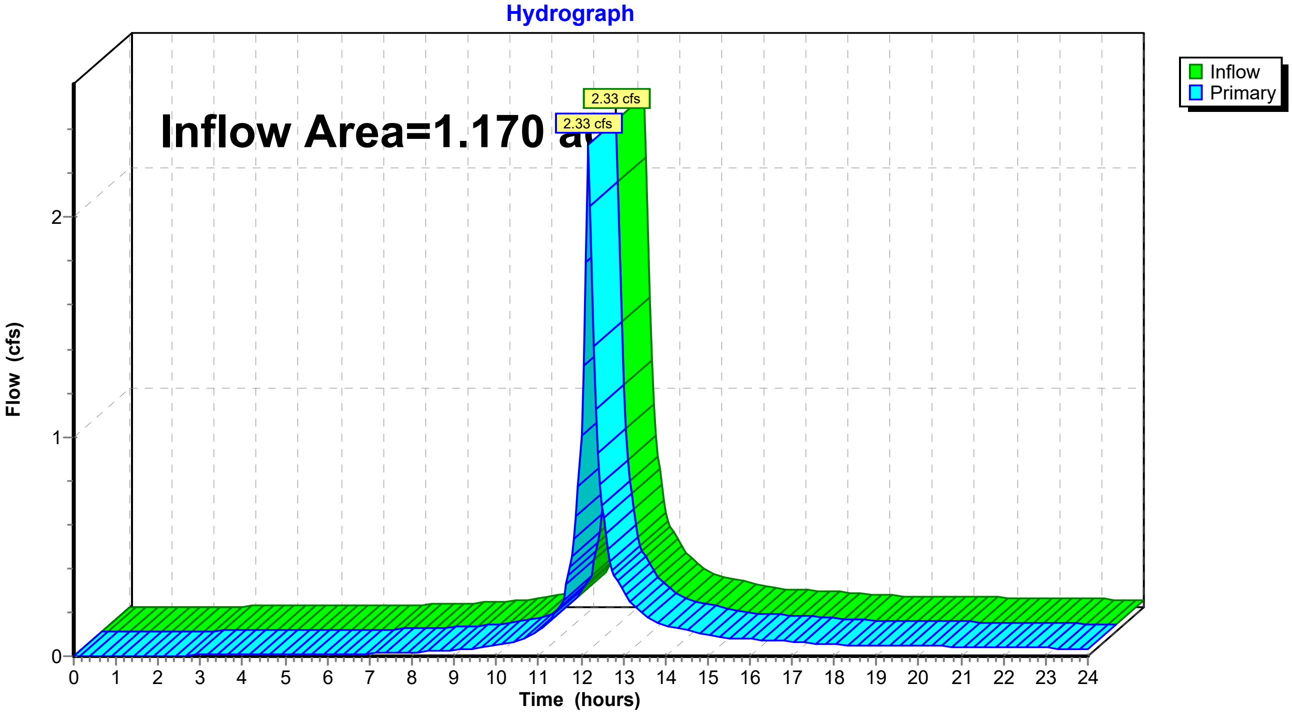
Summary for Link 21L: Swale 4/WQU-4

Inflow Area =	1.170 ac,	18.80% Impervious,	Inflow Depth > 1.89"	for 2-YR event	
Inflow =	2.33 cfs @	12.17 hrs,	Volume=	0.185 af	
Primary =	2.33 cfs @	12.17 hrs,	Volume=	0.185 af,	Atten= 0%, Lag= 0.0 min

Routed to Link 24L : To Pipe 3 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 21L: Swale 4/WQU-4

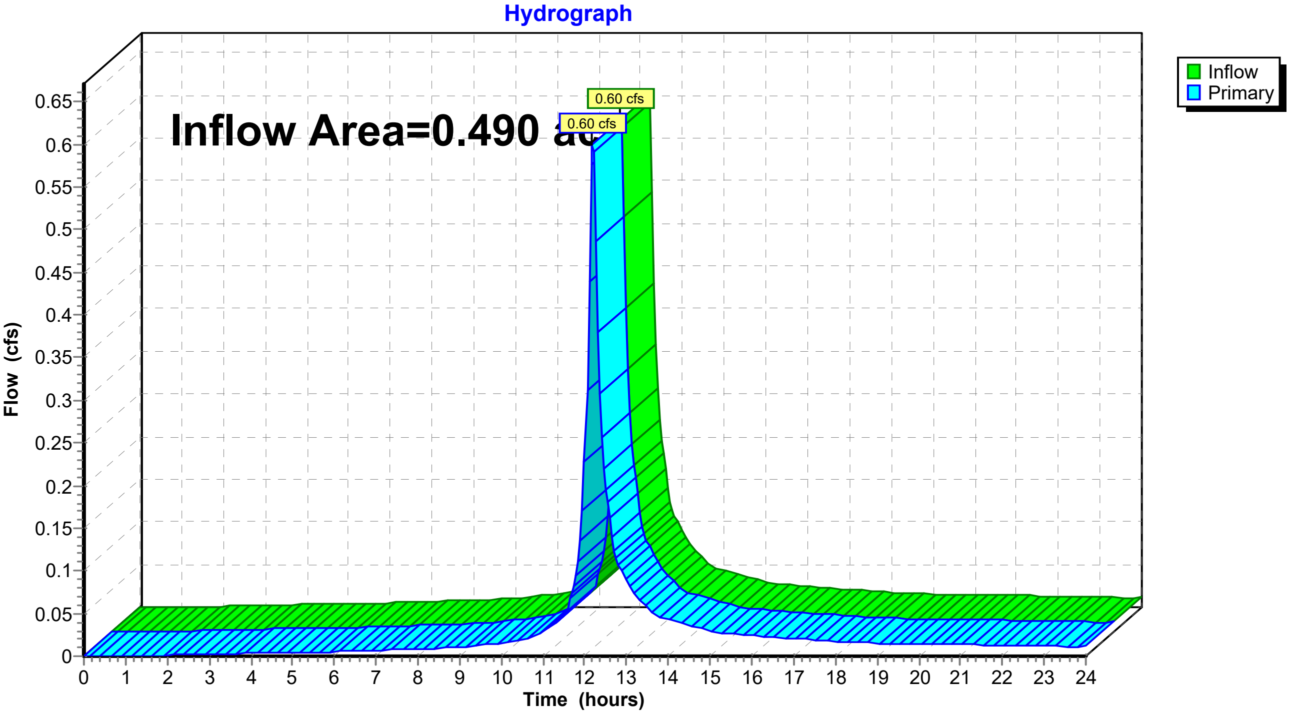


Summary for Link 22L: PDA-2A Total

Inflow Area = 0.490 ac, 24.49% Impervious, Inflow Depth > 1.28" for 2-YR event
Inflow = 0.60 cfs @ 12.18 hrs, Volume= 0.052 af
Primary = 0.60 cfs @ 12.18 hrs, Volume= 0.052 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 22L: PDA-2A Total

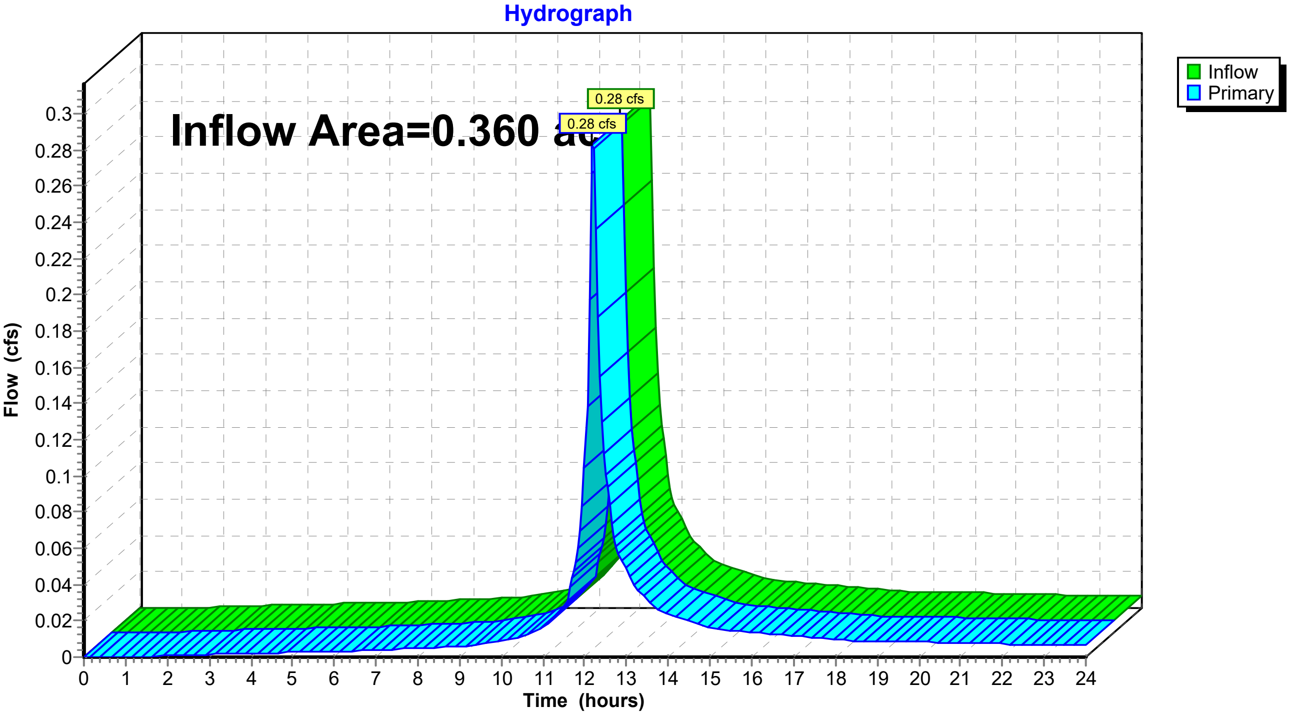


Summary for Link 23L: PDA-2B Total

Inflow Area = 0.360 ac, 19.44% Impervious, Inflow Depth > 0.93" for 2-YR event
Inflow = 0.28 cfs @ 12.19 hrs, Volume= 0.028 af
Primary = 0.28 cfs @ 12.19 hrs, Volume= 0.028 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 23L: PDA-2B Total

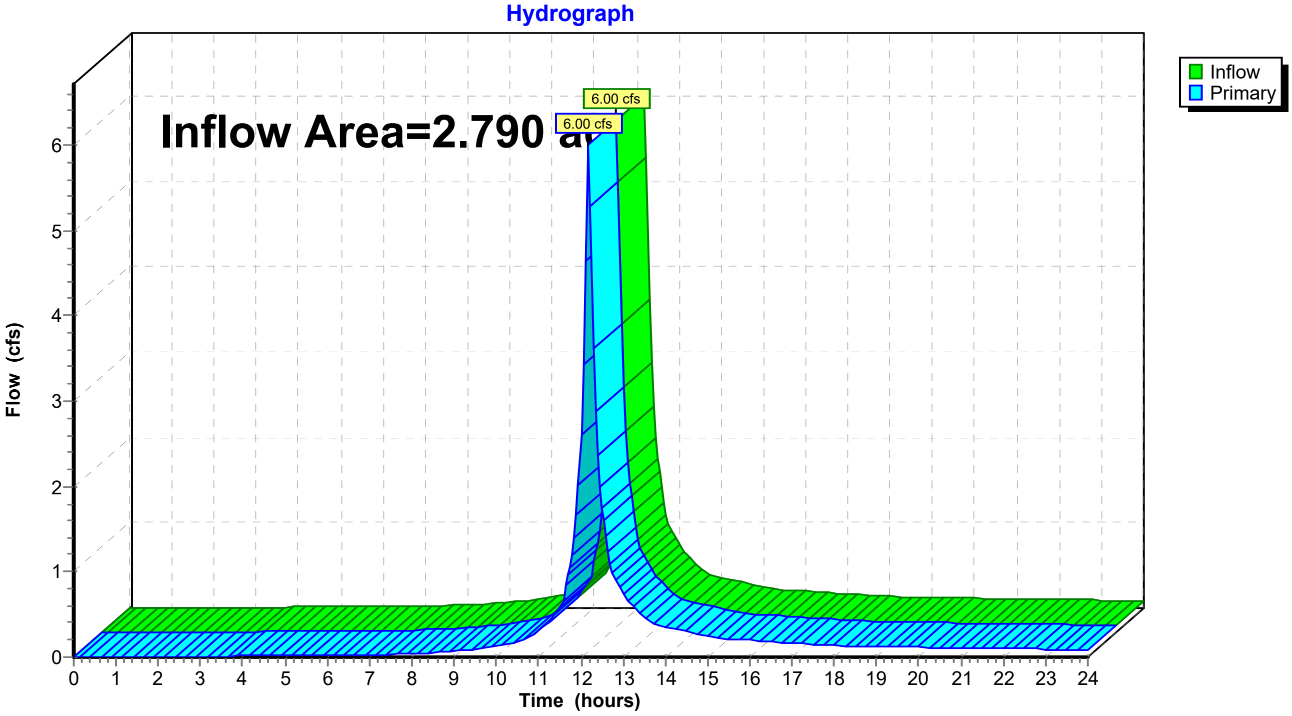


Summary for Link 24L: To Pipe 3 Overflow

Inflow Area = 2.790 ac, 19.71% Impervious, Inflow Depth > 2.01" for 2-YR event
Inflow = 6.00 cfs @ 12.17 hrs, Volume= 0.468 af
Primary = 6.00 cfs @ 12.17 hrs, Volume= 0.468 af, Atten= 0%, Lag= 0.0 min
Routed to Link 25L : To Pipe 4 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 24L: To Pipe 3 Overflow

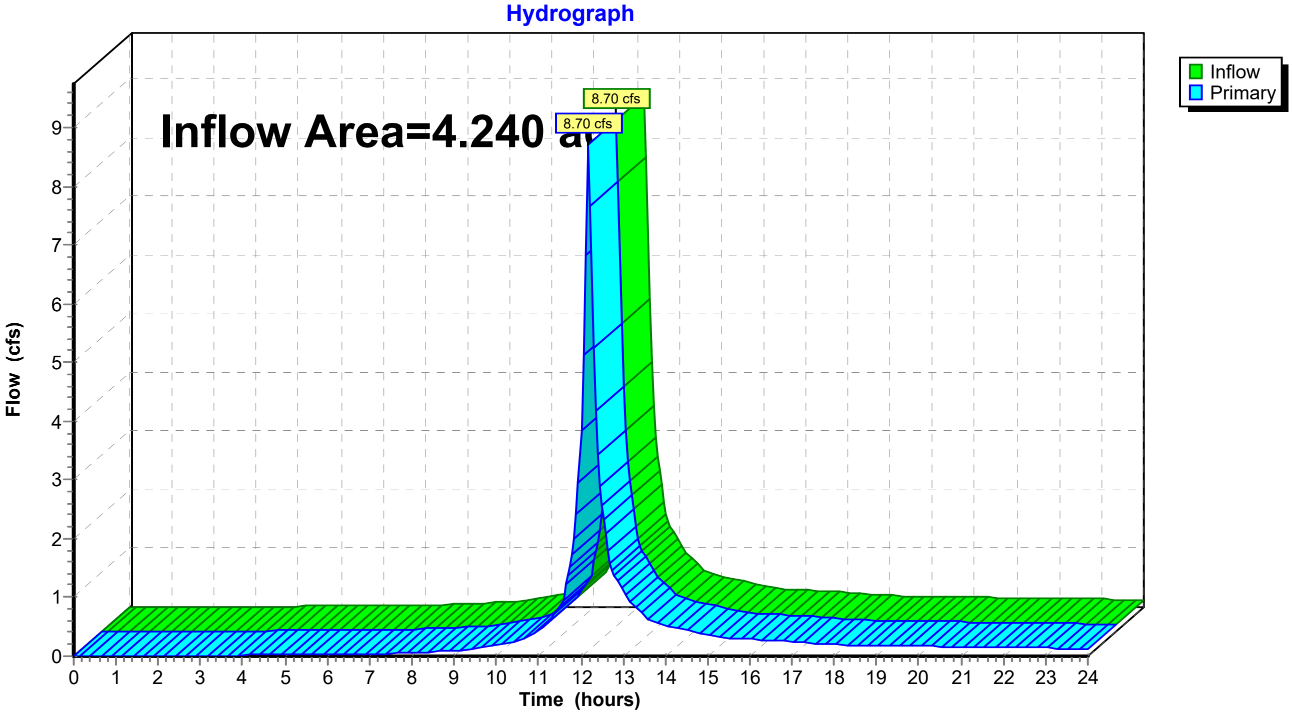


Summary for Link 25L: To Pipe 4 Overflow

Inflow Area = 4.240 ac, 17.45% Impervious, Inflow Depth > 1.94" for 2-YR event
Inflow = 8.70 cfs @ 12.17 hrs, Volume= 0.684 af
Primary = 8.70 cfs @ 12.17 hrs, Volume= 0.684 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 25L: To Pipe 4 Overflow

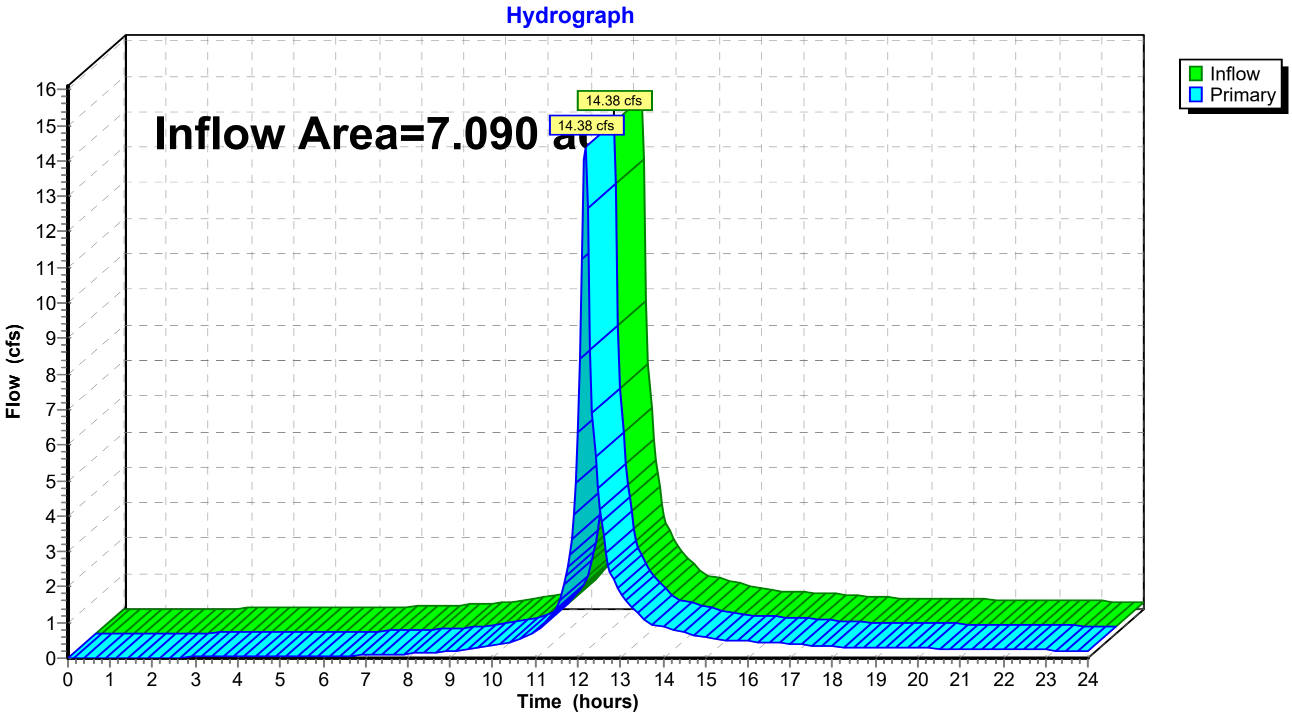


Summary for Link 26L: To Wetlands

Inflow Area = 7.090 ac, 25.67% Impervious, Inflow Depth > 1.94" for 2-YR event
Inflow = 14.38 cfs @ 12.17 hrs, Volume= 1.149 af
Primary = 14.38 cfs @ 12.17 hrs, Volume= 1.149 af, Atten= 0%, Lag= 0.0 min
Routed to Link 27L : Total Site Runoff

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 26L: To Wetlands

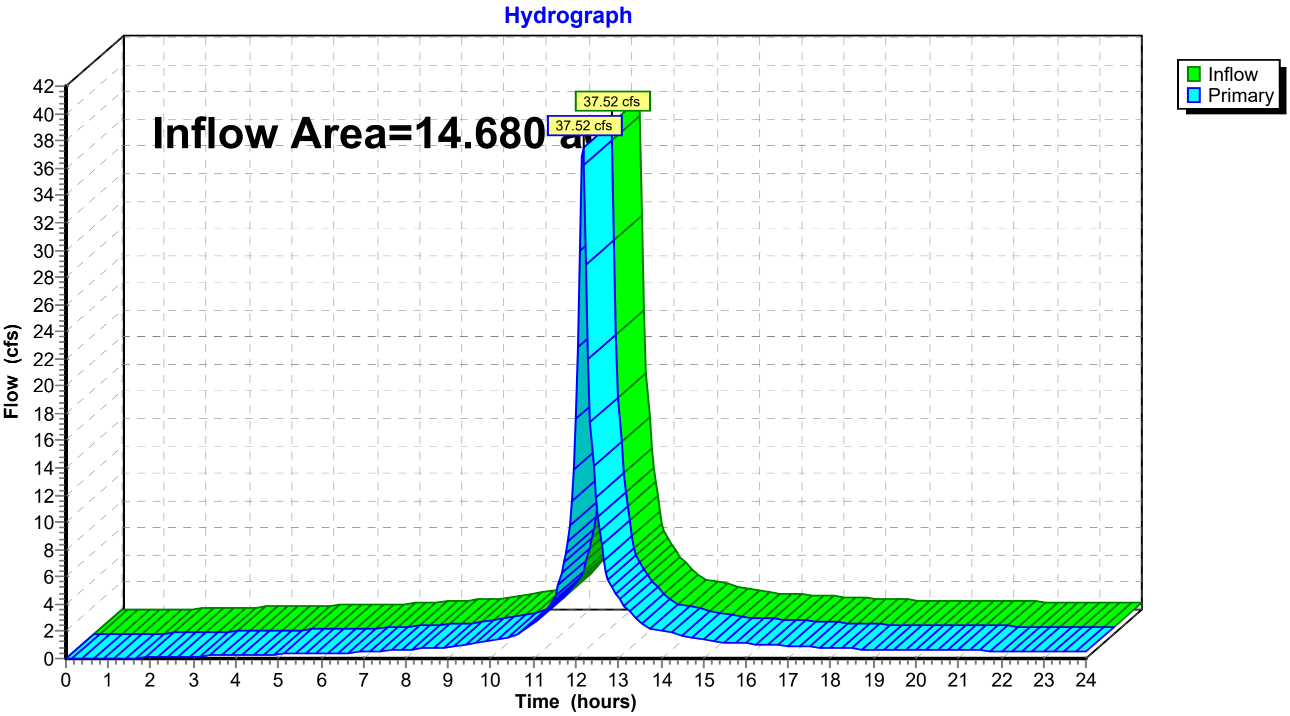


Summary for Link 27L: Total Site Runoff

Inflow Area = 14.680 ac, 64.10% Impervious, Inflow Depth > 2.56" for 2-YR event
Inflow = 37.52 cfs @ 12.17 hrs, Volume= 3.129 af
Primary = 37.52 cfs @ 12.17 hrs, Volume= 3.129 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 27L: Total Site Runoff



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

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Subcatchment1S: PDA-1A(IMP)          Runoff Area=1.250 ac  24.00% Impervious   Runoff Depth>3.90"
                                                Tc=10.0 min   CN=88   Runoff=5.22 cfs  0.406 af

Subcatchment2S: PDA-1ANew Road       Runoff Area=0.590 ac  100.00% Impervious   Runoff Depth>5.00"
                                                Tc=10.0 min   CN=98   Runoff=2.82 cfs  0.246 af

Subcatchment3S: PDA-1A(PERV)         Runoff Area=0.160 ac   0.00% Impervious   Runoff Depth>1.52"
                                                Tc=10.0 min   CN=61   Runoff=0.26 cfs  0.020 af

Subcatchment4S: PDA-1B(IMP)          Runoff Area=0.990 ac   4.04% Impervious   Runoff Depth>3.69"
                                                Tc=10.0 min   CN=86   Runoff=3.96 cfs  0.305 af

Subcatchment5S: PDA-1B New Road      Runoff Area=0.150 ac  100.00% Impervious   Runoff Depth>5.00"
                                                Tc=10.0 min   CN=98   Runoff=0.72 cfs  0.063 af

Subcatchment6S: PDA-1B(PERV)         Runoff Area=0.310 ac   0.00% Impervious   Runoff Depth>1.52"
                                                 Tc=0.0 min   CN=61   Runoff=0.67 cfs  0.039 af

Subcatchment7S: PDA-1C(IMP)          Runoff Area=1.390 ac  12.23% Impervious   Runoff Depth>3.80"
                                                Tc=10.0 min   CN=87   Runoff=5.68 cfs  0.440 af

Subcatchment8S: PDA-1C New Road      Runoff Area=0.160 ac  100.00% Impervious   Runoff Depth>5.00"
                                                Tc=10.0 min   CN=98   Runoff=0.77 cfs  0.067 af

Subcatchment9S: PDA-1C(PERV)         Runoff Area=0.070 ac   0.00% Impervious   Runoff Depth>1.52"
                                                Tc=10.0 min   CN=61   Runoff=0.11 cfs  0.009 af

Subcatchment10S: PDA-1D(IMP)         Runoff Area=0.750 ac   0.00% Impervious   Runoff Depth>3.59"
                                                Tc=10.0 min   CN=85   Runoff=2.93 cfs  0.225 af

Subcatchment11S: PDA-1D New Road     Runoff Area=0.220 ac  100.00% Impervious   Runoff Depth>5.00"
                                                Tc=10.0 min   CN=98   Runoff=1.05 cfs  0.092 af

Subcatchment12S: PDA-1D(PERV)        Runoff Area=0.200 ac   0.00% Impervious   Runoff Depth>1.52"
                                                Tc=10.0 min   CN=61   Runoff=0.32 cfs  0.025 af

Subcatchment13S: PDA-2A(IMP)         Runoff Area=0.120 ac  100.00% Impervious   Runoff Depth>5.00"
                                                Tc=10.0 min   CN=98   Runoff=0.57 cfs  0.050 af

Subcatchment14S: PDA-2A(PERV)        Runoff Area=0.370 ac   0.00% Impervious   Runoff Depth>1.82"
                                                Tc=10.0 min   CN=65   Runoff=0.73 cfs  0.056 af

Subcatchment15S: PDA-2B(IMP)         Runoff Area=0.070 ac  100.00% Impervious   Runoff Depth>5.00"
                                                Tc=10.0 min   CN=98   Runoff=0.33 cfs  0.029 af

Subcatchment16S: PDA-2B(PERV)        Runoff Area=0.290 ac   0.00% Impervious   Runoff Depth>1.30"
                                                Tc=10.0 min   CN=58   Runoff=0.38 cfs  0.032 af
```

Subcatchment17S: PDA-3 (IMP) Runoff Area=7.590 ac 100.00% Impervious Runoff Depth>5.00"
Tc=10.0 min CN=98 Runoff=36.30 cfs 3.165 af

Subcatchment26S: Sub-Catch to Swale 1 Runoff Area=1.010 ac 44.55% Impervious Runoff Depth>4.11"
Tc=10.0 min CN=90 Runoff=4.38 cfs 0.346 af

Link 18L: To WQU-1/Pipe 1 Overflow Inflow=8.29 cfs 0.672 af
Primary=8.29 cfs 0.672 af

Link 19L: Swale 2/WQU-2/Pipe 2 Overflow Inflow=4.91 cfs 0.407 af
Primary=4.91 cfs 0.407 af

Link 20L: Swale 3/WQU-3 Inflow=6.56 cfs 0.515 af
Primary=6.56 cfs 0.515 af

Link 21L: Swale 4/WQU-4 Inflow=4.30 cfs 0.342 af
Primary=4.30 cfs 0.342 af

Link 22L: PDA-2A Total Inflow=1.30 cfs 0.106 af
Primary=1.30 cfs 0.106 af

Link 23L: PDA-2B Total Inflow=0.71 cfs 0.061 af
Primary=0.71 cfs 0.061 af

Link 24L: To Pipe 3 Overflow Inflow=10.85 cfs 0.857 af
Primary=10.85 cfs 0.857 af

Link 25L: To Pipe 4 Overflow Inflow=15.76 cfs 1.263 af
Primary=15.76 cfs 1.263 af

Link 26L: To Wetlands Inflow=26.06 cfs 2.103 af
Primary=26.06 cfs 2.103 af

Link 27L: Total Site Runoff Inflow=62.36 cfs 5.268 af
Primary=62.36 cfs 5.268 af

Total Runoff Area = 15.690 ac Runoff Volume = 5.614 af Average Runoff Depth = 4.29"
37.16% Pervious = 5.830 ac 62.84% Impervious = 9.860 ac

Summary for Subcatchment 1S: PDA-1A (IMP)

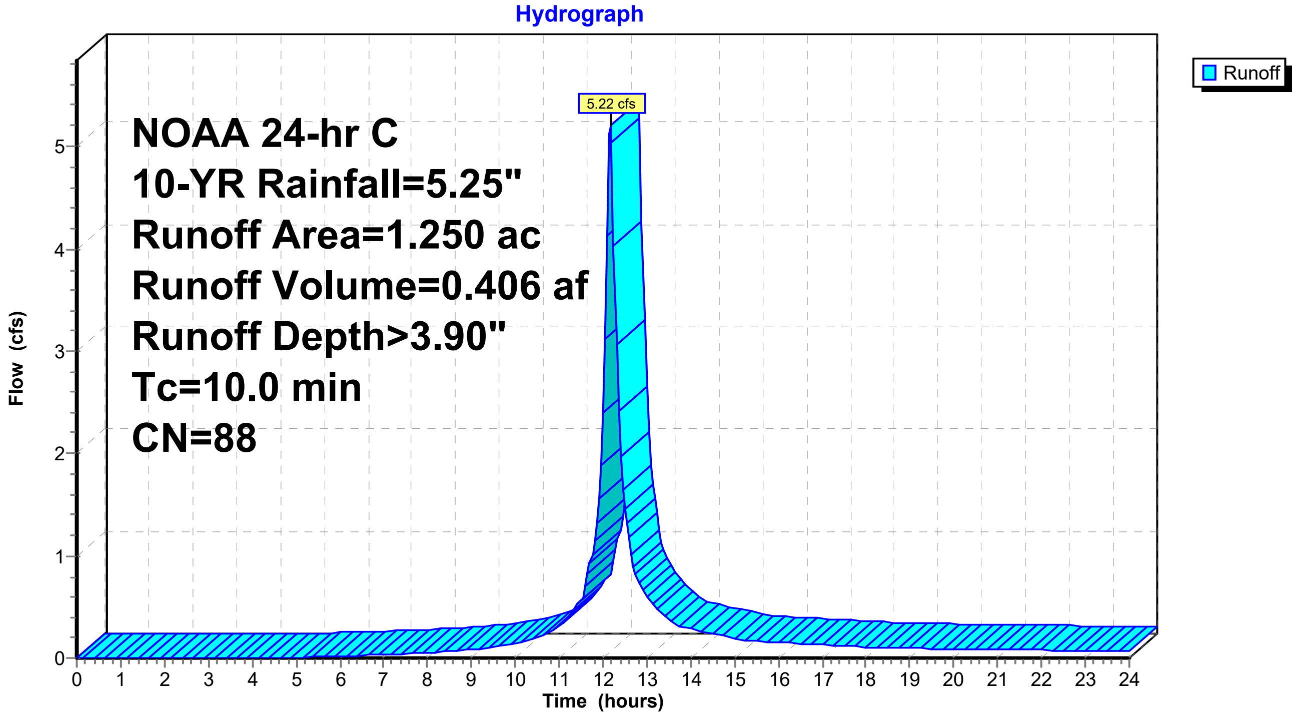
Runoff = 5.22 cfs @ 12.17 hrs, Volume= 0.406 af, Depth> 3.90"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.950	85	Gravel (B)
*	0.300	98	Impervious
	1.250	88	Weighted Average
	0.950		76.00% Pervious Area
	0.300		24.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 1S: PDA-1A (IMP)



Summary for Subcatchment 2S: PDA-1A New Road

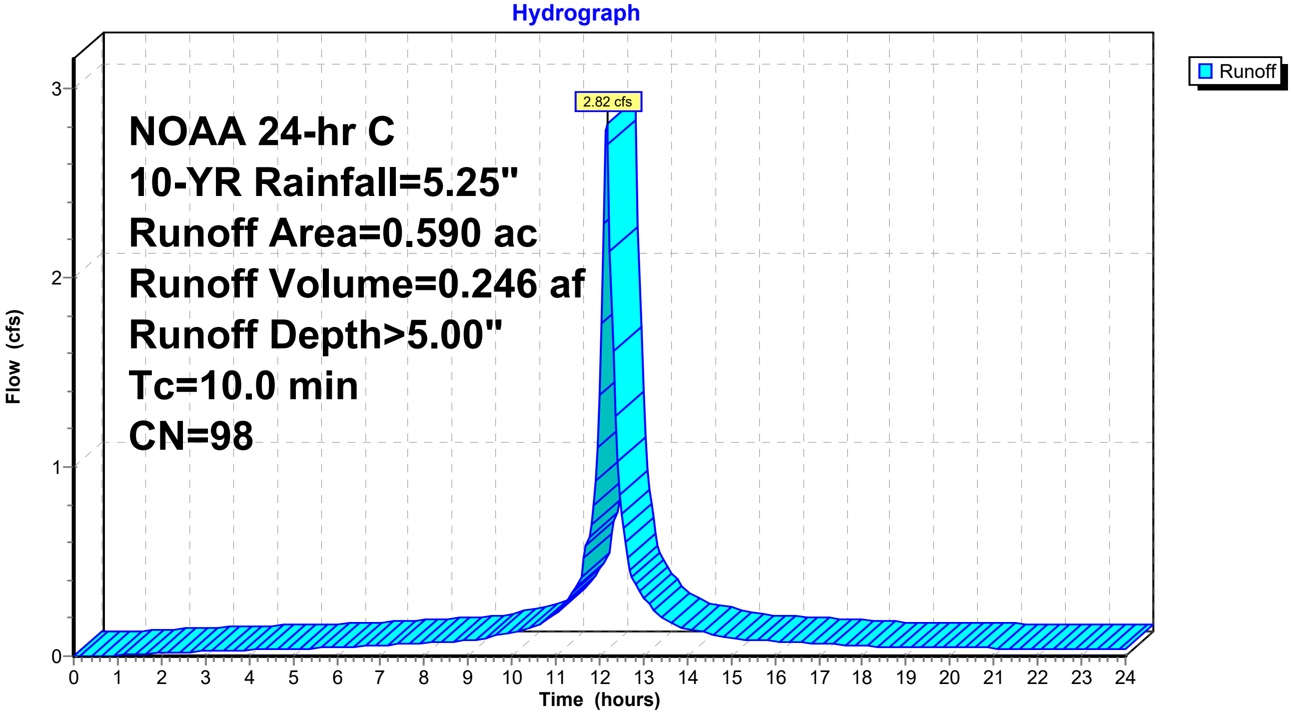
Runoff = 2.82 cfs @ 12.17 hrs, Volume= 0.246 af, Depth> 5.00"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.590	98	New Road
	0.590		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 2S: PDA-1A New Road



Summary for Subcatchment 3S: PDA-1A (PERV)

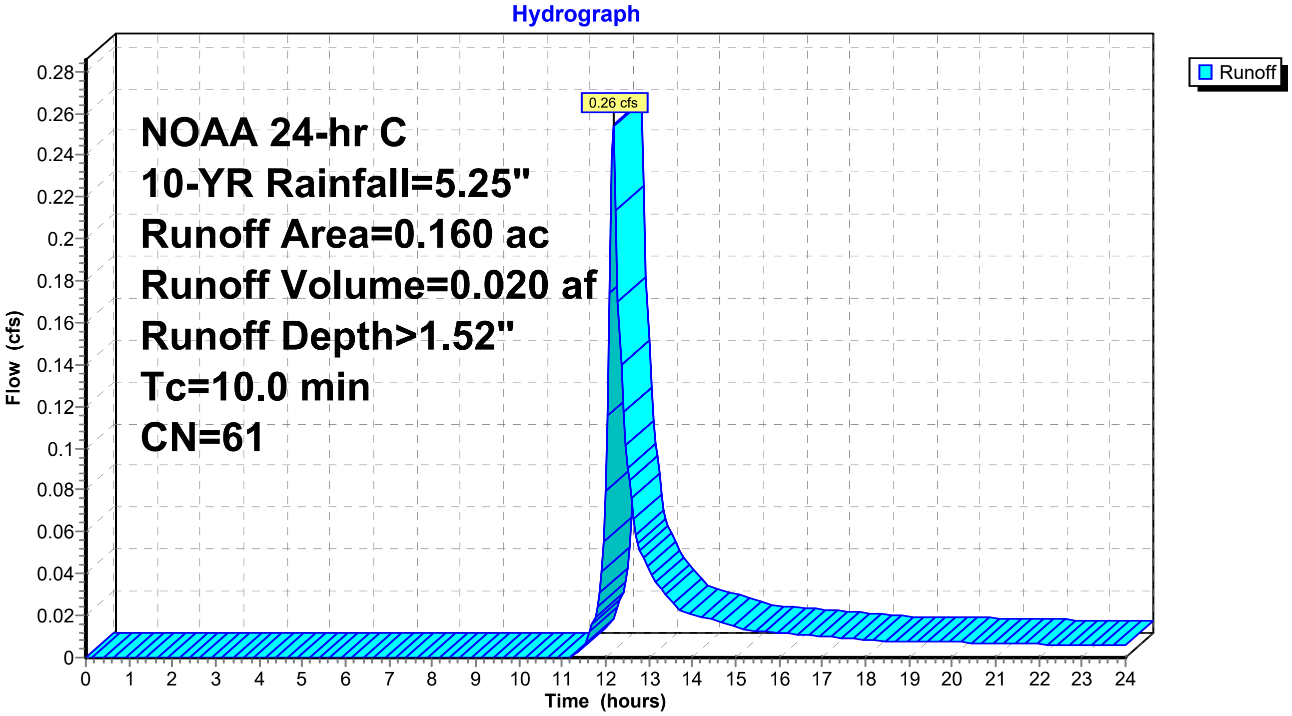
Runoff = 0.26 cfs @ 12.19 hrs, Volume= 0.020 af, Depth> 1.52"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.160	61	Lawn (B)
	0.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 3S: PDA-1A (PERV)



Summary for Subcatchment 4S: PDA-1B (IMP)

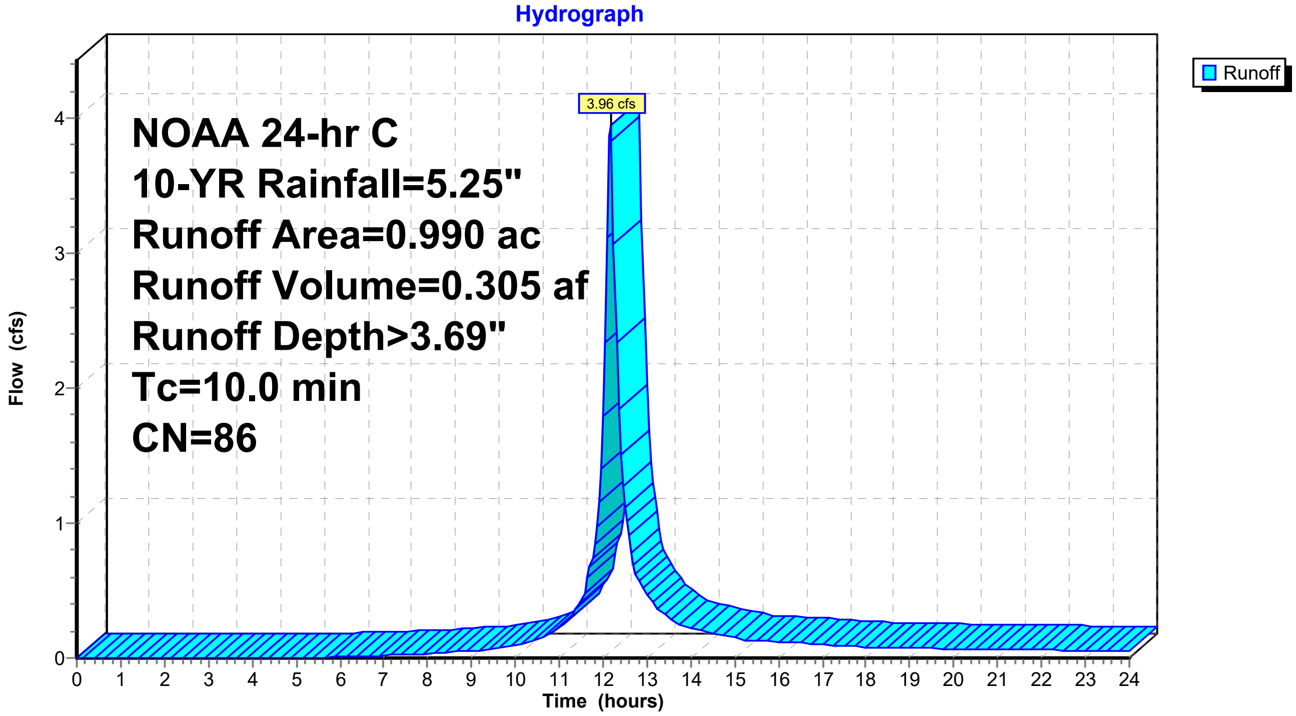
Runoff = 3.96 cfs @ 12.17 hrs, Volume= 0.305 af, Depth> 3.69"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.950	85	Gravel (B)
*	0.040	98	Impervious
	0.990	86	Weighted Average
	0.950		95.96% Pervious Area
	0.040		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 4S: PDA-1B (IMP)



Summary for Subcatchment 5S: PDA-1B New Road

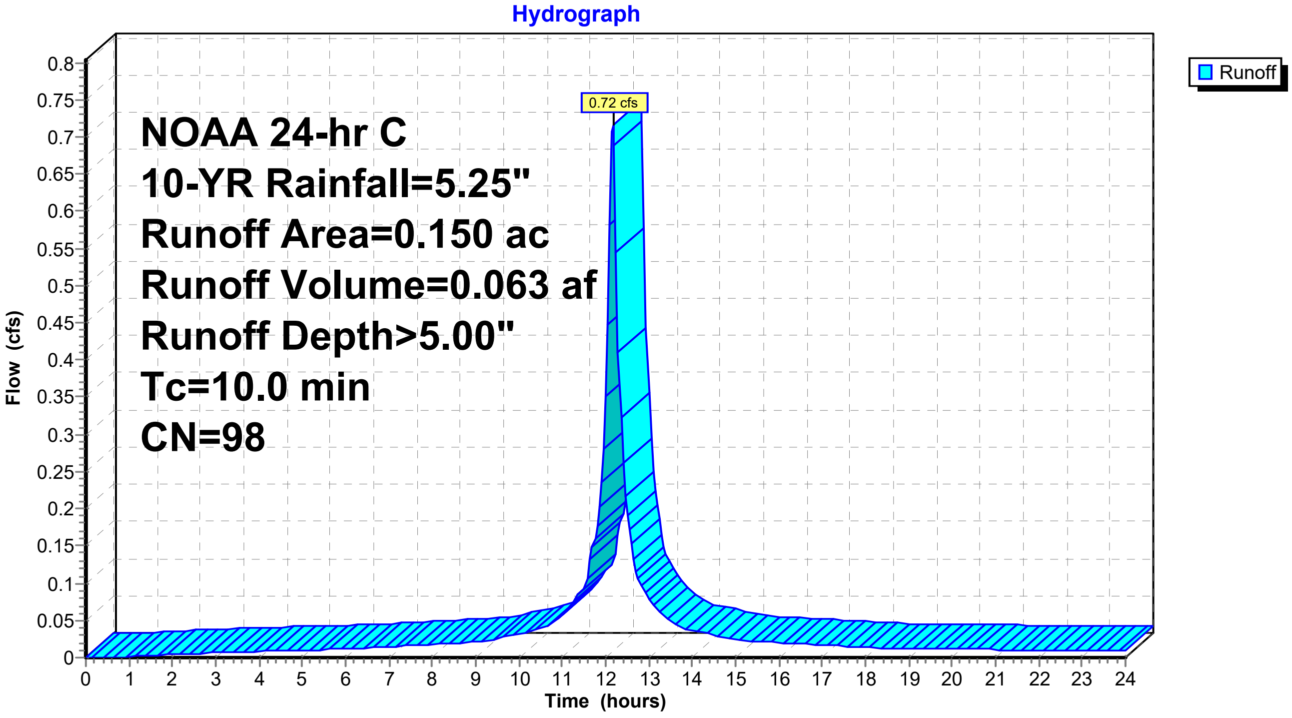
Runoff = 0.72 cfs @ 12.17 hrs, Volume= 0.063 af, Depth> 5.00"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.150	98	New Road
	0.150		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 5S: PDA-1B New Road



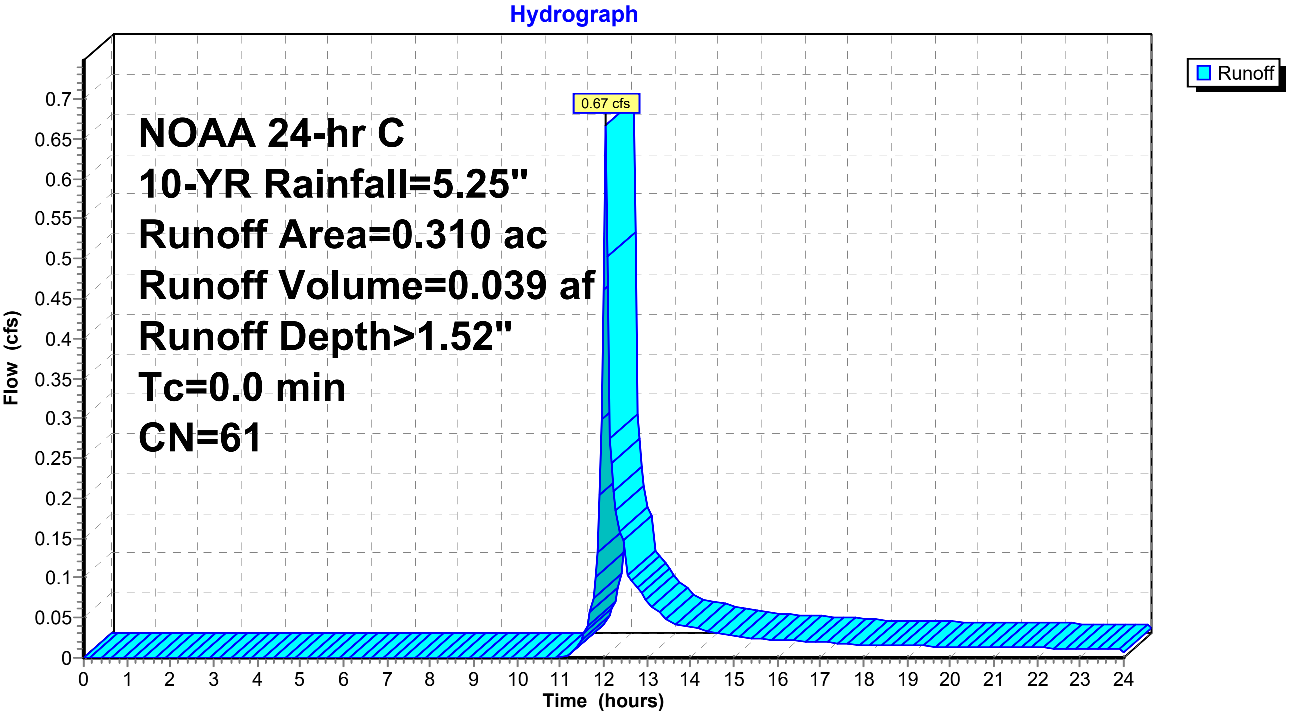
Summary for Subcatchment 6S: PDA-1B (PERV)

Runoff = 0.67 cfs @ 12.05 hrs, Volume= 0.039 af, Depth> 1.52"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.310	61	Lawn (B)
	0.310		100.00% Pervious Area

Subcatchment 6S: PDA-1B (PERV)



Summary for Subcatchment 7S: PDA-1C (IMP)

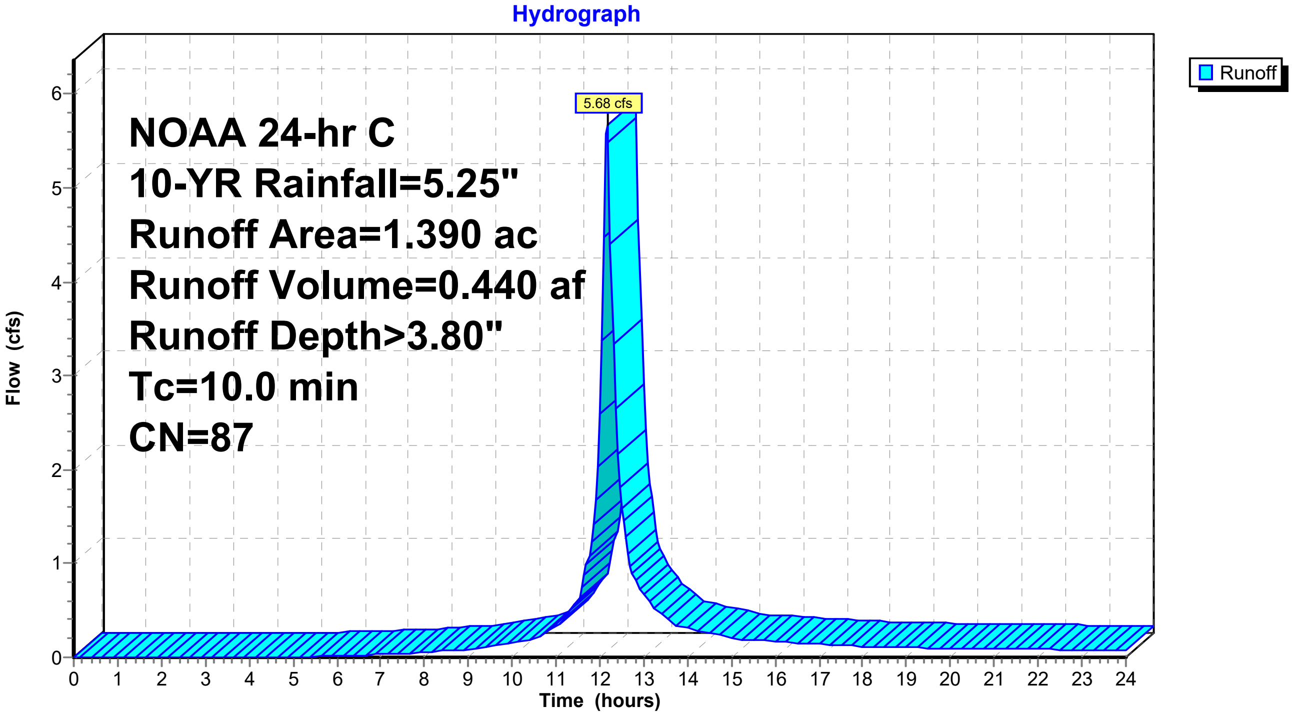
Runoff = 5.68 cfs @ 12.17 hrs, Volume= 0.440 af, Depth> 3.80"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	1.220	85	Gravel (B)
*	0.010	98	Impervious
*	0.160	98	New Roads
	1.390	87	Weighted Average
	1.220		87.77% Pervious Area
	0.170		12.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 7S: PDA-1C (IMP)



Summary for Subcatchment 8S: PDA-1C New Road

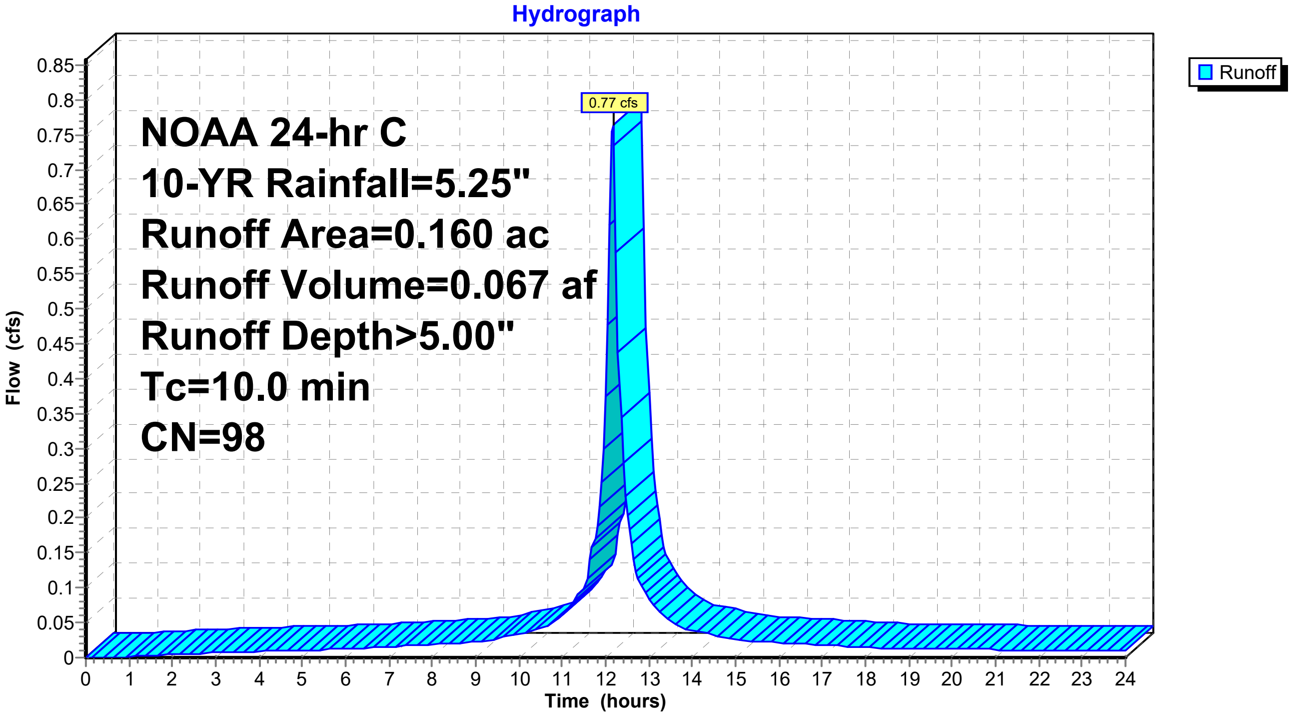
Runoff = 0.77 cfs @ 12.17 hrs, Volume= 0.067 af, Depth> 5.00"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.160	98	New Road
	0.160		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 8S: PDA-1C New Road



Summary for Subcatchment 9S: PDA-1C (PERV)

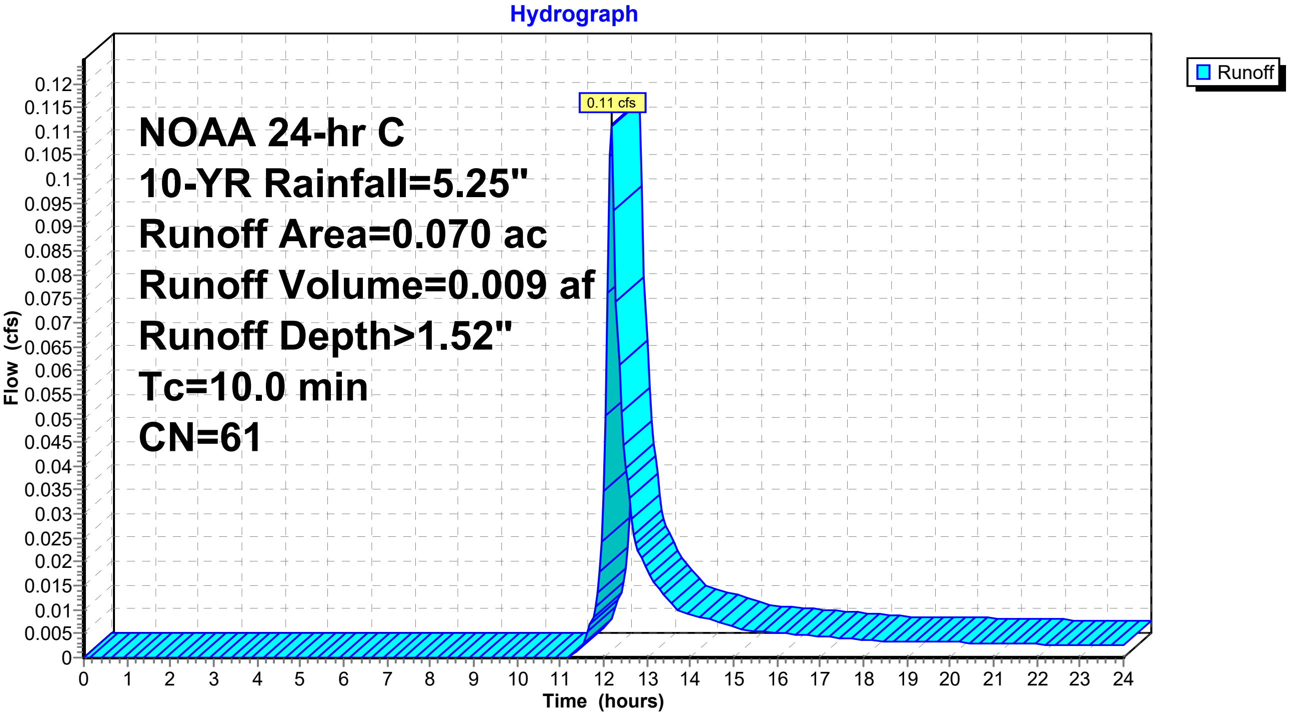
Runoff = 0.11 cfs @ 12.19 hrs, Volume= 0.009 af, Depth> 1.52"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.070	61	Lawn (B)
	0.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 9S: PDA-1C (PERV)



Summary for Subcatchment 10S: PDA-1D (IMP)

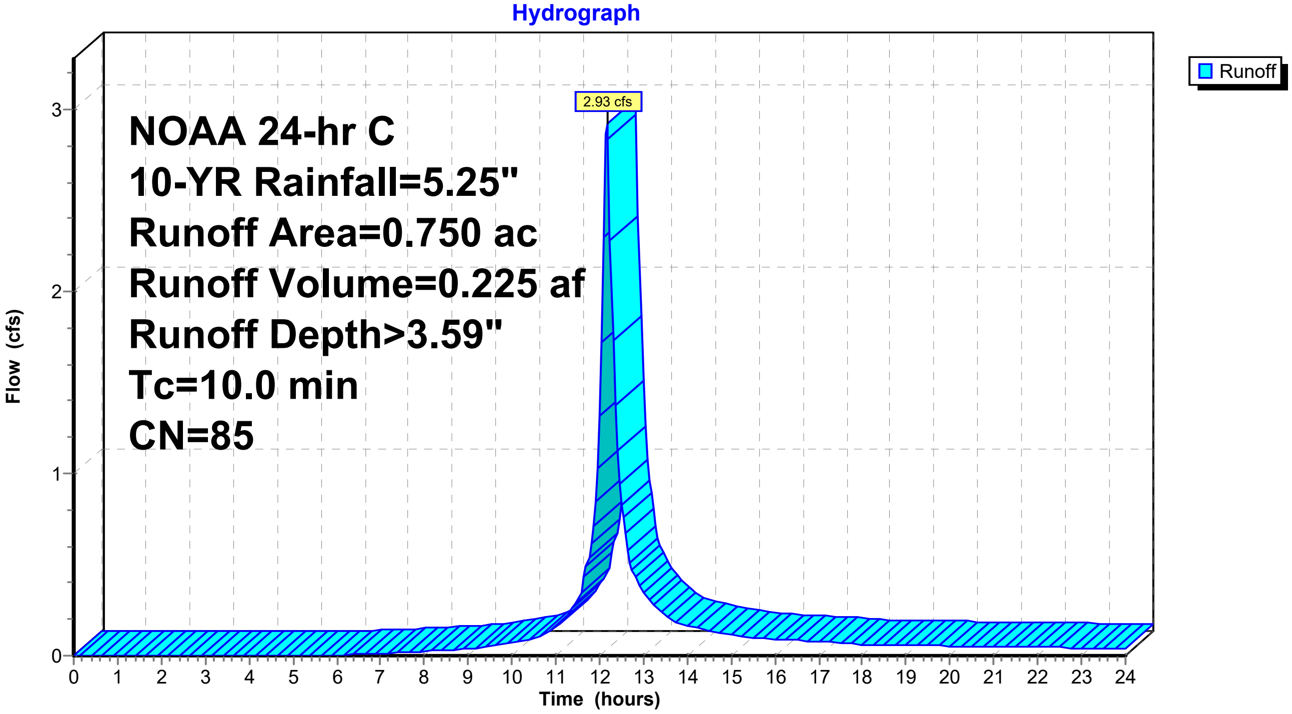
Runoff = 2.93 cfs @ 12.17 hrs, Volume= 0.225 af, Depth> 3.59"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.750	85	Gravel (B)
	0.750		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 10S: PDA-1D (IMP)



Summary for Subcatchment 11S: PDA-1D New Road

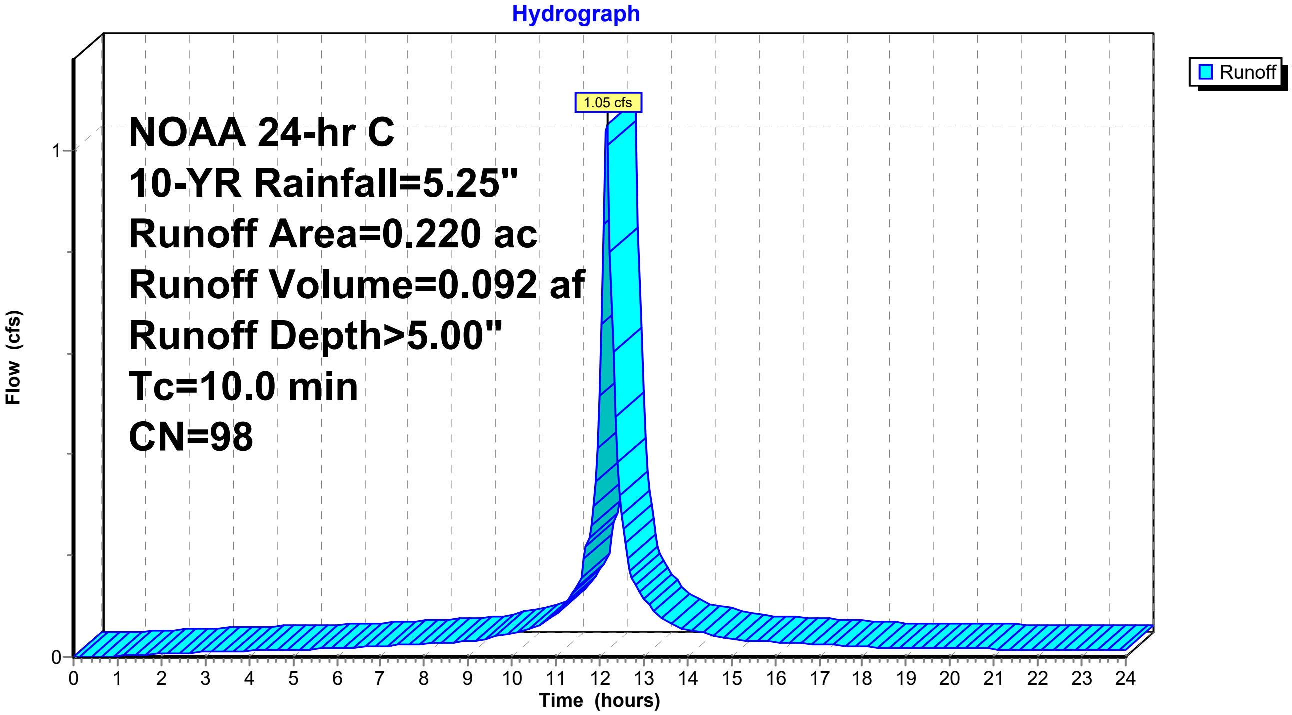
Runoff = 1.05 cfs @ 12.17 hrs, Volume= 0.092 af, Depth> 5.00"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.220	98	New Road
	0.220		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 11S: PDA-1D New Road



Summary for Subcatchment 12S: PDA-1D (PERV)

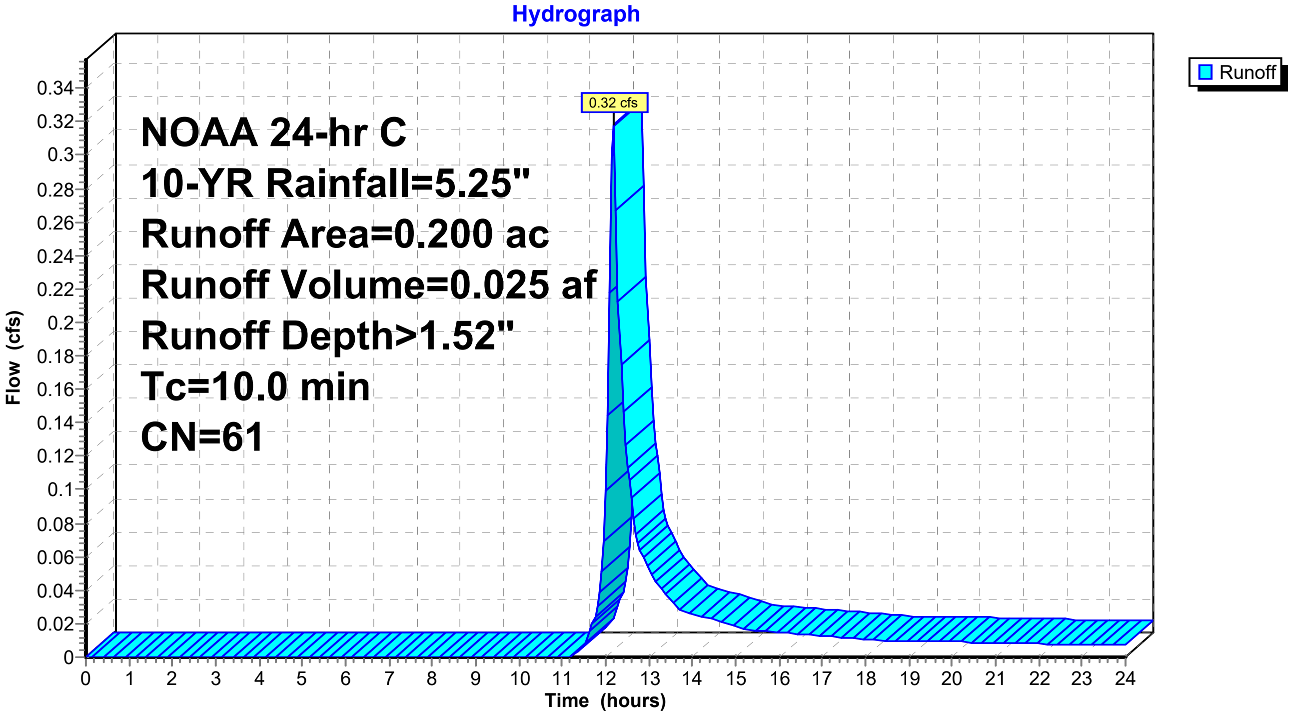
Runoff = 0.32 cfs @ 12.19 hrs, Volume= 0.025 af, Depth> 1.52"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.200	61	Lawn (B)
	0.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 12S: PDA-1D (PERV)



Summary for Subcatchment 13S: PDA-2A (IMP)

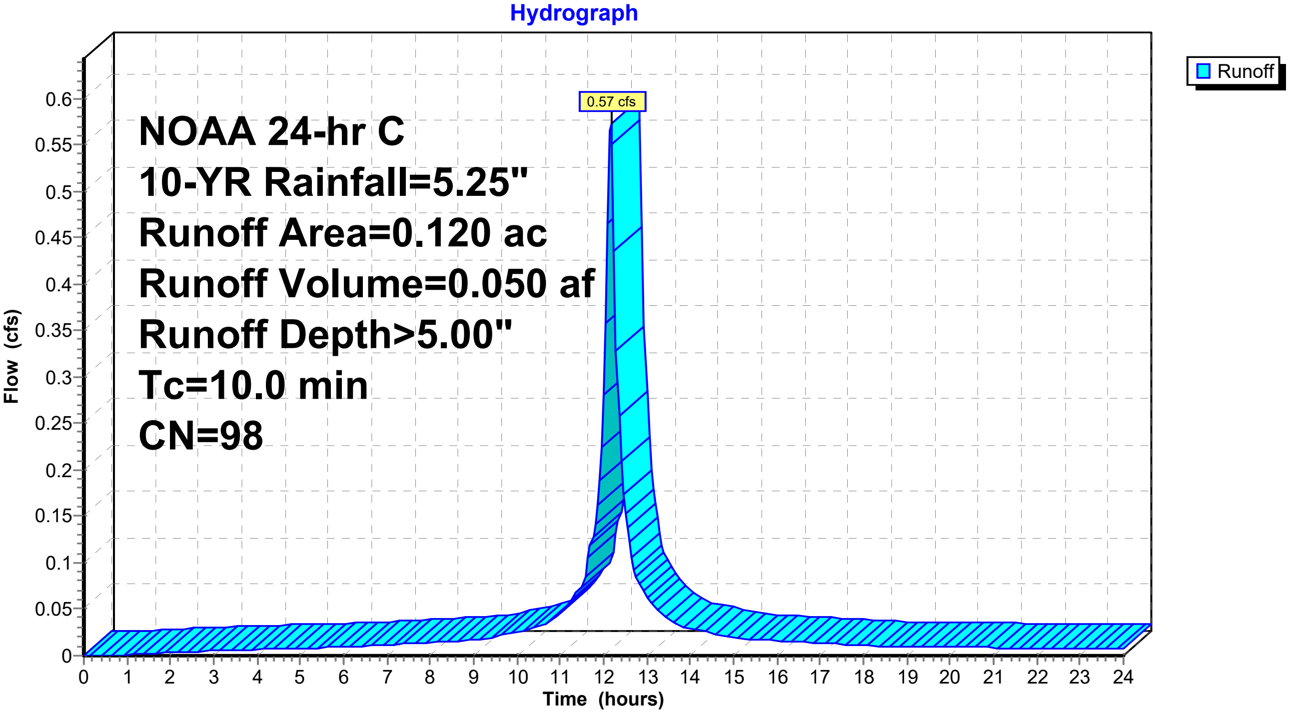
Runoff = 0.57 cfs @ 12.17 hrs, Volume= 0.050 af, Depth> 5.00"
Routed to Link 22L : PDA-2A Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.120	98	Impervious
	0.120		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 13S: PDA-2A (IMP)



Summary for Subcatchment 14S: PDA-2A (PERV)

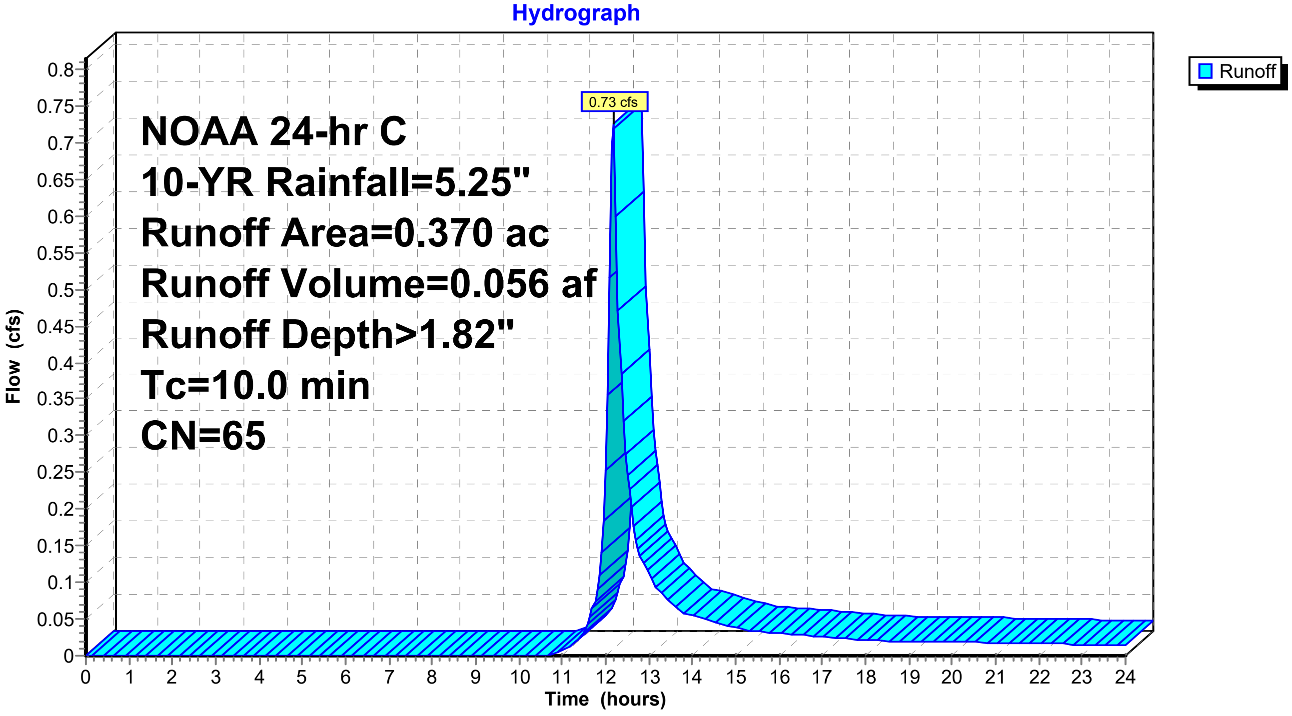
Runoff = 0.73 cfs @ 12.18 hrs, Volume= 0.056 af, Depth> 1.82"
Routed to Link 22L : PDA-2A Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.090	77	Wooded (D)
*	0.280	61	Lawn (B)
	0.370	65	Weighted Average
	0.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 14S: PDA-2A (PERV)



Summary for Subcatchment 15S: PDA-2B (IMP)

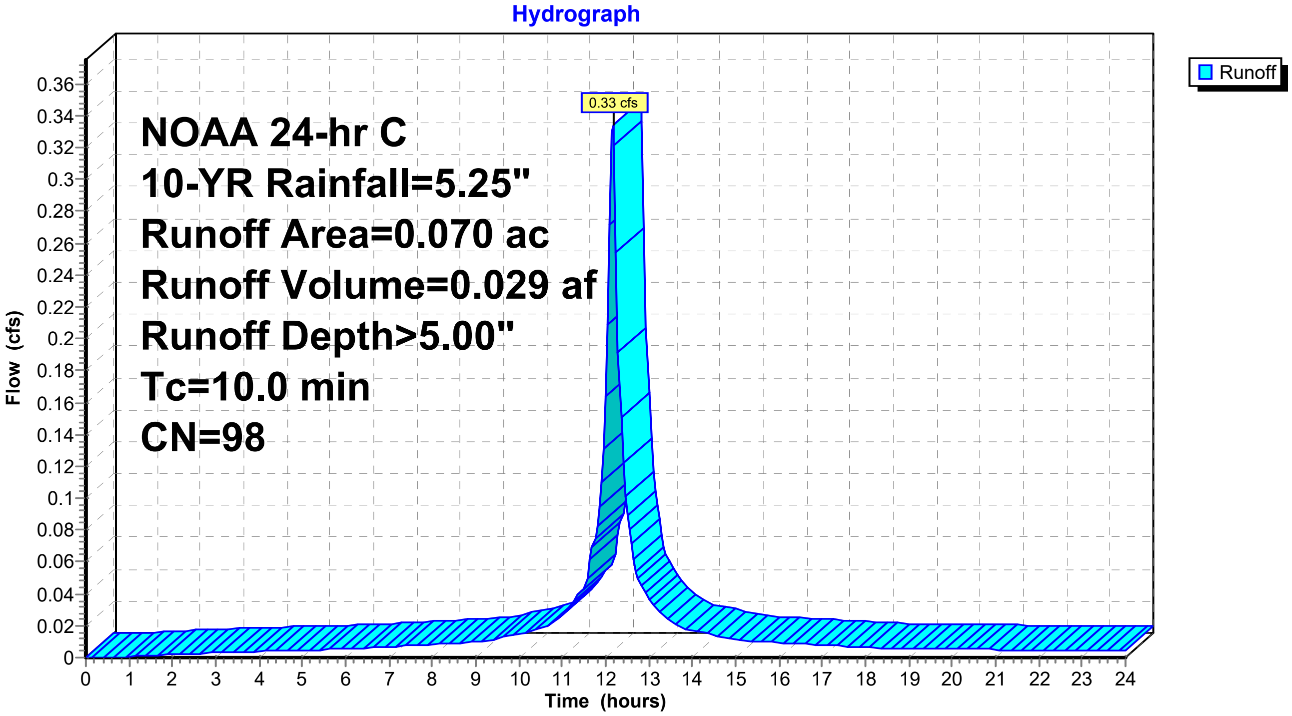
Runoff = 0.33 cfs @ 12.17 hrs, Volume= 0.029 af, Depth> 5.00"
Routed to Link 23L : PDA-2B Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.070	98	Impervious
	0.070		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 15S: PDA-2B (IMP)



Summary for Subcatchment 16S: PDA-2B (PERV)

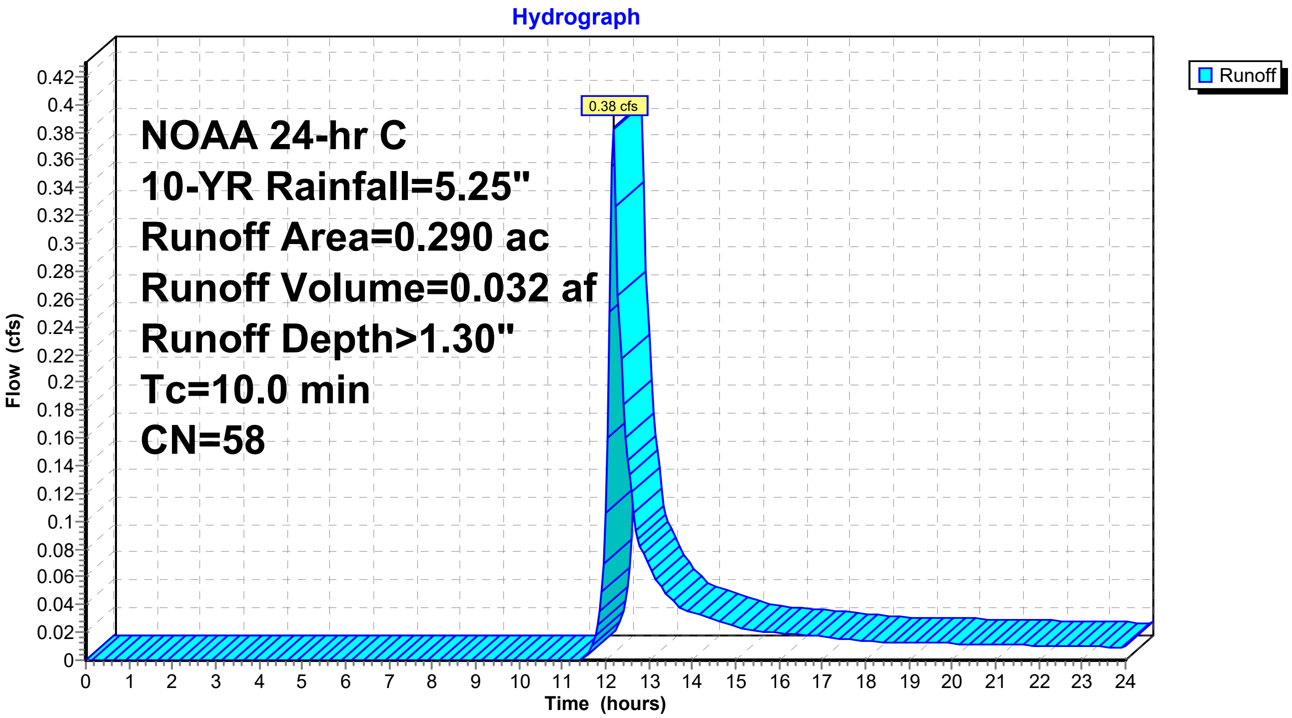
Runoff = 0.38 cfs @ 12.19 hrs, Volume= 0.032 af, Depth> 1.30"
Routed to Link 23L : PDA-2B Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.160	55	Wooded (B)
*	0.130	61	Lawn (B)
	0.290	58	Weighted Average
	0.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 16S: PDA-2B (PERV)



Summary for Subcatchment 17S: PDA-3 (IMP)

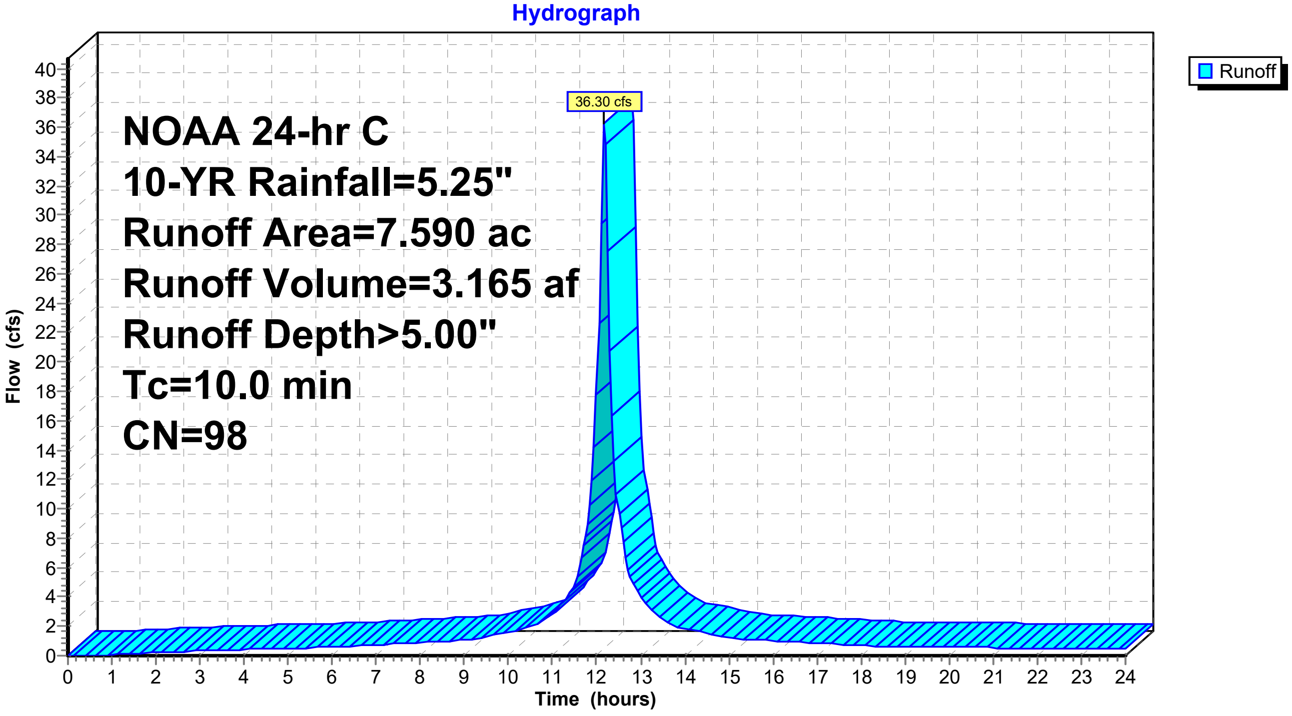
Runoff = 36.30 cfs @ 12.17 hrs, Volume= 3.165 af, Depth> 5.00"
Routed to Link 27L : Total Site Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	7.590	98	Impervious
	7.590		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 17S: PDA-3 (IMP)



Summary for Subcatchment 26S: Sub-Catch to Swale 1 (for Swale Calc Only)

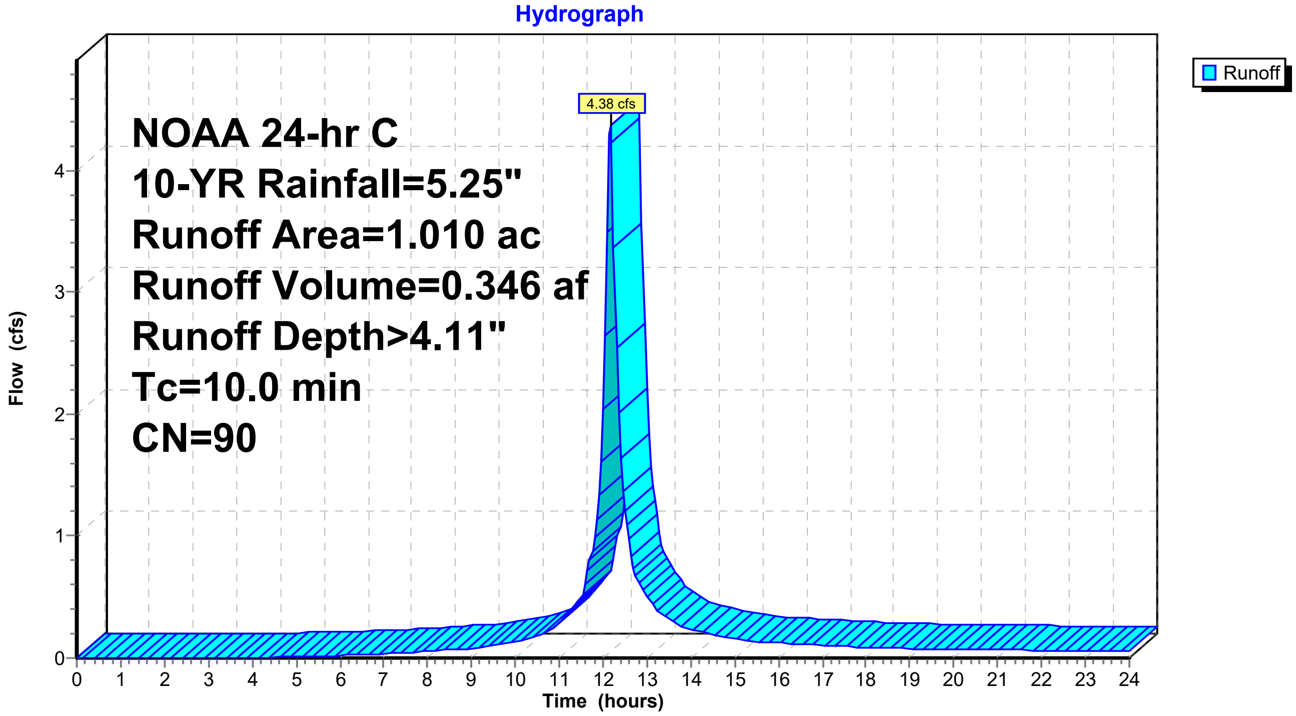
Runoff = 4.38 cfs @ 12.17 hrs, Volume= 0.346 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-YR Rainfall=5.25"

	Area (ac)	CN	Description
*	0.510	85	Gravel
*	0.450	98	Impervious
*	0.050	61	Lawn (B)
	1.010	90	Weighted Average
	0.560		55.45% Pervious Area
	0.450		44.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 26S: Sub-Catch to Swale 1 (for Swale Calc Only)

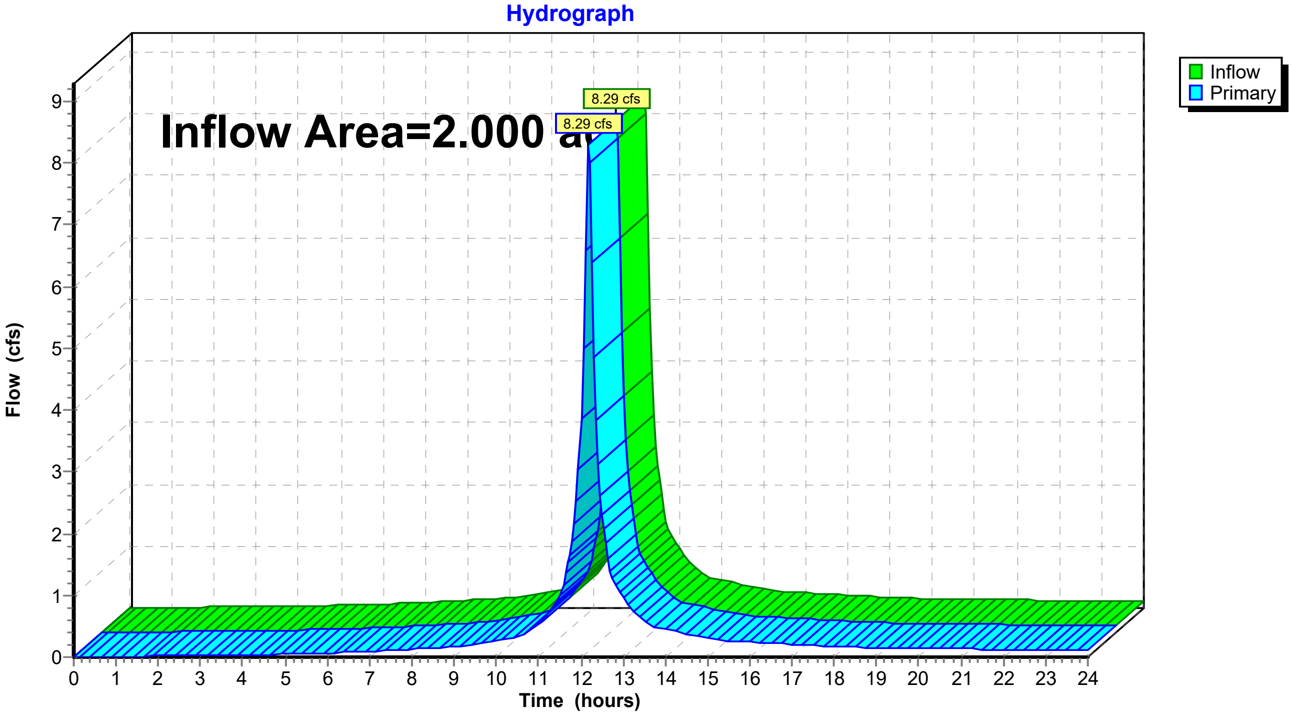


Summary for Link 18L: To WQU-1/Pipe 1 Overflow

Inflow Area = 2.000 ac, 44.50% Impervious, Inflow Depth > 4.03" for 10-YR event
Inflow = 8.29 cfs @ 12.17 hrs, Volume= 0.672 af
Primary = 8.29 cfs @ 12.17 hrs, Volume= 0.672 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 18L: To WQU-1/Pipe 1 Overflow

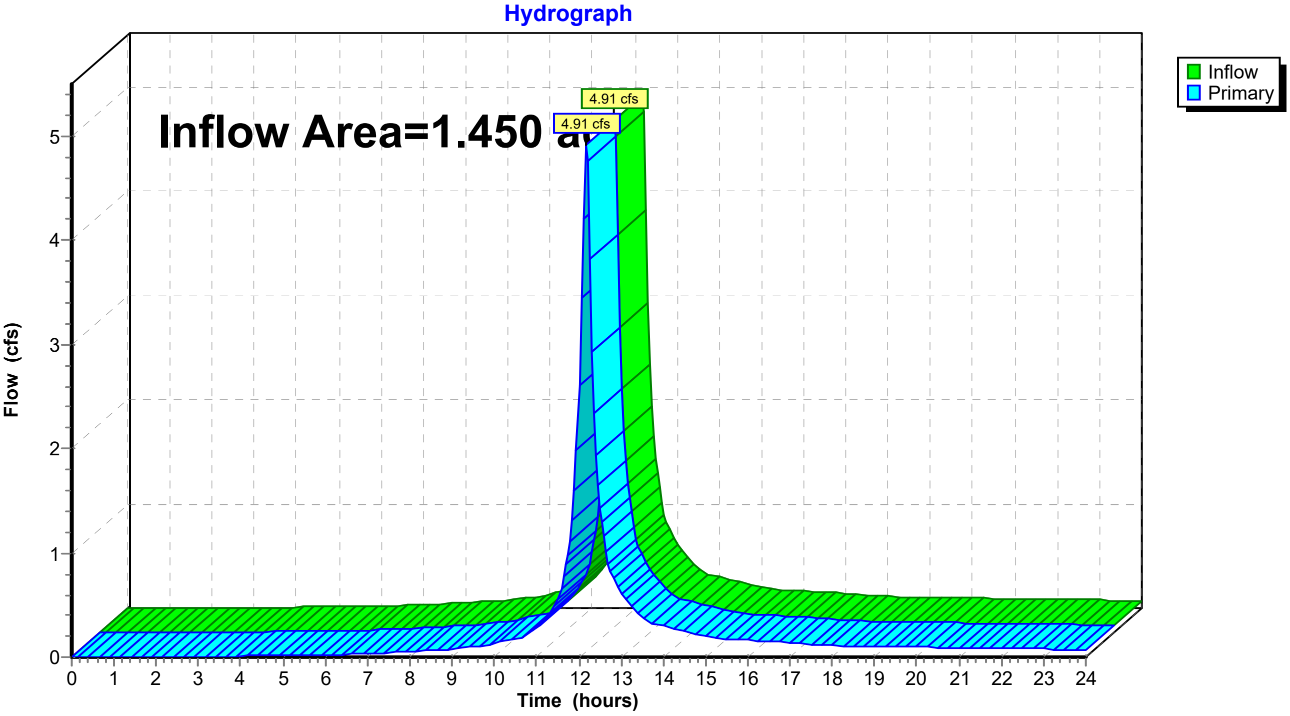


Summary for Link 19L: Swale 2/WQU-2/Pipe 2 Overflow

Inflow Area = 1.450 ac, 13.10% Impervious, Inflow Depth > 3.36" for 10-YR event
Inflow = 4.91 cfs @ 12.17 hrs, Volume= 0.407 af
Primary = 4.91 cfs @ 12.17 hrs, Volume= 0.407 af, Atten= 0%, Lag= 0.0 min
Routed to Link 25L : To Pipe 4 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 19L: Swale 2/WQU-2/Pipe 2 Overflow

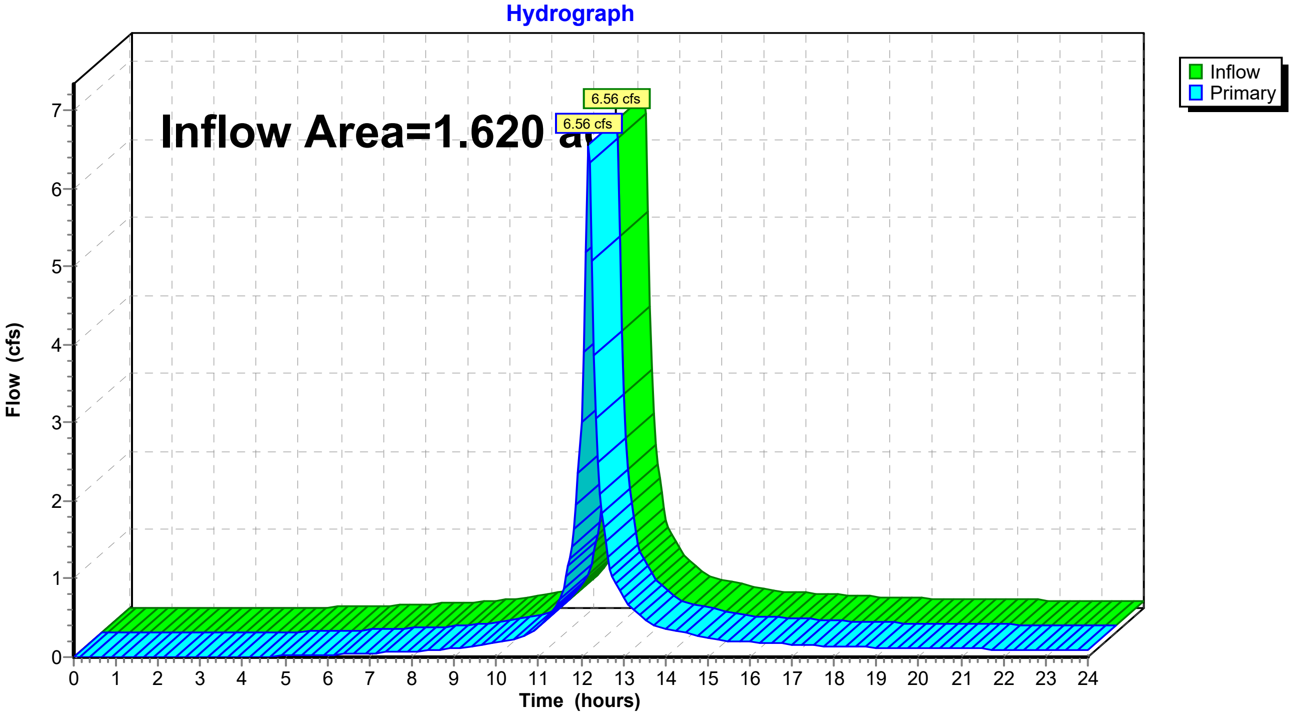


Summary for Link 20L: Swale 3/WQU-3

Inflow Area = 1.620 ac, 20.37% Impervious, Inflow Depth > 3.82" for 10-YR event
Inflow = 6.56 cfs @ 12.17 hrs, Volume= 0.515 af
Primary = 6.56 cfs @ 12.17 hrs, Volume= 0.515 af, Atten= 0%, Lag= 0.0 min
Routed to Link 24L : To Pipe 3 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 20L: Swale 3/WQU-3

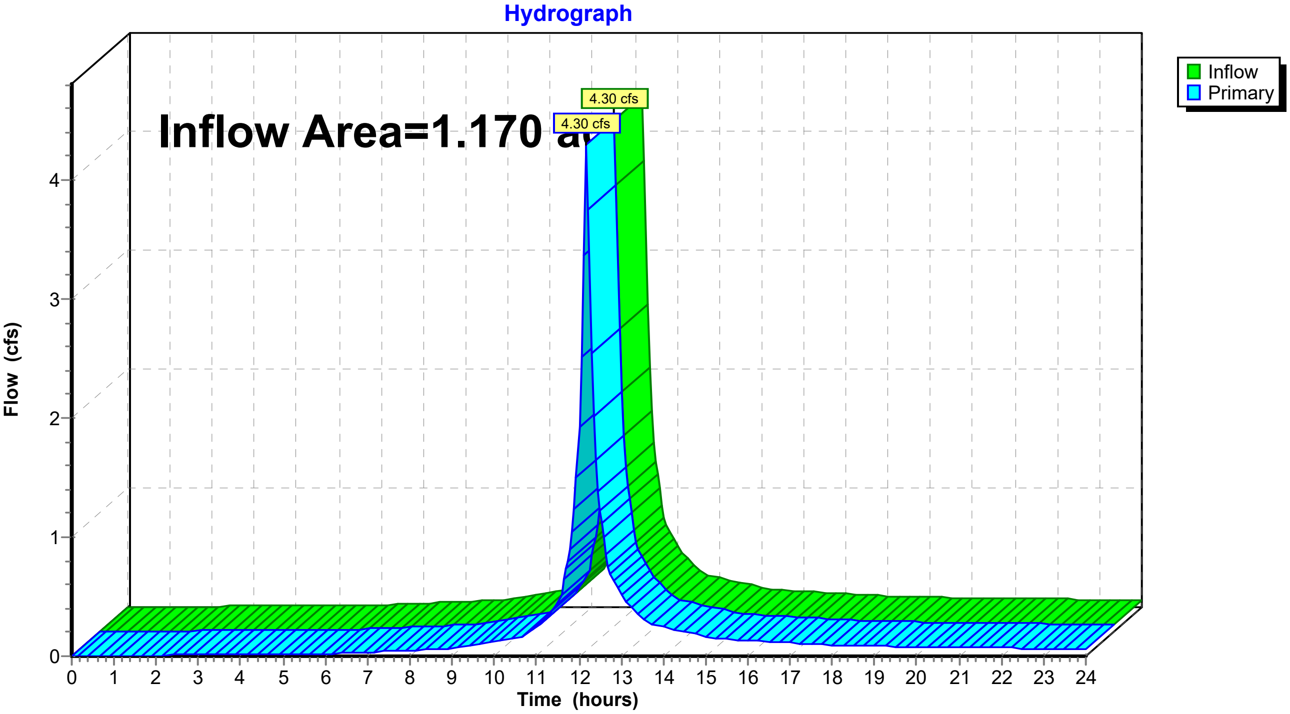


Summary for Link 21L: Swale 4/WQU-4

Inflow Area = 1.170 ac, 18.80% Impervious, Inflow Depth > 3.50" for 10-YR event
Inflow = 4.30 cfs @ 12.17 hrs, Volume= 0.342 af
Primary = 4.30 cfs @ 12.17 hrs, Volume= 0.342 af, Atten= 0%, Lag= 0.0 min
Routed to Link 24L : To Pipe 3 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 21L: Swale 4/WQU-4

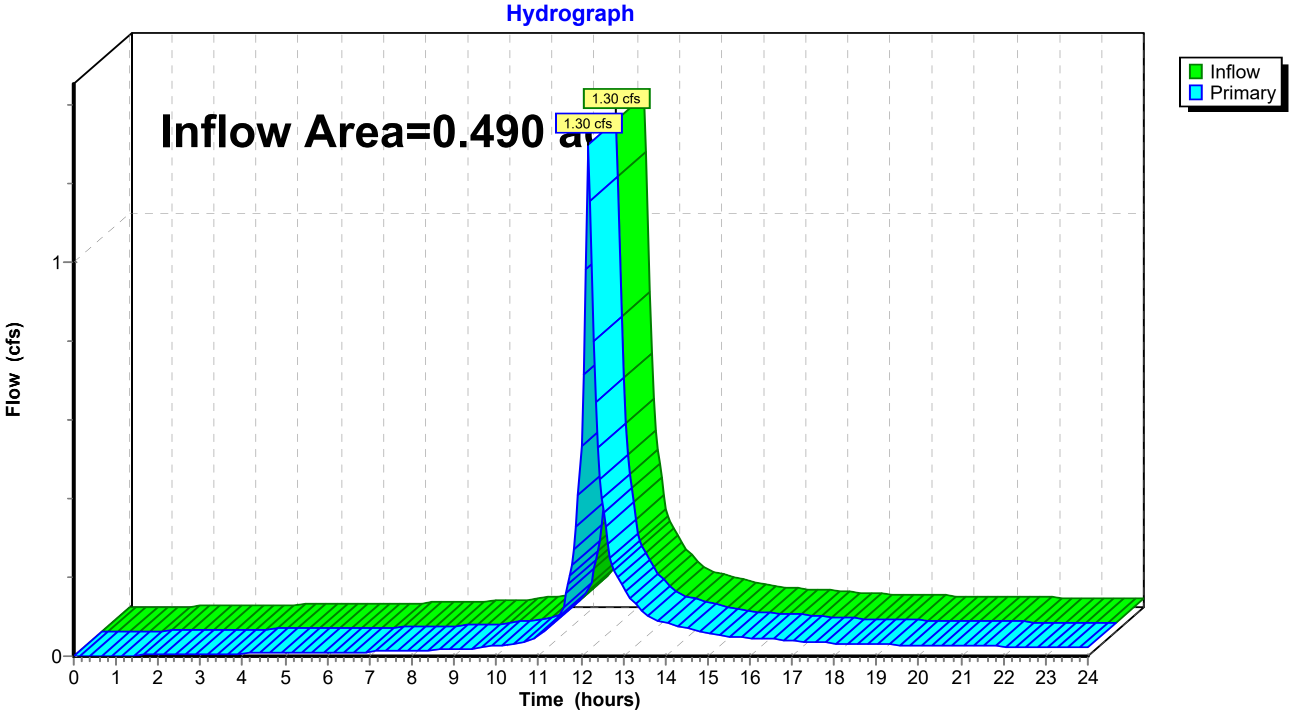


Summary for Link 22L: PDA-2A Total

Inflow Area = 0.490 ac, 24.49% Impervious, Inflow Depth > 2.60" for 10-YR event
Inflow = 1.30 cfs @ 12.18 hrs, Volume= 0.106 af
Primary = 1.30 cfs @ 12.18 hrs, Volume= 0.106 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 22L: PDA-2A Total

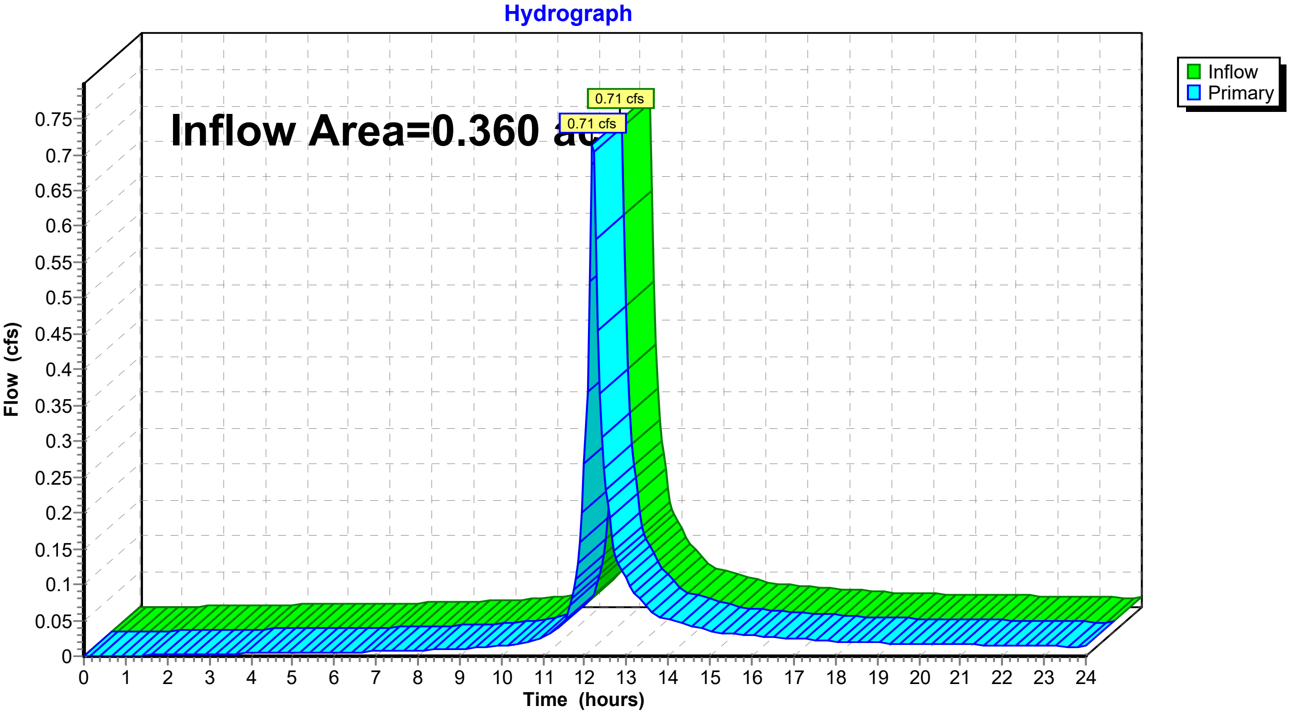


Summary for Link 23L: PDA-2B Total

Inflow Area = 0.360 ac, 19.44% Impervious, Inflow Depth > 2.02" for 10-YR event
Inflow = 0.71 cfs @ 12.18 hrs, Volume= 0.061 af
Primary = 0.71 cfs @ 12.18 hrs, Volume= 0.061 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 23L: PDA-2B Total

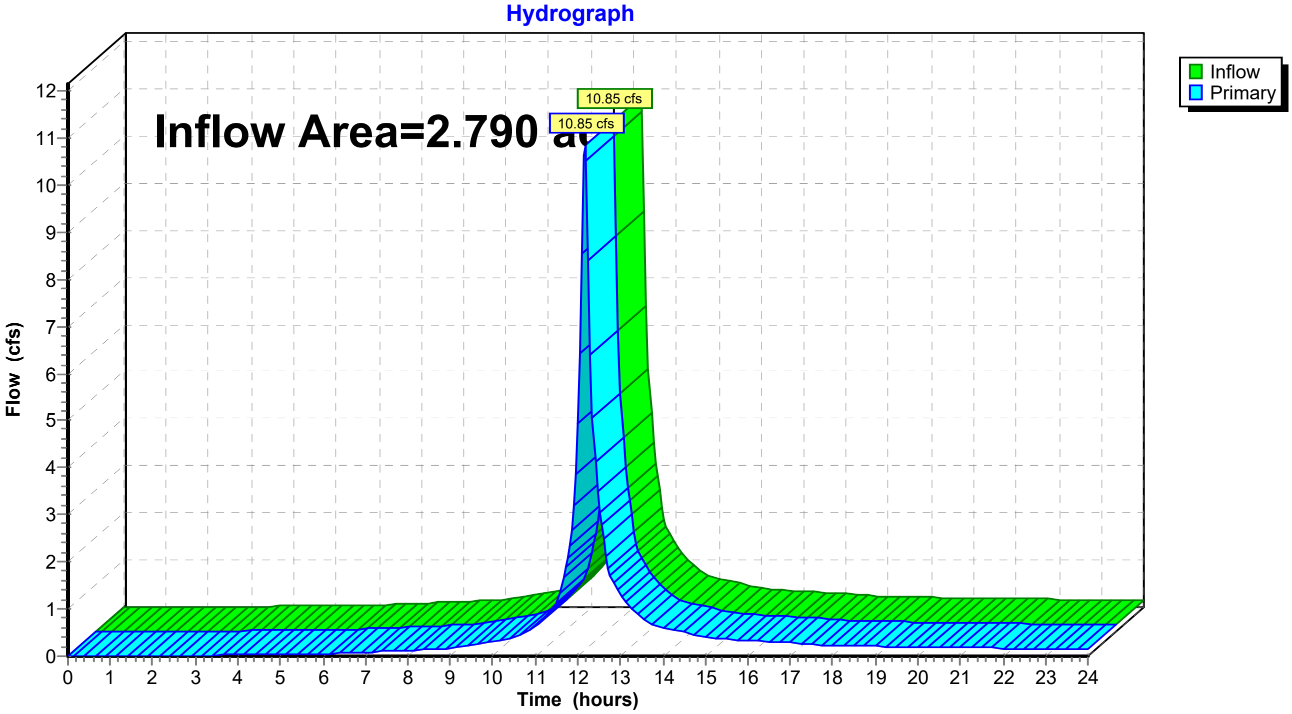


Summary for Link 24L: To Pipe 3 Overflow

Inflow Area = 2.790 ac, 19.71% Impervious, Inflow Depth > 3.69" for 10-YR event
Inflow = 10.85 cfs @ 12.17 hrs, Volume= 0.857 af
Primary = 10.85 cfs @ 12.17 hrs, Volume= 0.857 af, Atten= 0%, Lag= 0.0 min
Routed to Link 25L : To Pipe 4 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 24L: To Pipe 3 Overflow

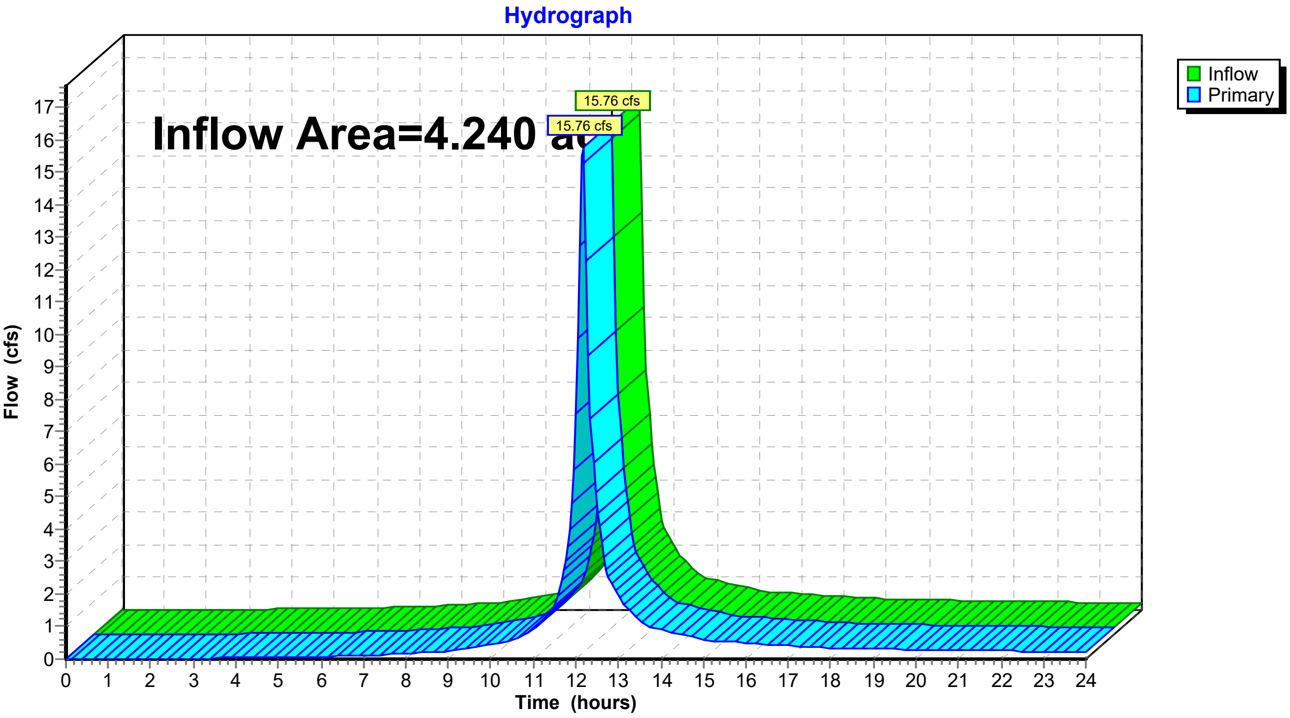


Summary for Link 25L: To Pipe 4 Overflow

Inflow Area = 4.240 ac, 17.45% Impervious, Inflow Depth > 3.58" for 10-YR event
Inflow = 15.76 cfs @ 12.17 hrs, Volume= 1.263 af
Primary = 15.76 cfs @ 12.17 hrs, Volume= 1.263 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 25L: To Pipe 4 Overflow

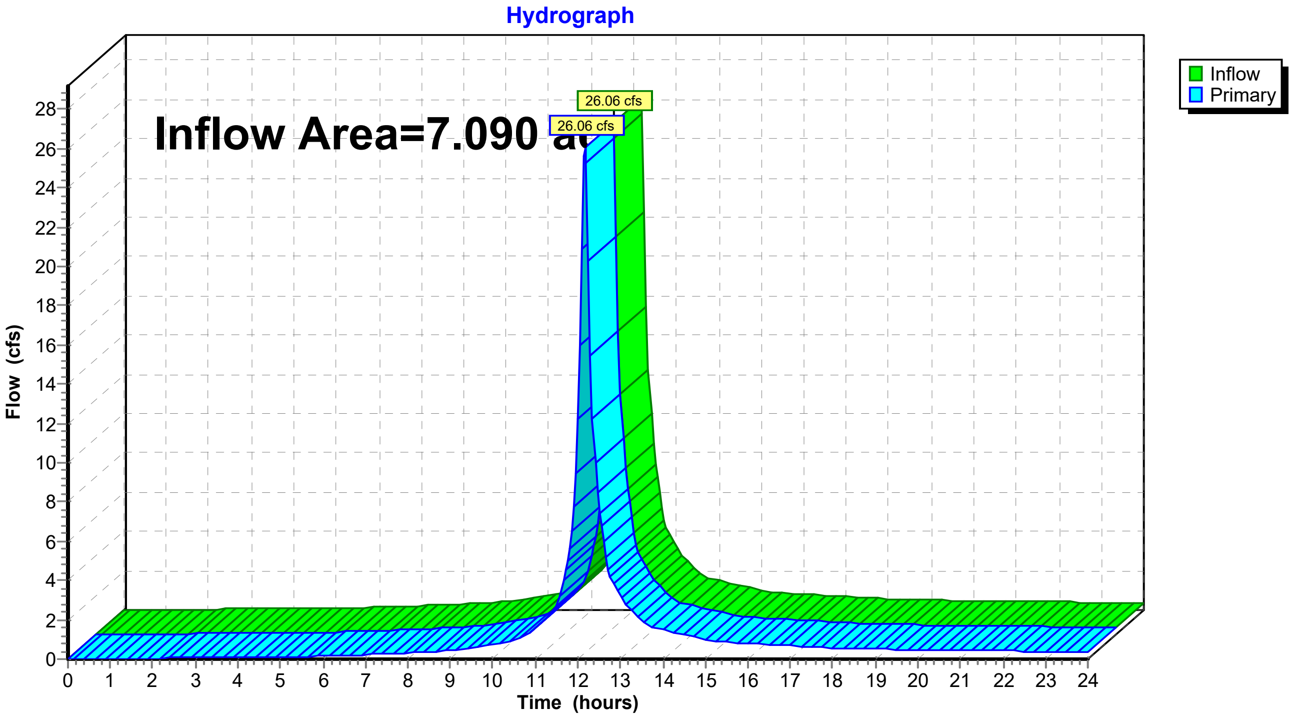


Summary for Link 26L: To Wetlands

Inflow Area = 7.090 ac, 25.67% Impervious, Inflow Depth > 3.56" for 10-YR event
Inflow = 26.06 cfs @ 12.17 hrs, Volume= 2.103 af
Primary = 26.06 cfs @ 12.17 hrs, Volume= 2.103 af, Atten= 0%, Lag= 0.0 min
Routed to Link 27L : Total Site Runoff

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 26L: To Wetlands

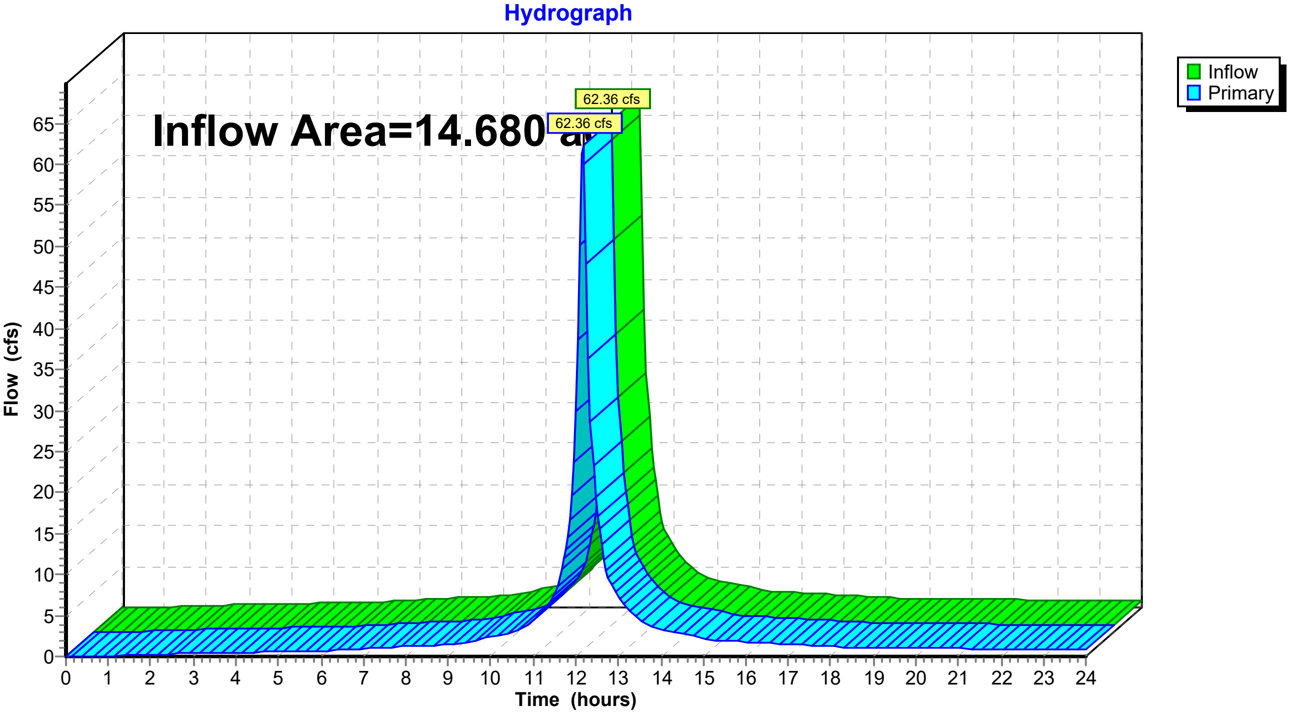


Summary for Link 27L: Total Site Runoff

Inflow Area =	14.680 ac,	64.10% Impervious,	Inflow Depth > 4.31"	for 10-YR event
Inflow =	62.36 cfs @	12.17 hrs, Volume=	5.268 af	
Primary =	62.36 cfs @	12.17 hrs, Volume=	5.268 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 27L: Total Site Runoff



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1S: PDA-1A (IMP) Runoff Area=1.250 ac 24.00% Impervious Runoff Depth>5.18"
Tc=10.0 min CN=88 Runoff=6.82 cfs 0.539 af

Subcatchment2S: PDA-1A New Road Runoff Area=0.590 ac 100.00% Impervious Runoff Depth>6.33"
Tc=10.0 min CN=98 Runoff=3.54 cfs 0.311 af

Subcatchment3S: PDA-1A (PERV) Runoff Area=0.160 ac 0.00% Impervious Runoff Depth>2.40"
Tc=10.0 min CN=61 Runoff=0.42 cfs 0.032 af

Subcatchment4S: PDA-1B (IMP) Runoff Area=0.990 ac 4.04% Impervious Runoff Depth>4.95"
Tc=10.0 min CN=86 Runoff=5.23 cfs 0.409 af

Subcatchment5S: PDA-1B New Road Runoff Area=0.150 ac 100.00% Impervious Runoff Depth>6.33"
Tc=10.0 min CN=98 Runoff=0.90 cfs 0.079 af

Subcatchment6S: PDA-1B (PERV) Runoff Area=0.310 ac 0.00% Impervious Runoff Depth>2.40"
Tc=0.0 min CN=61 Runoff=1.08 cfs 0.062 af

Subcatchment7S: PDA-1C (IMP) Runoff Area=1.390 ac 12.23% Impervious Runoff Depth>5.06"
Tc=10.0 min CN=87 Runoff=7.46 cfs 0.587 af

Subcatchment8S: PDA-1C New Road Runoff Area=0.160 ac 100.00% Impervious Runoff Depth>6.33"
Tc=10.0 min CN=98 Runoff=0.96 cfs 0.084 af

Subcatchment9S: PDA-1C (PERV) Runoff Area=0.070 ac 0.00% Impervious Runoff Depth>2.40"
Tc=10.0 min CN=61 Runoff=0.18 cfs 0.014 af

Subcatchment10S: PDA-1D (IMP) Runoff Area=0.750 ac 0.00% Impervious Runoff Depth>4.84"
Tc=10.0 min CN=85 Runoff=3.89 cfs 0.303 af

Subcatchment11S: PDA-1D New Road Runoff Area=0.220 ac 100.00% Impervious Runoff Depth>6.33"
Tc=10.0 min CN=98 Runoff=1.32 cfs 0.116 af

Subcatchment12S: PDA-1D (PERV) Runoff Area=0.200 ac 0.00% Impervious Runoff Depth>2.40"
Tc=10.0 min CN=61 Runoff=0.52 cfs 0.040 af

Subcatchment13S: PDA-2A (IMP) Runoff Area=0.120 ac 100.00% Impervious Runoff Depth>6.33"
Tc=10.0 min CN=98 Runoff=0.72 cfs 0.063 af

Subcatchment14S: PDA-2A (PERV) Runoff Area=0.370 ac 0.00% Impervious Runoff Depth>2.77"
Tc=10.0 min CN=65 Runoff=1.13 cfs 0.086 af

Subcatchment15S: PDA-2B (IMP) Runoff Area=0.070 ac 100.00% Impervious Runoff Depth>6.33"
Tc=10.0 min CN=98 Runoff=0.42 cfs 0.037 af

Subcatchment16S: PDA-2B (PERV) Runoff Area=0.290 ac 0.00% Impervious Runoff Depth>2.12"
Tc=10.0 min CN=58 Runoff=0.66 cfs 0.051 af

Subcatchment17S: PDA-3 (IMP) Runoff Area=7.590 ac 100.00% Impervious Runoff Depth>6.33"
Tc=10.0 min CN=98 Runoff=45.58 cfs 4.004 af

Subcatchment26S: Sub-Catch to Swale 1 Runoff Area=1.010 ac 44.55% Impervious Runoff Depth>5.40"
Tc=10.0 min CN=90 Runoff=5.66 cfs 0.455 af

Link 18L: To WQU-1/Pipe 1 Overflow Inflow=10.77 cfs 0.882 af
Primary=10.77 cfs 0.882 af

Link 19L: Swale 2/WQU-2/Pipe 2 Overflow Inflow=6.50 cfs 0.550 af
Primary=6.50 cfs 0.550 af

Link 20L: Swale 3/WQU-3 Inflow=8.61 cfs 0.685 af
Primary=8.61 cfs 0.685 af

Link 21L: Swale 4/WQU-4 Inflow=5.73 cfs 0.459 af
Primary=5.73 cfs 0.459 af

Link 22L: PDA-2A Total Inflow=1.85 cfs 0.149 af
Primary=1.85 cfs 0.149 af

Link 23L: PDA-2B Total Inflow=1.07 cfs 0.088 af
Primary=1.07 cfs 0.088 af

Link 24L: To Pipe 3 Overflow Inflow=14.34 cfs 1.144 af
Primary=14.34 cfs 1.144 af

Link 25L: To Pipe 4 Overflow Inflow=20.84 cfs 1.693 af
Primary=20.84 cfs 1.693 af

Link 26L: To Wetlands Inflow=34.53 cfs 2.813 af
Primary=34.53 cfs 2.813 af

Link 27L: Total Site Runoff Inflow=80.11 cfs 6.817 af
Primary=80.11 cfs 6.817 af

Total Runoff Area = 15.690 ac Runoff Volume = 7.272 af Average Runoff Depth = 5.56"
37.16% Pervious = 5.830 ac 62.84% Impervious = 9.860 ac

Summary for Subcatchment 1S: PDA-1A (IMP)

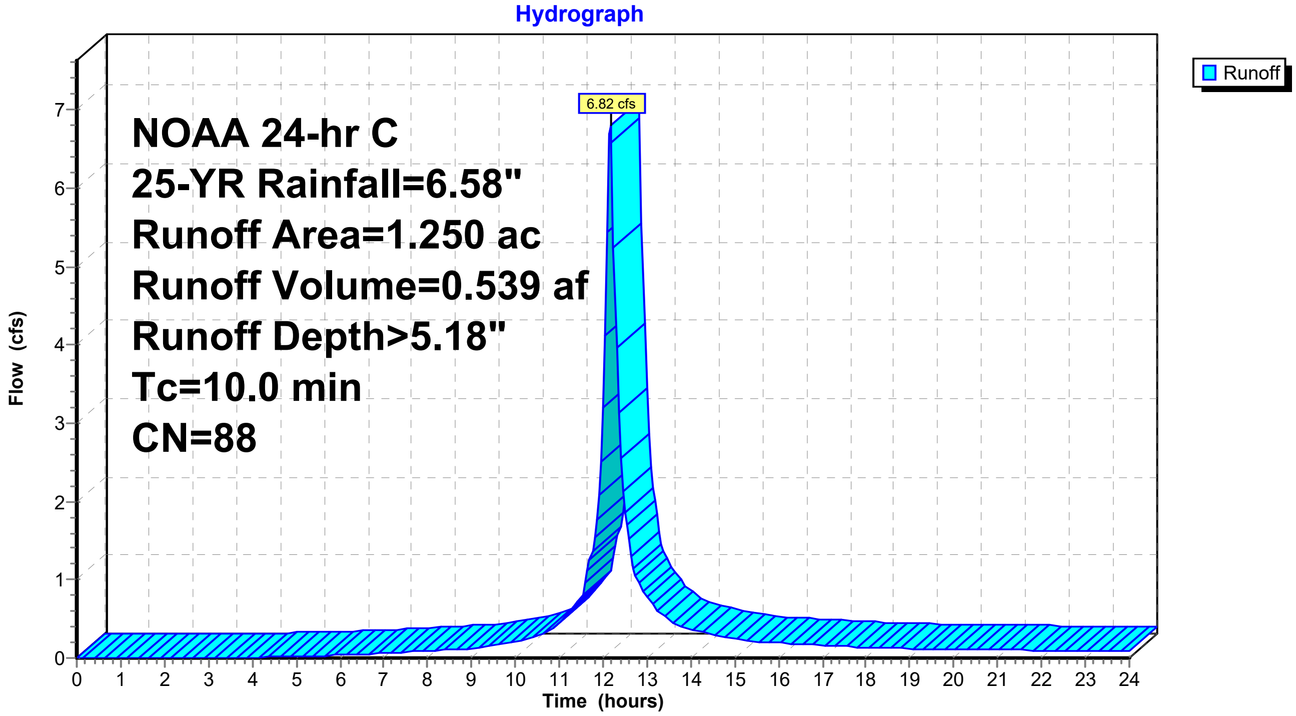
Runoff = 6.82 cfs @ 12.17 hrs, Volume= 0.539 af, Depth> 5.18"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.950	85	Gravel (B)
*	0.300	98	Impervious
	1.250	88	Weighted Average
	0.950		76.00% Pervious Area
	0.300		24.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 1S: PDA-1A (IMP)



Summary for Subcatchment 2S: PDA-1A New Road

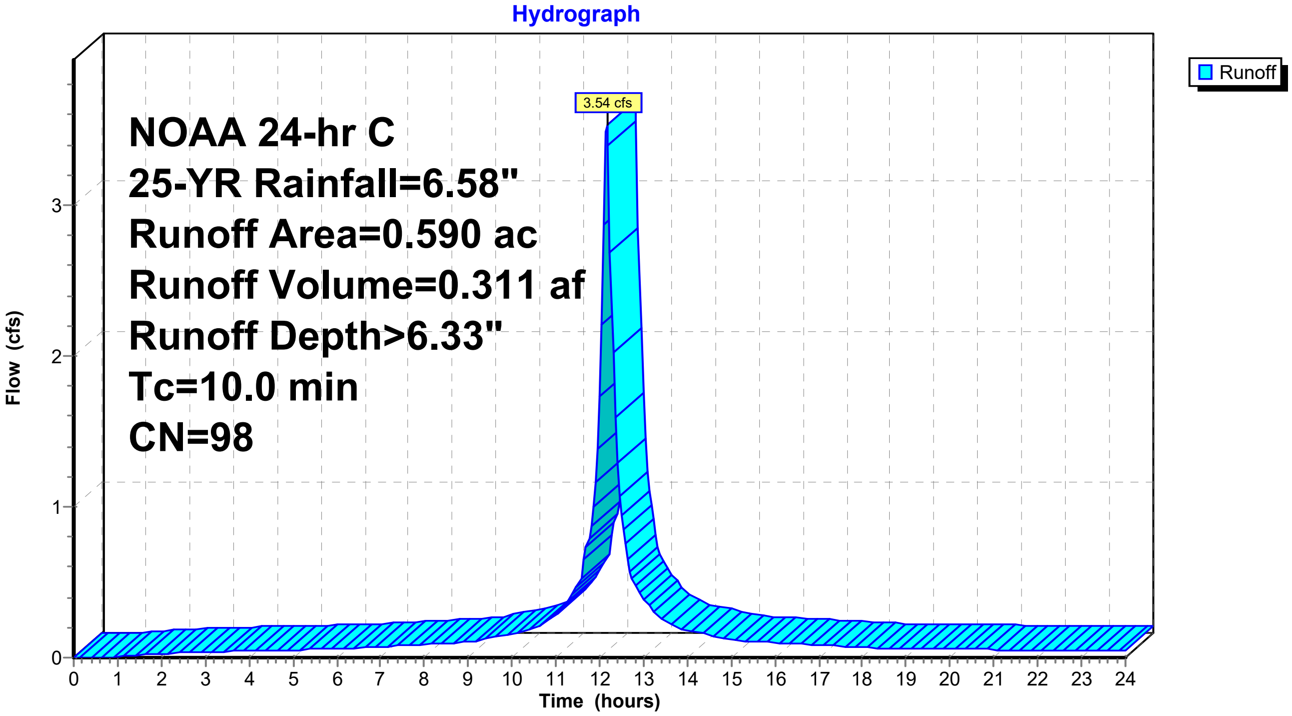
Runoff = 3.54 cfs @ 12.17 hrs, Volume= 0.311 af, Depth> 6.33"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.590	98	New Road
	0.590		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 2S: PDA-1A New Road



Summary for Subcatchment 3S: PDA-1A (PERV)

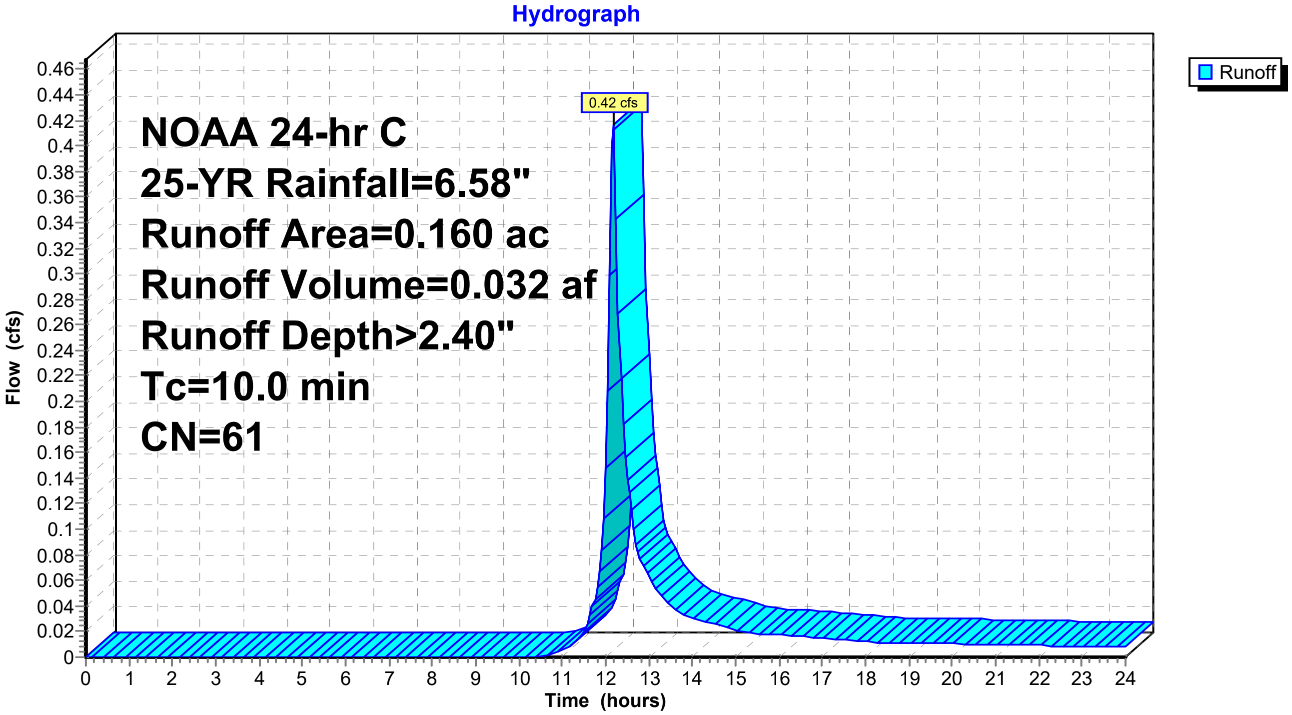
Runoff = 0.42 cfs @ 12.18 hrs, Volume= 0.032 af, Depth> 2.40"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.160	61	Lawn (B)
	0.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 3S: PDA-1A (PERV)



Summary for Subcatchment 4S: PDA-1B (IMP)

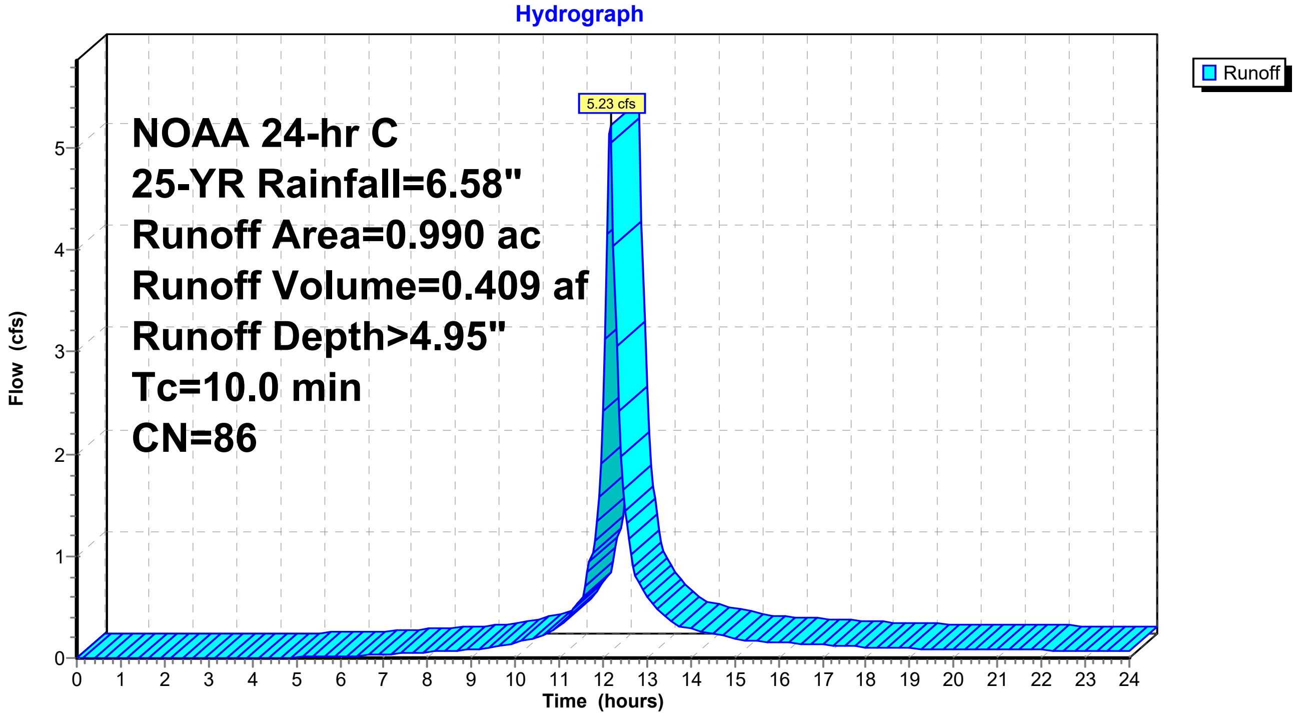
Runoff = 5.23 cfs @ 12.17 hrs, Volume= 0.409 af, Depth> 4.95"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.950	85	Gravel (B)
*	0.040	98	Impervious
	0.990	86	Weighted Average
	0.950		95.96% Pervious Area
	0.040		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 4S: PDA-1B (IMP)



Summary for Subcatchment 5S: PDA-1B New Road

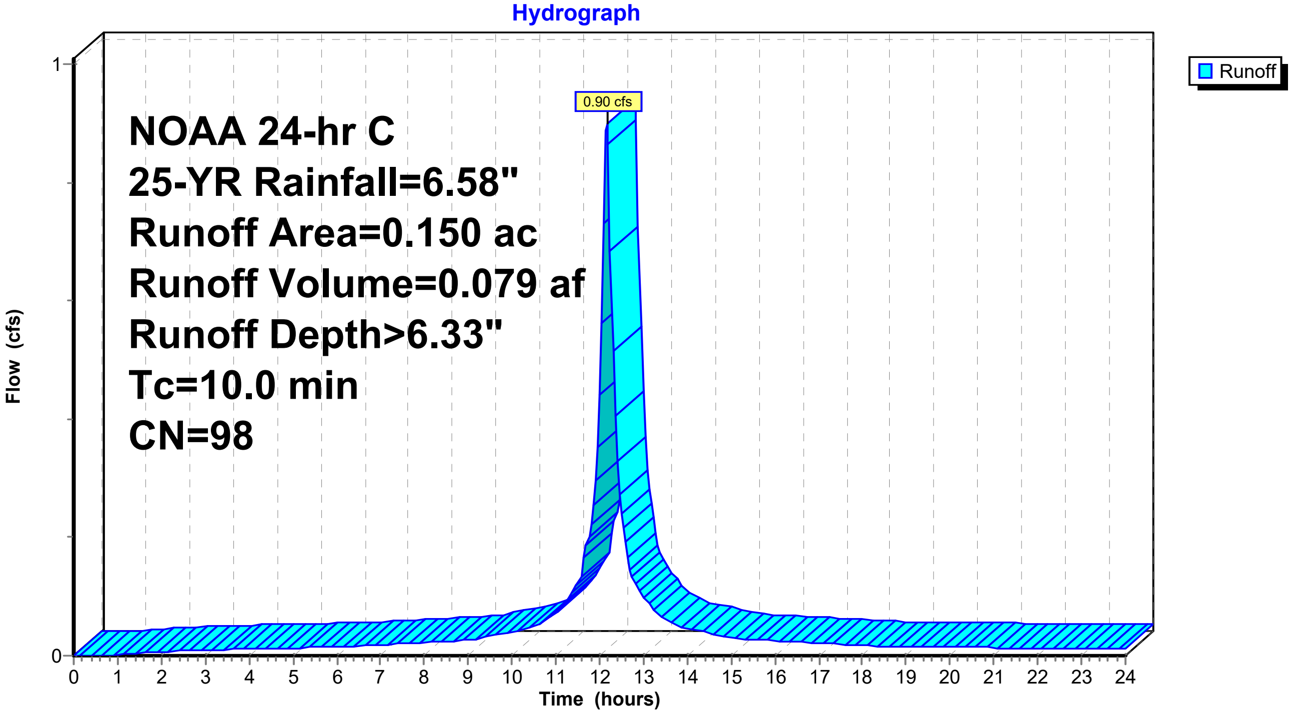
Runoff = 0.90 cfs @ 12.17 hrs, Volume= 0.079 af, Depth> 6.33"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.150	98	New Road
	0.150		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 5S: PDA-1B New Road



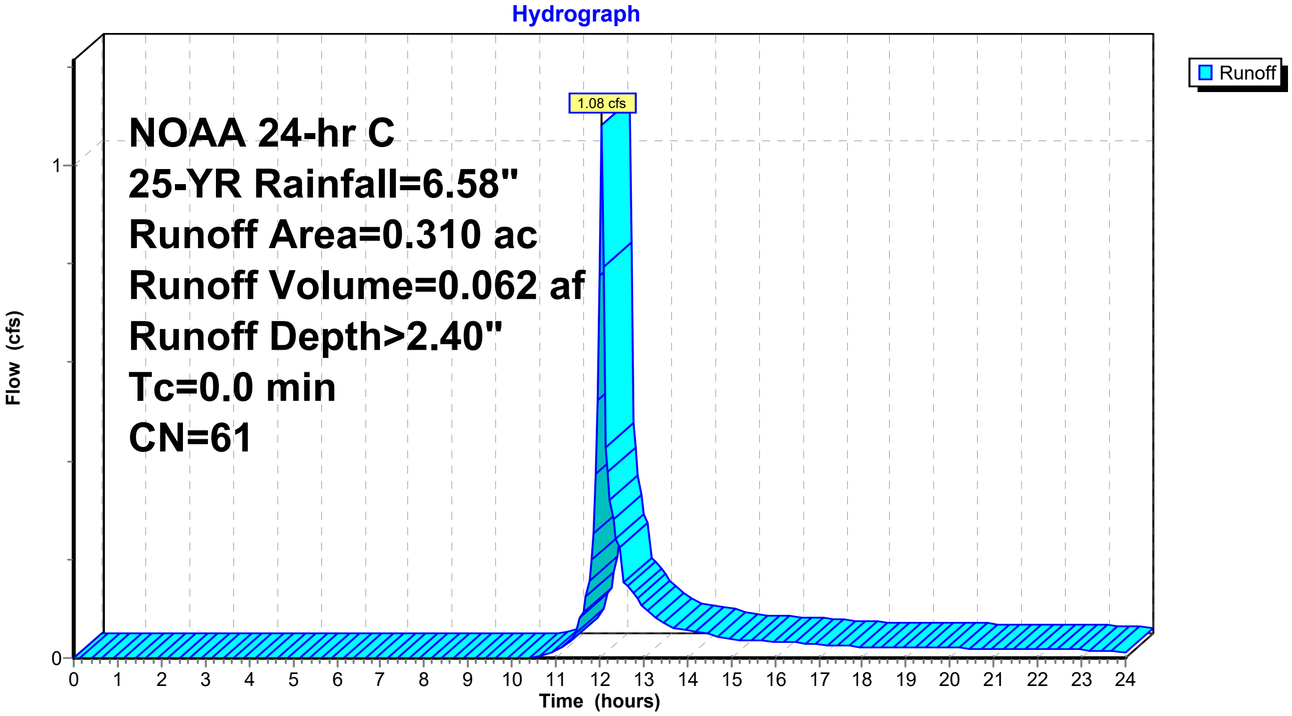
Summary for Subcatchment 6S: PDA-1B (PERV)

Runoff = 1.08 cfs @ 12.05 hrs, Volume= 0.062 af, Depth> 2.40"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.310	61	Lawn (B)
	0.310		100.00% Pervious Area

Subcatchment 6S: PDA-1B (PERV)



Summary for Subcatchment 7S: PDA-1C (IMP)

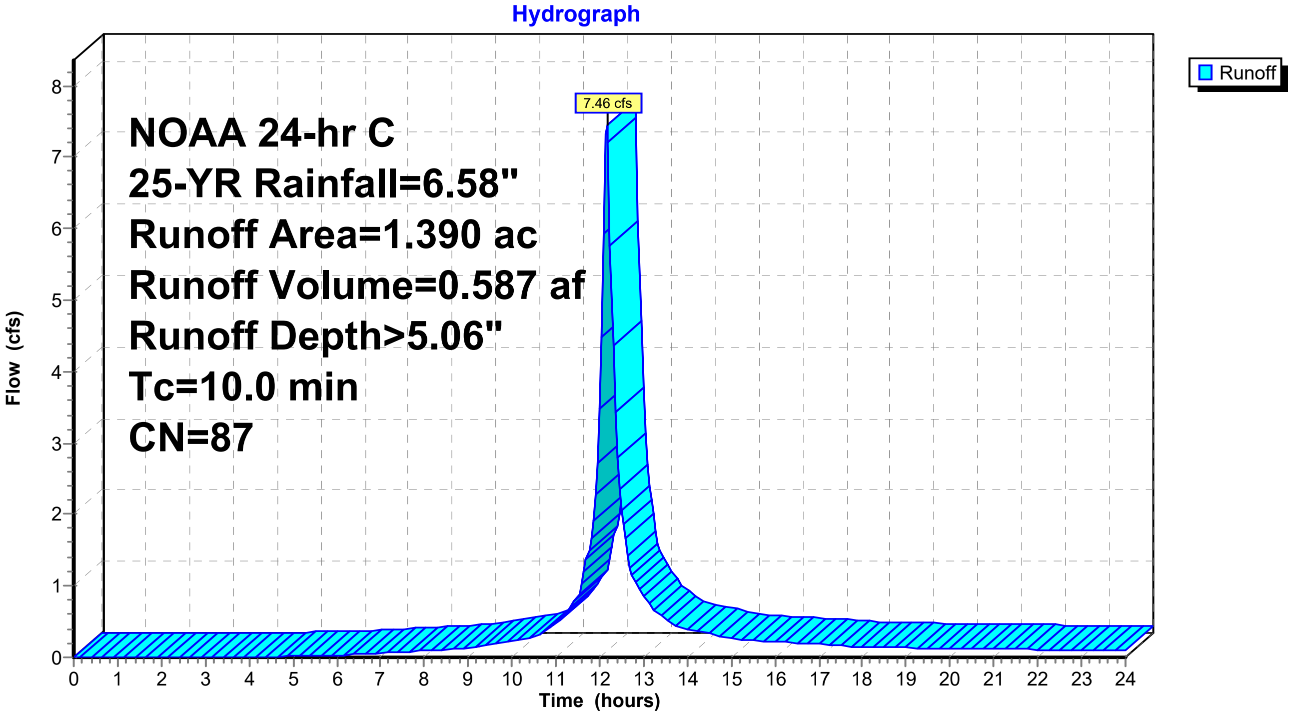
Runoff = 7.46 cfs @ 12.17 hrs, Volume= 0.587 af, Depth> 5.06"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	1.220	85	Gravel (B)
*	0.010	98	Impervious
*	0.160	98	New Roads
	1.390	87	Weighted Average
	1.220		87.77% Pervious Area
	0.170		12.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 7S: PDA-1C (IMP)



Summary for Subcatchment 8S: PDA-1C New Road

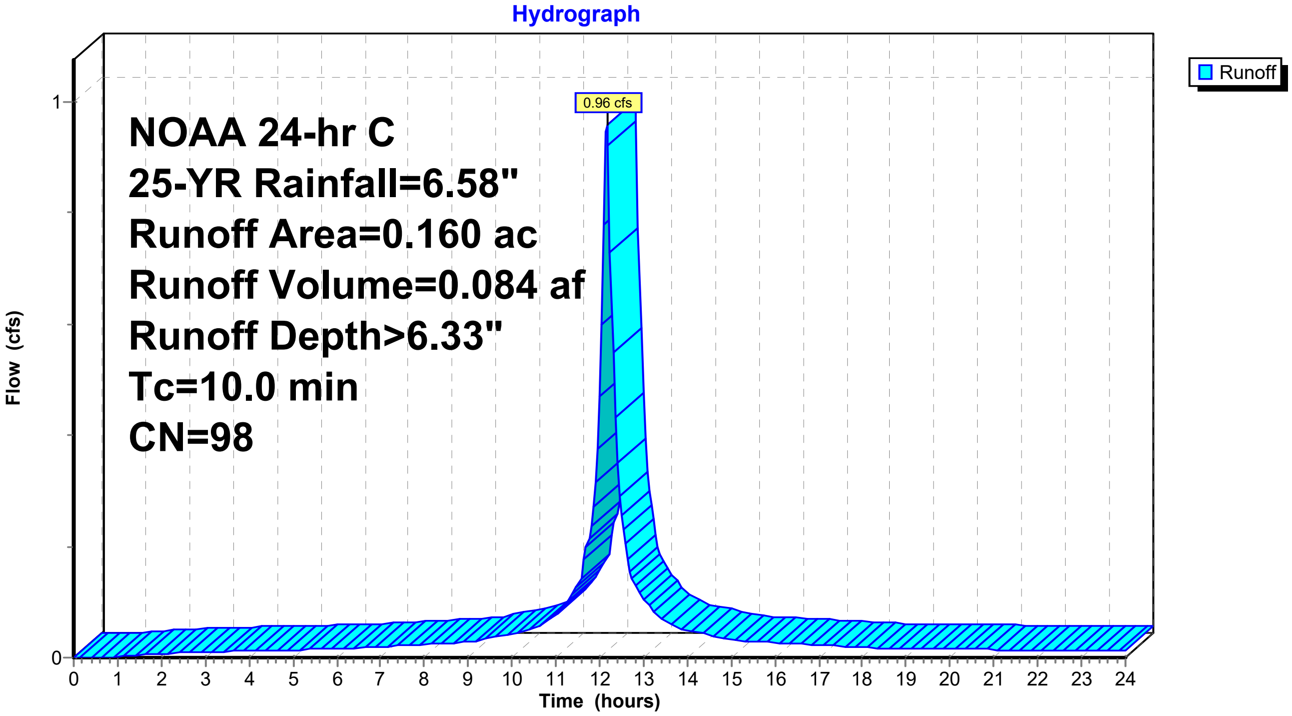
Runoff = 0.96 cfs @ 12.17 hrs, Volume= 0.084 af, Depth> 6.33"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.160	98	New Road
	0.160		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 8S: PDA-1C New Road



Summary for Subcatchment 9S: PDA-1C (PERV)

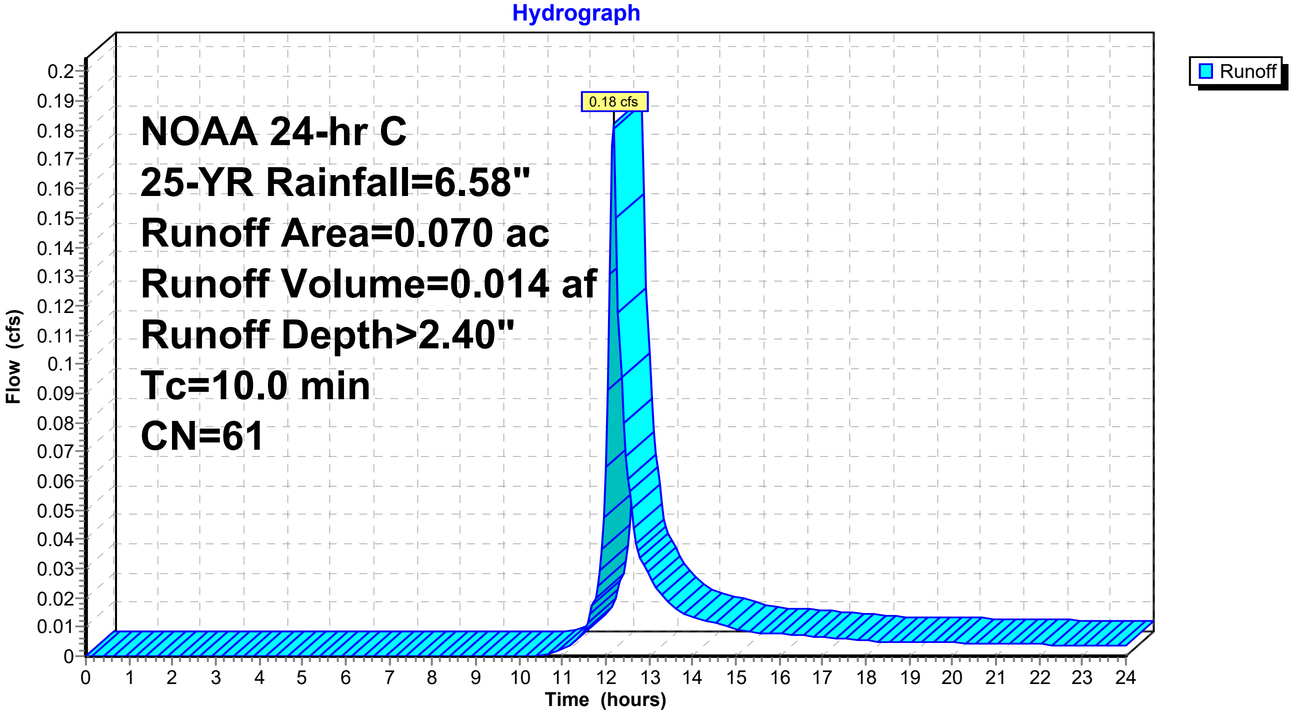
Runoff = 0.18 cfs @ 12.18 hrs, Volume= 0.014 af, Depth> 2.40"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.070	61	Lawn (B)
	0.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 9S: PDA-1C (PERV)



Summary for Subcatchment 10S: PDA-1D (IMP)

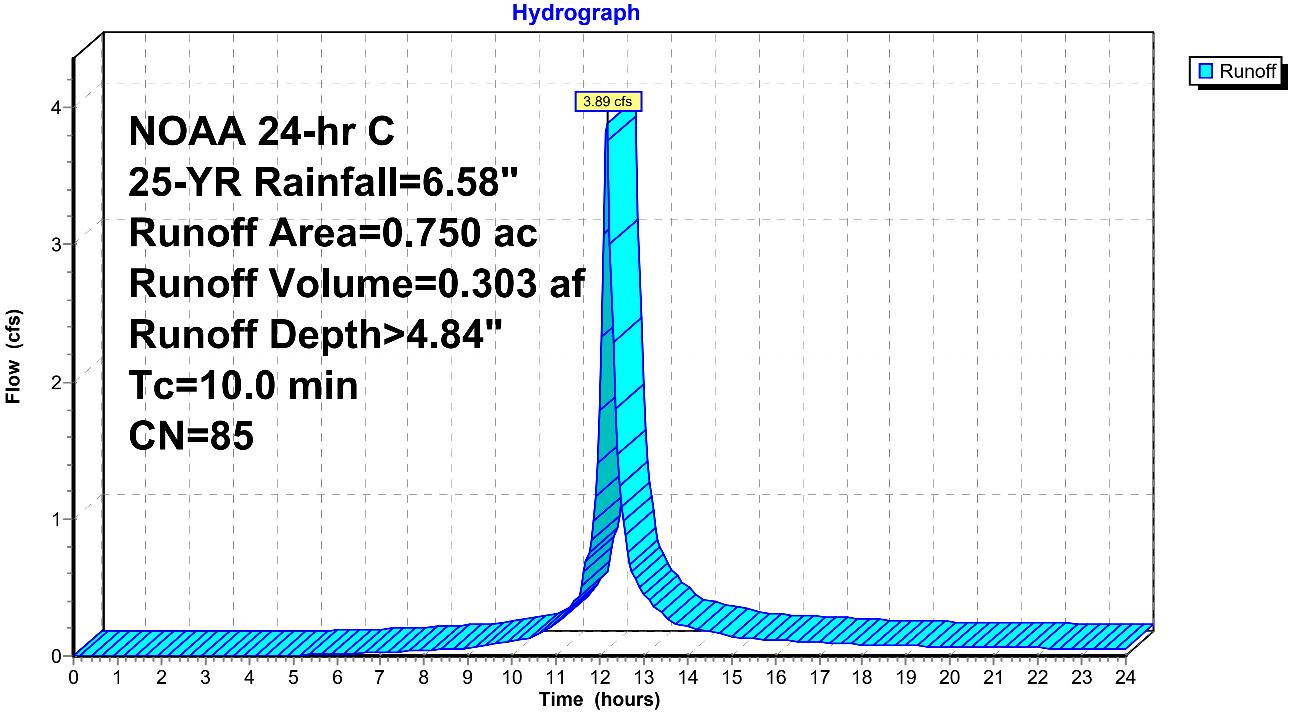
Runoff = 3.89 cfs @ 12.17 hrs, Volume= 0.303 af, Depth> 4.84"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.750	85	Gravel (B)
	0.750		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 10S: PDA-1D (IMP)



Summary for Subcatchment 11S: PDA-1D New Road

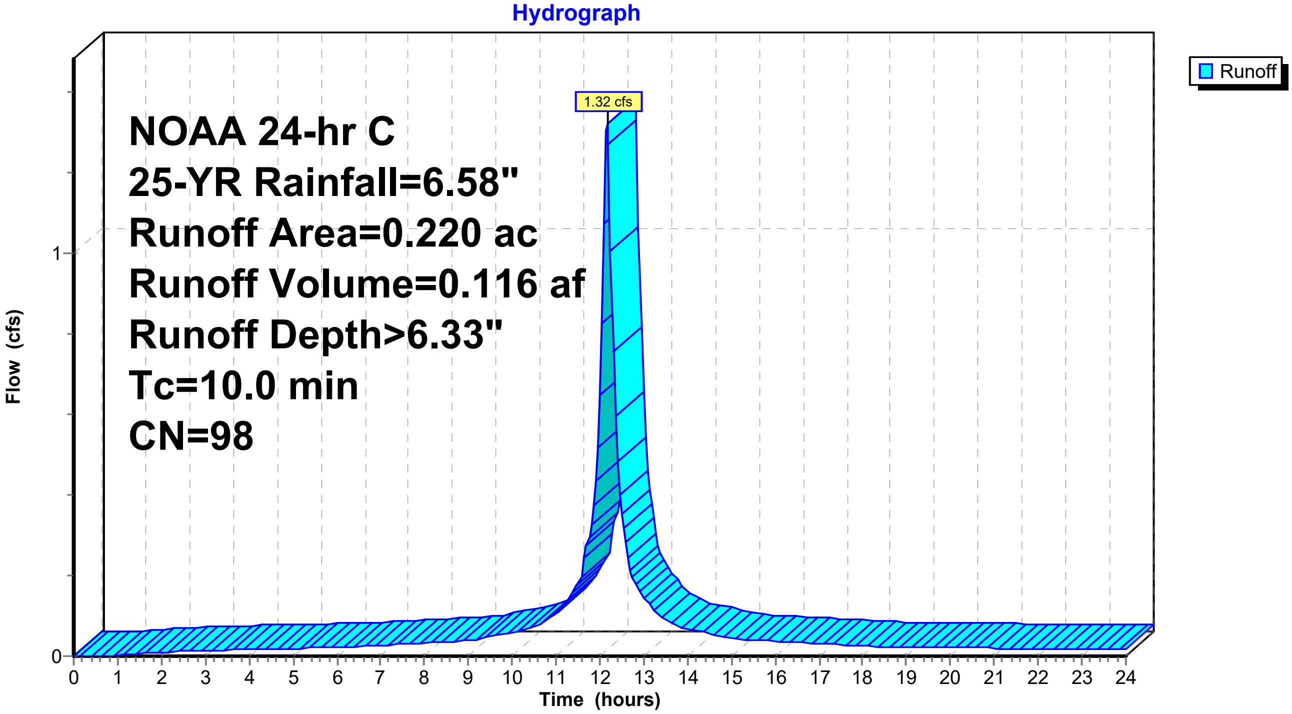
Runoff = 1.32 cfs @ 12.17 hrs, Volume= 0.116 af, Depth> 6.33"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.220	98	New Road
	0.220		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 11S: PDA-1D New Road



Summary for Subcatchment 12S: PDA-1D (PERV)

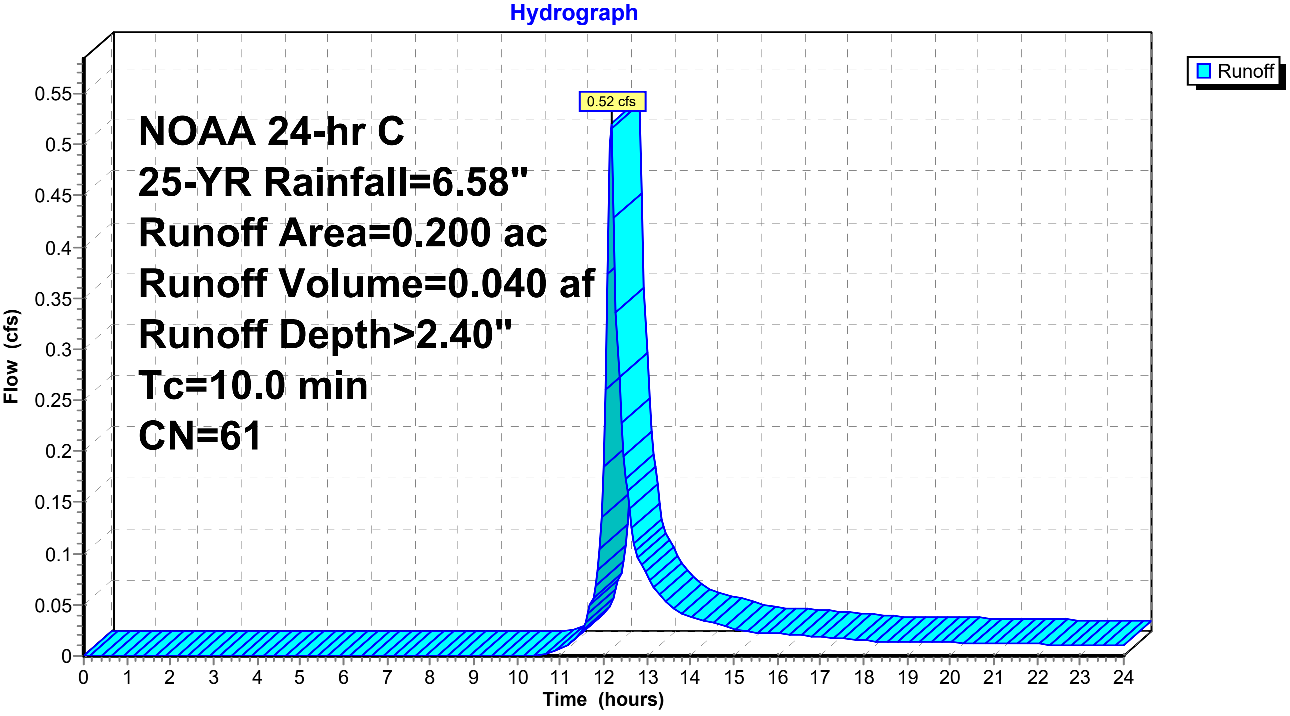
Runoff = 0.52 cfs @ 12.18 hrs, Volume= 0.040 af, Depth> 2.40"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.200	61	Lawn (B)
	0.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 12S: PDA-1D (PERV)



Summary for Subcatchment 13S: PDA-2A (IMP)

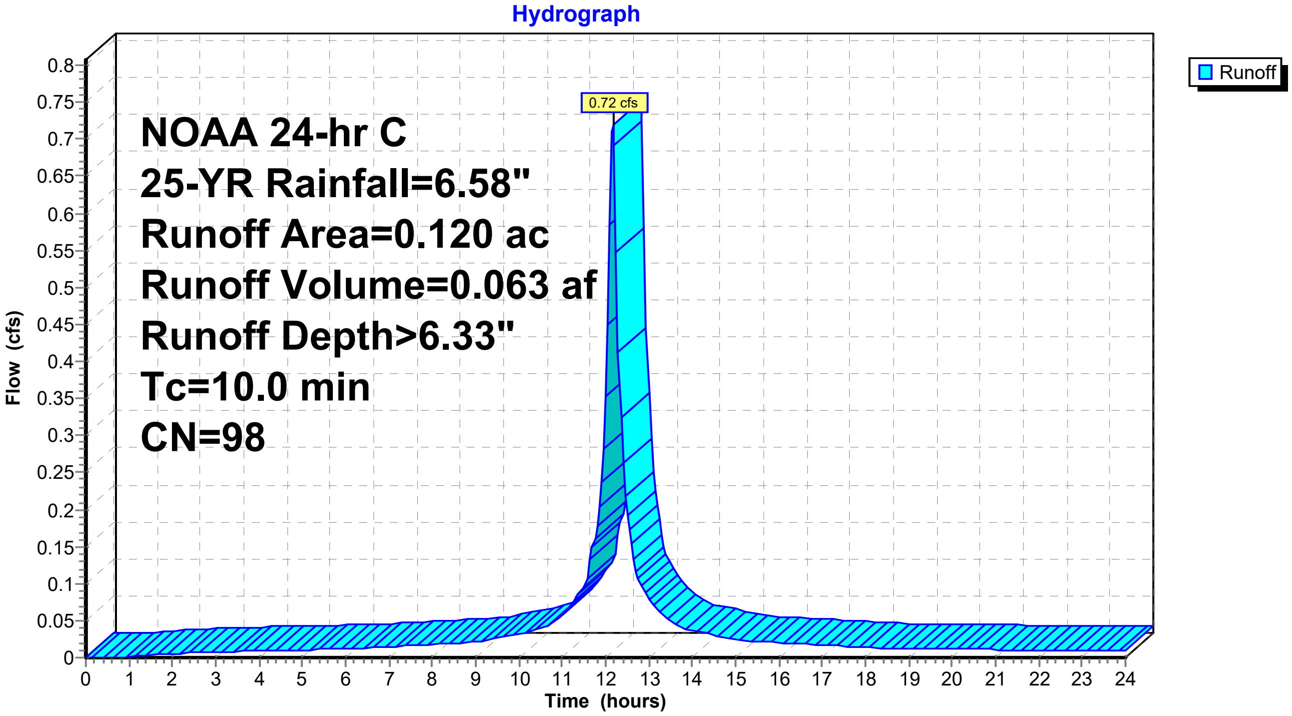
Runoff = 0.72 cfs @ 12.17 hrs, Volume= 0.063 af, Depth> 6.33"
Routed to Link 22L : PDA-2A Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.120	98	Impervious
	0.120		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 13S: PDA-2A (IMP)



Summary for Subcatchment 14S: PDA-2A (PERV)

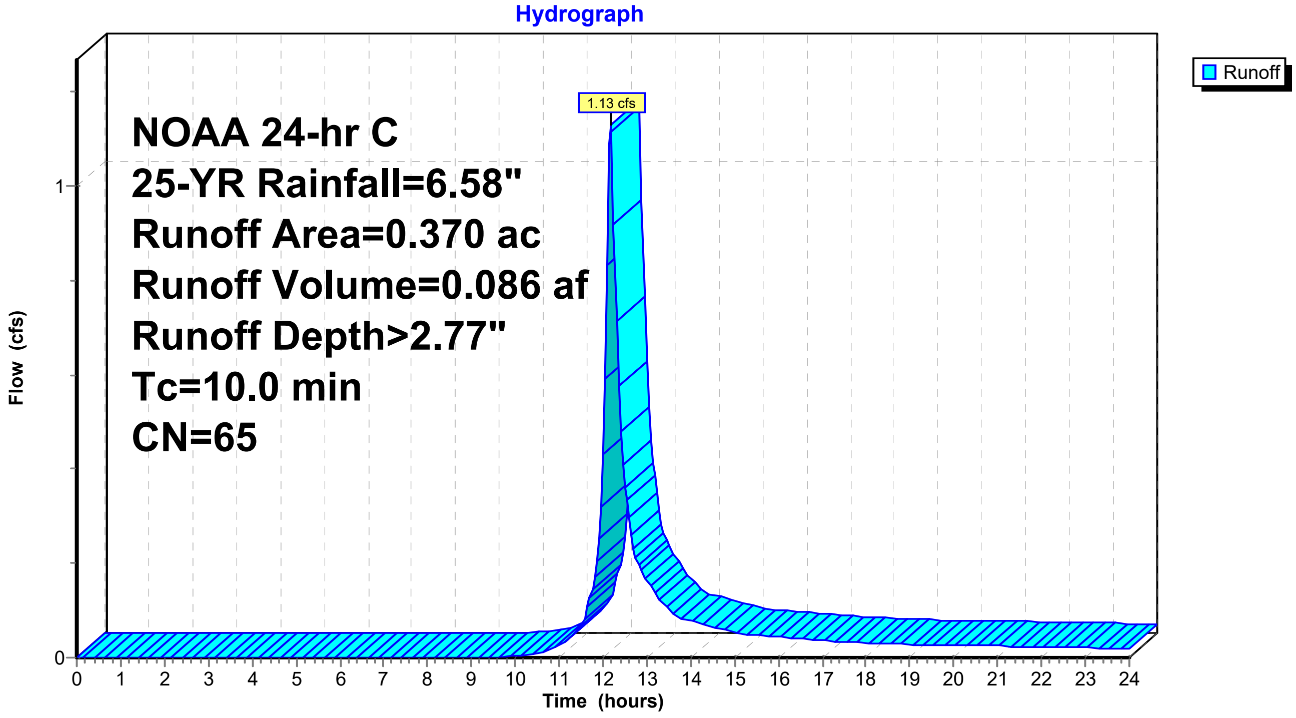
Runoff = 1.13 cfs @ 12.18 hrs, Volume= 0.086 af, Depth> 2.77"
Routed to Link 22L : PDA-2A Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.090	77	Wooded (D)
*	0.280	61	Lawn (B)
	0.370	65	Weighted Average
	0.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 14S: PDA-2A (PERV)



Summary for Subcatchment 15S: PDA-2B (IMP)

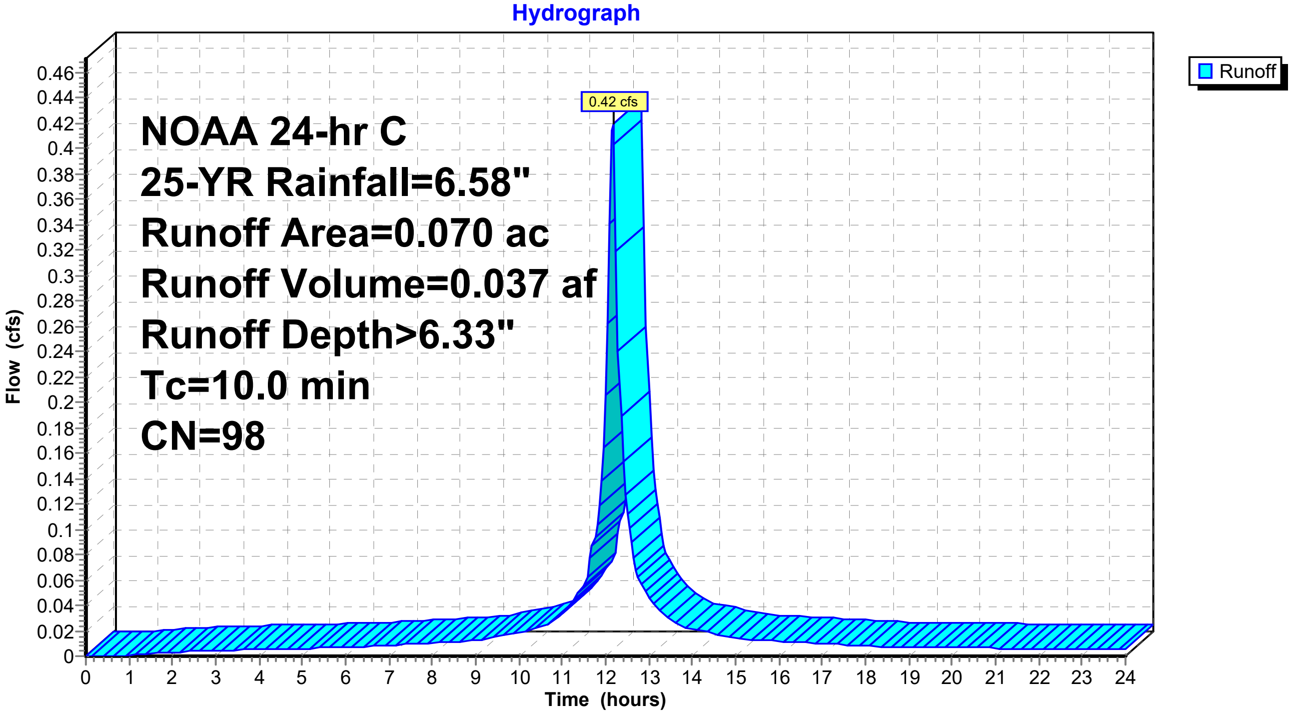
Runoff = 0.42 cfs @ 12.17 hrs, Volume= 0.037 af, Depth> 6.33"
Routed to Link 23L : PDA-2B Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.070	98	Impervious
	0.070		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 15S: PDA-2B (IMP)



Summary for Subcatchment 16S: PDA-2B (PERV)

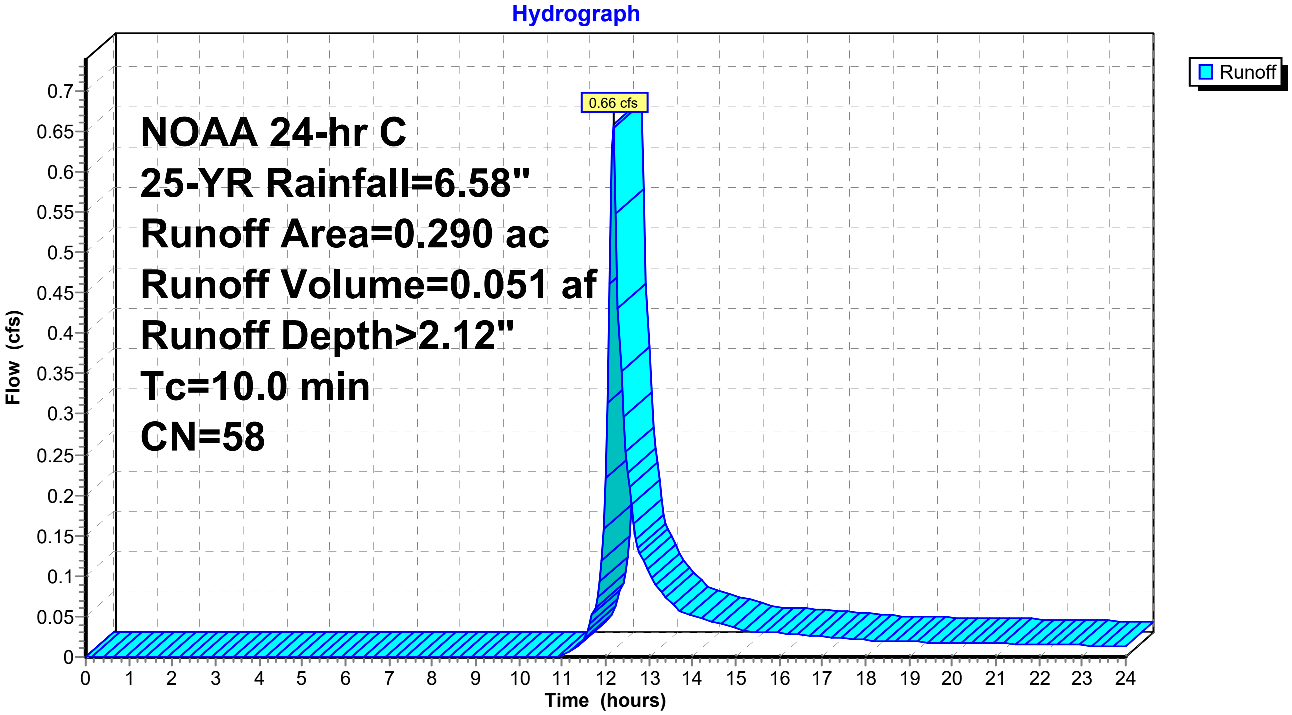
Runoff = 0.66 cfs @ 12.19 hrs, Volume= 0.051 af, Depth> 2.12"
Routed to Link 23L : PDA-2B Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.160	55	Wooded (B)
*	0.130	61	Lawn (B)
	0.290	58	Weighted Average
	0.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 16S: PDA-2B (PERV)



Summary for Subcatchment 17S: PDA-3 (IMP)

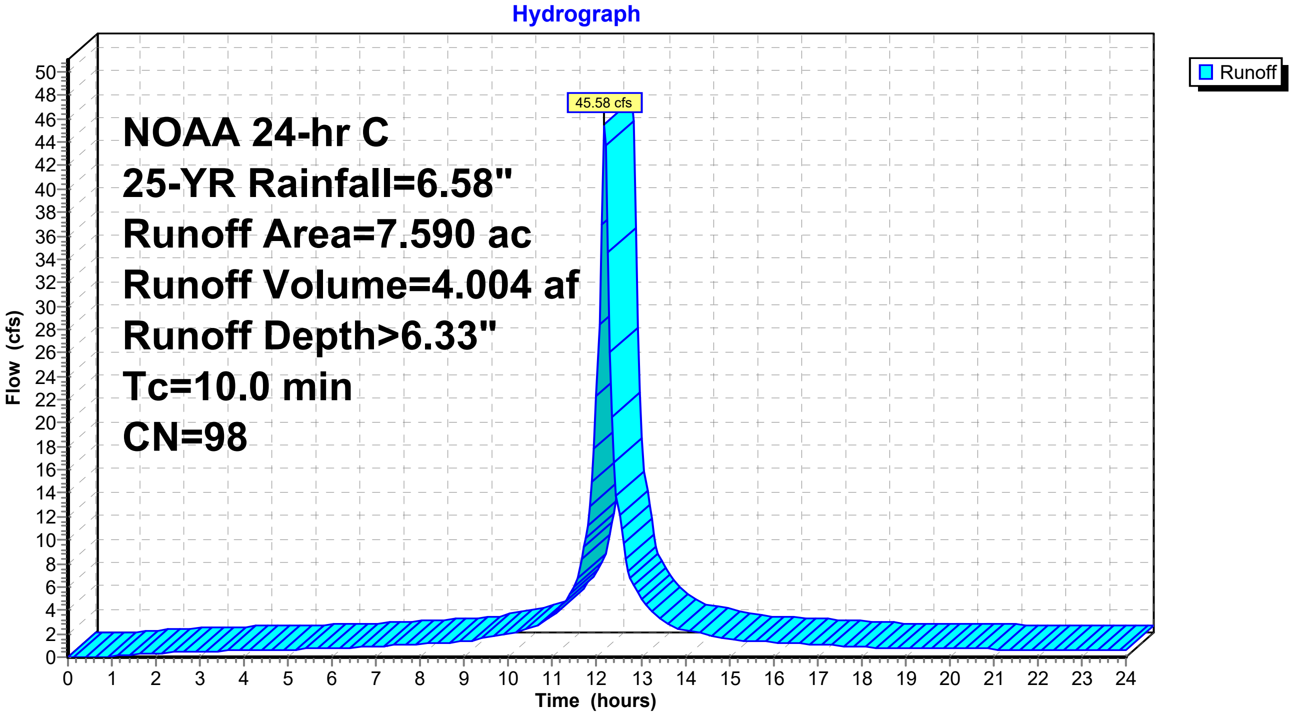
Runoff = 45.58 cfs @ 12.17 hrs, Volume= 4.004 af, Depth> 6.33"
Routed to Link 27L : Total Site Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	7.590	98	Impervious
	7.590		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 17S: PDA-3 (IMP)



Summary for Subcatchment 26S: Sub-Catch to Swale 1 (for Swale Calc Only)

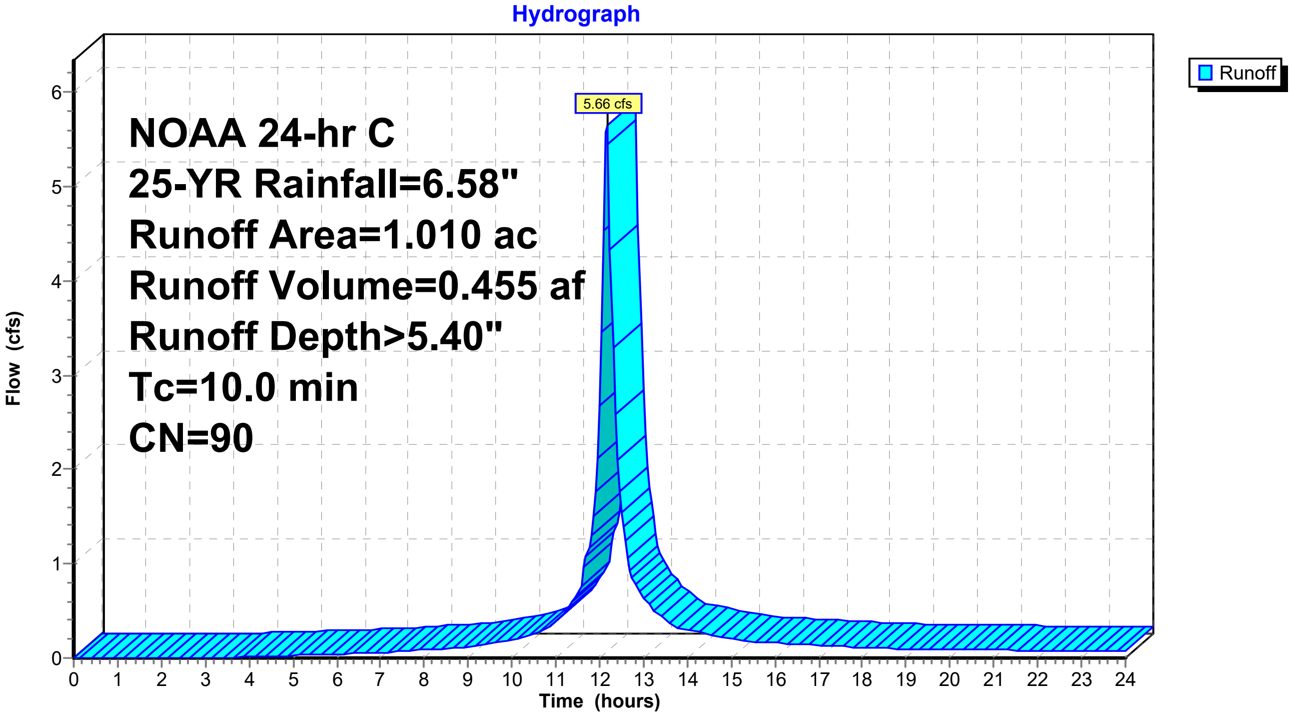
Runoff = 5.66 cfs @ 12.17 hrs, Volume= 0.455 af, Depth> 5.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-YR Rainfall=6.58"

	Area (ac)	CN	Description
*	0.510	85	Gravel
*	0.450	98	Impervious
*	0.050	61	Lawn (B)
	1.010	90	Weighted Average
	0.560		55.45% Pervious Area
	0.450		44.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 26S: Sub-Catch to Swale 1 (for Swale Calc Only)

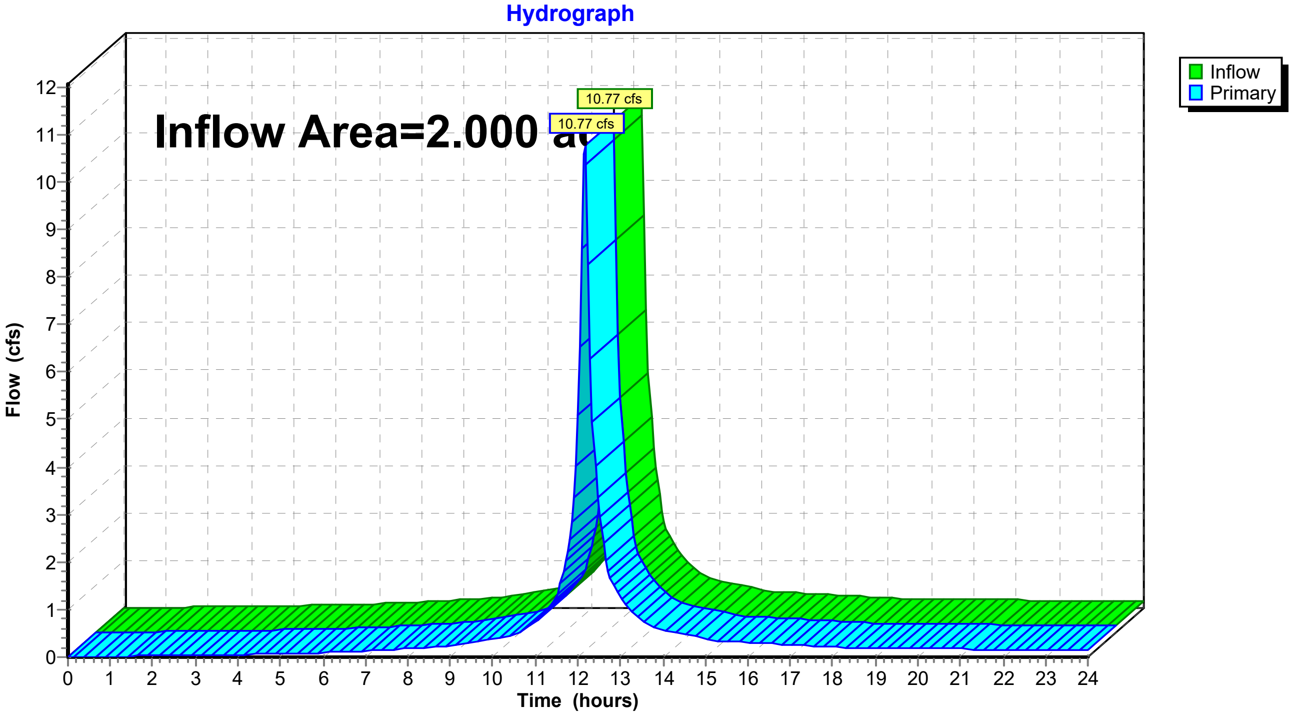


Summary for Link 18L: To WQU-1/Pipe 1 Overflow

Inflow Area = 2.000 ac, 44.50% Impervious, Inflow Depth > 5.29" for 25-YR event
Inflow = 10.77 cfs @ 12.17 hrs, Volume= 0.882 af
Primary = 10.77 cfs @ 12.17 hrs, Volume= 0.882 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 18L: To WQU-1/Pipe 1 Overflow

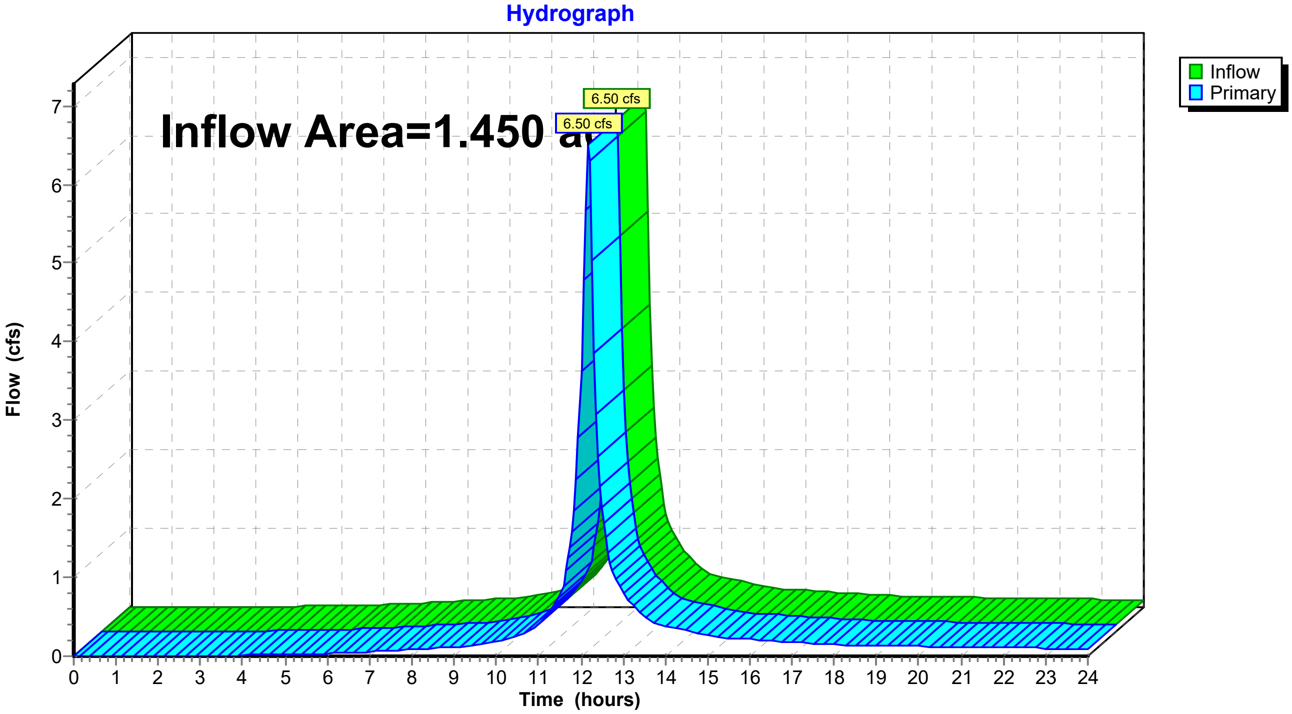


Summary for Link 19L: Swale 2/WQU-2/Pipe 2 Overflow

Inflow Area = 1.450 ac, 13.10% Impervious, Inflow Depth > 4.55" for 25-YR event
Inflow = 6.50 cfs @ 12.17 hrs, Volume= 0.550 af
Primary = 6.50 cfs @ 12.17 hrs, Volume= 0.550 af, Atten= 0%, Lag= 0.0 min
Routed to Link 25L : To Pipe 4 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 19L: Swale 2/WQU-2/Pipe 2 Overflow

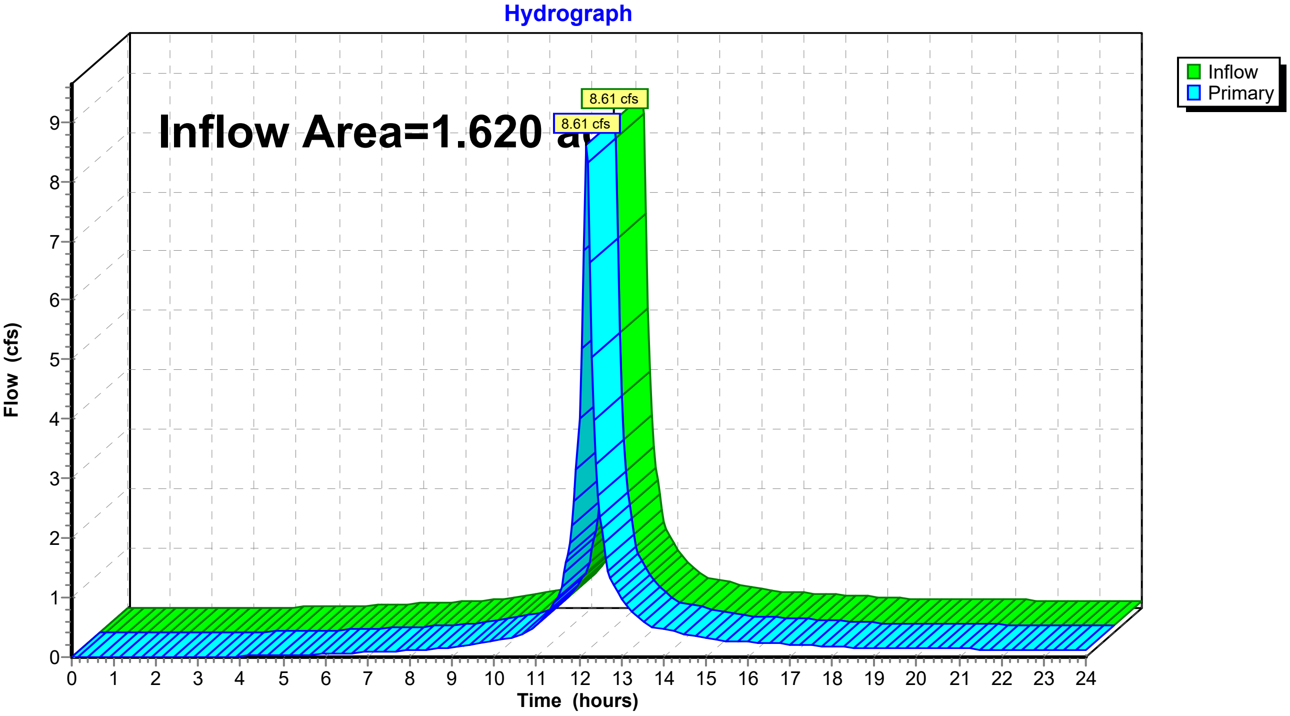


Summary for Link 20L: Swale 3/WQU-3

Inflow Area = 1.620 ac, 20.37% Impervious, Inflow Depth > 5.07" for 25-YR event
Inflow = 8.61 cfs @ 12.17 hrs, Volume= 0.685 af
Primary = 8.61 cfs @ 12.17 hrs, Volume= 0.685 af, Atten= 0%, Lag= 0.0 min
Routed to Link 24L : To Pipe 3 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 20L: Swale 3/WQU-3

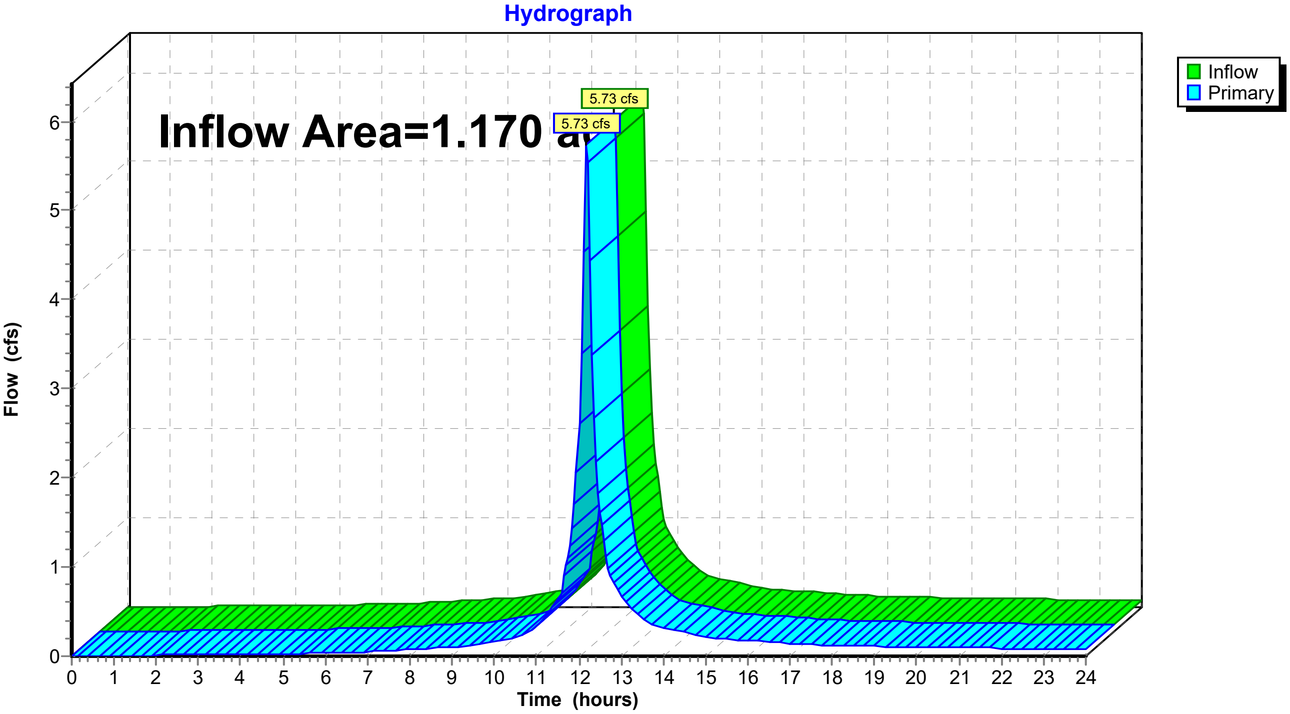


Summary for Link 21L: Swale 4/WQU-4

Inflow Area = 1.170 ac, 18.80% Impervious, Inflow Depth > 4.70" for 25-YR event
Inflow = 5.73 cfs @ 12.17 hrs, Volume= 0.459 af
Primary = 5.73 cfs @ 12.17 hrs, Volume= 0.459 af, Atten= 0%, Lag= 0.0 min
Routed to Link 24L : To Pipe 3 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 21L: Swale 4/WQU-4

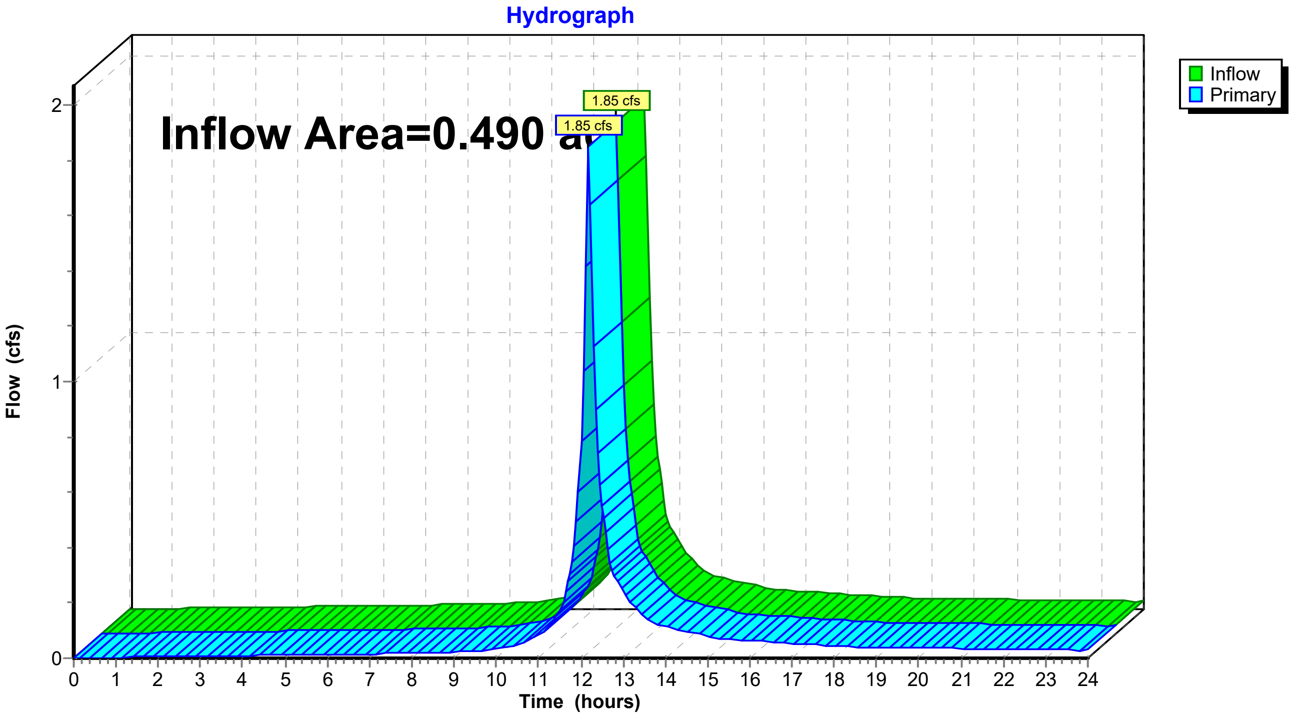


Summary for Link 22L: PDA-2A Total

Inflow Area = 0.490 ac, 24.49% Impervious, Inflow Depth > 3.64" for 25-YR event
Inflow = 1.85 cfs @ 12.18 hrs, Volume= 0.149 af
Primary = 1.85 cfs @ 12.18 hrs, Volume= 0.149 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 22L: PDA-2A Total

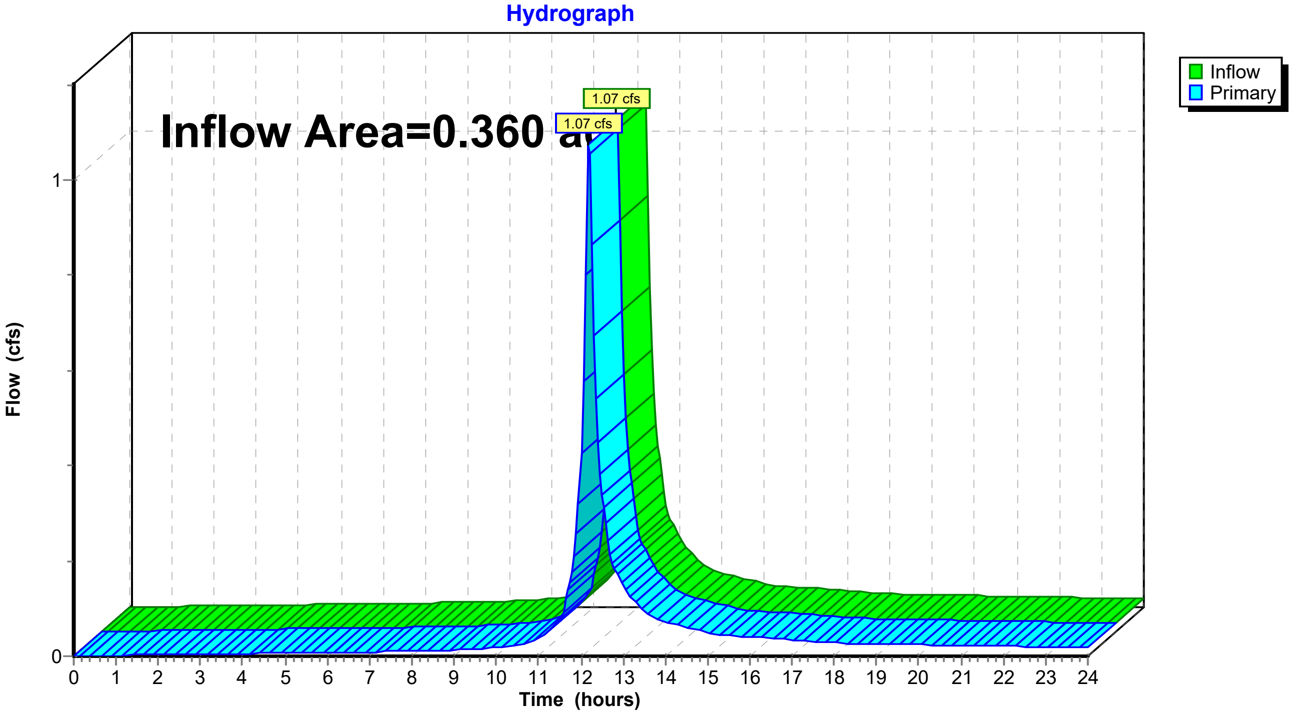


Summary for Link 23L: PDA-2B Total

Inflow Area = 0.360 ac, 19.44% Impervious, Inflow Depth > 2.94" for 25-YR event
Inflow = 1.07 cfs @ 12.18 hrs, Volume= 0.088 af
Primary = 1.07 cfs @ 12.18 hrs, Volume= 0.088 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 23L: PDA-2B Total

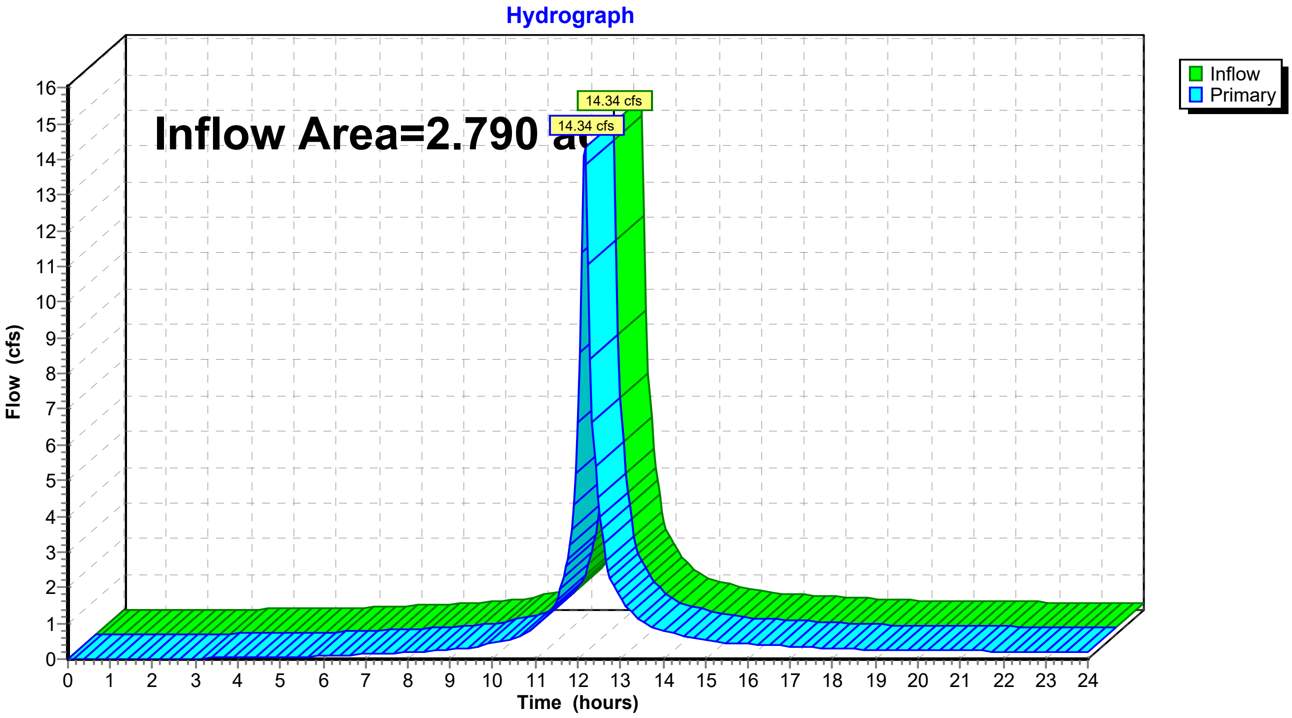


Summary for Link 24L: To Pipe 3 Overflow

Inflow Area = 2.790 ac, 19.71% Impervious, Inflow Depth > 4.92" for 25-YR event
Inflow = 14.34 cfs @ 12.17 hrs, Volume= 1.144 af
Primary = 14.34 cfs @ 12.17 hrs, Volume= 1.144 af, Atten= 0%, Lag= 0.0 min
Routed to Link 25L : To Pipe 4 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 24L: To Pipe 3 Overflow

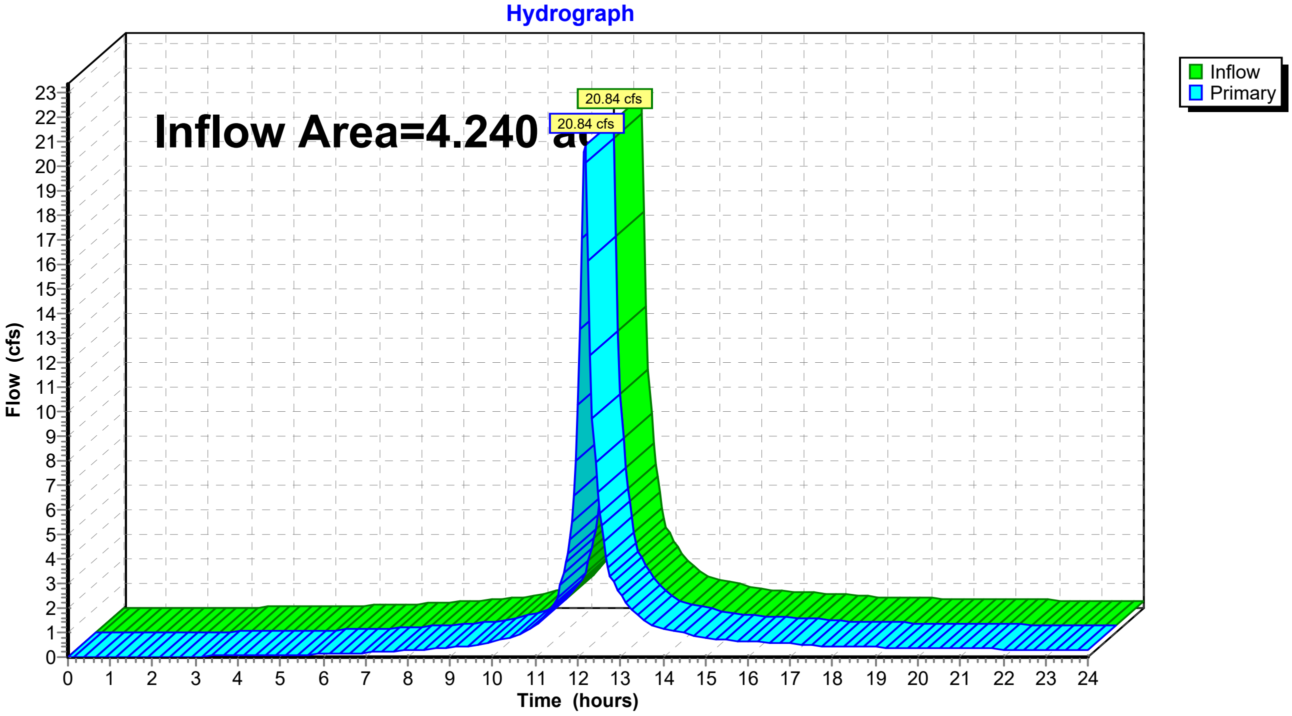


Summary for Link 25L: To Pipe 4 Overflow

Inflow Area = 4.240 ac, 17.45% Impervious, Inflow Depth > 4.79" for 25-YR event
Inflow = 20.84 cfs @ 12.17 hrs, Volume= 1.693 af
Primary = 20.84 cfs @ 12.17 hrs, Volume= 1.693 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 25L: To Pipe 4 Overflow

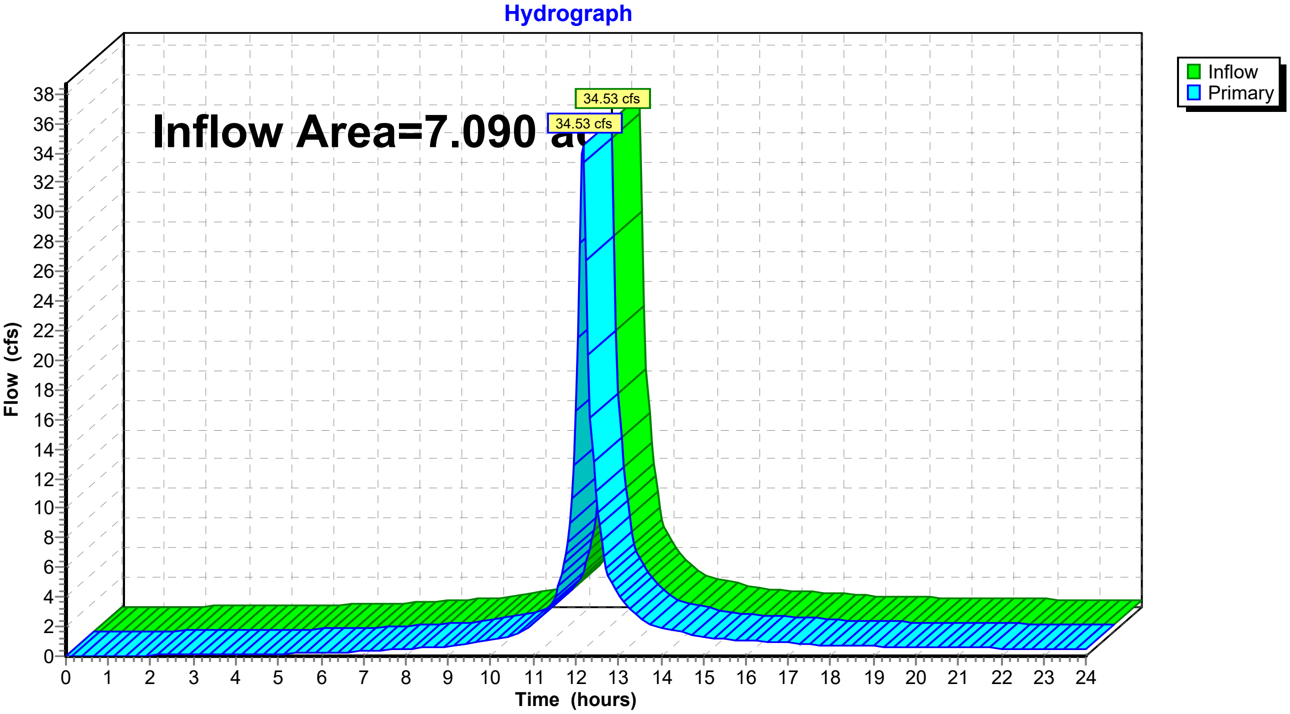


Summary for Link 26L: To Wetlands

Inflow Area = 7.090 ac, 25.67% Impervious, Inflow Depth > 4.76" for 25-YR event
Inflow = 34.53 cfs @ 12.17 hrs, Volume= 2.813 af
Primary = 34.53 cfs @ 12.17 hrs, Volume= 2.813 af, Atten= 0%, Lag= 0.0 min
Routed to Link 27L : Total Site Runoff

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 26L: To Wetlands

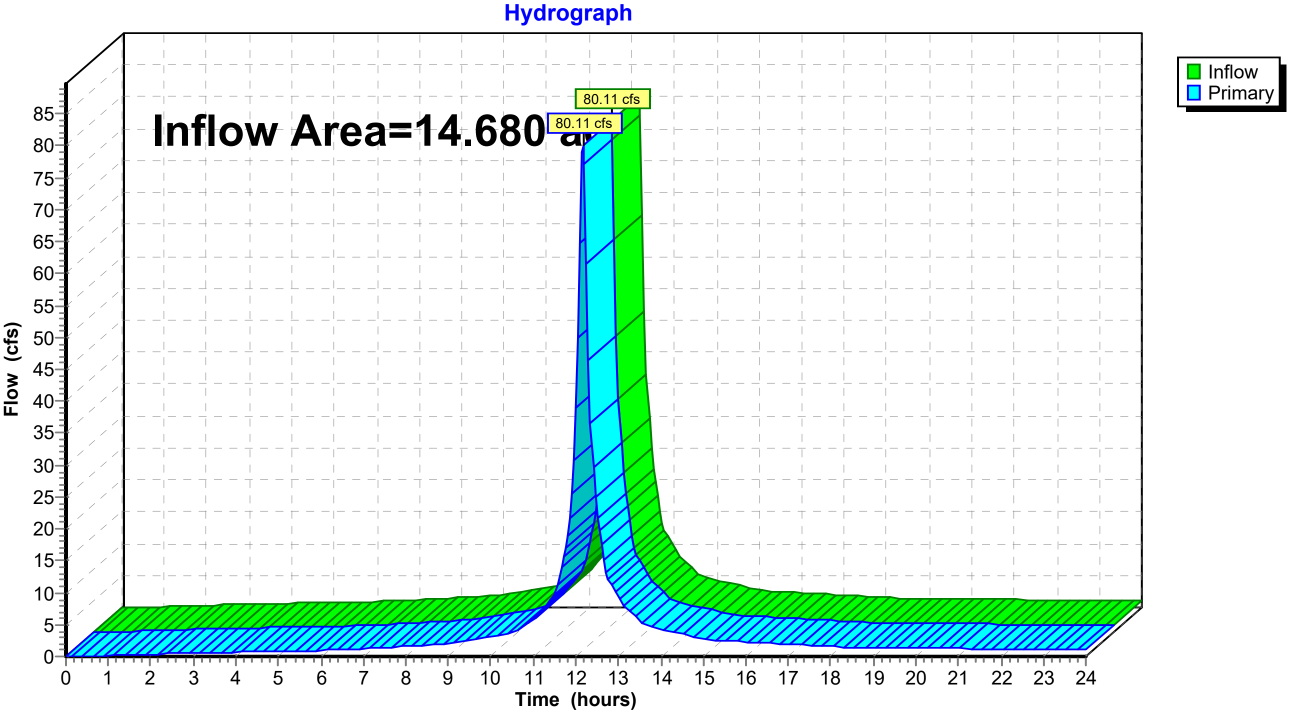


Summary for Link 27L: Total Site Runoff

Inflow Area =	14.680 ac,	64.10% Impervious,	Inflow Depth > 5.57"	for 25-YR event	
Inflow =	80.11 cfs @	12.17 hrs,	Volume=	6.817 af	
Primary =	80.11 cfs @	12.17 hrs,	Volume=	6.817 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 27L: Total Site Runoff



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                       Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
                       Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
               Reach routing by Stor-Ind method  -  Pond routing by Stor-Ind method

Subcatchment1S: PDA-1A(IMP)          Runoff Area=1.250 ac  24.00% Impervious  Runoff Depth>7.59"
                                                  Tc=10.0 min  CN=88  Runoff=9.77 cfs  0.791 af

Subcatchment2S: PDA-1A New Road     Runoff Area=0.590 ac  100.00% Impervious  Runoff Depth>8.81"
                                                  Tc=10.0 min  CN=98  Runoff=4.89 cfs  0.433 af

Subcatchment3S: PDA-1A(PERV)          Runoff Area=0.160 ac  0.00% Impervious  Runoff Depth>4.26"
                                                  Tc=10.0 min  CN=61  Runoff=0.75 cfs  0.057 af

Subcatchment4S: PDA-1B (IMP)          Runoff Area=0.990 ac  4.04% Impervious  Runoff Depth>7.35"
                                                  Tc=10.0 min  CN=86  Runoff=7.59 cfs  0.606 af

Subcatchment5S: PDA-1B New Road     Runoff Area=0.150 ac  100.00% Impervious  Runoff Depth>8.81"
                                                  Tc=10.0 min  CN=98  Runoff=1.24 cfs  0.110 af

Subcatchment6S: PDA-1B (PERV)          Runoff Area=0.310 ac  0.00% Impervious  Runoff Depth>4.27"
                                                   Tc=0.0 min  CN=61  Runoff=1.94 cfs  0.110 af

Subcatchment7S: PDA-1C (IMP)         Runoff Area=1.390 ac  12.23% Impervious  Runoff Depth>7.47"
                                                Tc=10.0 min  CN=87  Runoff=10.76 cfs  0.865 af

Subcatchment8S: PDA-1C New Road     Runoff Area=0.160 ac  100.00% Impervious  Runoff Depth>8.81"
                                                  Tc=10.0 min  CN=98  Runoff=1.33 cfs  0.117 af

Subcatchment9S: PDA-1C (PERV)          Runoff Area=0.070 ac  0.00% Impervious  Runoff Depth>4.26"
                                                  Tc=10.0 min  CN=61  Runoff=0.33 cfs  0.025 af

Subcatchment10S: PDA-1D (IMP)          Runoff Area=0.750 ac  0.00% Impervious  Runoff Depth>7.23"
                                                  Tc=10.0 min  CN=85  Runoff=5.68 cfs  0.452 af

Subcatchment11S: PDA-1D New Road    Runoff Area=0.220 ac  100.00% Impervious  Runoff Depth>8.81"
                                                  Tc=10.0 min  CN=98  Runoff=1.82 cfs  0.161 af

Subcatchment12S: PDA-1D (PERV)         Runoff Area=0.200 ac  0.00% Impervious  Runoff Depth>4.26"
                                                  Tc=10.0 min  CN=61  Runoff=0.94 cfs  0.071 af

Subcatchment13S: PDA-2A(IMP)        Runoff Area=0.120 ac  100.00% Impervious  Runoff Depth>8.81"
                                                  Tc=10.0 min  CN=98  Runoff=0.99 cfs  0.088 af

Subcatchment14S: PDA-2A(PERV)          Runoff Area=0.370 ac  0.00% Impervious  Runoff Depth>4.76"
                                                  Tc=10.0 min  CN=65  Runoff=1.95 cfs  0.147 af

Subcatchment15S: PDA-2B (IMP)       Runoff Area=0.070 ac  100.00% Impervious  Runoff Depth>8.81"
                                                  Tc=10.0 min  CN=98  Runoff=0.58 cfs  0.051 af

Subcatchment16S: PDA-2B (PERV)         Runoff Area=0.290 ac  0.00% Impervious  Runoff Depth>3.89"
                                                  Tc=10.0 min  CN=58  Runoff=1.24 cfs  0.094 af
```

Subcatchment17S: PDA-3 (IMP)	Runoff Area=7.590 ac 100.00% Impervious Runoff Depth>8.81" Tc=10.0 min CN=98 Runoff=62.86 cfs 5.570 af
Subcatchment26S: Sub-Catch to Swale 1	Runoff Area=1.010 ac 44.55% Impervious Runoff Depth>7.84" Tc=10.0 min CN=90 Runoff=8.03 cfs 0.660 af
Link 18L: To WQU-1/Pipe 1 Overflow	Inflow=15.41 cfs 1.281 af Primary=15.41 cfs 1.281 af
Link 19L: Swale 2/WQU-2/Pipe 2 Overflow	Inflow=9.47 cfs 0.827 af Primary=9.47 cfs 0.827 af
Link 20L: Swale 3/WQU-3	Inflow=12.42 cfs 1.008 af Primary=12.42 cfs 1.008 af
Link 21L: Swale 4/WQU-4	Inflow=8.45 cfs 0.684 af Primary=8.45 cfs 0.684 af
Link 22L: PDA-2A Total	Inflow=2.95 cfs 0.235 af Primary=2.95 cfs 0.235 af
Link 23L: PDA-2B Total	Inflow=1.82 cfs 0.145 af Primary=1.82 cfs 0.145 af
Link 24L: To Pipe 3 Overflow	Inflow=20.86 cfs 1.692 af Primary=20.86 cfs 1.692 af
Link 25L: To Pipe 4 Overflow	Inflow=30.33 cfs 2.518 af Primary=30.33 cfs 2.518 af
Link 26L: To Wetlands	Inflow=50.50 cfs 4.179 af Primary=50.50 cfs 4.179 af
Link 27L: Total Site Runoff	Inflow=113.36 cfs 9.749 af Primary=113.36 cfs 9.749 af

Total Runoff Area = 15.690 ac Runoff Volume = 10.408 af Average Runoff Depth = 7.96"
37.16% Pervious = 5.830 ac 62.84% Impervious = 9.860 ac

Summary for Subcatchment 1S: PDA-1A (IMP)

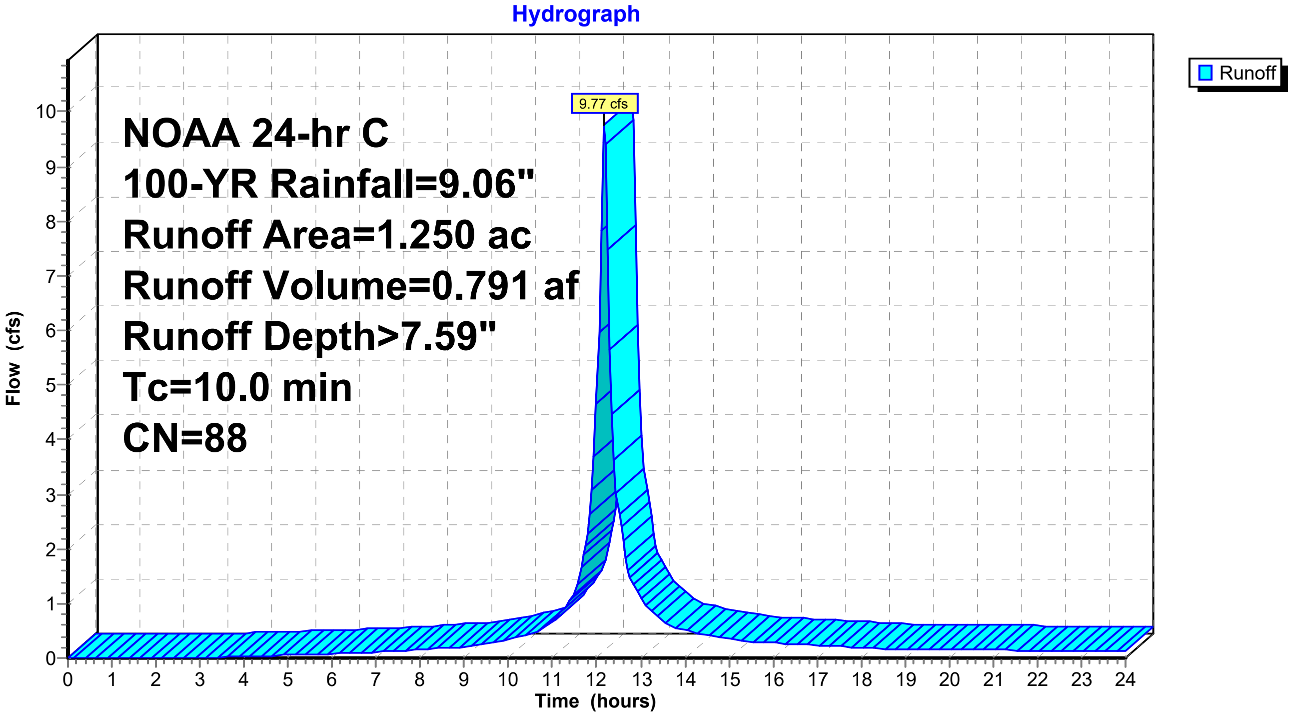
Runoff = 9.77 cfs @ 12.17 hrs, Volume= 0.791 af, Depth> 7.59"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.950	85	Gravel (B)
*	0.300	98	Impervious
	1.250	88	Weighted Average
	0.950		76.00% Pervious Area
	0.300		24.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 1S: PDA-1A (IMP)



Summary for Subcatchment 2S: PDA-1A New Road

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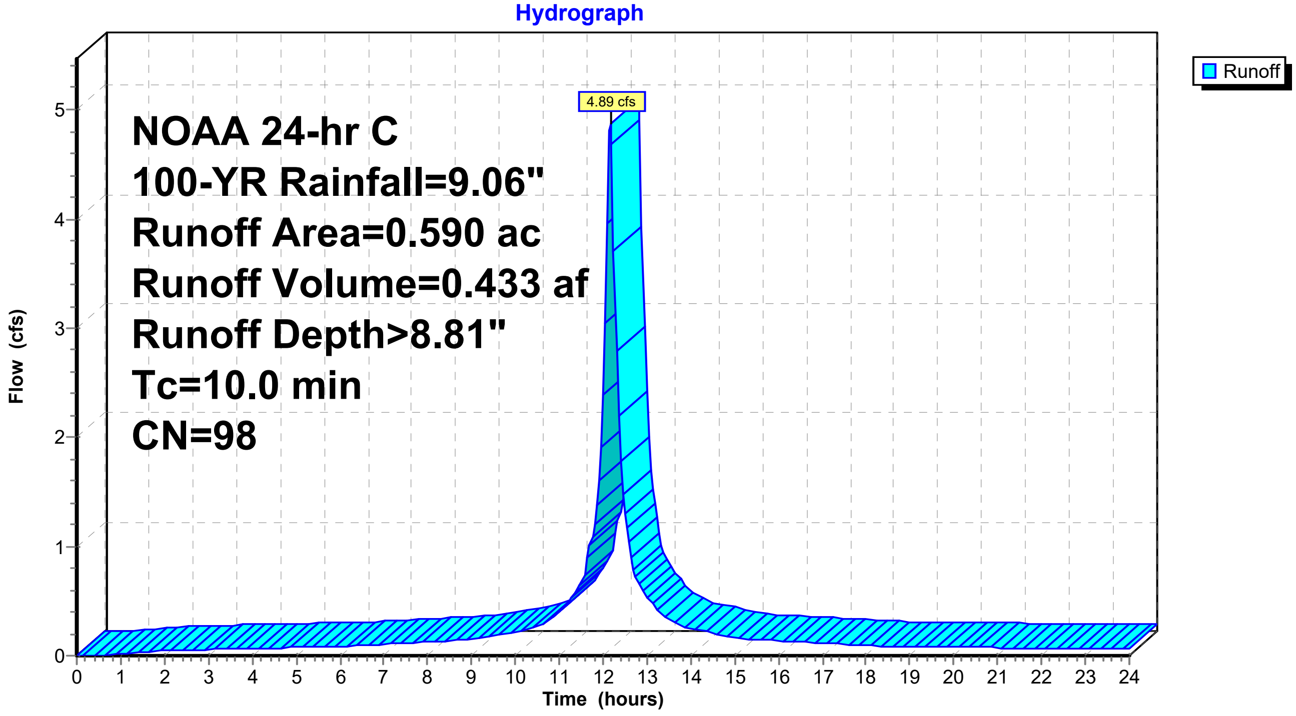
Runoff      =        4.89 cfs @   12.17 hrs,  Volume=          0.433 af,  Depth>  8.81"
    Routed to Link 18L : To WQU-1/Pipe 1 Overflow
```

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.590	98	New Road
	0.590		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 2S: PDA-1A New Road



Summary for Subcatchment 3S: PDA-1A (PERV)

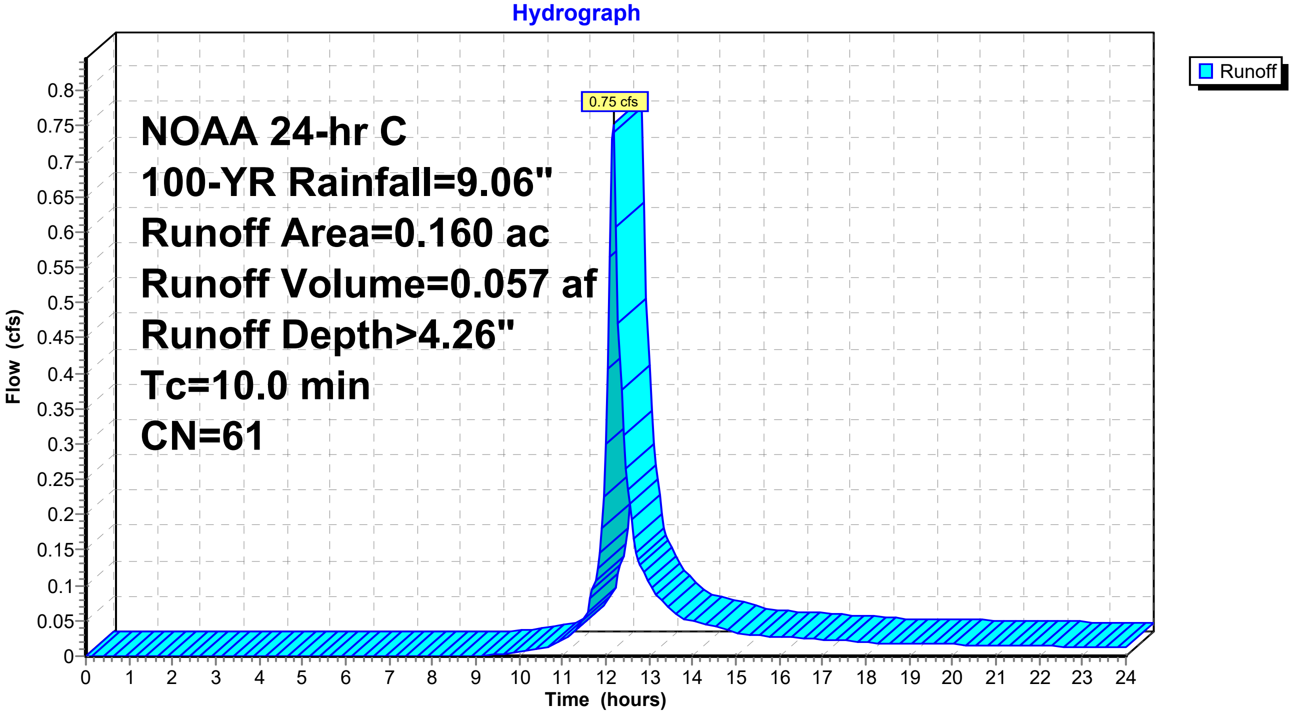
Runoff = 0.75 cfs @ 12.18 hrs, Volume= 0.057 af, Depth> 4.26"
Routed to Link 18L : To WQU-1/Pipe 1 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.160	61	Lawn (B)
	0.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 3S: PDA-1A (PERV)



Summary for Subcatchment 4S: PDA-1B (IMP)

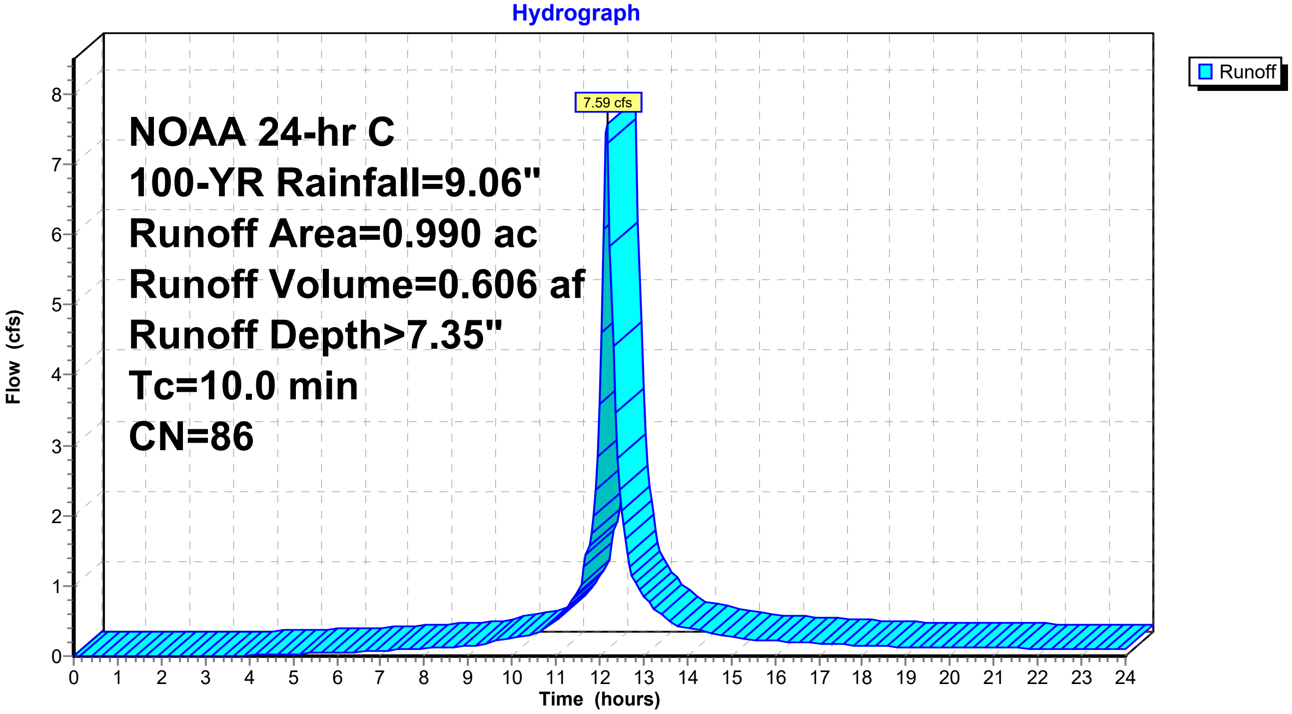
Runoff = 7.59 cfs @ 12.17 hrs, Volume= 0.606 af, Depth> 7.35"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.950	85	Gravel (B)
*	0.040	98	Impervious
	0.990	86	Weighted Average
	0.950		95.96% Pervious Area
	0.040		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 4S: PDA-1B (IMP)



Summary for Subcatchment 5S: PDA-1B New Road

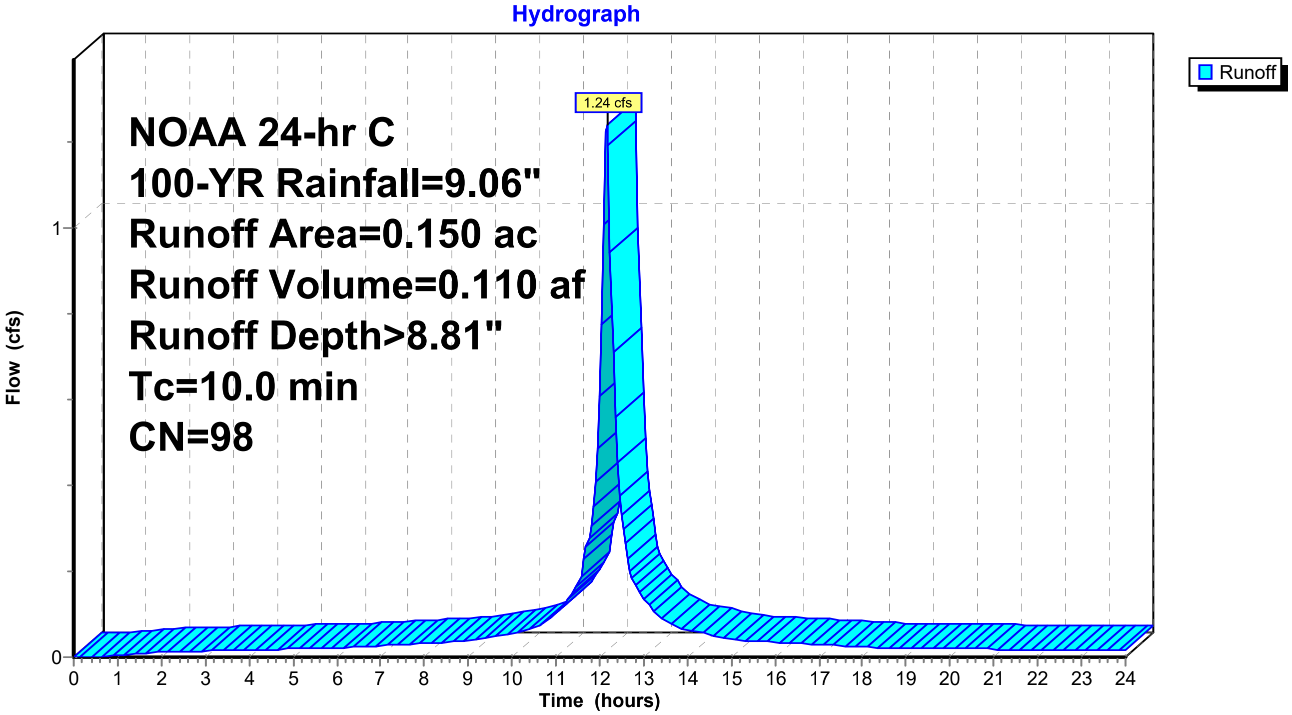
Runoff = 1.24 cfs @ 12.17 hrs, Volume= 0.110 af, Depth> 8.81"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.150	98	New Road
	0.150		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 5S: PDA-1B New Road



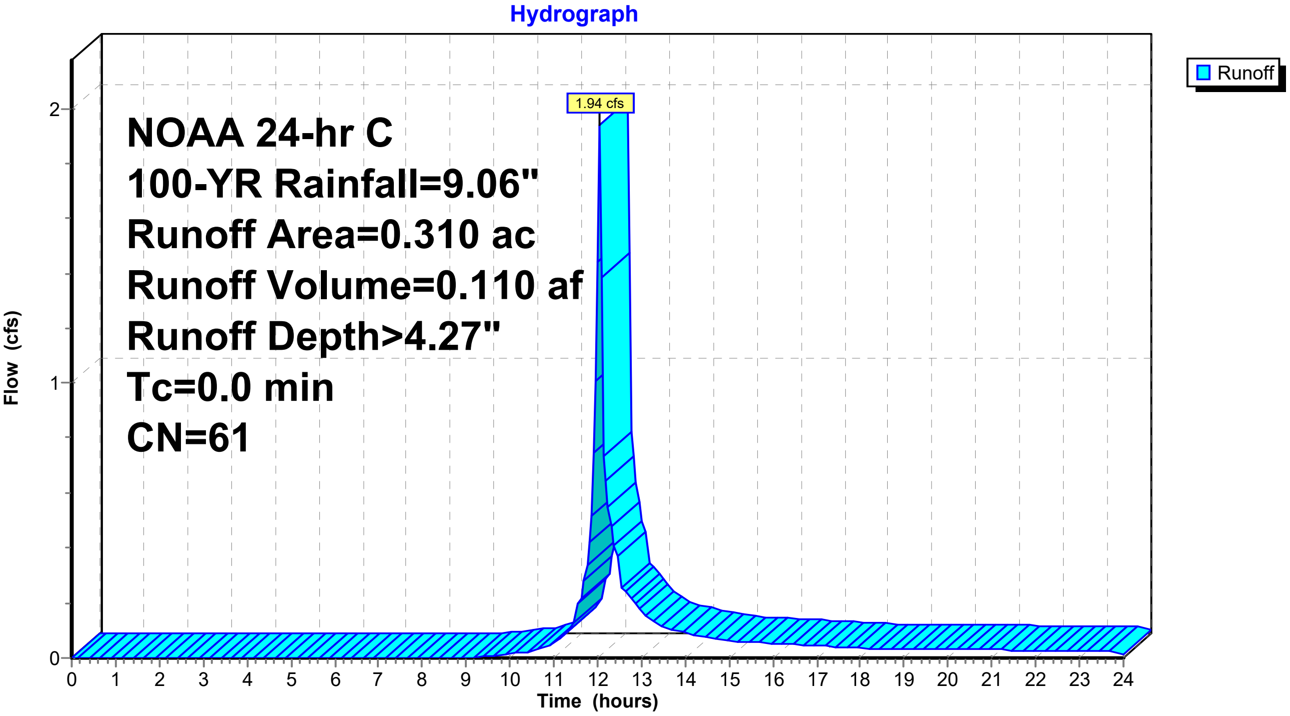
Summary for Subcatchment 6S: PDA-1B (PERV)

Runoff = 1.94 cfs @ 12.05 hrs, Volume= 0.110 af, Depth> 4.27"
Routed to Link 19L : Swale 2/WQU-2/Pipe 2 Overflow

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.310	61	Lawn (B)
	0.310		100.00% Pervious Area

Subcatchment 6S: PDA-1B (PERV)



Summary for Subcatchment 7S: PDA-1C (IMP)

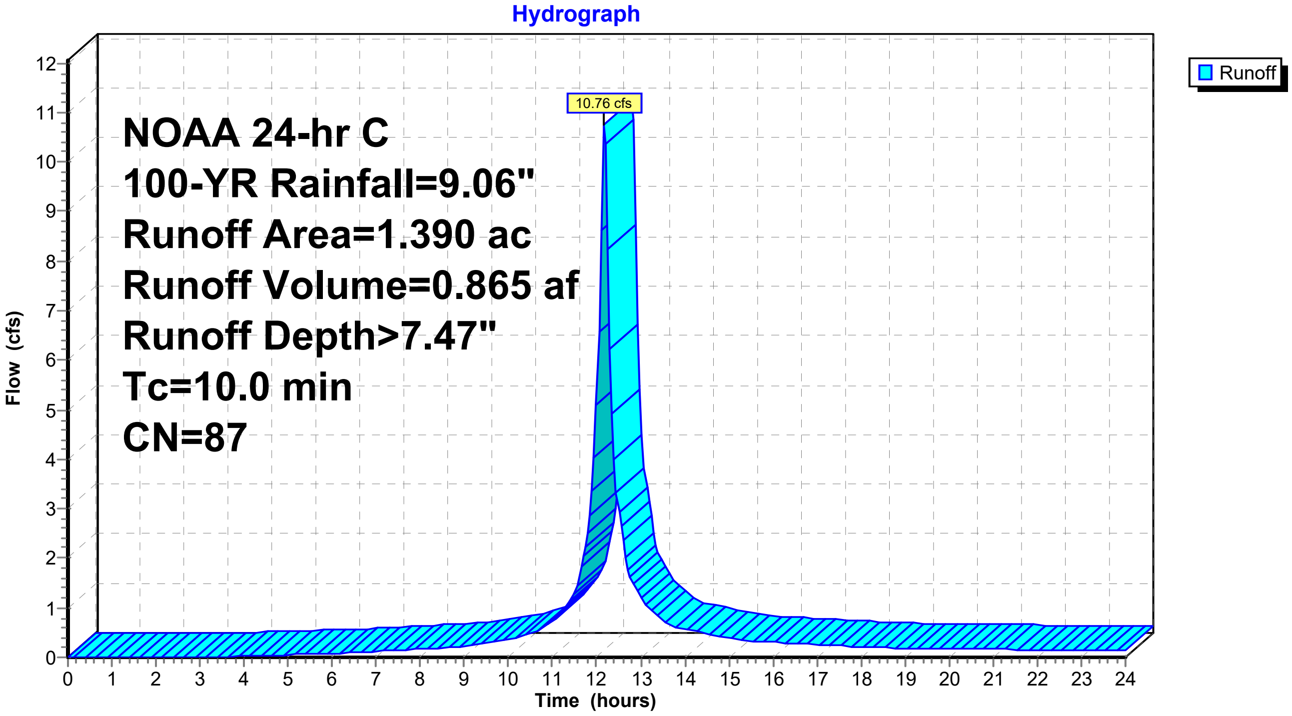
Runoff = 10.76 cfs @ 12.17 hrs, Volume= 0.865 af, Depth> 7.47"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	1.220	85	Gravel (B)
*	0.010	98	Impervious
*	0.160	98	New Roads
	1.390	87	Weighted Average
	1.220		87.77% Pervious Area
	0.170		12.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 7S: PDA-1C (IMP)



Summary for Subcatchment 8S: PDA-1C New Road

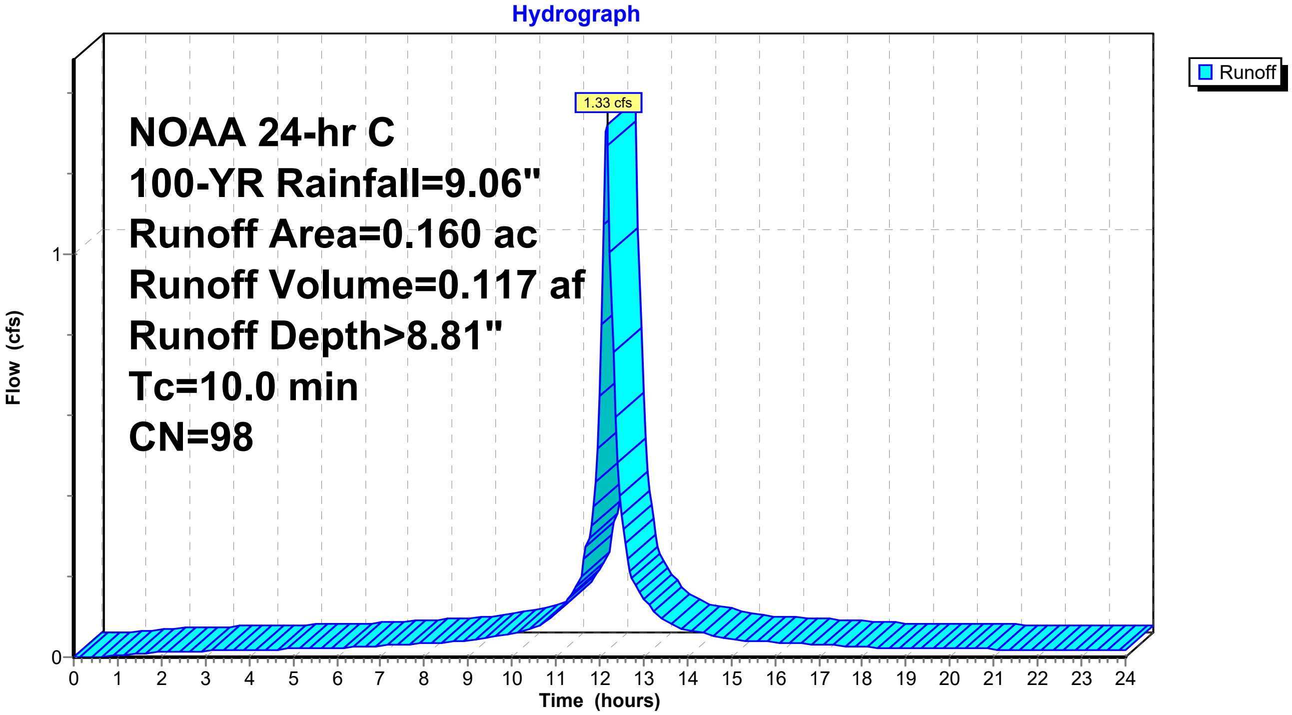
Runoff = 1.33 cfs @ 12.17 hrs, Volume= 0.117 af, Depth> 8.81"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.160	98	New Road
	0.160		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 8S: PDA-1C New Road



Summary for Subcatchment 9S: PDA-1C (PERV)

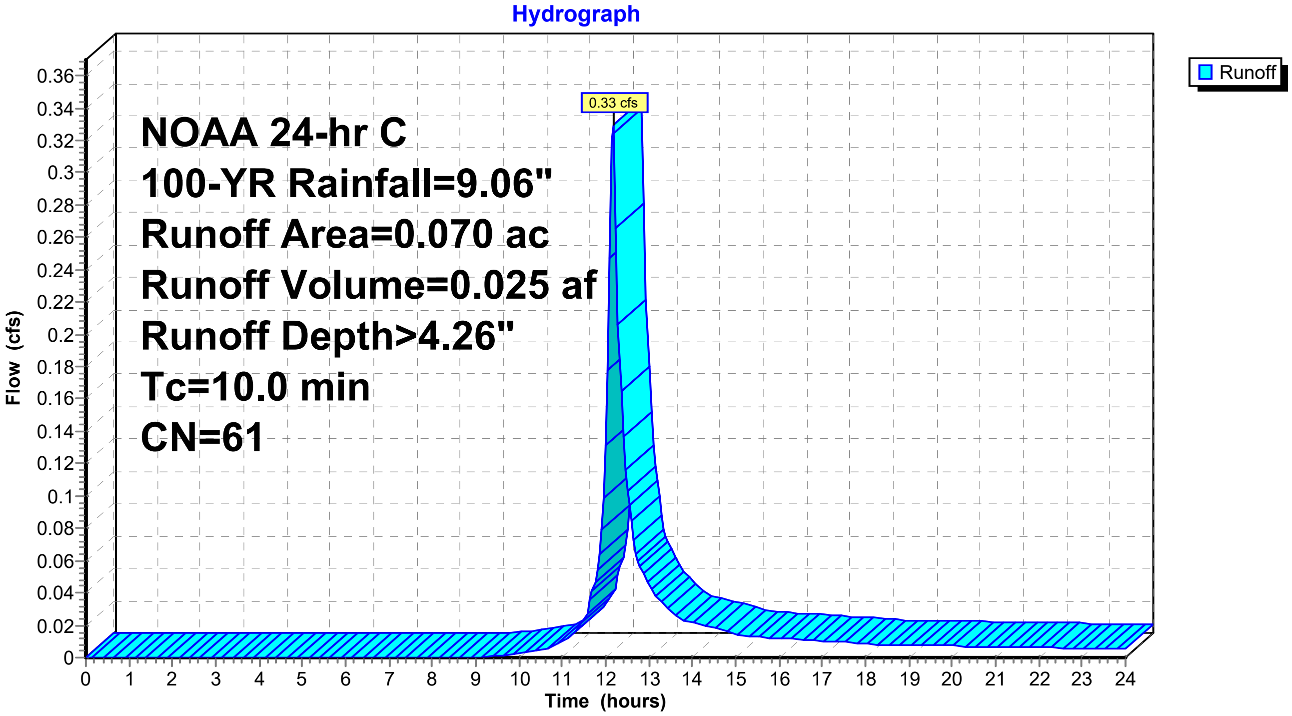
Runoff = 0.33 cfs @ 12.18 hrs, Volume= 0.025 af, Depth> 4.26"
Routed to Link 20L : Swale 3/WQU-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.070	61	Lawn (B)
	0.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 9S: PDA-1C (PERV)



Summary for Subcatchment 10S: PDA-1D (IMP)

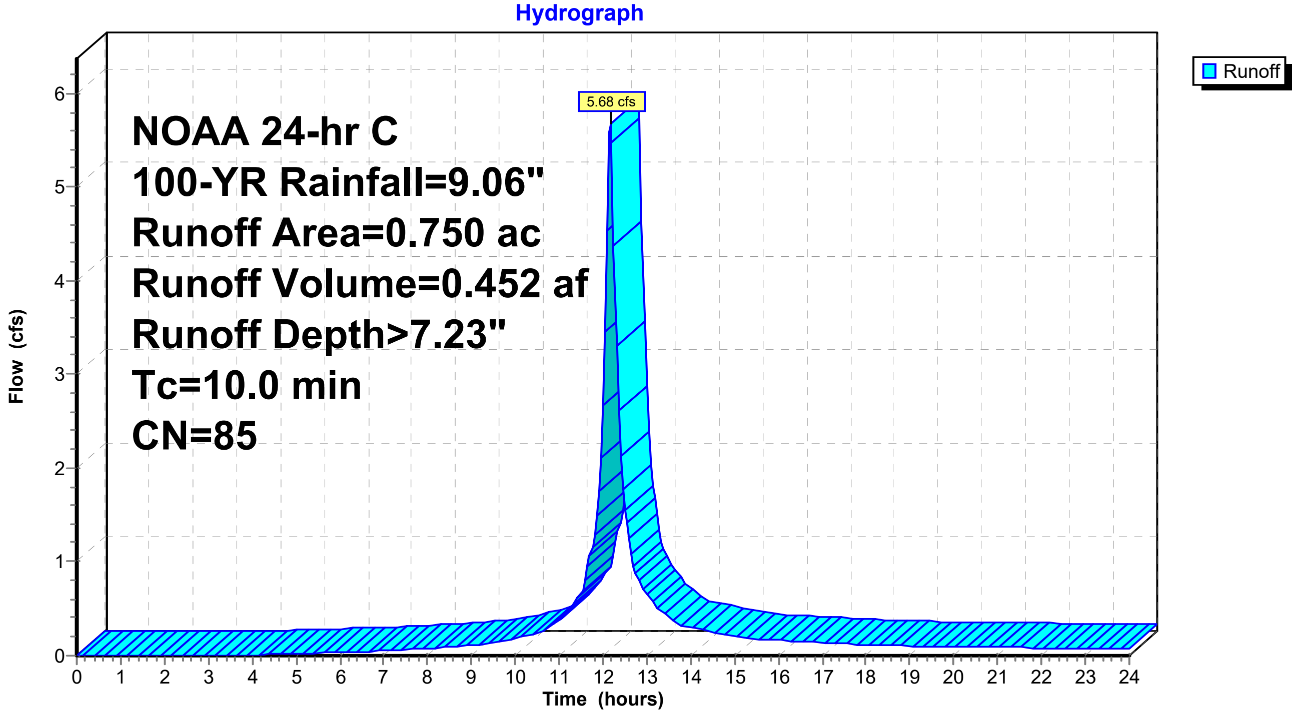
Runoff = 5.68 cfs @ 12.17 hrs, Volume= 0.452 af, Depth> 7.23"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.750	85	Gravel (B)
	0.750		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 10S: PDA-1D (IMP)



Summary for Subcatchment 11S: PDA-1D New Road

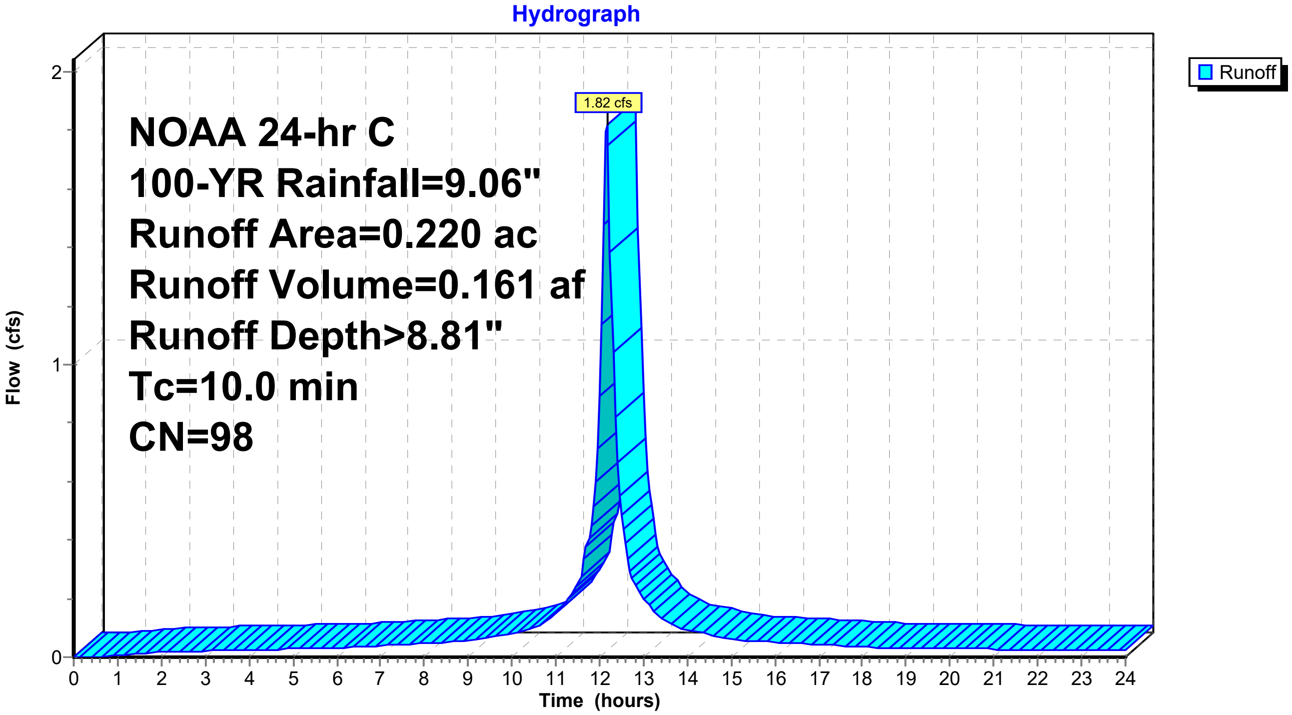
Runoff = 1.82 cfs @ 12.17 hrs, Volume= 0.161 af, Depth> 8.81"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.220	98	New Road
	0.220		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 11S: PDA-1D New Road



Summary for Subcatchment 12S: PDA-1D (PERV)

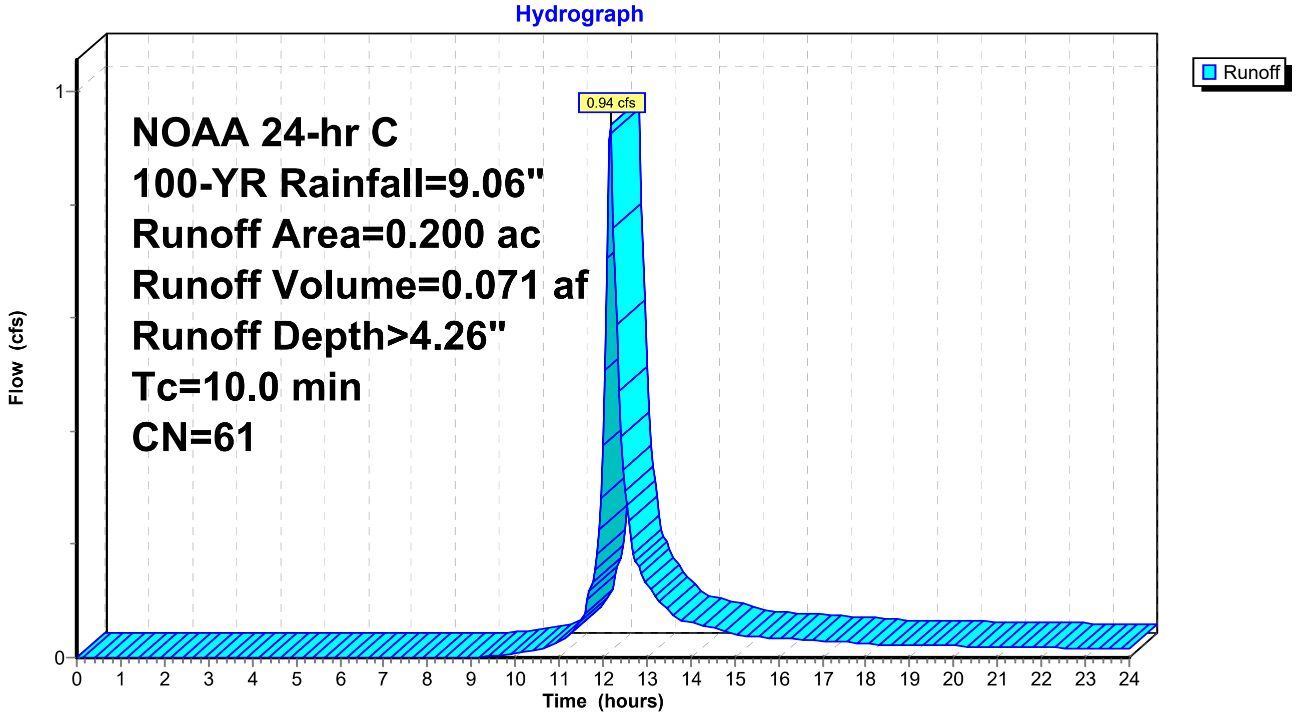
Runoff = 0.94 cfs @ 12.18 hrs, Volume= 0.071 af, Depth> 4.26"
Routed to Link 21L : Swale 4/WQU-4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.200	61	Lawn (B)
	0.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 12S: PDA-1D (PERV)



Summary for Subcatchment 13S: PDA-2A (IMP)

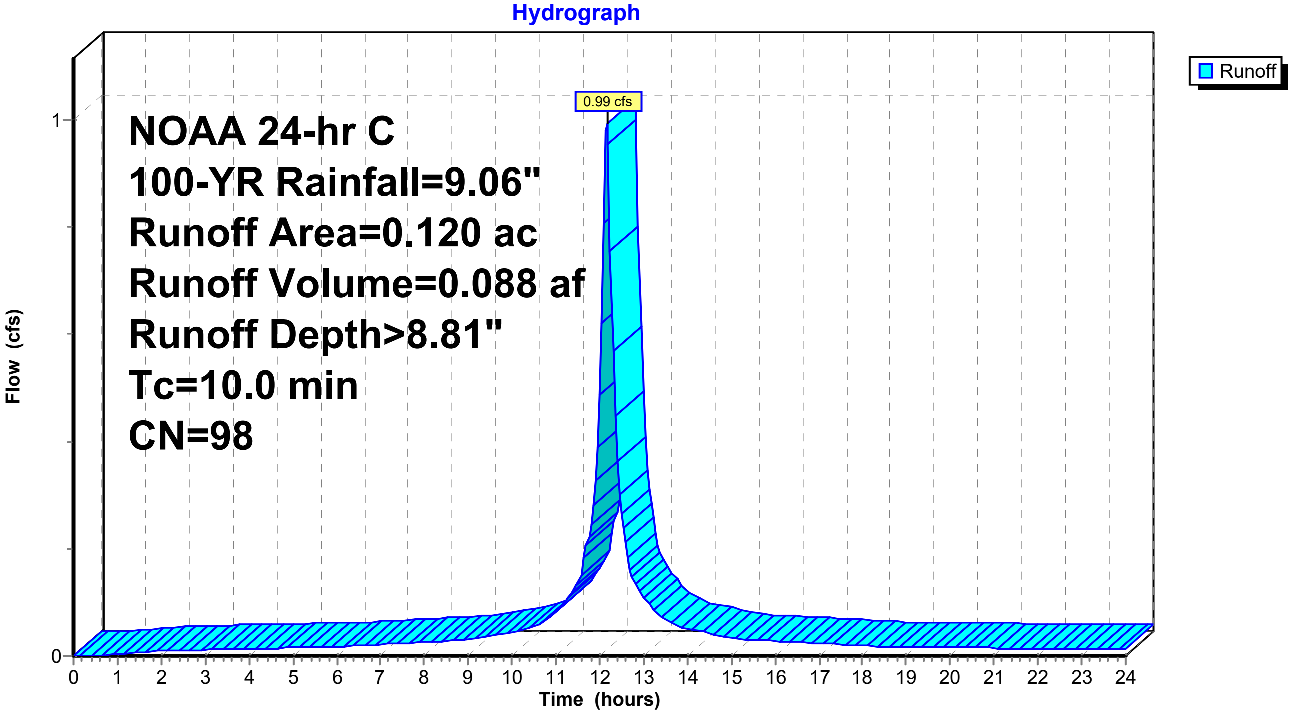
Runoff = 0.99 cfs @ 12.17 hrs, Volume= 0.088 af, Depth> 8.81"
Routed to Link 22L : PDA-2A Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.120	98	Impervious
	0.120		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 13S: PDA-2A (IMP)



Summary for Subcatchment 14S: PDA-2A (PERV)

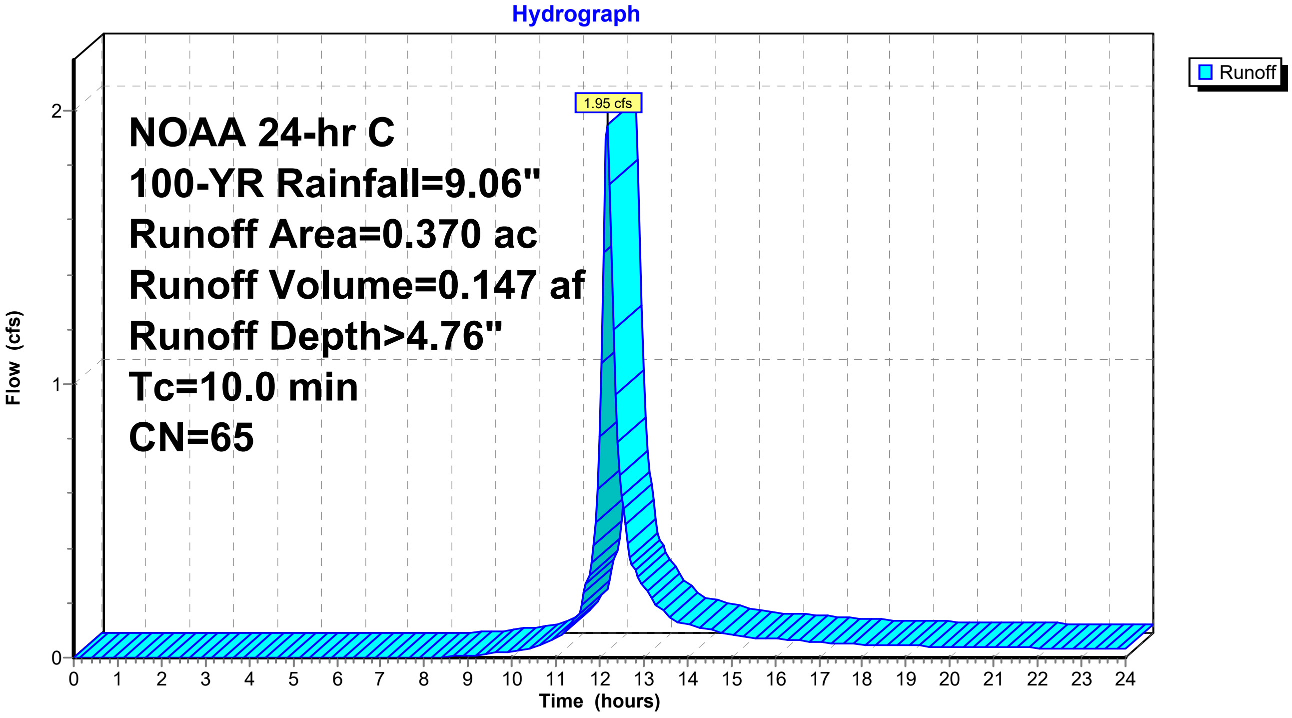
Runoff = 1.95 cfs @ 12.18 hrs, Volume= 0.147 af, Depth> 4.76"
Routed to Link 22L : PDA-2A Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.090	77	Wooded (D)
*	0.280	61	Lawn (B)
	0.370	65	Weighted Average
	0.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 14S: PDA-2A (PERV)



Summary for Subcatchment 15S: PDA-2B (IMP)

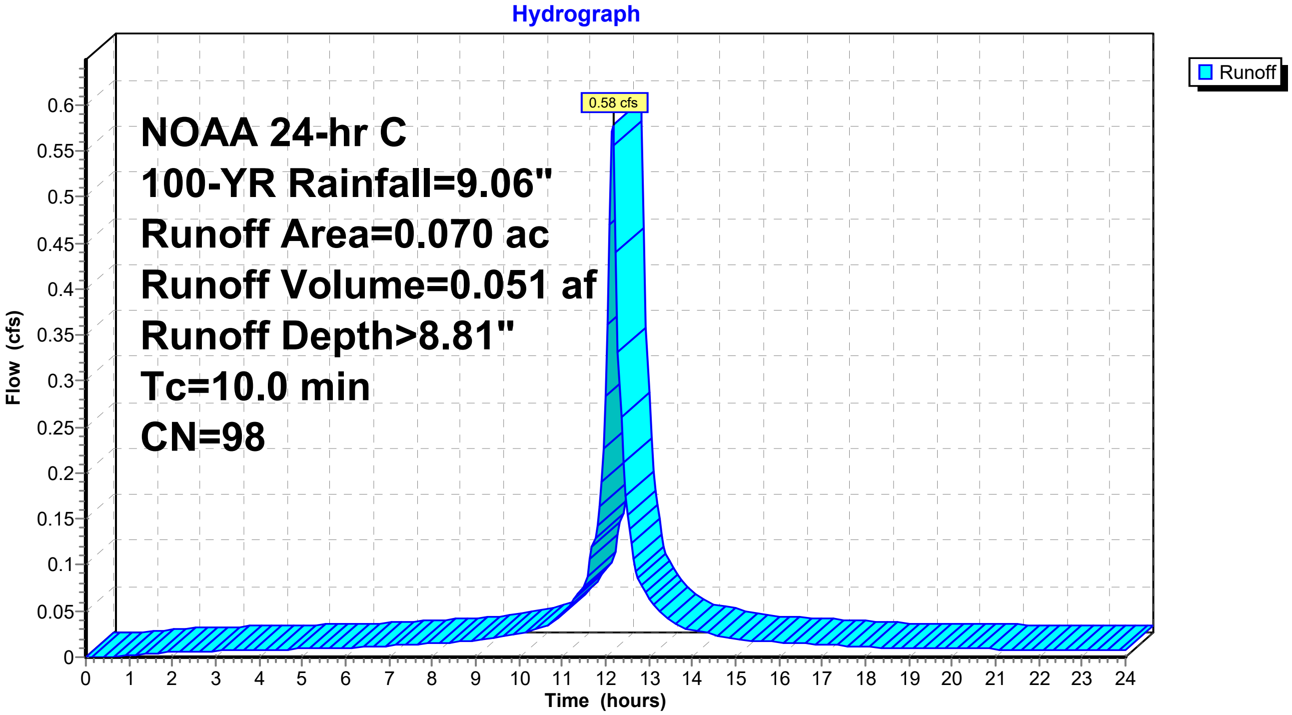
Runoff = 0.58 cfs @ 12.17 hrs, Volume= 0.051 af, Depth> 8.81"
Routed to Link 23L : PDA-2B Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.070	98	Impervious
	0.070		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 15S: PDA-2B (IMP)



Summary for Subcatchment 16S: PDA-2B (PERV)

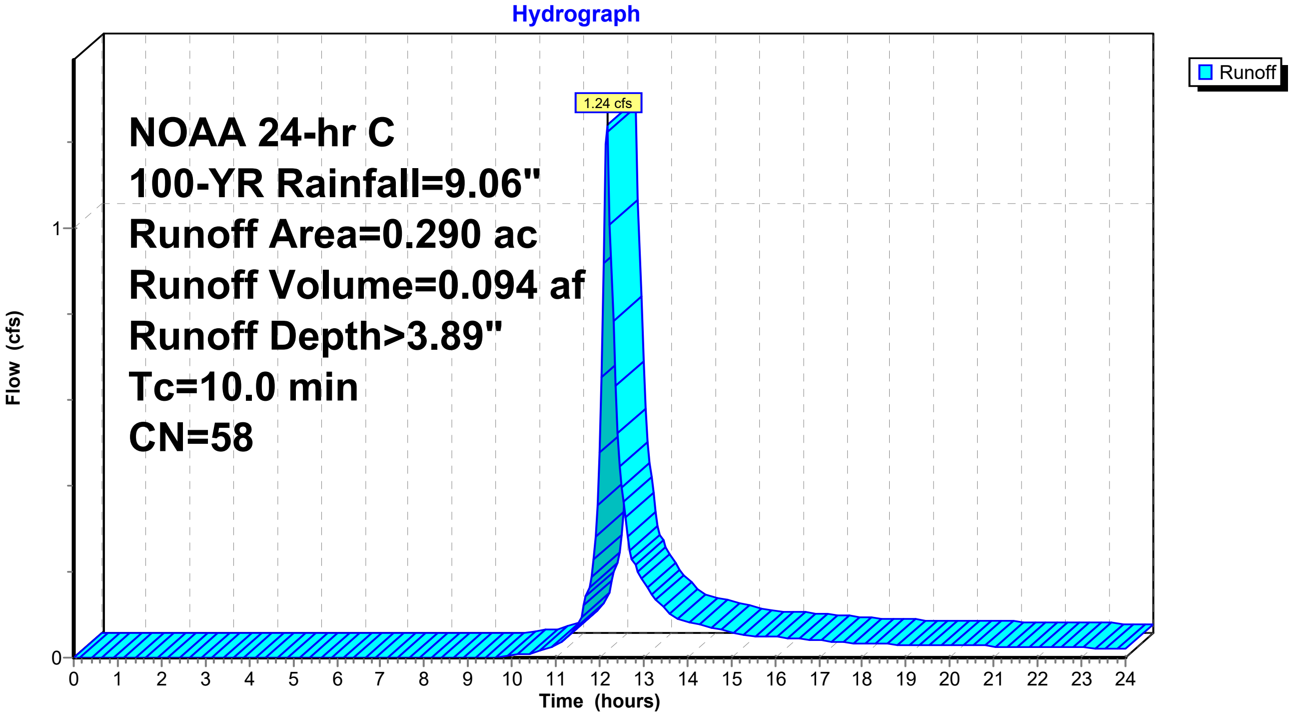
Runoff = 1.24 cfs @ 12.18 hrs, Volume= 0.094 af, Depth> 3.89"
Routed to Link 23L : PDA-2B Total

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.160	55	Wooded (B)
*	0.130	61	Lawn (B)
	0.290	58	Weighted Average
	0.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 16S: PDA-2B (PERV)



Summary for Subcatchment 17S: PDA-3 (IMP)

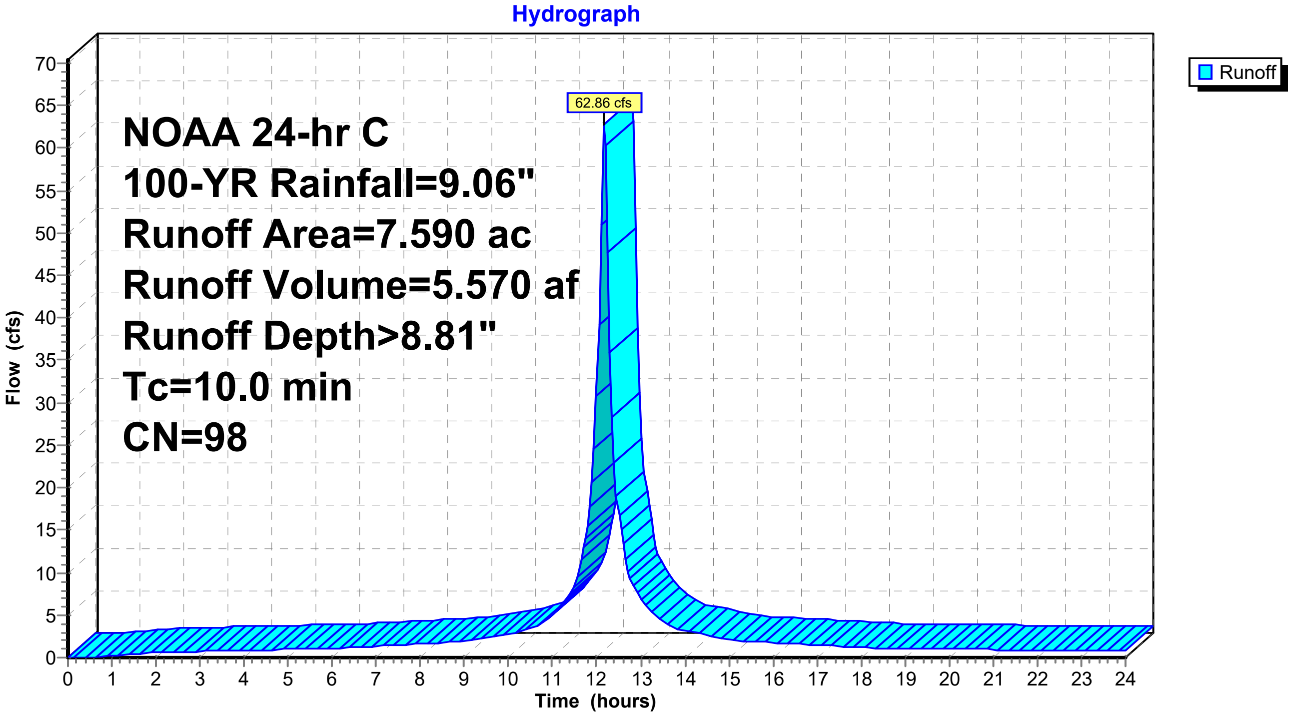
Runoff = 62.86 cfs @ 12.17 hrs, Volume= 5.570 af, Depth> 8.81"
Routed to Link 27L : Total Site Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	7.590	98	Impervious
	7.590		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

Subcatchment 17S: PDA-3 (IMP)



Summary for Subcatchment 26S: Sub-Catch to Swale 1 (for Swale Calc Only)

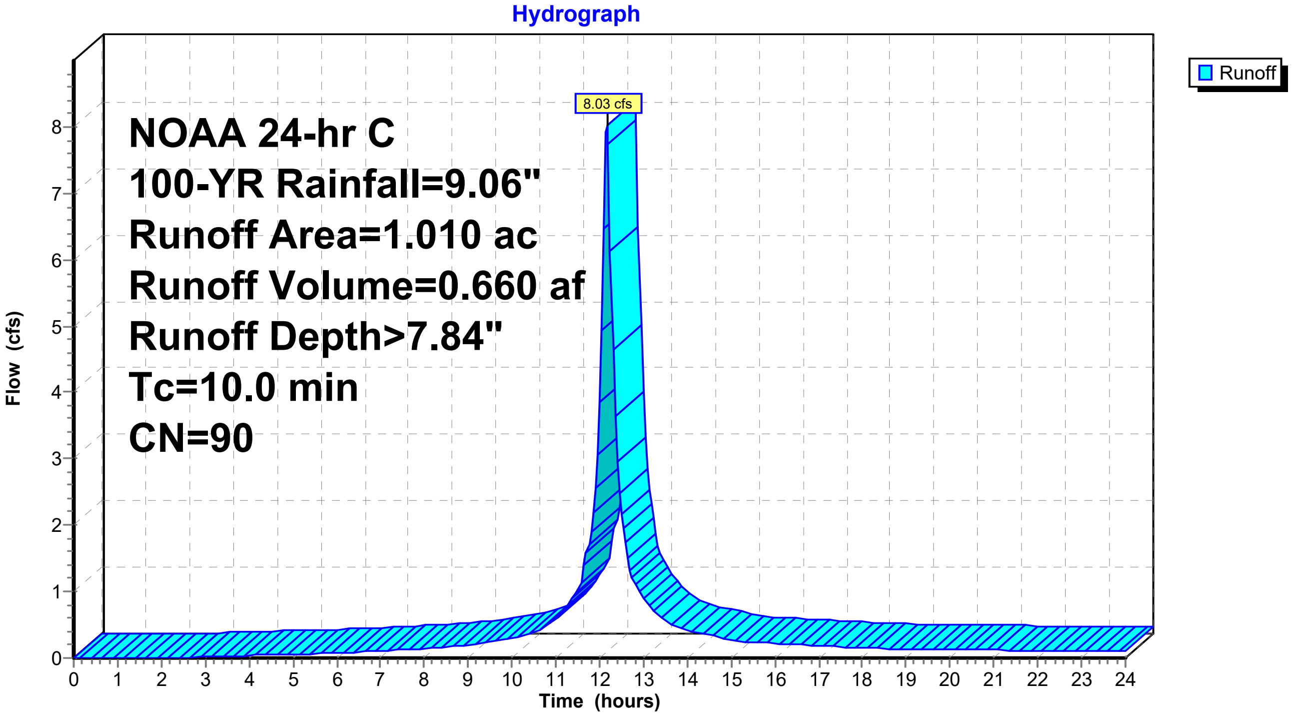
Runoff = 8.03 cfs @ 12.17 hrs, Volume= 0.660 af, Depth> 7.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-YR Rainfall=9.06"

	Area (ac)	CN	Description
*	0.510	85	Gravel
*	0.450	98	Impervious
*	0.050	61	Lawn (B)
	1.010	90	Weighted Average
	0.560		55.45% Pervious Area
	0.450		44.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum Tc**

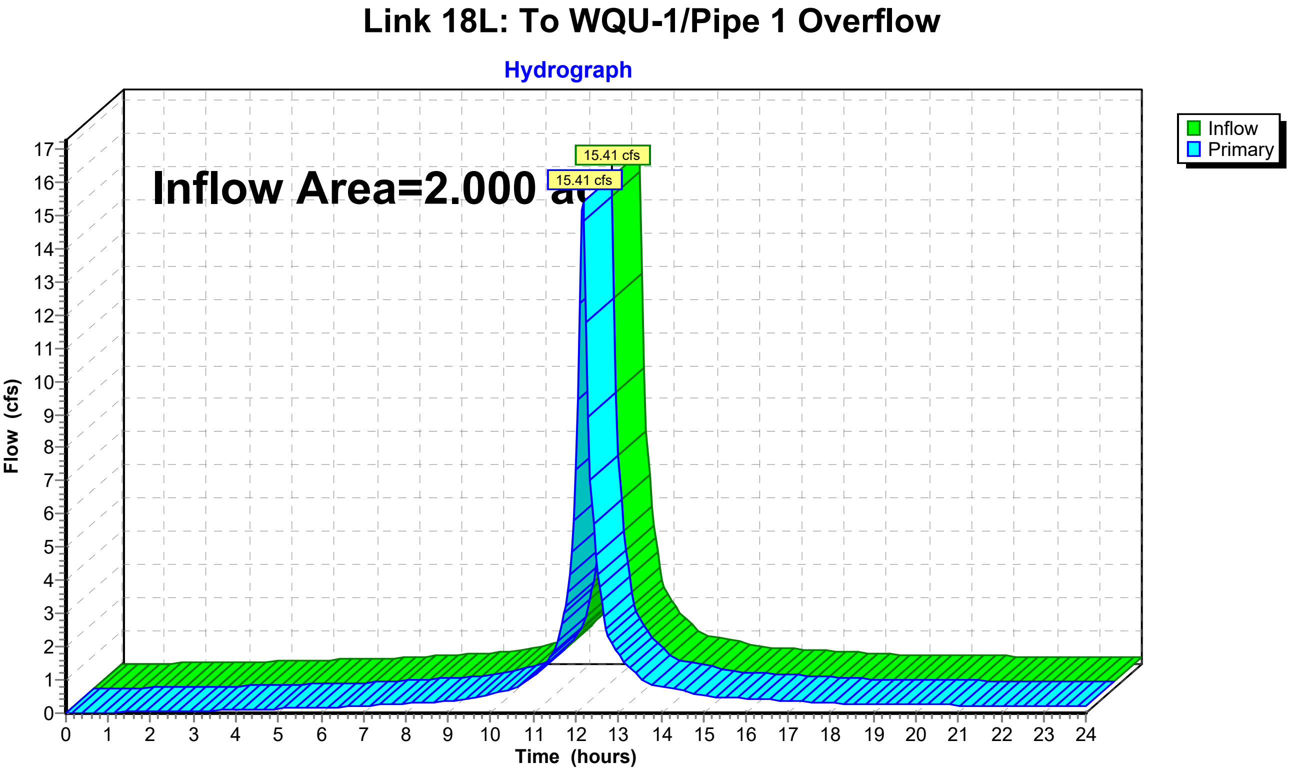
Subcatchment 26S: Sub-Catch to Swale 1 (for Swale Calc Only)



Summary for Link 18L: To WQU-1/Pipe 1 Overflow

Inflow Area = 2.000 ac, 44.50% Impervious, Inflow Depth > 7.68" for 100-YR event
Inflow = 15.41 cfs @ 12.17 hrs, Volume= 1.281 af
Primary = 15.41 cfs @ 12.17 hrs, Volume= 1.281 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

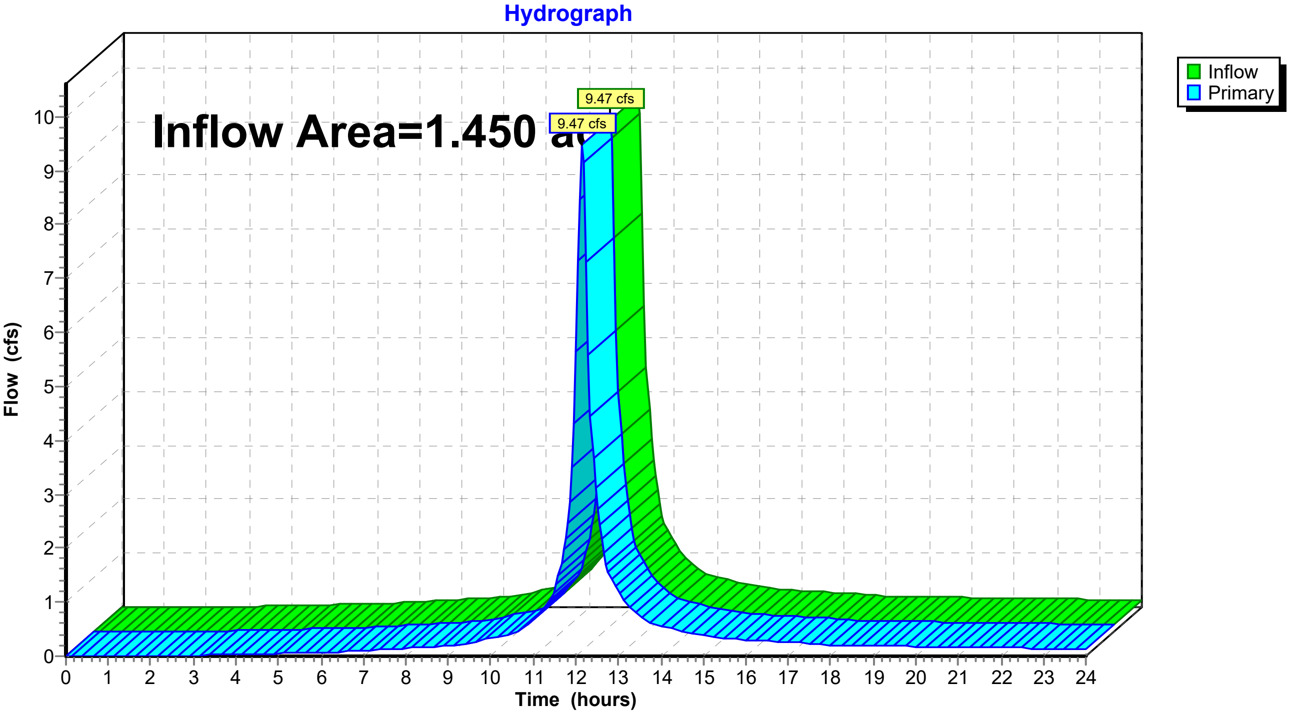


Summary for Link 19L: Swale 2/WQU-2/Pipe 2 Overflow

Inflow Area = 1.450 ac, 13.10% Impervious, Inflow Depth > 6.84" for 100-YR event
Inflow = 9.47 cfs @ 12.16 hrs, Volume= 0.827 af
Primary = 9.47 cfs @ 12.16 hrs, Volume= 0.827 af, Atten= 0%, Lag= 0.0 min
Routed to Link 25L : To Pipe 4 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 19L: Swale 2/WQU-2/Pipe 2 Overflow

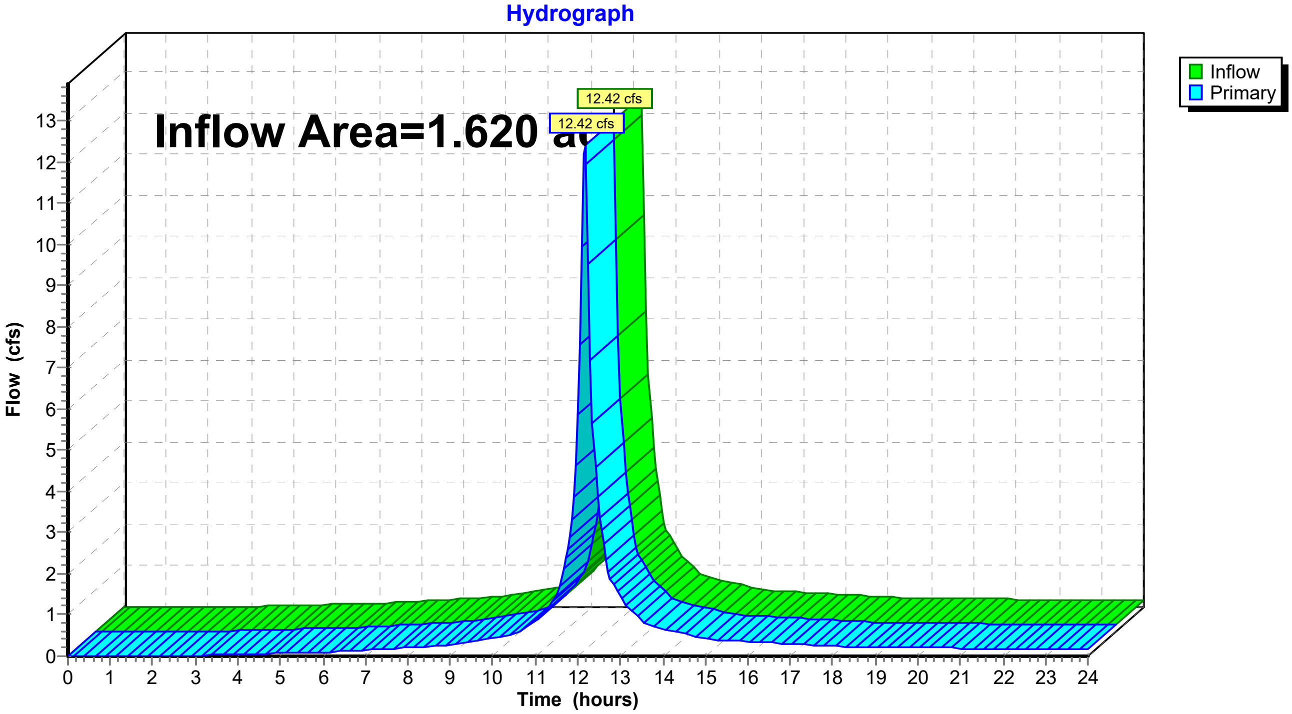


Summary for Link 20L: Swale 3/WQU-3

Inflow Area = 1.620 ac, 20.37% Impervious, Inflow Depth > 7.46" for 100-YR event
Inflow = 12.42 cfs @ 12.17 hrs, Volume= 1.008 af
Primary = 12.42 cfs @ 12.17 hrs, Volume= 1.008 af, Atten= 0%, Lag= 0.0 min
Routed to Link 24L : To Pipe 3 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 20L: Swale 3/WQU-3

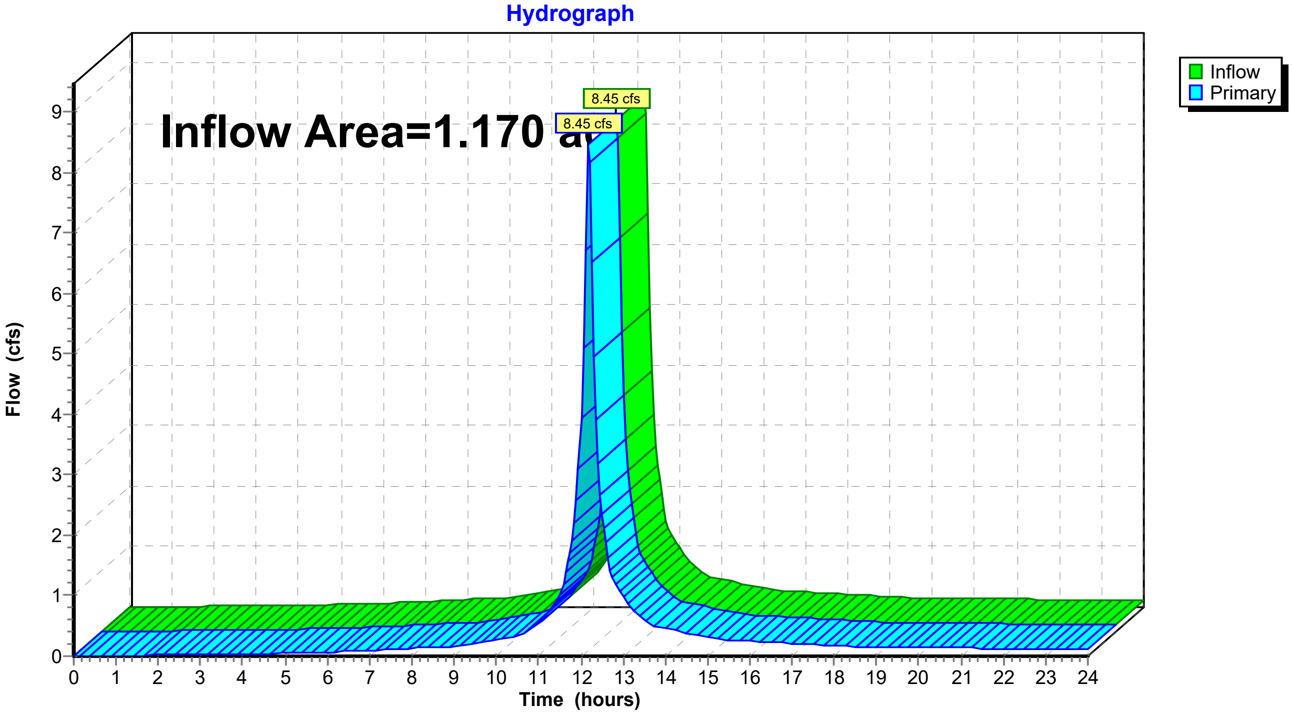


Summary for Link 21L: Swale 4/WQU-4

Inflow Area = 1.170 ac, 18.80% Impervious, Inflow Depth > 7.02" for 100-YR event
Inflow = 8.45 cfs @ 12.17 hrs, Volume= 0.684 af
Primary = 8.45 cfs @ 12.17 hrs, Volume= 0.684 af, Atten= 0%, Lag= 0.0 min
Routed to Link 24L : To Pipe 3 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 21L: Swale 4/WQU-4



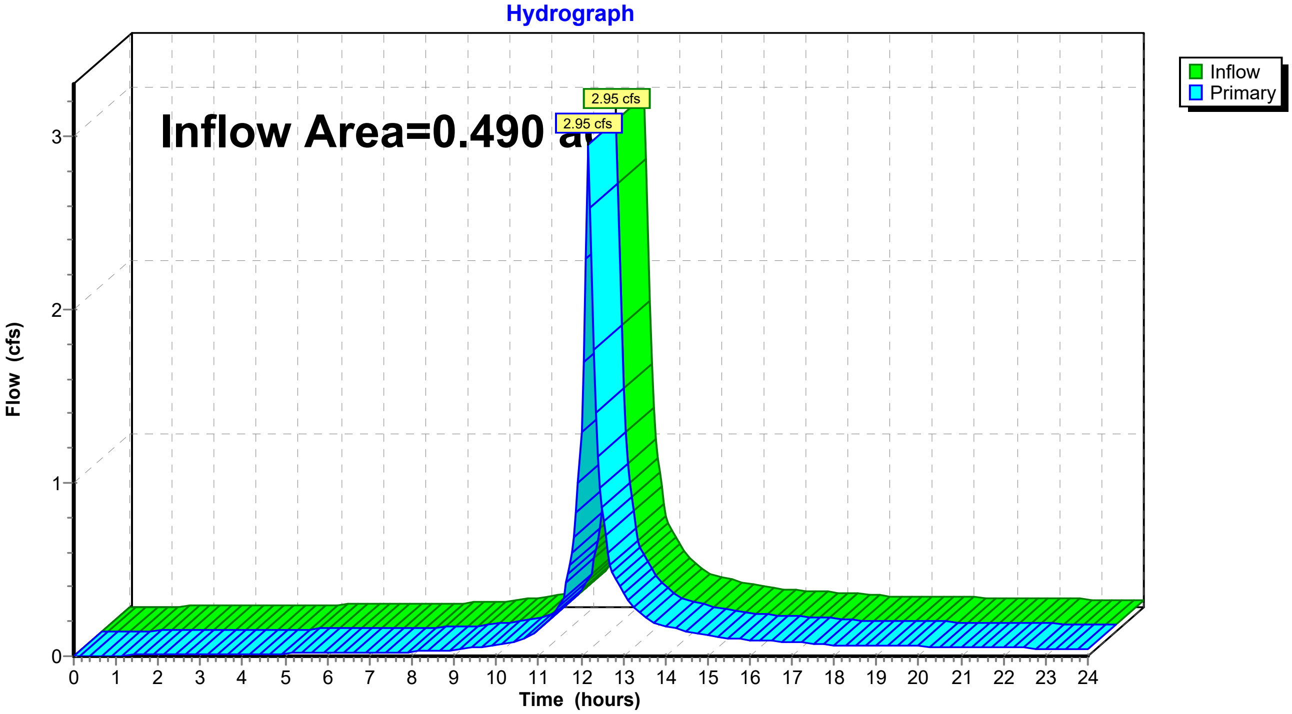
Summary for Link 22L: PDA-2A Total

Inflow Area =	0.490 ac,	24.49% Impervious,	Inflow Depth > 5.75"	for 100-YR event
Inflow =	2.95 cfs @	12.17 hrs,	Volume=	0.235 af
Primary =	2.95 cfs @	12.17 hrs,	Volume=	0.235 af, Atten= 0%, Lag= 0.0 min

Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 22L: PDA-2A Total

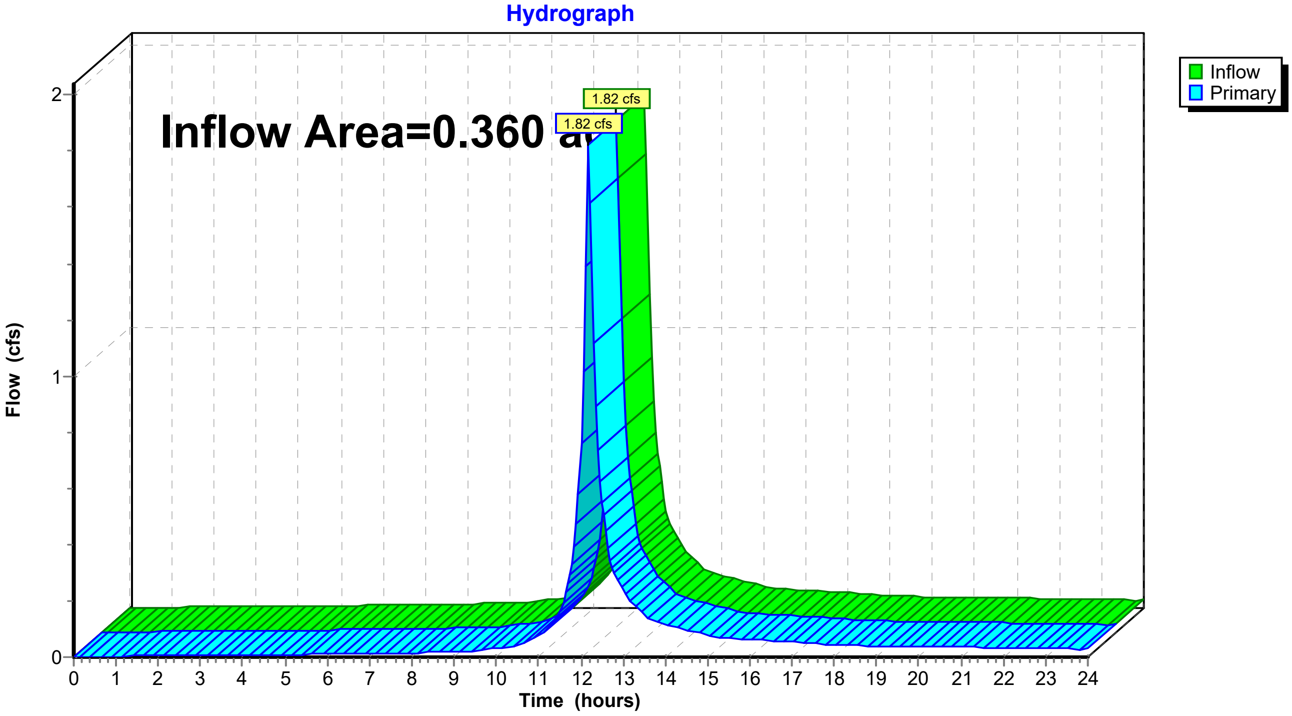


Summary for Link 23L: PDA-2B Total

Inflow Area = 0.360 ac, 19.44% Impervious, Inflow Depth > 4.85" for 100-YR event
Inflow = 1.82 cfs @ 12.18 hrs, Volume= 0.145 af
Primary = 1.82 cfs @ 12.18 hrs, Volume= 0.145 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 23L: PDA-2B Total

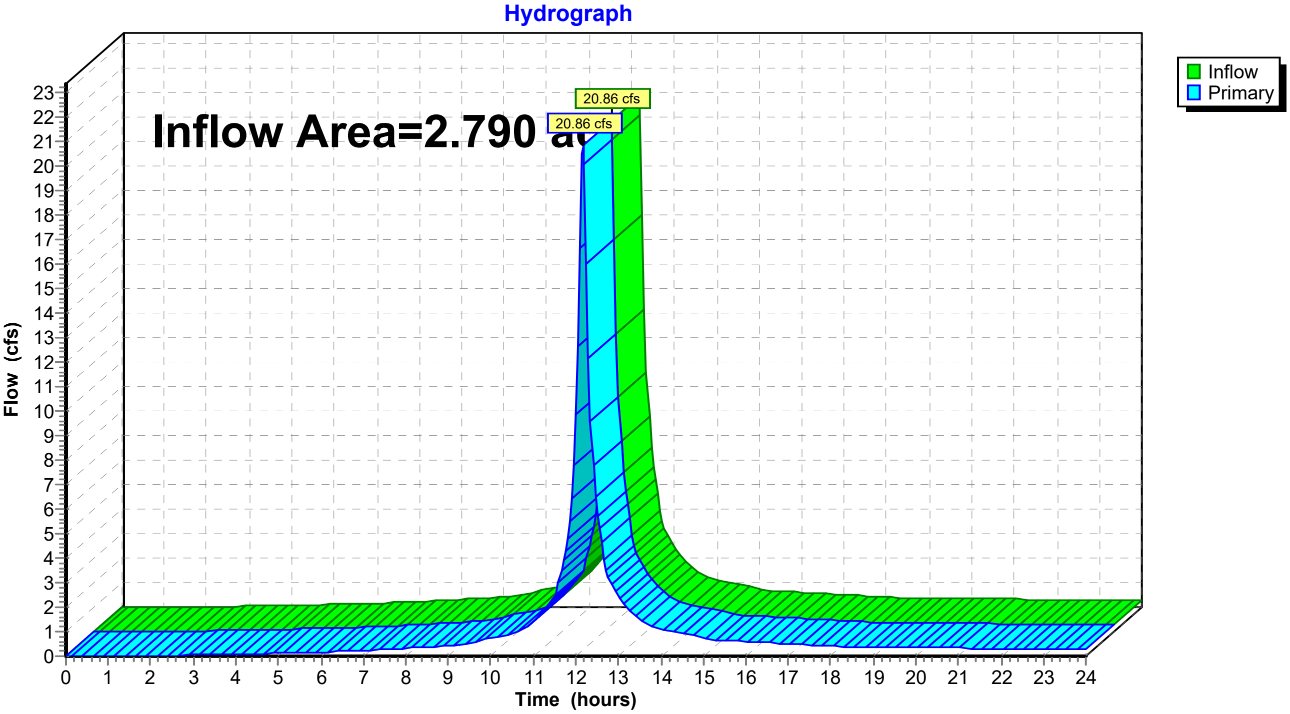


Summary for Link 24L: To Pipe 3 Overflow

Inflow Area = 2.790 ac, 19.71% Impervious, Inflow Depth > 7.28" for 100-YR event
Inflow = 20.86 cfs @ 12.17 hrs, Volume= 1.692 af
Primary = 20.86 cfs @ 12.17 hrs, Volume= 1.692 af, Atten= 0%, Lag= 0.0 min
Routed to Link 25L : To Pipe 4 Overflow

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 24L: To Pipe 3 Overflow

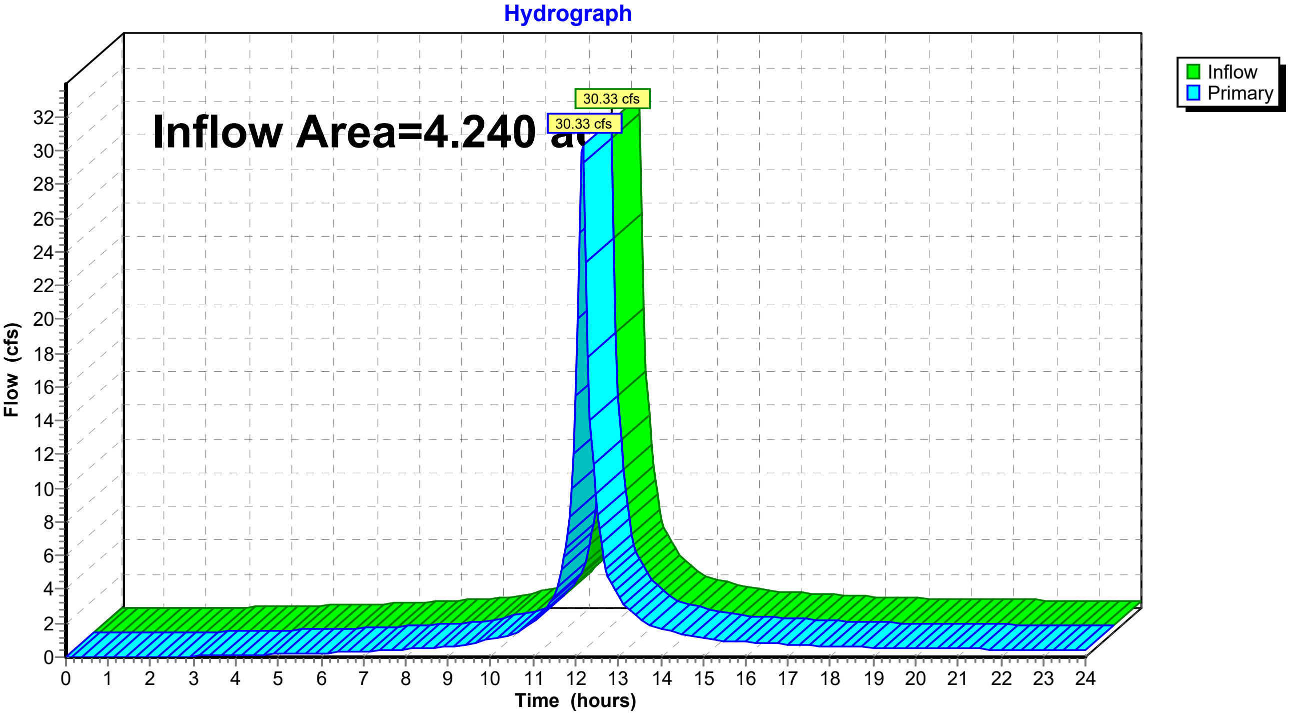


Summary for Link 25L: To Pipe 4 Overflow

Inflow Area = 4.240 ac, 17.45% Impervious, Inflow Depth > 7.13" for 100-YR event
Inflow = 30.33 cfs @ 12.17 hrs, Volume= 2.518 af
Primary = 30.33 cfs @ 12.17 hrs, Volume= 2.518 af, Atten= 0%, Lag= 0.0 min
Routed to Link 26L : To Wetlands

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 25L: To Pipe 4 Overflow

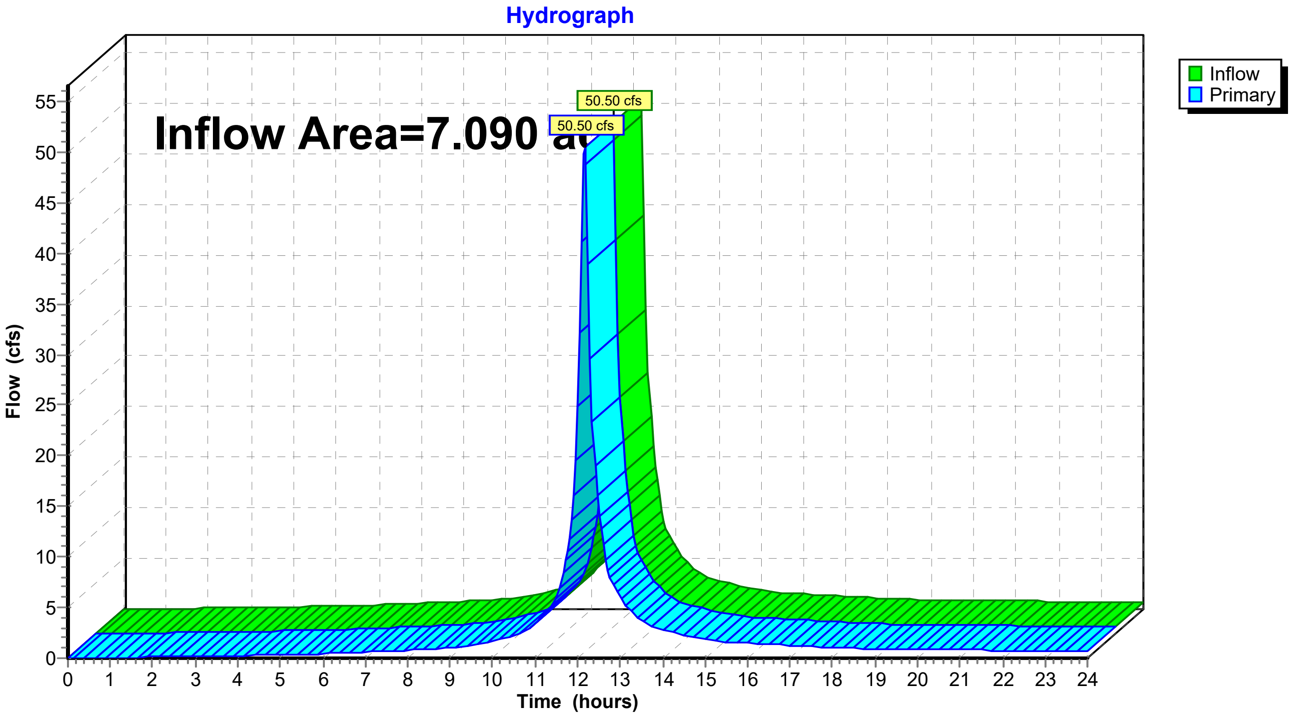


Summary for Link 26L: To Wetlands

Inflow Area = 7.090 ac, 25.67% Impervious, Inflow Depth > 7.07" for 100-YR event
Inflow = 50.50 cfs @ 12.17 hrs, Volume= 4.179 af
Primary = 50.50 cfs @ 12.17 hrs, Volume= 4.179 af, Atten= 0%, Lag= 0.0 min
Routed to Link 27L : Total Site Runoff

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 26L: To Wetlands

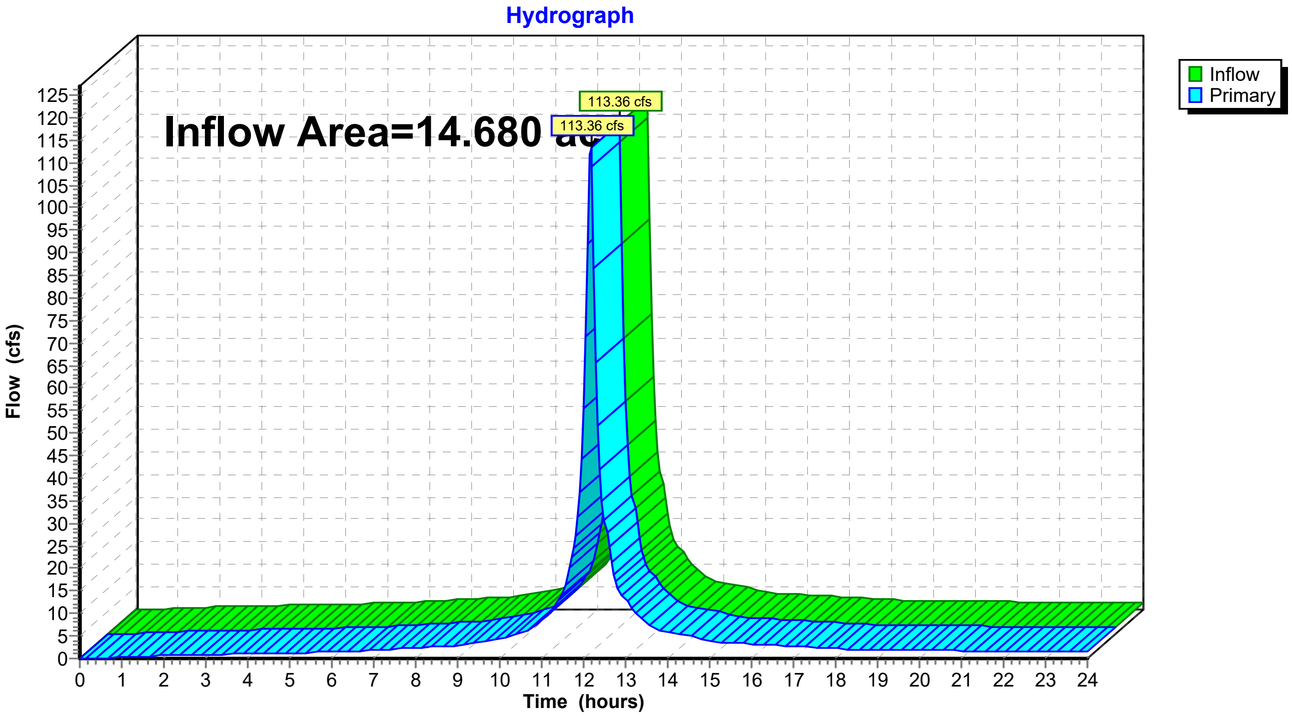


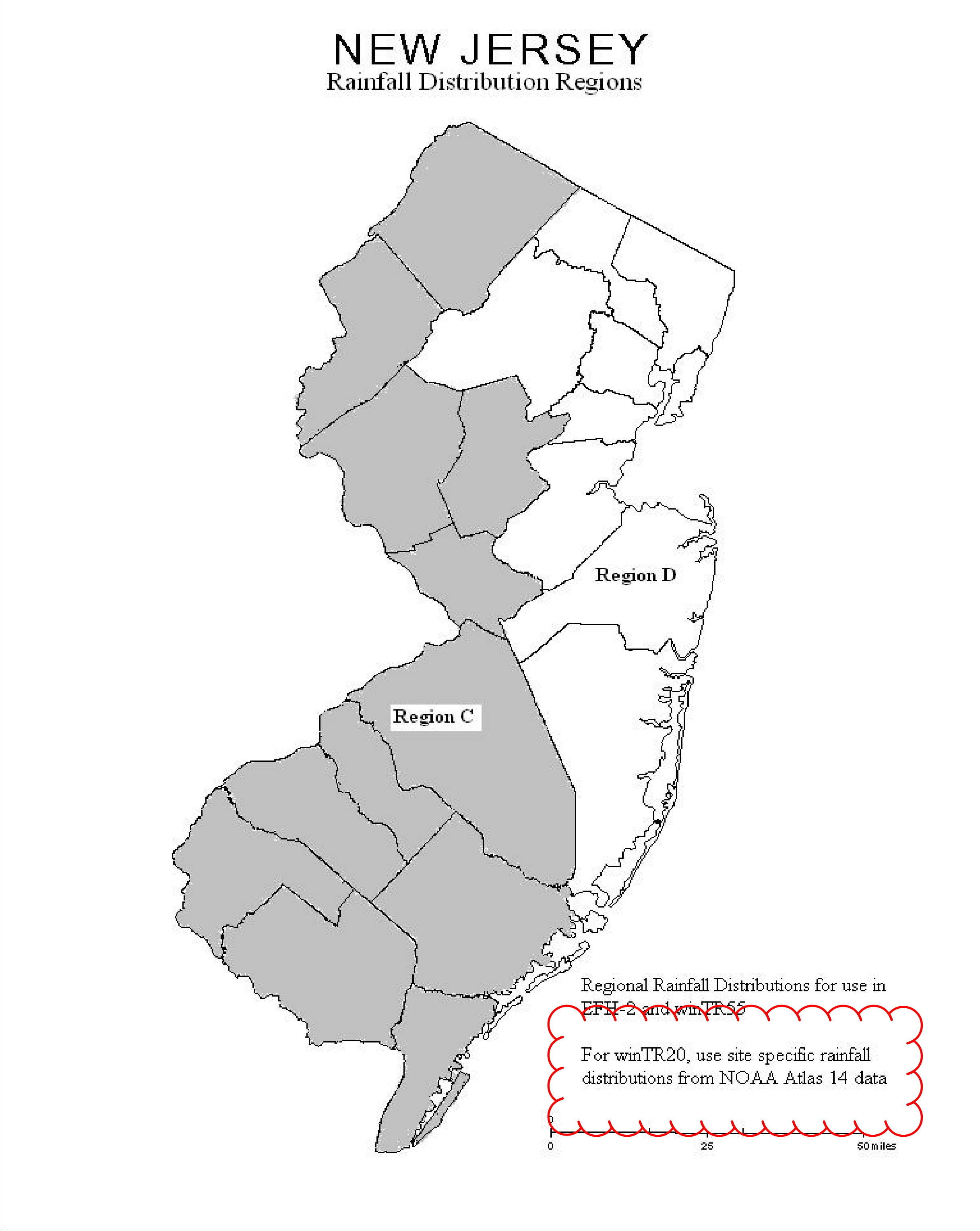
Summary for Link 27L: Total Site Runoff

```
Inflow Area =       14.680 ac, 64.10% Impervious, Inflow Depth >  7.97"   for 100-YR event
Inflow      =      113.36 cfs @  12.17 hrs, Volume=          9.749 af
Primary     =      113.36 cfs @  12.17 hrs, Volume=          9.749 af, Atten= 0%, Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 27L: Total Site Runoff





Regional Rainfall Distributions for use in EFH-2 and winTR55

For winTR20, use site specific rainfall distributions from NOAA Atlas 14 data

NOAA Atlas 14, Volume 2, Version 3
Location name: Marmora, New Jersey, USA*
Latitude: 39.2899°, Longitude: -74.6358°
Elevation: 8.8 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]										
Duration	**Average recurrence interval (years)**									
	1	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	**0.357** (0.320-0.396)	**0.419** (0.376-0.465)	**0.483** (0.432-0.535)	**0.552** (0.494-0.613)	**0.622** (0.554-0.691)	**0.682** (0.605-0.759)	**0.737** (0.651-0.820)	**0.788** (0.690-0.881)	**0.847** (0.734-0.953)	**0.903** (0.775-1.02)
10-min	**0.570** (0.511-0.633)	**0.670** (0.601-0.743)	**0.773** (0.692-0.857)	**0.882** (0.790-0.980)	**0.992** (0.884-1.10)	**1.09** (0.964-1.21)	**1.17** (1.03-1.30)	**1.25** (1.09-1.40)	**1.34** (1.16-1.51)	**1.42** (1.22-1.61)
15-min	**0.713** (0.638-0.792)	**0.842** (0.755-0.934)	**0.978** (0.875-1.08)	**1.12** (0.999-1.24)	**1.26** (1.12-1.40)	**1.38** (1.22-1.53)	**1.48** (1.31-1.65)	**1.58** (1.38-1.76)	**1.69** (1.46-1.90)	**1.78** (1.53-2.02)
30-min	**0.977** (0.875-1.09)	**1.16** (1.04-1.29)	**1.39** (1.24-1.54)	**1.62** (1.45-1.80)	**1.86** (1.66-2.07)	**2.07** (1.84-2.31)	**2.27** (2.00-2.52)	**2.45** (2.15-2.74)	**2.68** (2.33-3.02)	**2.89** (2.48-3.27)
60-min	**1.22** (1.09-1.35)	**1.46** (1.31-1.62)	**1.78** (1.59-1.98)	**2.11** (1.89-2.34)	**2.48** (2.21-2.75)	**2.81** (2.49-3.12)	**3.12** (2.76-3.48)	**3.44** (3.01-3.85)	**3.85** (3.34-4.33)	**4.22** (3.62-4.78)
2-hr	**1.52** (1.35-1.72)	**1.82** (1.61-2.06)	**2.24** (1.98-2.53)	**2.67** (2.35-3.02)	**3.17** (2.78-3.59)	**3.61** (3.15-4.10)	**4.05** (3.51-4.61)	**4.50** (3.88-5.15)	**5.09** (4.33-5.87)	**5.64** (4.74-6.54)
3-hr	**1.67** (1.48-1.90)	**2.01** (1.77-2.28)	**2.47** (2.17-2.80)	**2.96** (2.60-3.36)	**3.53** (3.08-4.01)	**4.06** (3.52-4.62)	**4.58** (3.93-5.23)	**5.13** (4.36-5.87)	**5.86** (4.92-6.76)	**6.54** (5.42-7.59)
6-hr	**2.05** (1.82-2.36)	**2.45** (2.17-2.81)	**3.00** (2.65-3.44)	**3.60** (3.17-4.12)	**4.34** (3.79-4.97)	**5.04** (4.36-5.78)	**5.74** (4.93-6.60)	**6.50** (5.51-7.50)	**7.54** (6.29-8.75)	**8.53** (6.99-9.96)
12-hr	**2.44** (2.17-2.79)	**2.90** (2.58-3.32)	**3.58** (3.16-4.08)	**4.33** (3.82-4.94)	**5.31** (4.64-6.05)	**6.25** (5.42-7.14)	**7.23** (6.19-8.29)	**8.32** (7.02-9.58)	**9.88** (8.13-11.4)	**11.4** (9.19-13.3)
24-hr	**2.77** (2.51-3.08)	**3.37** (3.05-3.75)	**4.38** (3.96-4.87)	**5.25** (4.73-5.83)	**6.58** (5.88-7.27)	**7.74** (6.87-8.54)	**9.06** (7.97-9.97)	**10.5** (9.19-11.6)	**12.8** (11.0-14.0)	**14.8** (12.5-16.2)
2-day	**3.17** (2.86-3.53)	**3.86** (3.48-4.30)	**5.01** (4.52-5.58)	**6.01** (5.40-6.67)	**7.51** (6.70-8.32)	**8.82** (7.83-9.76)	**10.3** (9.06-11.4)	**11.9** (10.4-13.2)	**14.5** (12.4-15.9)	**16.6** (14.1-18.4)
3-day	**3.33** (3.03-3.68)	**4.05** (3.69-4.47)	**5.24** (4.76-5.78)	**6.25** (5.67-6.89)	**7.78** (7.00-8.55)	**9.11** (8.15-9.99)	**10.6** (9.40-11.6)	**12.2** (10.8-13.4)	**14.7** (12.8-16.1)	**16.9** (14.5-18.5)
4-day	**3.49** (3.20-3.83)	**4.24** (3.89-4.64)	**5.46** (5.00-5.98)	**6.50** (5.93-7.10)	**8.05** (7.31-8.78)	**9.39** (8.47-10.2)	**10.9** (9.74-11.8)	**12.5** (11.1-13.6)	**15.0** (13.2-16.3)	**17.1** (14.9-18.7)
7-day	**4.03** (3.72-4.39)	**4.86** (4.49-5.30)	**6.16** (5.69-6.72)	**7.26** (6.69-7.91)	**8.89** (8.14-9.65)	**10.3** (9.37-11.2)	**11.8** (10.7-12.8)	**13.5** (12.1-14.6)	**16.0** (14.2-17.3)	**18.1** (15.9-19.7)
10-day	**4.51** (4.19-4.89)	**5.42** (5.04-5.87)	**6.76** (6.27-7.32)	**7.87** (7.29-8.51)	**9.47** (8.72-10.2)	**10.8** (9.92-11.7)	**12.3** (11.2-13.2)	**13.8** (12.5-14.9)	**16.2** (14.5-17.5)	**18.3** (16.2-19.7)
20-day	**6.02** (5.66-6.43)	**7.16** (6.74-7.65)	**8.66** (8.13-9.25)	**9.88** (9.26-10.5)	**11.6** (10.8-12.3)	**12.9** (12.0-13.8)	**14.4** (13.3-15.3)	**15.8** (14.6-16.9)	**17.9** (16.4-19.1)	**19.5** (17.8-20.9)
30-day	**7.51** (7.08-7.97)	**8.90** (8.38-9.45)	**10.6** (9.99-11.3)	**12.0** (11.3-12.7)	**13.8** (13.0-14.6)	**15.3** (14.3-16.2)	**16.8** (15.6-17.8)	**18.3** (17.0-19.4)	**20.3** (18.8-21.6)	**21.9** (20.1-23.3)
45-day	**9.51** (9.03-10.0)	**11.2** (10.7-11.8)	**13.1** (12.5-13.9)	**14.6** (13.9-15.4)	**16.6** (15.7-17.5)	**18.0** (17.0-19.0)	**19.5** (18.4-20.5)	**20.9** (19.6-22.0)	**22.7** (21.2-24.0)	**24.1** (22.4-25.5)
60-day	**11.3** (10.7-11.8)	**13.2** (12.6-13.9)	**15.3** (14.6-16.1)	**16.9** (16.0-17.7)	**18.8** (17.9-19.8)	**20.3** (19.2-21.3)	**21.7** (20.5-22.8)	**23.0** (21.7-24.2)	**24.7** (23.2-26.0)	**25.8** (24.2-27.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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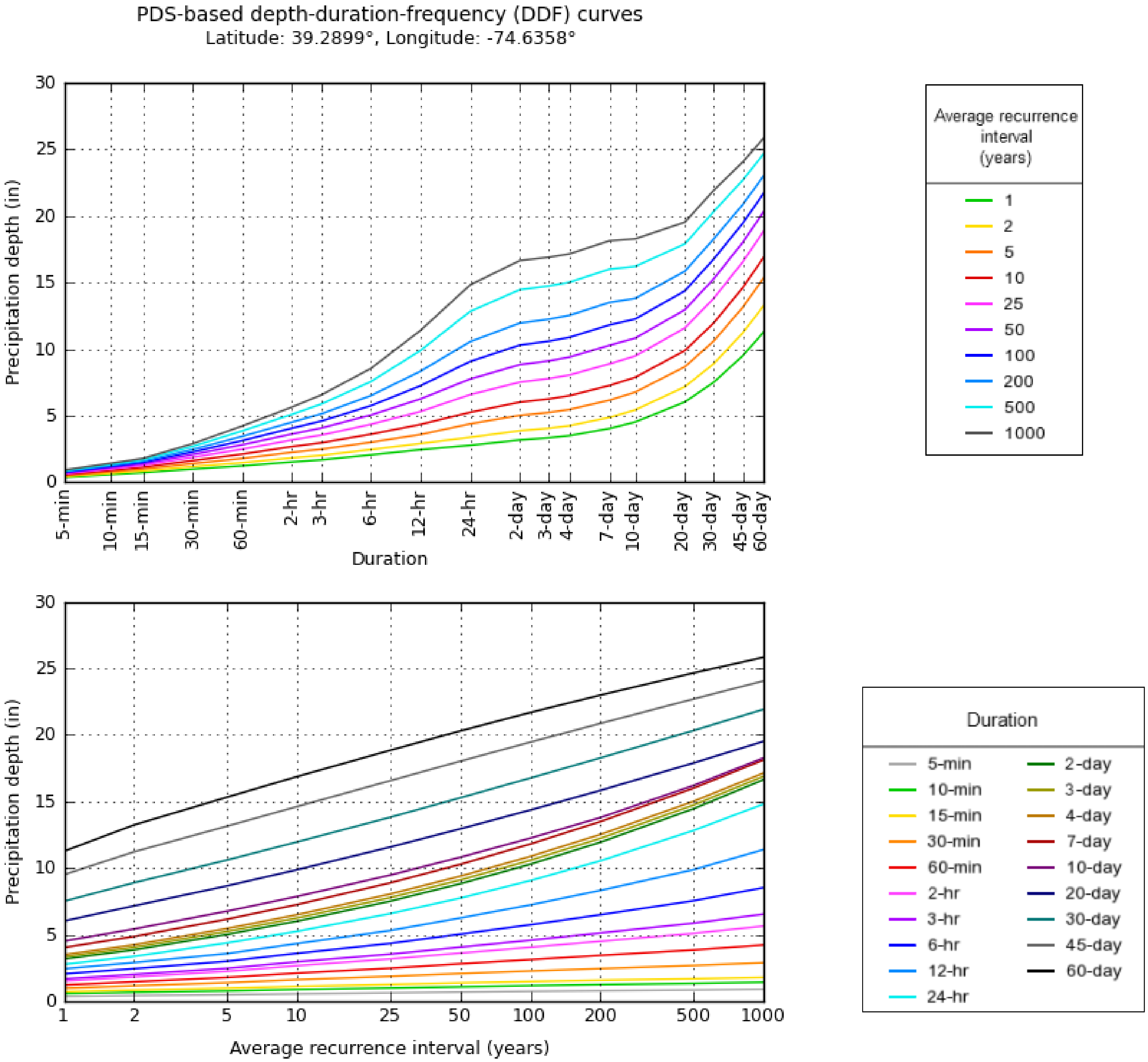
PF graphical



NOAA Atlas 14, Volume 2, Version 3

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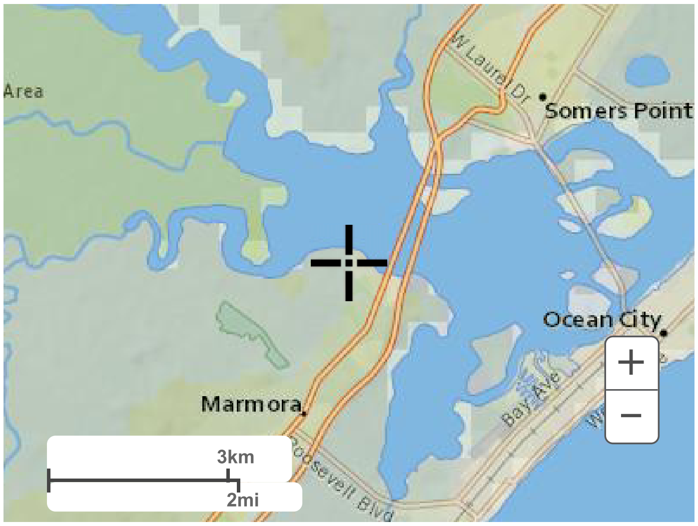
Maps & aerials

Small scale terrain



Large scale terrain

Large scale map

Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX C – HYDRAULIC & STABILITY CALCULATIONS

Channel Report

SWALE 1_PDA-1A_25-YR

Trapezoidal

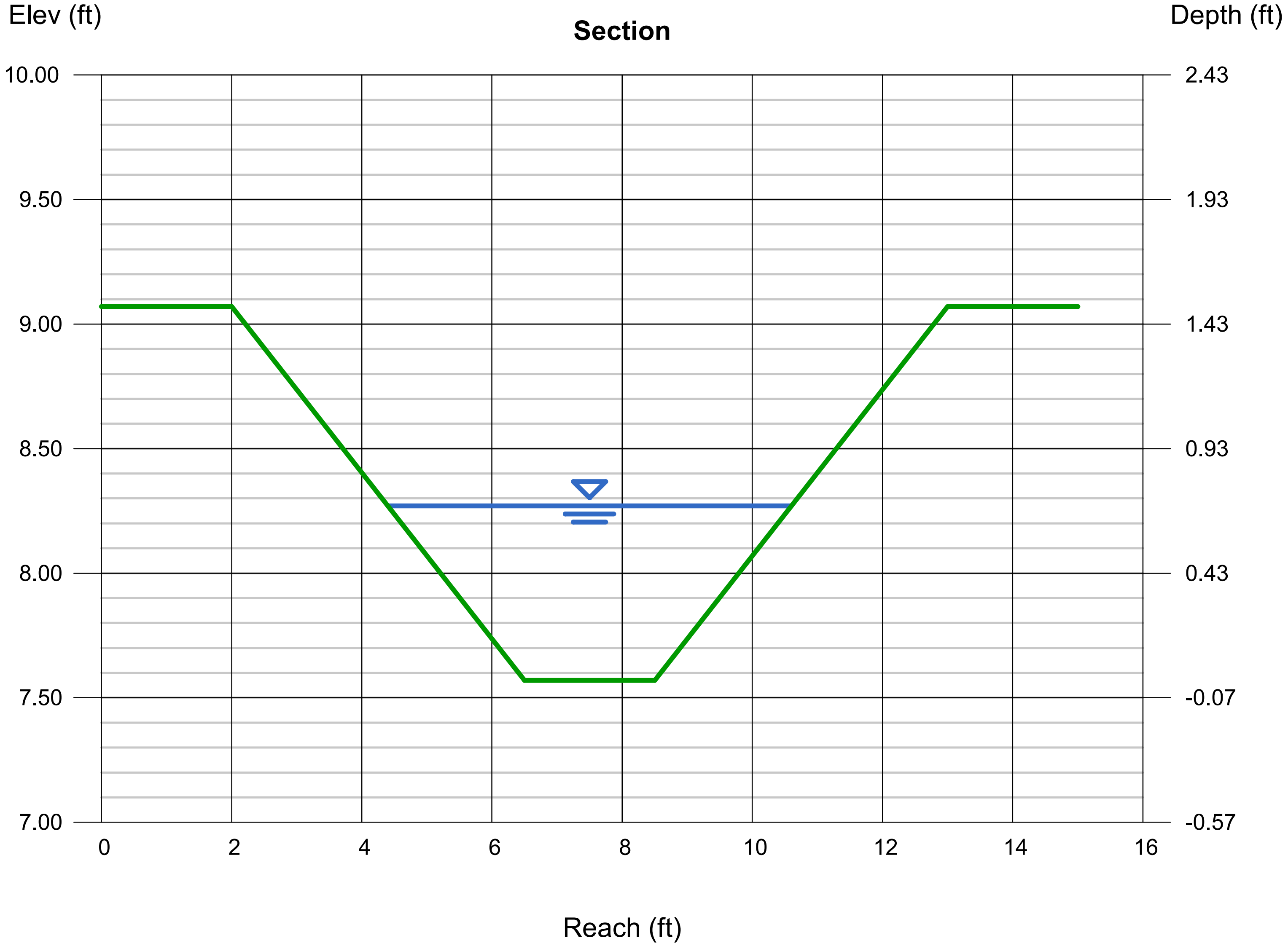
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 7.57
Slope (%)	= 0.33
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.66

Highlighted

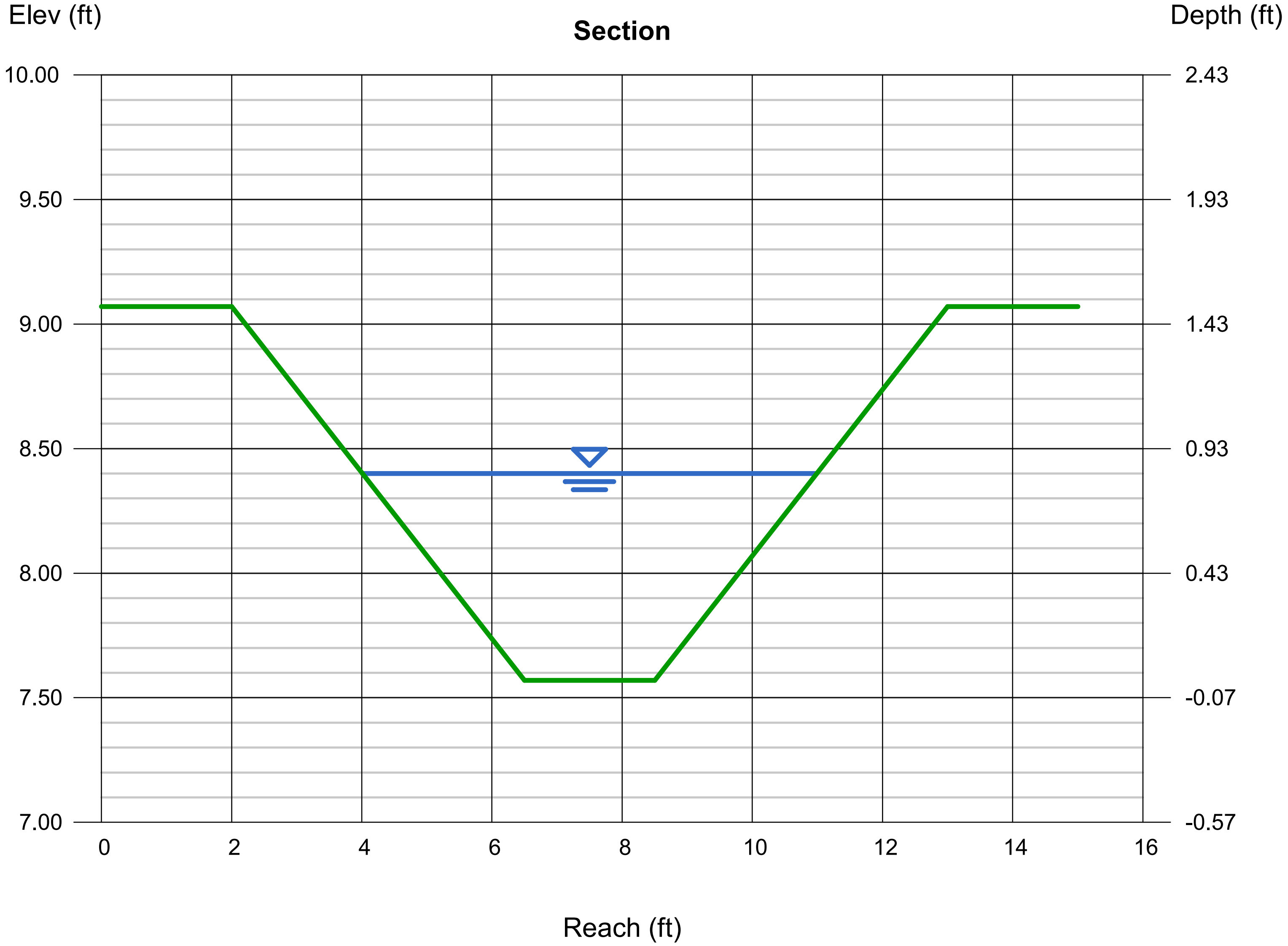
Depth (ft)	= 0.70
Q (cfs)	= 5.660
Area (sqft)	= 2.87
Velocity (ft/s)	= 1.97
Wetted Perim (ft)	= 6.43
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 6.20
EGL (ft)	= 0.76



Channel Report

SWALE 1_PDA-1A_100-YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 2.00	Depth (ft)	= 0.83
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 8.030
Total Depth (ft)	= 1.50	Area (sqft)	= 3.73
Invert Elev (ft)	= 7.57	Velocity (ft/s)	= 2.15
Slope (%)	= 0.33	Wetted Perim (ft)	= 7.25
N-Value	= 0.025	Crit Depth, Yc (ft)	= 0.60
		Top Width (ft)	= 6.98
Calculations		EGL (ft)	= 0.90
Compute by:	Known Q		
Known Q (cfs)	= 8.03		



Channel Report

SWALE 2_PDA-1B_25-YR

Trapezoidal

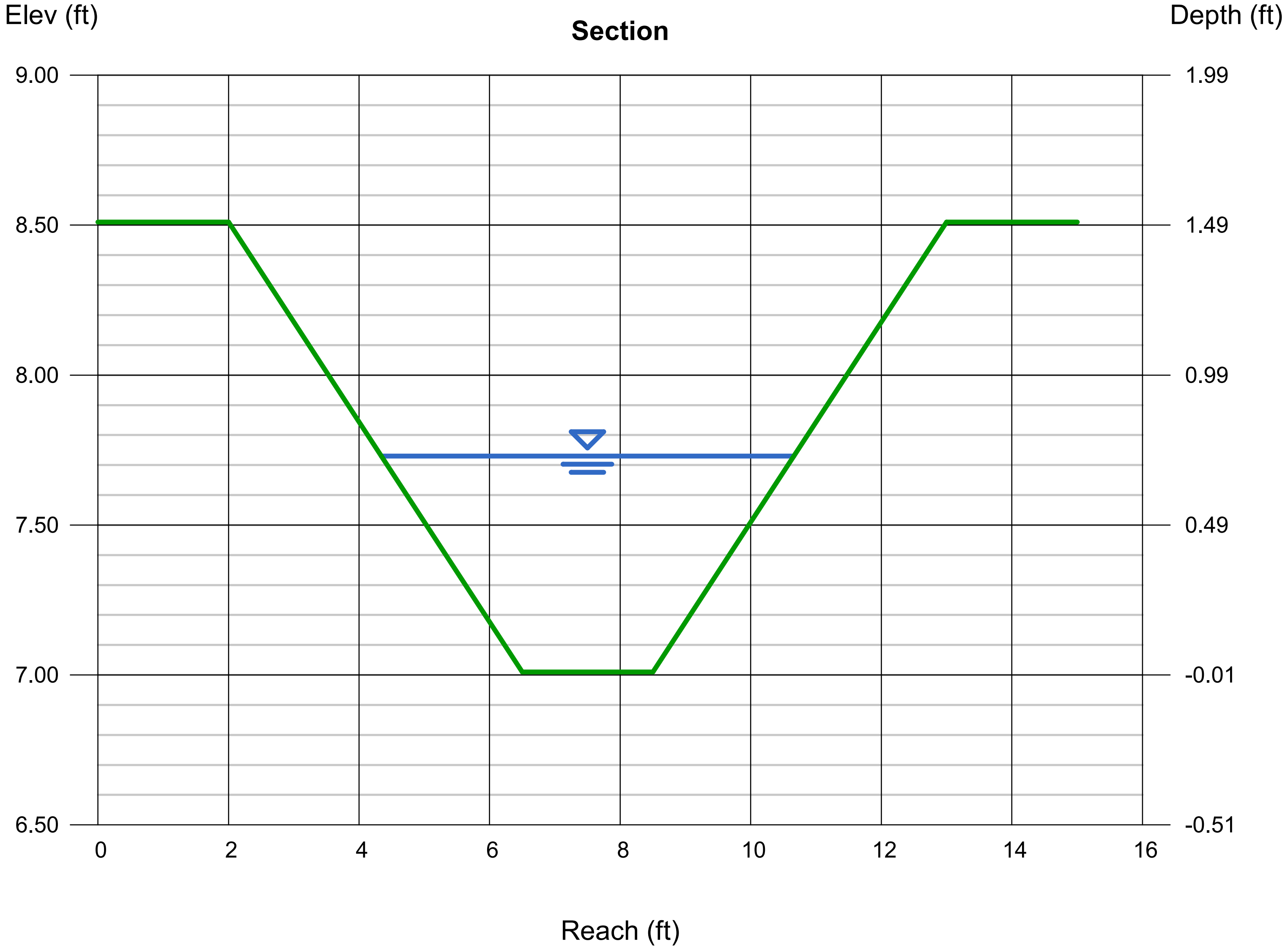
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 7.01
Slope (%)	= 0.39
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cfs)	= 6.50

Highlighted

Depth (ft)	= 0.72
Q (cfs)	= 6.500
Area (sqft)	= 3.00
Velocity (ft/s)	= 2.17
Wetted Perim (ft)	= 6.55
Crit Depth, Yc (ft)	= 0.53
Top Width (ft)	= 6.32
EGL (ft)	= 0.79



Channel Report

SWALE 2_PDA-1B_100-YR

Trapezoidal

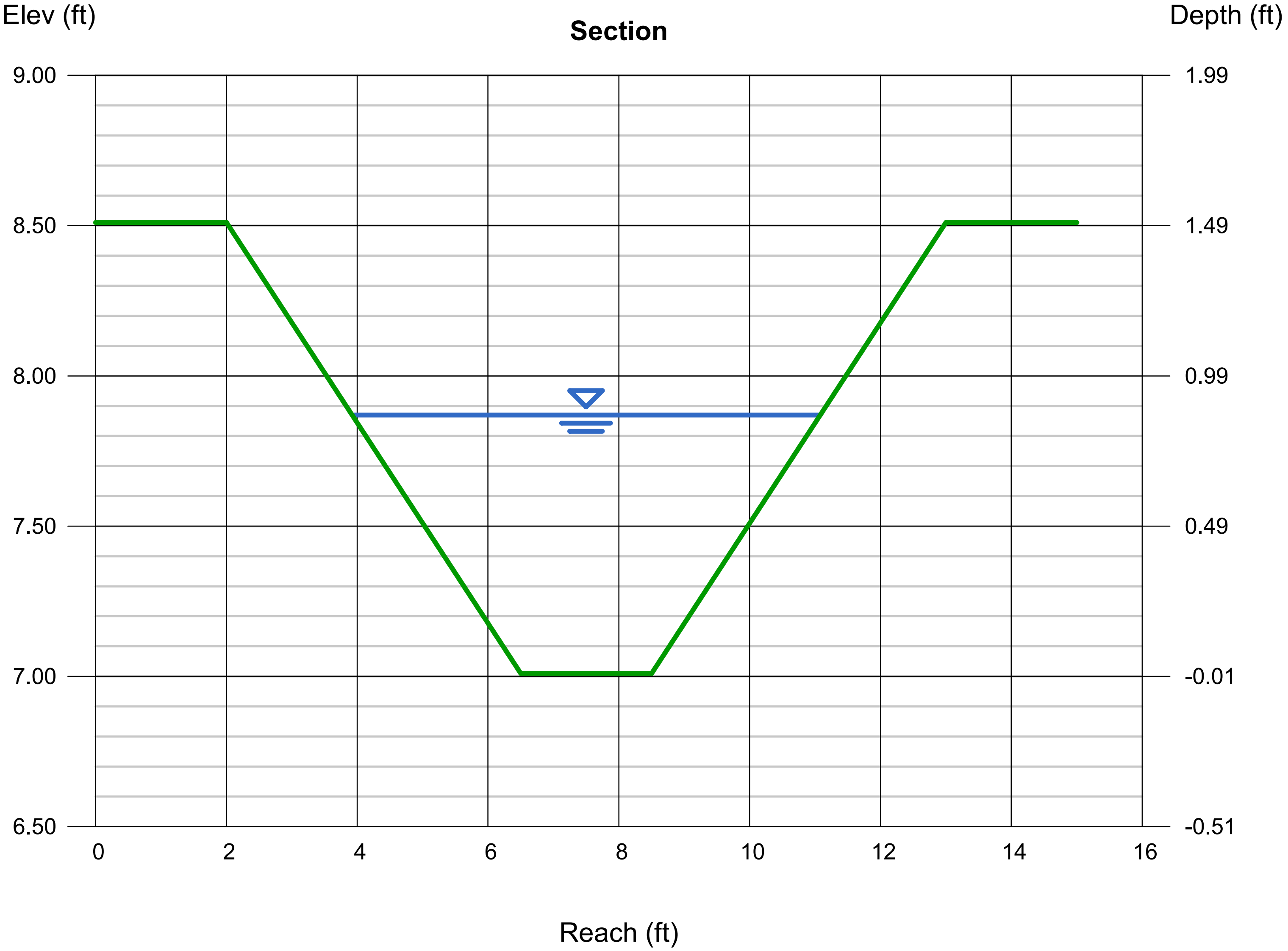
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 7.01
Slope (%)	= 0.39
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cfs)	= 9.47

Highlighted

Depth (ft)	= 0.86
Q (cfs)	= 9.470
Area (sqft)	= 3.94
Velocity (ft/s)	= 2.40
Wetted Perim (ft)	= 7.44
Crit Depth, Yc (ft)	= 0.65
Top Width (ft)	= 7.16
EGL (ft)	= 0.95



Channel Report

SWALE 3_PDA-1C_25-YR

Trapezoidal

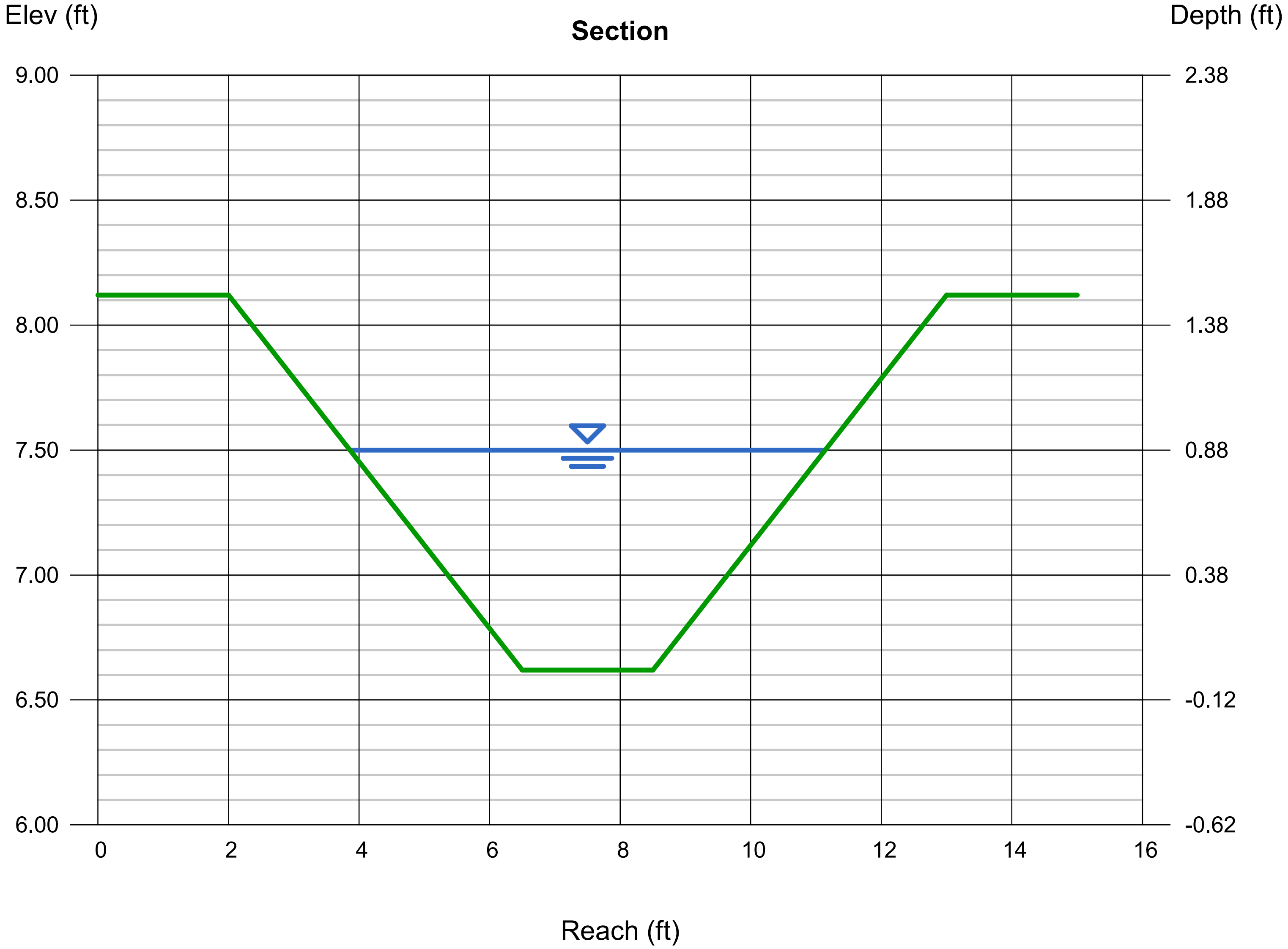
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 6.62
Slope (%)	= 0.29
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cfs)	= 8.61

Highlighted

Depth (ft)	= 0.88
Q (cfs)	= 8.610
Area (sqft)	= 4.08
Velocity (ft/s)	= 2.11
Wetted Perim (ft)	= 7.57
Crit Depth, Yc (ft)	= 0.62
Top Width (ft)	= 7.28
EGL (ft)	= 0.95



Channel Report

SWALE 3_PDA-1C_100-YR

Trapezoidal

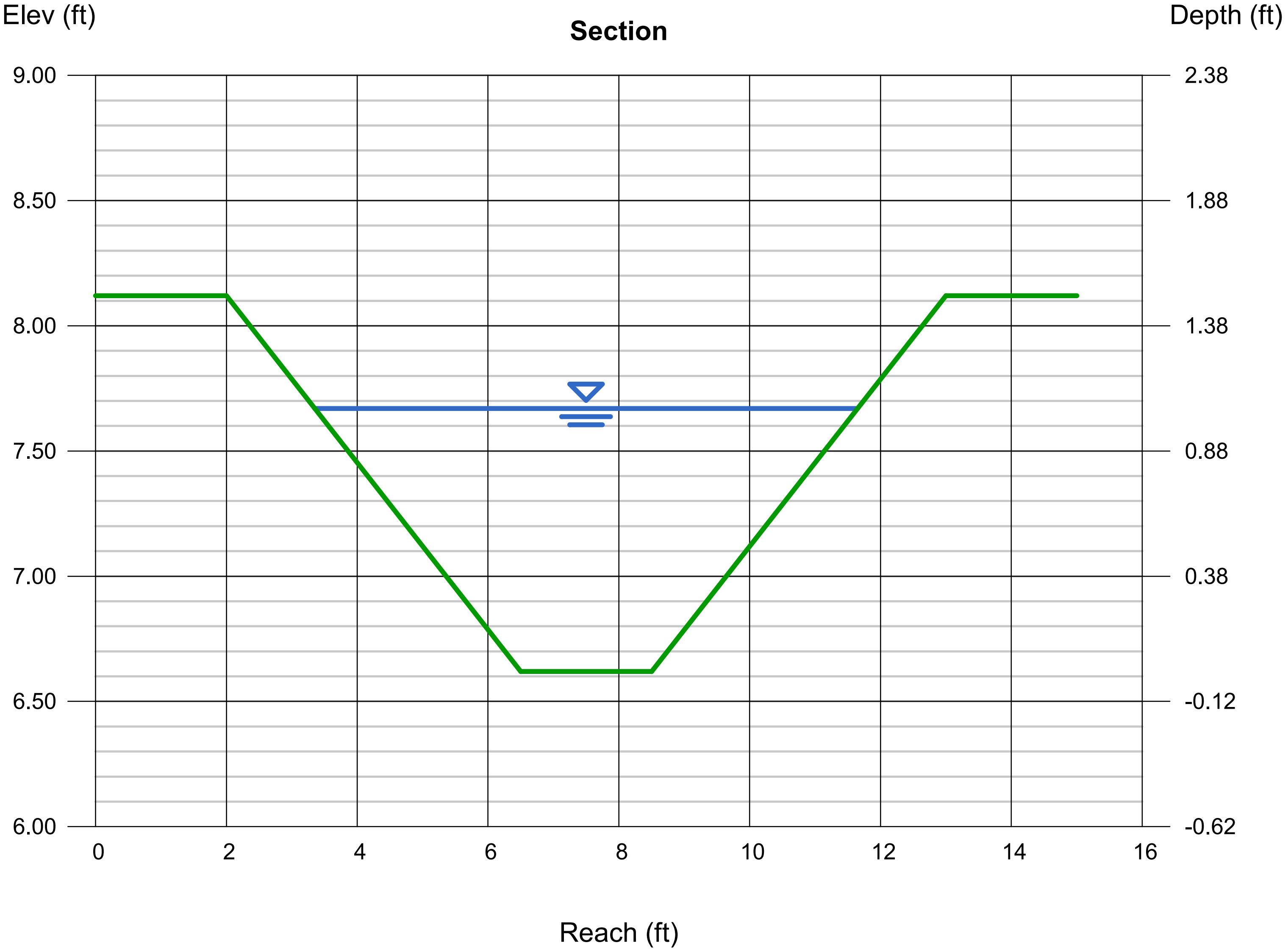
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 6.62
Slope (%)	= 0.29
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cfs)	= 12.42

Highlighted

Depth (ft)	= 1.05
Q (cfs)	= 12.42
Area (sqft)	= 5.41
Velocity (ft/s)	= 2.30
Wetted Perim (ft)	= 8.64
Crit Depth, Yc (ft)	= 0.75
Top Width (ft)	= 8.30
EGL (ft)	= 1.13



Channel Report

SWALE 4_PDA-1D_25-YR

Trapezoidal

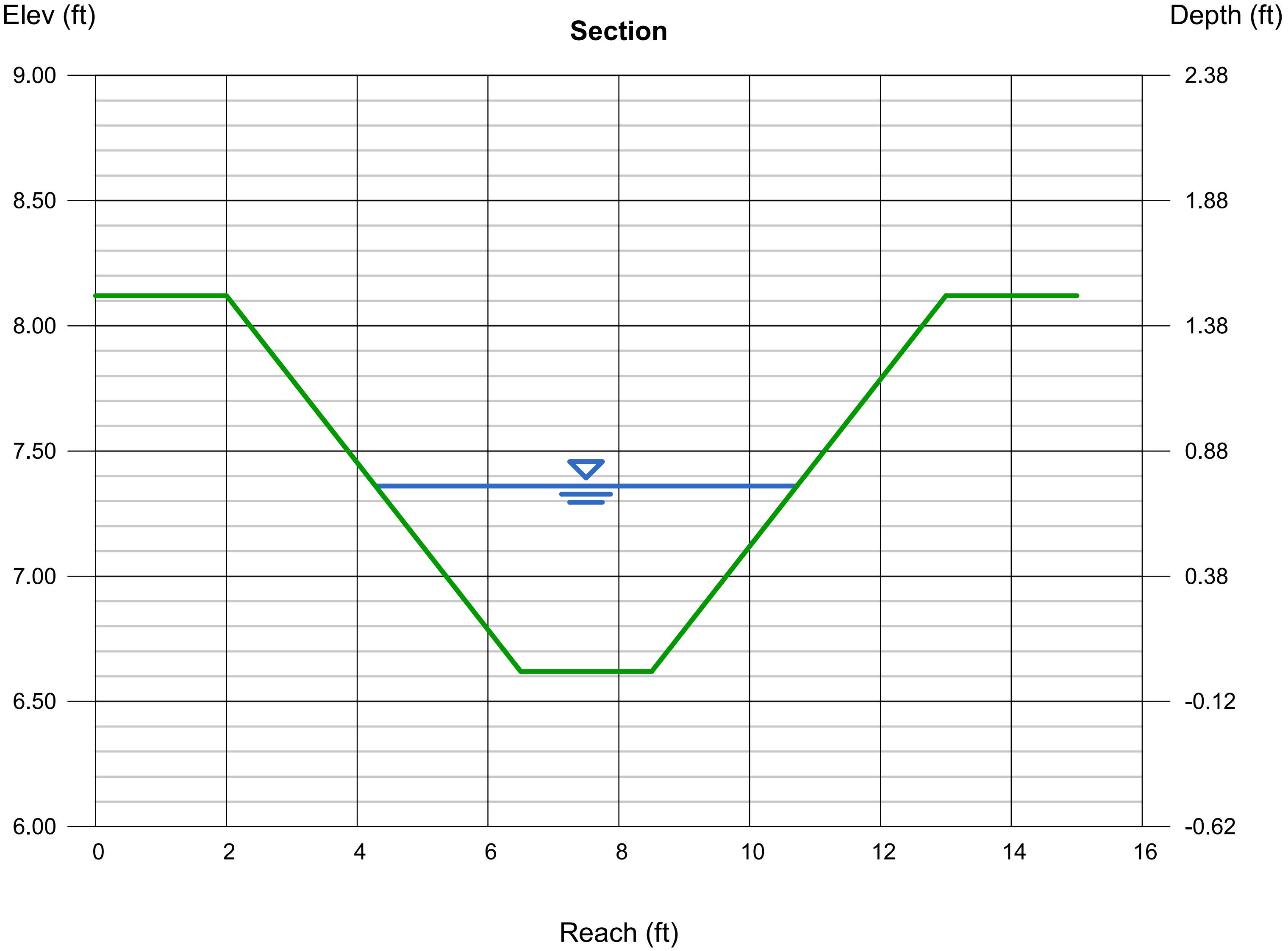
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 6.62
Slope (%)	= 0.27
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.73

Highlighted

Depth (ft)	= 0.74
Q (cfs)	= 5.730
Area (sqft)	= 3.12
Velocity (ft/s)	= 1.83
Wetted Perim (ft)	= 6.68
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 6.44
EGL (ft)	= 0.79



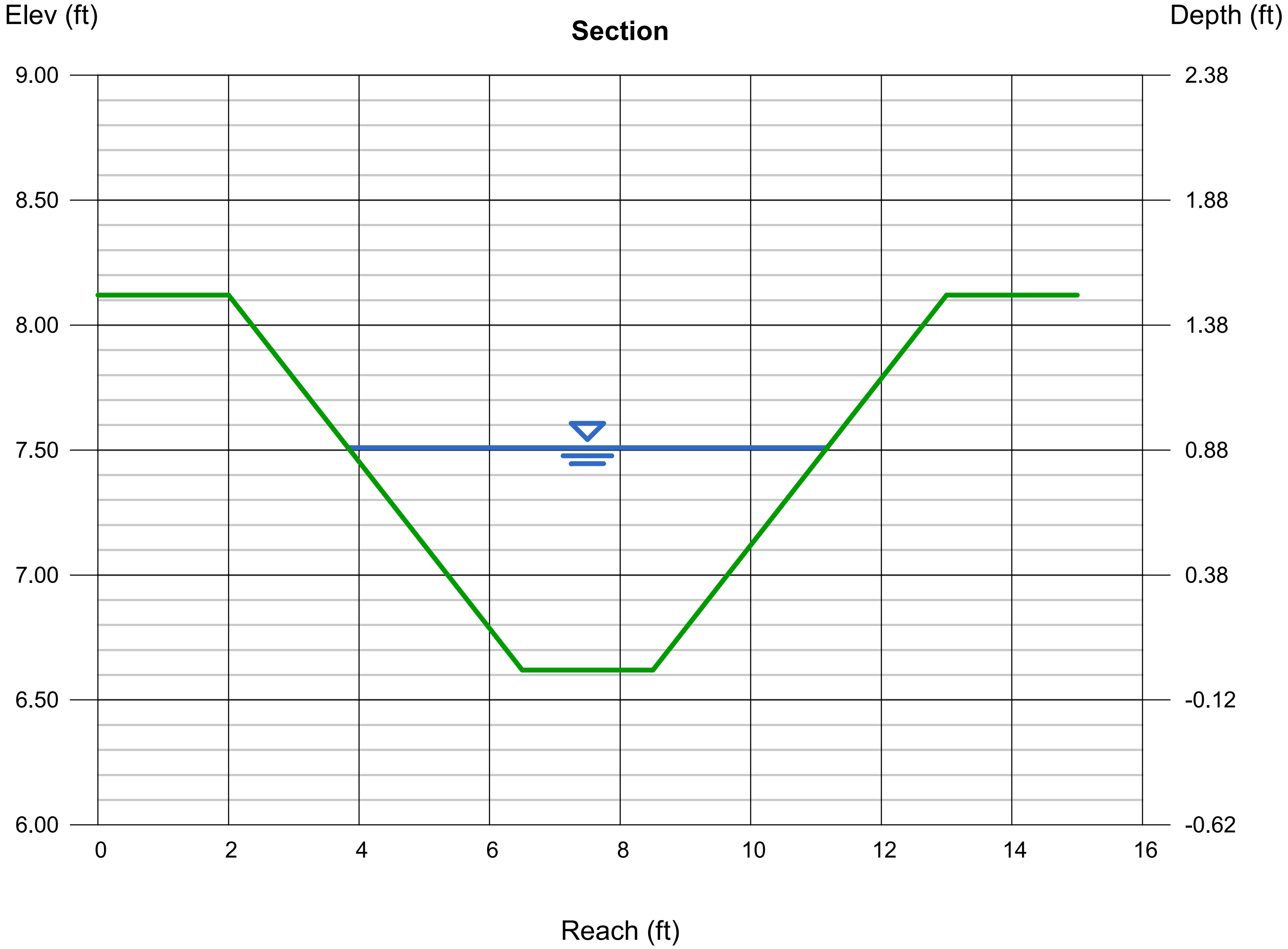
Channel Report

SWALE 4_PDA-1D_100-YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 2.00	Depth (ft)	= 0.89
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 8.450
Total Depth (ft)	= 1.50	Area (sqft)	= 4.16
Invert Elev (ft)	= 6.62	Velocity (ft/s)	= 2.03
Slope (%)	= 0.27	Wetted Perim (ft)	= 7.63
N-Value	= 0.025	Crit Depth, Yc (ft)	= 0.61
		Top Width (ft)	= 7.34
		EGL (ft)	= 0.95

Calculations

Compute by:	Known Q
Known Q (cfs)	= 8.45



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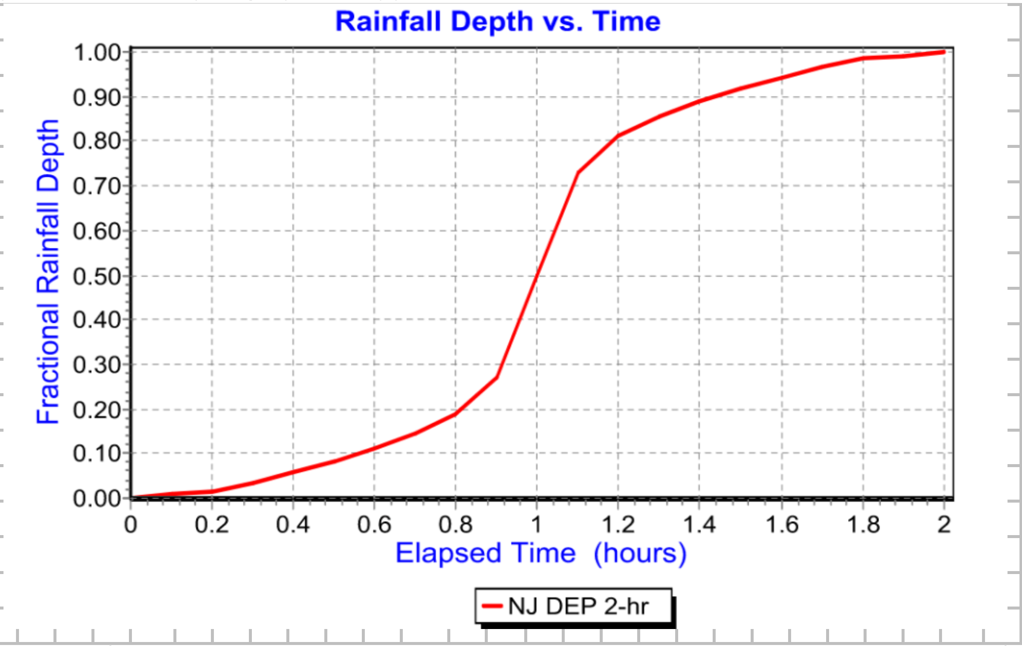
Client	*Ocean Wind 1*	Page	*1* of *1*
Project	Date 12/01/22	Made By	
	Offshore Wind Farm Substation	Checked By	
	Water Quality Volume	Preliminary	Final

The water quality flow to manufactured treatment devices was determined using the NJ 2 Hour, 1.25" WQ Storm in HydroCAD. See Hydragraphs in Appendix B



The Aqua-Ponic Biofiltration Device is an approved MTD on the NJDEP list. It is sized based on flow and contributing driange areas.

Draiange Area	Required WQ Flow (CFS)	Treated WQ Flow (CFS)	Contributing Drainage Area (AC)	Aqua-Ponic Device
PDA-1A	1.52	2.07	2.00	AP-13
PDA-1B	0.39	1.21	1.45	AP-11
PDA-1C	0.41	1.72	1.45	AP-12
PDA-1D	0.57	1.11	1.16	AP-10

The following table is referenced from the Aqua-Ponic Stormwater Biofiltration System NJDEP Certificaiton for 80% TSS Removal Rate.

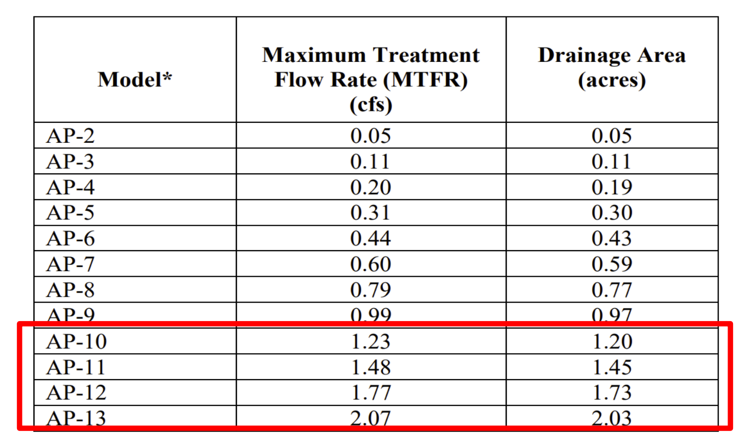


Table 1. Aqua-Ponic^{TM} MTFRs and Maximum Allowable Drainage Areas

Model*	Maximum Treatment Flow Rate (MTFR) (cfs)	Drainage Area (acres)
AP-2	0.05	0.05
AP-3	0.11	0.11
AP-4	0.20	0.19
AP-5	0.31	0.30
AP-6	0.44	0.43
AP-7	0.60	0.59
AP-8	0.79	0.77
AP-9	0.99	0.97
AP-10	1.23	1.20
AP-11	1.48	1.45
AP-12	1.77	1.73
AP-13	2.07	2.03

State of New Jersey
Division of Water Quality
Bureau of Stormwater Permitting
401 East State Street
P.O. Box 420 Mail Code 401-02B
Trenton, New Jersey 08625-0420
Phone: 609-633-7021 / Fax: 609-777-0432
http://www.state.nj.us/dep/dwq/bnpc_home.htm

PHILIP D. MURPHY
Governor

SHEILA Y. OLIVER
Lt. Governor

SHAWN M. LATOURETTE
Acting Commissioner

January 21, 2021

Mark B. Miller
Research Scientist
AquaShield^{TM}, Inc.
2733 Kanasita Drive, Suite 111
Chattanooga, TN 37343

Re: MTD Lab Certification
Aqua-Ponic^{TM} Stormwater Biofiltration System
Off-line Installation

TSS Removal Rate 80%

Dear Mr. Miller:

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7(c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). AquaShield^{TM}, Inc. has requested a Laboratory Certification for the Aqua-Ponic^{TM} Stormwater Biofiltration System.

The project falls under the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advance Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the aforementioned protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report with the Verification Appendix (dated November 2020) for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the Aqua-Ponic™ stormwater treatment unit by AquaShield™ at a TSS removal rate of 80% when designed, operated, and maintained in accordance with the information provided in the Verification Appendix and the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5. The MTFR is calculated based on a verified loading rate of 7.0 gpm/ft^2 of effective filtration treatment area.

2. The Aqua-Ponic™ stormwater treatment unit shall be installed using the same configuration reviewed by NJCAT, and sized in accordance with the criteria specified in item 7 below.

3. This device cannot be used in series with another MTD or a media filter (such as a sand filter) to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

4. Additional design criteria for MTDs can be found in Chapter 9.6 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual, which can be found online at www.njstormwater.org.

5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the Aqua-Ponic™. A copy of the maintenance plan is attached to this certification. However, it is recommended to review the maintenance website at
   maintenance_manual_aqua-ponic_6-20.pdf (aquashieldinc.com) for any changes to the maintenance requirements.

6. For an MTD to be considered "green infrastructure" (GI) in accordance with the March 2, 2020 amendments to the Stormwater Management rules at N.J.A.C. 7:8, the MTD must meet the GI definition noted at amended N.J.A.C. 7:8-1.2. Specifically, the MTD shall (1) treat runoff by infiltration into subsoil; and/or (2) treat stormwater runoff through filtration by vegetation or soil; and/or (3) store stormwater for reuse.

   In order for an Aqua-Ponic™ system to meet the definition of GI, the Aqua-Ponic™ system must treat stormwater runoff through filtration by vegetation. To this end, consistent with the vegetative cover requirement for bioretention systems, the minimum vegetative cover in an Aqua-Ponic™ system is 85% in order to qualify as GI under the Stormwater Management rules at N.J.A.C. 7:8. The vegetative cover should be determined based on the expected coverage of the proposed plantings when matured. Plant death or damage shall require replanting to maintain this 85% coverage requirement if the system is installed as GI.

7. Sizing Requirement:

   The example below demonstrates the sizing procedure for the Aqua-Ponic™:

Example: A 0.25-acre impervious site is to be treated to 80% TSS removal using the Aqua-Ponic^{TM}. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs.

The selection of the appropriate model of Aqua-Ponic^{TM} is based upon both the maximum inflow drainage area and the MTFR. It is necessary to calculate the required model using both methods and to use the largest model determined by the two methods.

Inflow Drainage Area Evaluation:

The drainage area to the Aqua-Ponic^{TM} in this example is 0.25 acres. Included in Table 1 below, several Aqua-Ponic^{TM} models are designed with a maximum allowable drainage area greater than 0.25 acres. Specifically, the Aqua-Ponic^{TM} model AP-5 with a maximum drainage area allowable of 0.30 acres would be the smallest model able to treat runoff without exceeding the maximum allowable drainage area.

Maximum Treatment Flow Rate (MTFR) Evaluation:

The site runoff (Q) was based on the following:
time of concentration = 10 minutes
i = 3.2 in/hr (page 5-8, Fig. 5-3 of the NJ Stormwater BMP Manual)
c = 0.99 (runoff coefficient for impervious)
Q = ciA = 0.99 x 3.2 x 0.25 = 0.79 cfs

Given the site runoff is 0.79 cfs and based on the MTFR's listed in Table 1 below, the AP-8 with an MTFR of 0.79 cfs would be the smallest model that could be used to treat the impervious area without exceeding the MTFR. If using more than one unit for treating runoff, the units should be configured such that the flowrate to each unit does not exceed the design MTFR for each unit and ensuring the entire 0.25 acre area is treated.

The MTFR evaluation results will be used since that method results in the highest minimum configuration determined by the two methods.

The sizing table corresponding to the available system models is noted below:

Table 1. Aqua-Ponic™ MTFRs and Maximum Allowable Drainage Areas

Model*	Maximum Treatment Flow Rate (MTFR) (cfs)	Drainage Area (acres)
AP-2	0.05	0.05
AP-3	0.11	0.11
AP-4	0.20	0.19
AP-5	0.31	0.30
AP-6	0.44	0.43
AP-7	0.60	0.59
AP-8	0.79	0.77
AP-9	0.99	0.97
AP-10	1.23	1.20
AP-11	1.48	1.45
AP-12	1.77	1.73
AP-13	2.07	2.03

Be advised a detailed maintenance plan is mandatory for any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8. The plan must include all of the items identified in the Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact our office at (609) 633-7021.

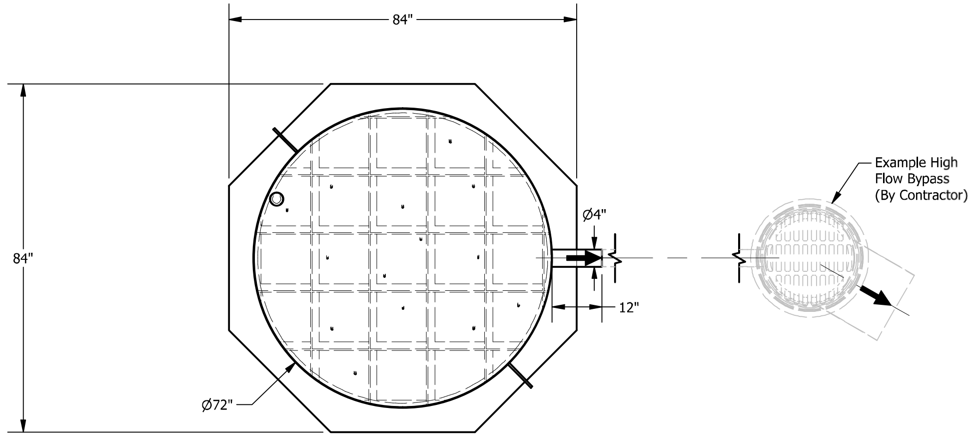
Sincerely,

Gabriel Mahon

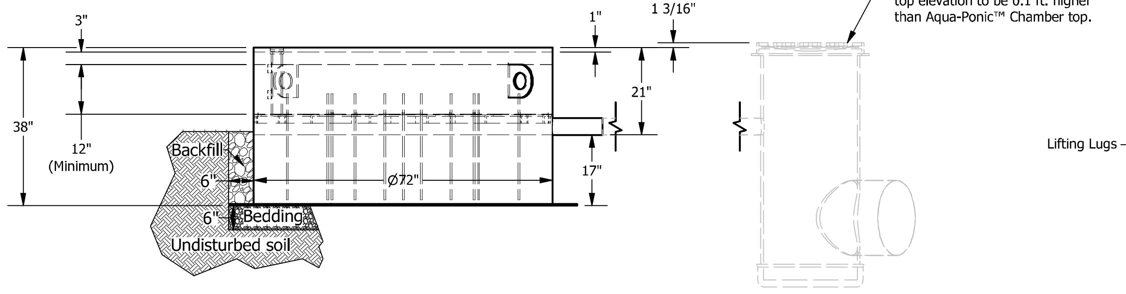
Gabriel Mahon, Chief
Bureau of Stormwater Permitting

Attachment: Maintenance Plan
cc: Chron File
Richard Magee, NJCAT
Vince Mazzei, NJDEP – Water & Land Management
Nancy Kempel, NJDEP– BSTP
Keith Stampfel, NJDEP – DLRP
Dennis Contois, NJDEP – DLRP

Aqua-Ponic™ Polymer Coated Steel (PCS)
Stormwater Biofiltration System



Plan View
SCALE 1:30

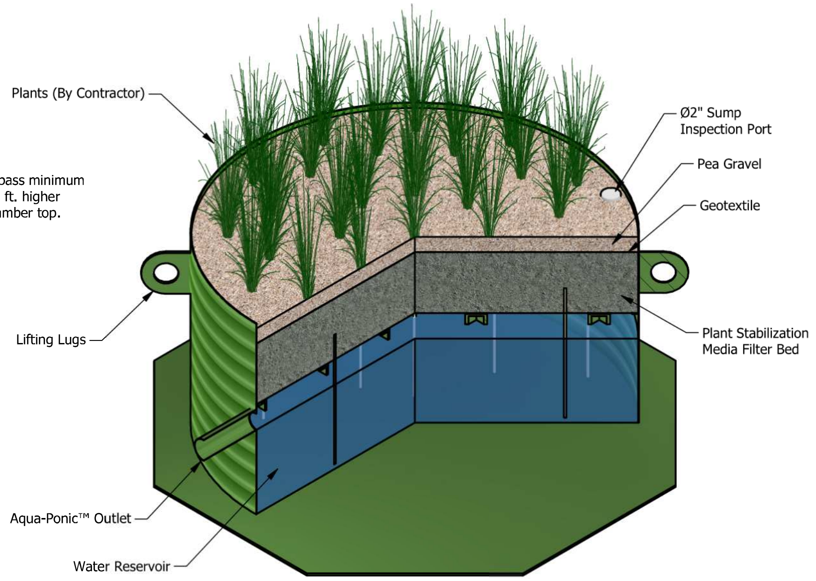


Elevation View
SCALE 1:30

Aqua-Ponic™ Standard Details

Aqua-Ponic™ Model	Chamber Diameter (in)	Minimum Chamber Height (in)*	Outlet Pipe Diameter (in)	Invert Depth from Grade (in)*
AP-2	24"	38"	4"	21"
AP-3	36"			
AP-4	48"			
AP-5	60"			
AP-6	72"			
AP-7	84"	40"	6"	23"
AP-8	96"			
AP-9	108"			
AP-10	120"	42"	8"	25"
AP-11	132"			
AP-12	144"			
AP-13	156"	44"	10"	27"

**** Chamber height & Invert depth based on 12" filter bed depth (18" & 24" available upon request).***



AquaShield™
WATER TREATMENT SOLUTIONS
2733 Kanasita Drive, Suite 111, Chattanooga, TN 37343
Phone (888) 344-9044 Fax (423) 826-2112
www.aquashieldinc.com

Aqua-Ponic™ Stormwater Biofiltration System
(AP-6 Shown)

Standard Detail

		Rvwed	Rvw. Date	Rev Date	Description of Revision
Structure #:	AP-6 STD				
Drawn By:	OFlores				
Scale:	As Shown				
Date:	2/25/2022				

U.S. Patent Pending

Channel Report

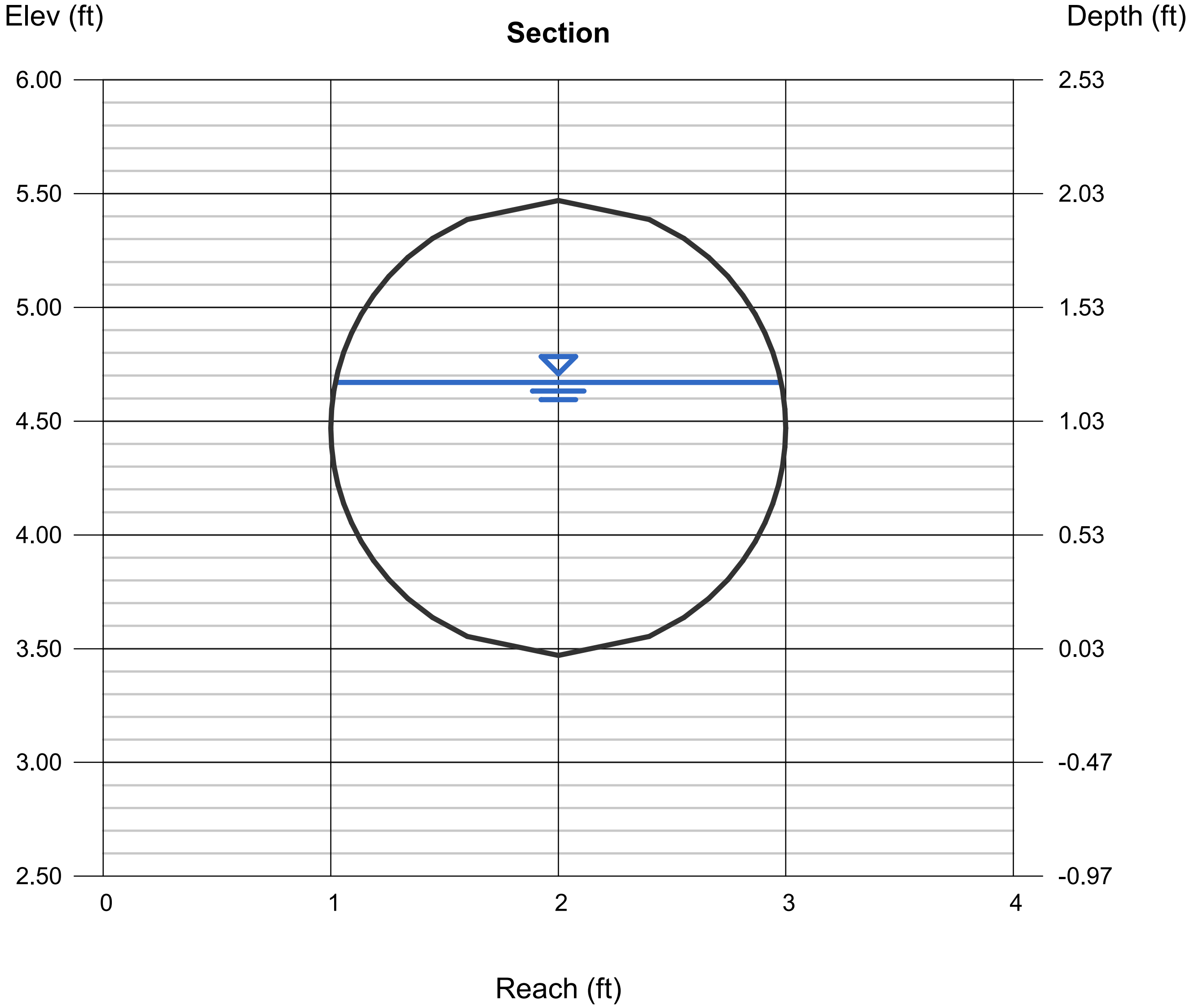
Pipe 1_25YR

Circular
Diameter (ft) = 2.00

Invert Elev (ft) = 3.47
Slope (%) = 0.50
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 10.77

Highlighted
Depth (ft) = 1.20
Q (cfs) = 10.77
Area (sqft) = 1.97
Velocity (ft/s) = 5.46
Wetted Perim (ft) = 3.55
Crit Depth, Yc (ft) = 1.18
Top Width (ft) = 1.96
EGL (ft) = 1.66



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.   Friday, Dec 2 2022

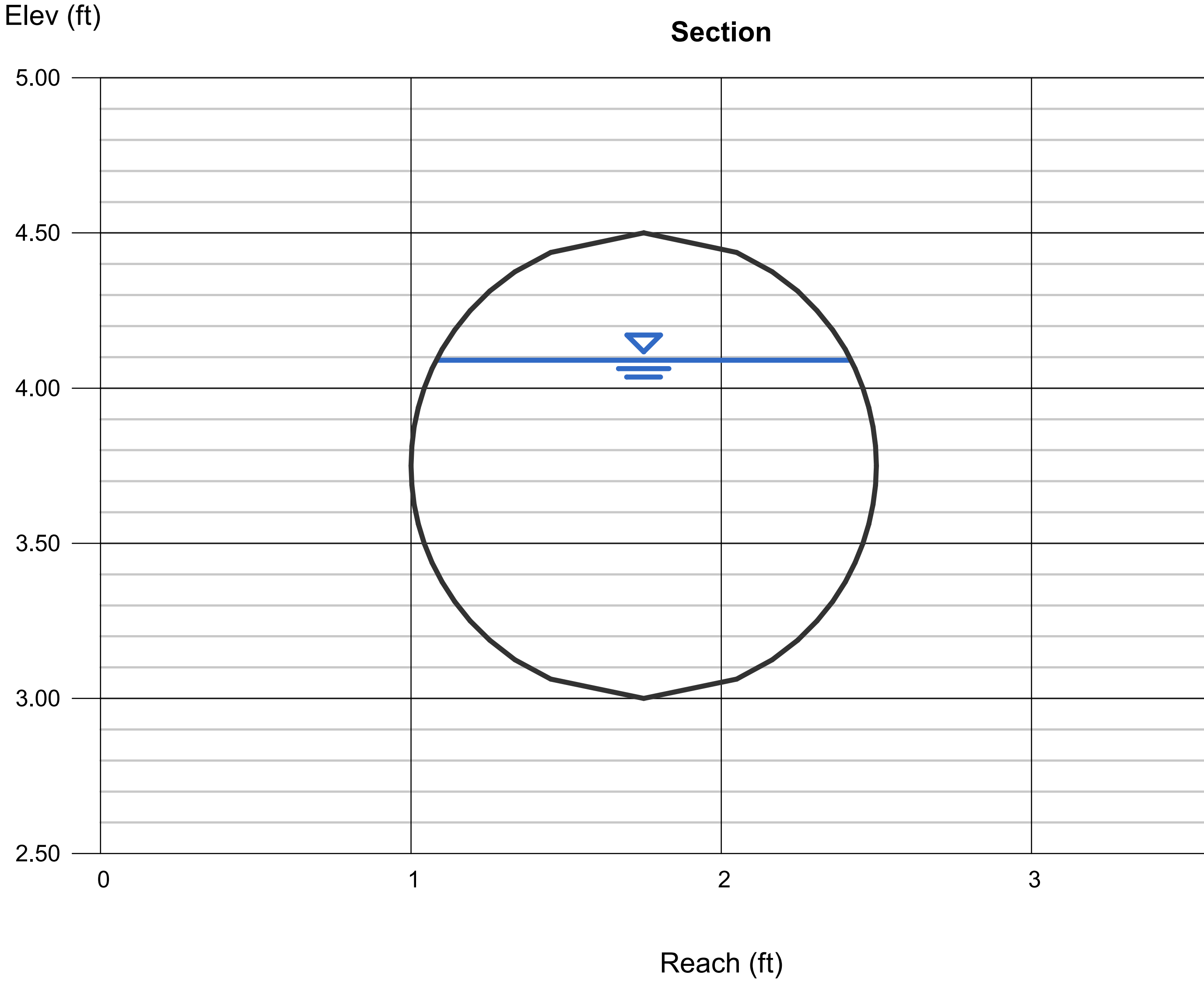
Pipe 2_25YR

Circular
Diameter (ft) = 1.50

Invert Elev (ft) = 3.00
Slope (%) = 0.50
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 6.50

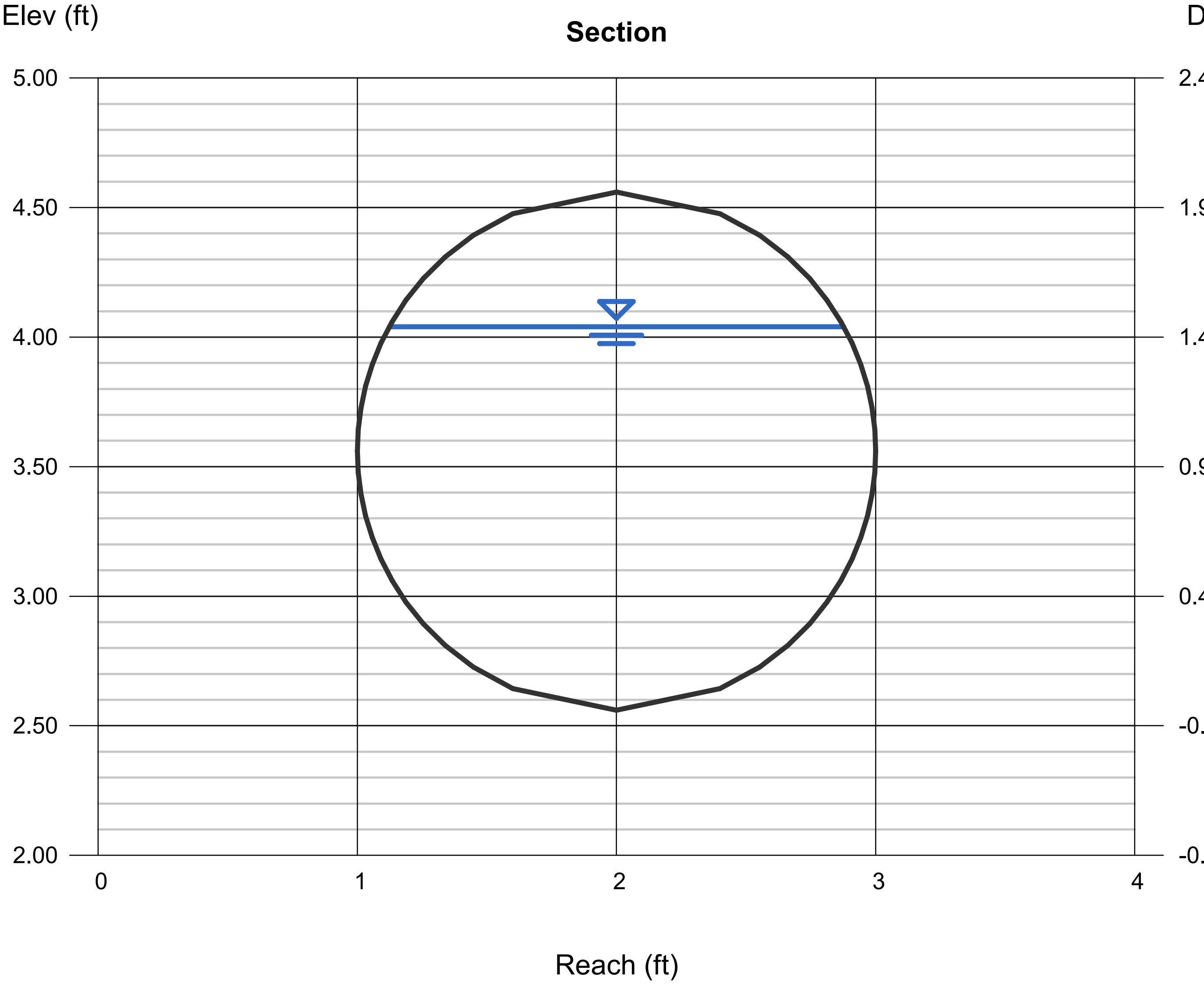
Highlighted
Depth (ft) = 1.09
Q (cfs) = 6.500
Area (sqft) = 1.38
Velocity (ft/s) = 4.71
Wetted Perim (ft) = 3.07
Crit Depth, Yc (ft) = 0.99
Top Width (ft) = 1.33
EGL (ft) = 1.44



Channel Report

Pipe 3_25YR

Circular		**Highlighted**	
Diameter (ft)	= 2.00	Depth (ft)	= 1.48
		Q (cfs)	= 14.34
		Area (sqft)	= 2.50
Invert Elev (ft)	= 2.56	Velocity (ft/s)	= 5.74
Slope (%)	= 0.50	Wetted Perim (ft)	= 4.15
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.37
		Top Width (ft)	= 1.75
Calculations		EGL (ft)	= 1.99
Compute by:	Known Q		
Known Q (cfs)	= 14.34		



Channel Report

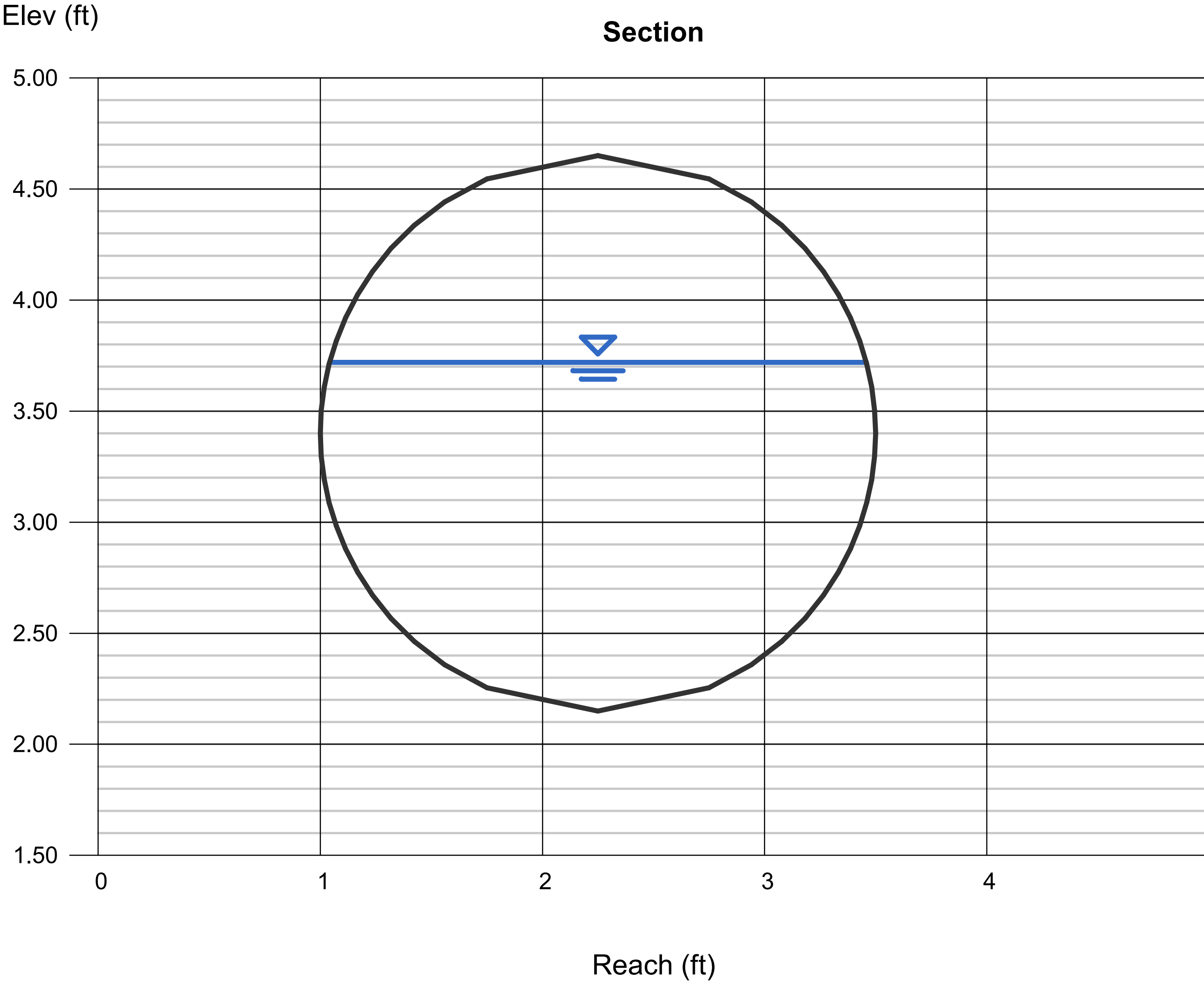
Pipe 4_25YR

Circular
Diameter (ft) = 2.50

Invert Elev (ft) = 2.15
Slope (%) = 0.50
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 20.84

Highlighted
Depth (ft) = 1.57
Q (cfs) = 20.84
Area (sqft) = 3.25
Velocity (ft/s) = 6.42
Wetted Perim (ft) = 4.57
Crit Depth, Yc (ft) = 1.55
Top Width (ft) = 2.42
EGL (ft) = 2.21



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Client *Ocean Wind 1* Page 1 of
Project Date 12/01/22 Made By LMG
Offshore Wind Farm Substation Checked By
Outlet Protection - FES-1 Preliminary Final x

Conduit Outlet Protection Sizing

Equations:

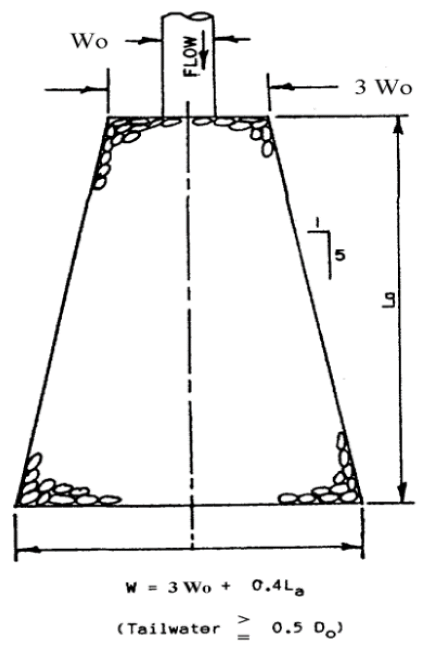
$$TW \geq \tfrac{1}{2} D_o \qquad La = 3\left(\frac{q}{Do^{0.5}}\right)$$

$$Wa = 3Wo + 0.4La$$

Where:
La - Length of Apron (FT)
Wa - Width of Apron at Downstream Side (FT)
Wo - Maximum Inside Culvert Width FT)
Do - Maximum Inside Culvert Height (FT)
q - Unit Discharge (CFS / FT)

$$\text{where} \quad q = \frac{Q}{Wo}$$

Q25 = 10.77 CFS
Wo= 2.0 FT
Do = 2.0 FT
q = 5.39 CFS/FT
La = 11 FT
Wa = 11 FT



Riprap Sizing

$$d_{50} = \frac{0.02}{Tw} q^{1.33}$$

Where:
d50 - Median Stone Size
Tw - Tailwater Depth Above the Culvert Invert (FT)
q - Unit Discharge (CFS / FT)

Tw = 0.8 FT
d50 = 0.23 FT

d50 = 3 IN (MIN)

50% by weight of riprap mixture shall be smaller than the median size stone (d50). Largest stone size in the mixture shall be 1.5 times the d50 size
Thickness, T = 2 times the d50 size with a geotextile filter layer (minimum 6 IN)
d50 size is minimum, availabe d50 stone shall be greater than or equal to calculated diameter.

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Client	*Ocean Wind 1*	Page	1 of
Project	Date 12/01/22	Made By	LMG
	Offshore Wind Farm Substation	Checked By	
	Outlet Protection - FES-2	Preliminary	Final x

Conduit Outlet Protection Sizing

Equations:

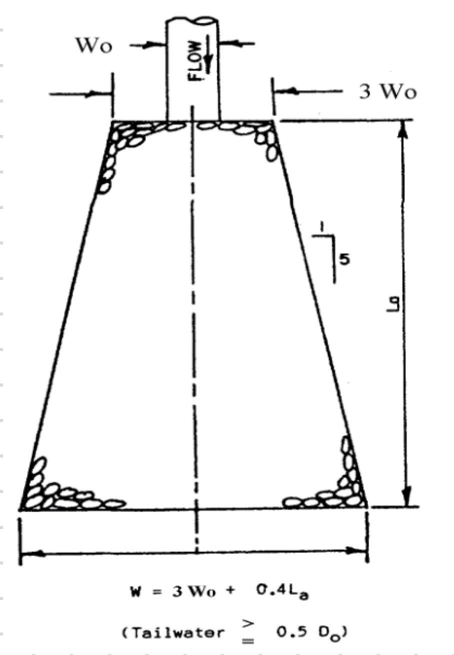
$$TW \geq \tfrac{1}{2} D_o \qquad La = 3\left(\frac{q}{Do^{0.5}}\right)$$

$$Wa = 3Wo + 0.4La$$

Where:
La - Length of Apron (FT)
Wa - Width of Apron at Downstream Side (FT)
Wo - Maximum Inside Culvert Width FT)
Do - Maximum Inside Culvert Height (FT)
q - Unit Discharge (CFS / FT)

where $q = \frac{Q}{Wo}$

Q25 = 20.84 CFS
Wo= 2.5 FT
Do = 2.5 FT
q = 8.34 CFS/FT
La = 16 FT
Wa = 14 FT



Riprap Sizing

$$d_{50} = \frac{0.02}{Tw} q^{1.33}$$

Where:
d50 - Median Stone Size
Tw - Tailwater Depth Above the Culvert Invert (FT)
q - Unit Discharge (CFS / FT)

Tw = 0.63 FT
d50 = 0.53 FT

d50 = 6 IN (MIN)

50% by weight of riprap mixture shall be smaller than the median size stone (d50). Largest stone size in the mixture shall be 1.5 times the d50 size
Thickness, T = 2 times the d50 size with a geotextile filter layer (minimum 6 IN)
d50 size is minimum, availabe d50 stone shall be greater than or equal to calculated diameter.

APPENDIX D – FEMA FLOOD INSURANCE RATE MAP

National Flood Hazard Layer FIRMette

FEMA

74°38'29"W 39°17'36"N

74°37'51"W 39°17'8"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	🟦	Without Base Flood Elevation (BFE) *Zone A, V, A99*
		With BFE or Depth *Zone AE, AO, AH, VE, AR*
	▨	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	🟧	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	▨	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	▨	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	▨	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
	▭	Effective LOMRs
	▭	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	— — —	Channel, Culvert, or Storm Sewer
	IIIIIII	Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8 — — —	Coastal Transect
	~~ 513 ~~~	Base Flood Elevation Line (BFE)
	—	Limit of Study
	—	Jurisdiction Boundary
	— — —	Coastal Transect Baseline
	— —	Profile Baseline
	—	Hydrographic Feature
MAP PANELS	☐	Digital Data Available
	⬚	No Digital Data Available
	☒	Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

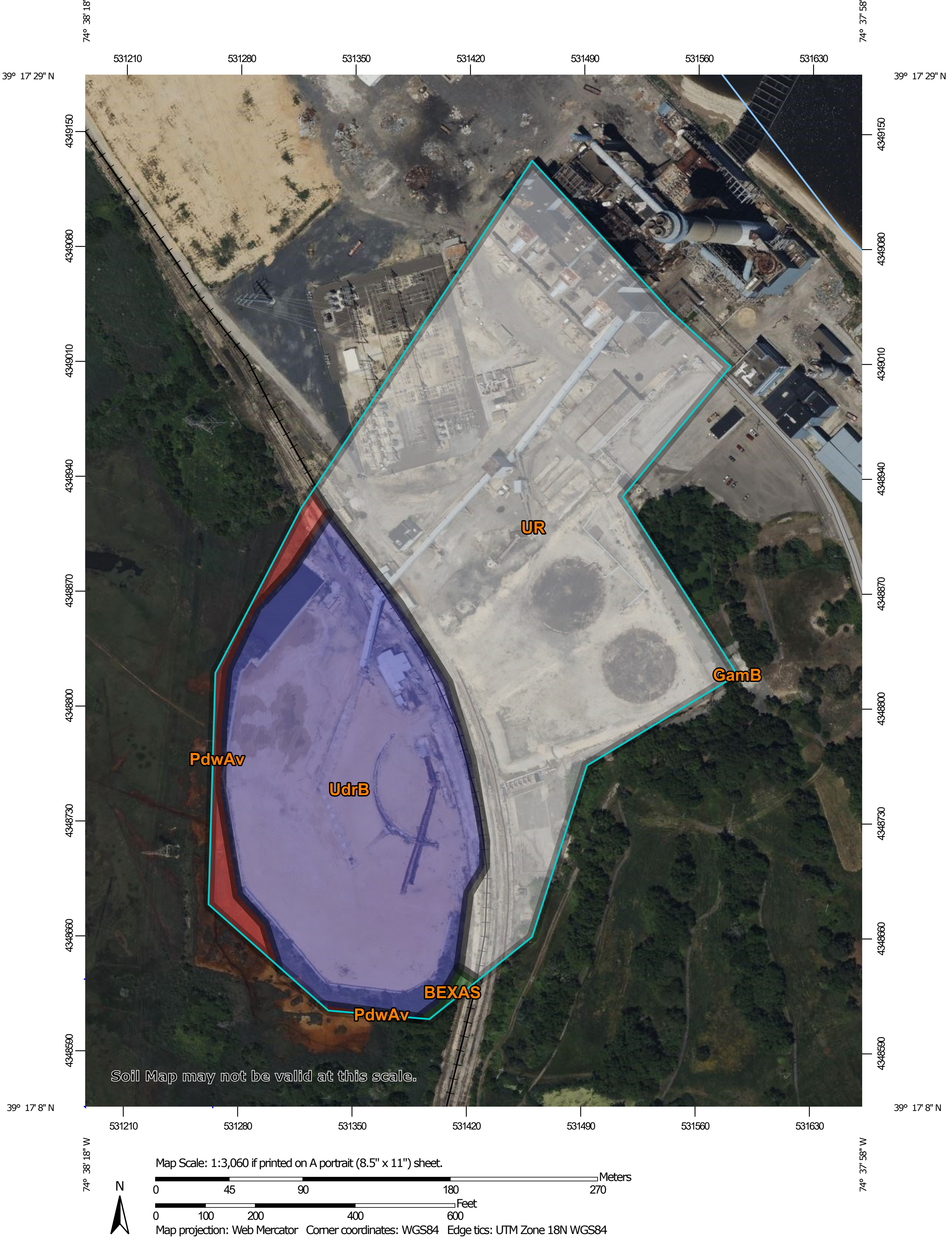
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/20/2022 at 4:02 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX E – WEB SOIL SURVEY REPORT

Hydrologic Soil Group—Cape May County, New Jersey



Map Scale: 1:3,060 if printed on A portrait (8.5" x 11") sheet.

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

MAP LEGEND

Area of Interest (AOI)

☐ Area of Interest (AOI)

Soils

Soil Rating Polygons

- ▭ A
- ▭ A/D
- ▭ B
- ▭ B/D
- ▭ C
- ▭ C/D
- ▭ D
- ▭ Not rated or not available

Soil Rating Lines

- 〰 A
- 〰 A/D
- 〰 B
- 〰 B/D
- 〰 C
- 〰 C/D
- 〰 D
- 〰 Not rated or not available

Soil Rating Points

- ■ A
- ■ A/D
- ■ B
- ■ B/D
- ■ C
- ■ C/D
- ■ D
- ■ Not rated or not available

Water Features

- 〰 Streams and Canals

Transportation

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

Background

- ▦ Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Cape May County, New Jersey
Survey Area Data: Version 17, Aug 30, 2021

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

Date(s) aerial images were photographed: Data not available.

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BEXAS	Berryland and Mullica soils, 0 to 2 percent slopes, occasionally flooded	A/D	0.1	0.3%
GamB	Galloway loamy sand, 0 to 5 percent slopes	A/D	0.0	0.0%
PdwAv	Pawcatuck-Transquaking complex, 0 to 1 percent slopes, very frequently flooded	D	0.7	3.0%
UdrB	Udorthents, refuse substratum, 0 to 8 percent slopes	B	8.7	35.2%
UR	Urban land		15.1	61.5%
Totals for Area of Interest			**24.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

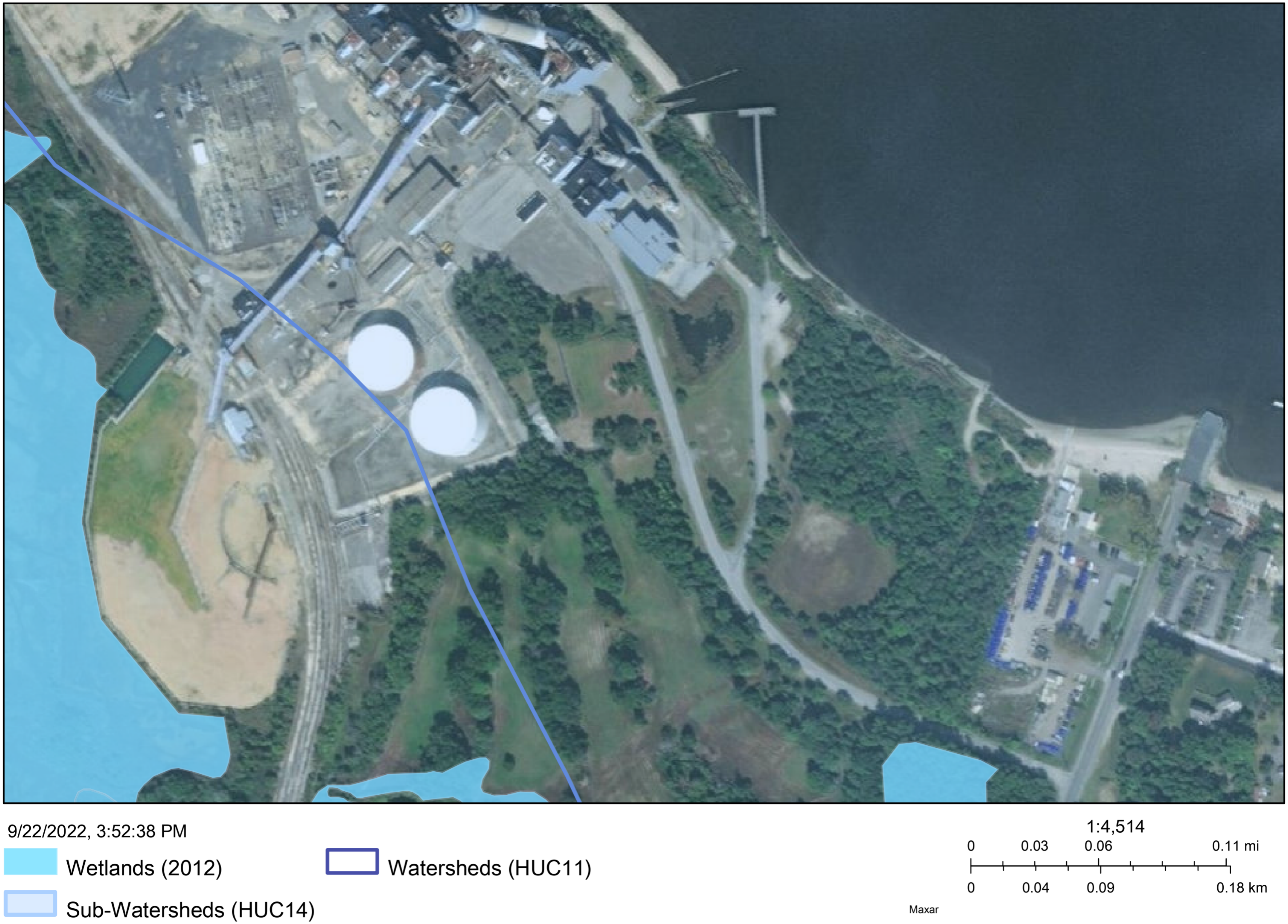
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX F – NJ-GEOWEB DATA

900 North Shore Road NJ-GeoWeb Mapper



9/22/2022, 3:52:38 PM

New Jersey Department of Environmental Protection

NJDEP | NJDEP, Bureau of Energy and Sustainability Edition 20190327 | NJDEP, Division of Fish and Wildlife (DFW), Office of Fish and Wildlife Information Systems. | -NJ Office of Information Technology, Office of GIS (NJOGIS)

APPENDIX G – OPERATION AND MAINTENANCE PLAN

STORMWATER MANAGEMENT REPORT
OPERATION AND MAINTENANCE PLAN

Table of Contents

Appendix

STORMWATER MANAGEMENT REPORT
OPERATION AND MAINTENANCE PLAN

Ocean Wind 1
BLW01 Offshore Wind Farm Substation
Upper Township, New Jersey

1.0 GENERAL OVERVIEW

Ocean Wind 1 has established an Operations and Maintenance (O&M) plan for the improvements to the post-construction stormwater management system for the Offshore Wind arm Substation located at 900 North Shore Avenue, Upper Townhip, NJ. The O&M plan will be implemented upon completion of construction as outlined below. Any required post construction stormwater management permits will be obtained and implemented by Ocean Wind 1.

Operation and maintenance procedures made part of this Plan shall be in addition to any operation and maintenance procedures already in place at the facility.

1.1 Purpose and Goals

The purpose of this O&M Plan is to provide guidance for the implementation and documentation process of the facility's site stormwater management system associated with the improvements made at substation to help conform with the corresponding regulatory agency approvals and permits. The guidance provided herein is the minimum required. The primary goal is to inform all the property managers about how the system operates and what maintenance items are necessary to protect the downstream waters. The secondary goal is to provide a practical, efficient means of maintenance planning and record keeping to verify permit compliance.

2.0 MAINTENANCE PLAN PROCEDURES AND RESPONSIBLE PARTY

Responsible Person:

Name: ____

Address: ____

Email: ____

Phone: ____

Ocean Wind 1, as the owner of the stormwater system, shall be responsible for implementing the O&M Plan and shall follow all procedures per the NJDEP Stormwater Management Rules.

a) The responsible party shall provide a copy of this Maintenance Plan to the local mosquito control or extermination commission upon request.
b) The title and date of the maintenance plan and the name, address, and telephone number of the person with stormwater management measure maintenance responsibility as specified in the plan must be recorded on the deed of the property on which the measure is located.
c) The person with maintenance responsibility must evaluate the maintenance plan for effectiveness at least annually and revise as necessary.
d) A detailed, written log of all preventative and corrective maintenance performed at the stormwater management measure must be kept, including a record of all inspections and copies of maintenance-related work orders.
e) The person with maintenance responsibility must retain and, upon request, make available the maintenance plan and associated logs and other records for review by a public entity with administrative, health, environmental, or safety authority over the site.

3.0 TRAINING

Responsible operations and maintenance workers and contractors will be trained with a basic description of the purpose and function of the onsite stormwater management system as well as safety protocol and procedures, with annual up-dates, to provide that the workers tasked with maintaining the facility site do so in accordance with the approved permit conditions. All workers that have maintenance duties will be adequately informed of their responsibilities. All sub-contractors (Vactor, landscaping, snowplowing, etc.) will be informed of special requirements and responsibilities.

4.0 EXISTING STORMWATER MANAGEMENT SYSTEM

The existing stormwater management system shall continue to be maintained under the existing operation and maintenance plan already in place at the site. This includes, but is not limited to, existing riprap protection, catch basins and swales.

5.0 STORMWATER MANAGEMENT SYSTEM

The onsite stormwater management system has several components that perform functions in conveying and treating stormwater runoff. Refer to the Site Plans or the Facilities Map in Appendix F for locations and details for each of the stormwater system components. Regular operations and maintenance are critical to the long-term success of the stormwater management system components. The stormwater system components are:

- Grass Swales
- Flared End Section and Riprap
- Manufactured Treatment Device

5.1 Grass Swale

Regular and effective maintenance is crucial to ensure effective grass swale performance. Specific maintenance requirements are listed below:

General Maintenance:

- All components must be inspected, at least once annually, for cracking, subsidence, spalling, erosion and deterioration.
- Components expected to receive and/or trap debris must be inspected for clogging at least twice annually, as well as after every storm exceeding 1 inch of rainfall.
- Sediment removal should take place when the swale is thoroughly dry and should not result in the loss of vegetation.

Vegetated Areas:

- Bi-weekly inspections are required when establishing/restoring vegetation.
- A minimum of one inspection during the growing season and one inspection during the non-growing season is required to ensure the health, density and diversity of the vegetation.
- Vegetative cover must be maintained at 95%; damage must be addressed through replanting in accordance with the original specifications.

- Mowing and/or trimming of vegetation should be performed on a regular schedule based on specific site conditions.
- Grass outside of the swale should be mowed at least once a month during growing season. Grass height shall fall in the range of 3 to 6 inches.
- Grass clippings must either be removed or sufficiently small to avoid both damage to the turf and the facilitation of mosquito breeding.
- Vegetated areas must be inspected at least once annually for erosion, scour and unwanted growth; any unwanted growth should be removed with minimum disruption to the soil bed and remaining vegetation.
- If disruption to the vegetation occurs, the area must be re-seeded. If ponding in excess of 72 hours occurs, action must be taken to either re-establish the appropriate slope and/or permeability rate of the soil bed.
- All use of fertilizers, mechanical treatments, pesticides and any other means utilized to assure optimum vegetation health should not compromise the intended purpose of the manufactured treatment device at the end of each swale.

5.2 Flared End Section and Riprap

Fared end sections and riprap refers to the new outlet point where runoff from the proposed MTS discharge into the existing wetlands. The flared end section and riprap shall be inspected for structural damage, erosion, scour and riprap washout at least one time per year. Inspections for debris and sediment buildup shall be done and at least 4 times per year and after runoff events exceeding 1-inch of rainfall. The following is recommended for regular maintenance:

- Inspect riprap for washout and bare areas. Displaced riprap within the apron shall be replaced immediately to prevent scouring.
- Inspect riprap and flared end section for accumulated sediment and debris. Sediment and debris shall be removed and properly disposed.
- The flared end section shall be inspected for damage and deterioration. Repairs to the flared end section shall be made as needed.

5.5 Manufactured Device – Aqua-Ponic Stormwater Biofiltration System

The manufactured treatment devise used to provide treatment of motor vehicle surfaces on site shall be maintained and inspected in accordance with the manufacturer's recommendations found in the Appendix. It is recommended that the device be inspected quarterly for the first years to determine the appropriate maintenance frequency required for subsequent years.

5.6 Disposal

All sediment, debris, trash, etc. removed from the stormwater management system during operations and maintenance shall be disposed of at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

6.0 MAINTENANCE EQUIPMENT AND MATERIALS

Listed below is equipment and materials that may be needed to properly maintain the stormwater management facilities at the site. These lists are not all inclusive.

Note: Only light equipment is allowed to be used within open basins to prevent compaction.

6.1 Grass Maintenance Equipment

a) Riding Mowers
b) Hand Mowers
c) Gas Powered Trimmers
d) Gas Powered Edgers
e) Seed Spreaders
f) Fertilizer Spreaders
g) De-Thatching Equipment
h) Pesticide and Herbicide Application Equipment
i) Grass Clipping and Leaf Collection Equipment

6.2 Vegetative Maintenance Equipment

a) Saws
b) Pruning Shears

c) Hedge Trimmers

d) Aquatic Weed Harvester (owned/operated by subcontractor)

6.3 Transportation Equipment

6.4 Debris, Trash and Sediment Removal Equipment

a) Loader (not to be used in the bottom of basins)

b) Backhoe (not to be used in the bottom of the basins)

c) Grader (not to be used in the bottom of the basins)

d) Dredging Equipment (not to be used in the bottom of the basins)

e) Portable Pump for Dewatering

f) Jet Vac Equipment for removal of sediment in underground pipe & chamber basins

6.5 Manufactured Treatment Device Maintenance Equipment

a) Crowbar or other tool to remove cover

b) Pole with skimmer or net (floatable removal)

c) Sediment Probe (such as a Sludge Judge)

d) Vactor Truck with flexible hose

6.6 Miscellaneous Equipment

a) Shovels

b) Wheelbarrows

c) Gloves

d) Hand Pushed Tilling Machine

e) Brooms

6.7 Standard Mechanics Tools

6.8 Tools for Maintenance of Equipment

6.9 Materials

a) Topsoil

b) Fill

c) Seed

d) Soil Amenities (Fertilizer, Lime, etc.)
e) Chemicals (Pesticides, Herbicides, etc.)
f) Mulch
g) Paint Removers
h) Spare Parts for Equipment

6.10 Parking Maintenance Equipment

a) Sweeping/Vacuuming Equipment
b) Trash Receptacles
c) Snow Plowing Equipment
d) Snow Shovels

7.0 RECORD KEEPING AND LOGS

Record keeping for operation and maintenance is required per the NJDEP Stormwater Management Design Manual. The following record keeping forms are provided in the appendix:

- Appendix A – Maintenance Work Orders and Checklists
- Appendix B – Maintenance Logs for Stormwater Management Facilities
- Appendix C - Inspection Logs for Stormwater Management Facilities
- Appendix E – Manufacturer's Operation and Maintenance Manual for Aqua-Ponic Stormwater Biofiltration System

NJDEP Stormwater Design Manual, Chapter 8 for Maintenance is provided in Appendix D and a Facilities Map is provided in Appendix F

8.0 OPERATION AND MAINTENANCE BUDGET

Operation and maintenance shall be performed as outlined in this document. The estimated yearly cost to perform all inspections is $3,250.00. Corrective and preventative maintenance shall be performed as needed. The cost estimate provided in Appendix G breaks down the individual costs for inspections and preventative and corrective maintenance.

* * * * *

APPENDIX A
MAINTENANCE WORK ORDERS & CHECKLISTS

MAINTENANCE WORK ORDER AND CHECKLIST

FACILITY: OCEAN WIND 1 OFFSHORE WIND FARM SUBSTATION, UPPER TOWNSHIP, NJ

DATE OF INSPECTION: ____________________

PERSON/CREW PERFORMING INSPECTIONS: ____________________

WORK START TIME: ____________________ WORK END TIME: ____________________

A. PREVENTATIVE MAINTENANCE

WORK ITEM	ITEMS REQUIRED (X)	ITEMS COMPLETE (X)	COMMENTS AND SPECIAL INSTRUCTIONS

1. GRASS CUTTING

BOTTOMS			
BASIN EMBANKMENT AND SIDE SLOPES			
PERIMETER AREAS			
ACCESS AREAS AND ROADS			
OTHER			

2. GRASS MAINTENANCE

FERTILIZING			
RE-SEEDING			
DE-THATCHING			
PEST CONTROL			
OTHER			

3. VEGETATIVE COVER

FERTILIZING			
PRUNING			
PEST CONTROL			
OTHER			

4. TRASH AND DEBRIS REMOVAL

BOTTOMS			
BASIN EMBANKMENT AND SIDE SLOPES			
PERIMETER AREAS			
ACCESS AREAS AND ROADS			
INLETS			
OUTLETS AND TRASH RACKS			
OTHER			

5. SEDIMENT REMOVAL

BOTTOMS			
INLETS			
OUTLETS AND TRASH RACKS			
OTHER			

6. MOSQUITOS

ELIMINATION OF POTENTIAL MOSQUITO BREEDING HABITATS			

7. INFILTRATION BASIN

TILLING BOTTOM SAND LAYER			

8. OTHER PREVENTATIVE MAINTENANCE

PARKING LOT SWEEPING			
EMPTYING TRASH RECEPTACLES			

B. CORRECTIVE MAINTENANCE

WORK ITEM	ITEMS REQUIRED (X)	ITEMS COMPLETE (X)	COMMENTS AND SPECIAL INSTRUCTIONS
1. REMOVAL OF DEBRIS AND SEDIMENT			
2. STRUCTURAL REPAIRS			
3. EMBANKMENTS AND SIDE SLOPES			
4. DEWATERING			
5. BASIN MAINTENANCE			
6. CONTROL OF MOSQUITOES			
7. EROSION REPAIR			
8. SNOW AND ICE REMOVAL			
9. OTHER			

C. AESTHETIC MAINTENANCE

WORK ITEM	ITEMS REQUIRED (X)	ITEMS COMPLETE (X)	COMMENTS AND SPECIAL INSTRUCTIONS
1. GRAFFITI REMOVAL			
2. GRASS TRIMMING			
3. WEEDING			
4. OTHER			

NOTES (refer to item number, if applicable):

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WORK ORDER PREPARED BY: ____

APPENDIX B
MAINTENANCE LOGS FOR STORMWATER MANAGEMENT FACILITIES

MAINTENANCE LOGS

FACILITY: OCEAN WIND 1 OFFSHORE WIND FARM SUBSTATION, UPPER TOWNSHIP, NJ

DATE OF INSPECTION: ____________________

PERSON/CREW PERFORMING INSPECTIONS: ____________________

WORK START TIME:____________________ WORK END TIME:____________________

A. PREVENTATIVE MAINTENANCE

WORK ITEM	ITEMS REQUIRED (X)	DATE REQUIRED	ITEMS COMPLETE (X)	DATE COMPLETE	COMMENTS AND SPECIAL INSTRUCTIONS
1. GRASS CUTTING					
BOTTOMS					
BASIN EMBANKMENT AND SIDE SLOPES					
PERIMETER AREAS					
ACCESS AREAS AND ROADS					
OTHER					
2. GRASS MAINTENANCE					
FERTILIZING					
RE-SEEDING					
DE-THATCHING					
PEST CONTROL					
OTHER					
3. VEGETATIVE COVER					
FERTILIZING					
PRUNING					
PEST CONTROL					
OTHER					

WORK ITEM	ITEMS REQUIRED (X)	DATE REQUIRED	ITEMS COMPLETE (X)	DATE COMPLETE	COMMENTS AND SPECIAL INSTRUCTIONS

4. TRASH AND DEBRIS REMOVAL

BOTTOMS					
BASIN EMBANKMENT AND SIDE SLOPES					
PERIMETER AREAS					
ACCESS AREAS AND ROADS					
INLETS					
OUTLETS AND TRASH RACKS					
OTHER					

5. SEDIMENT REMOVAL

BOTTOMS					
INLETS					
OUTLETS AND TRASH RACKS					
OTHER					

6. MOSQUITOS

ELIMINATION OF POTENTIAL MOSQUITO BREEDING HABITATS					

7. INFILTRATION BASIN

TILLING BOTTOM SAND LAYER					

8. OTHER PREVENTATIVE MAINTENANCE

PARKING LOT SWEEPING					
EMPTYING TRASH RECEPTACLES					

B. CORRECTIVE MAINTENANCE

WORK ITEM	ITEMS REQUIRED (X)	DATE REQUIRED	ITEMS COMPLETE (X)	DATE COMPLETE	COMMENTS AND SPECIAL INSTRUCTIONS
1. REMOVAL OF DEBRIS AND SEDIMENT					
2. STRUCTURAL REPAIRS					
3. EMBANKMENTS AND SIDE SLOPES					
4. DEWATERING					
5. BASIN MAINTENANCE					
6. CONTROL OF MOSQUITOES					
7. EROSION REPAIR					
8. SNOW AND ICE REMOVAL					
9. OTHER					

C. AESTHETIC MAINTENANCE

WORK ITEM	ITEMS REQUIRED (X)	DATE REQUIRED	ITEMS COMPLETE (X)	DATE COMPLETE	COMMENTS AND SPECIAL INSTRUCTIONS
1. GRAFFITI REMOVAL					
2. GRASS TRIMMING					
3. WEEDING					
4. OTHER					

NOTES (refer to item number, if applicable):

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WORK PERFORMED BY: ____

APPENDIX C
INSPECTION LOGS FOR STORMWATER MANAGEMENT FACILITIES

INSPECTION LOG

FACILITY: OCEAN WIND 1 OFFSHORE WIND FARM SUBSTATION, UPPER TOWNSHIP, NJ

DATE OF INSPECTION: ____________________

PERSON/CREW PERFORMING INSPECTIONS: ____________________

WORK START TIME: ____________________ WORK END TIME: ____________________

A. PREVENTATIVE MAINTENANCE

WORK ITEM	OK (1)	ROUTINE (2)	URGENT (3)	COMMENTS (4)
1. GRASS CUTTING				
BOTTOMS				
BASIN EMBANKMENT AND SIDE SLOPES				
PERIMETER AREAS				
ACCESS AREAS AND ROADS				
OTHER				
2. GRASS MAINTENANCE				
FERTILIZING				
RE-SEEDING				
DE-THATCHING				
PEST CONTROL				
OTHER				
3. VEGETATIVE COVER				
FERTILIZING				
PRUNING				
PEST CONTROL				
OTHER				

WORK ITEM	OK (1)	ROUTINE (2)	URGENT (3)	COMMENTS (4)

4. TRASH AND DEBRIS REMOVAL

BOTTOMS				
BASIN EMBANKMENT AND SIDE SLOPES				
PERIMETER AREAS				
ACCESS AREAS AND ROADS				
INLETS				
OUTLETS AND TRASH RACKS				
OTHER				

5. SEDIMENT REMOVAL

BOTTOMS				
INLETS				
OUTLETS AND TRASH RACKS				
OTHER				

6. MOSQUITOS

ELIMINATION OF POTENTIAL MOSQUITO BREEDING HABITATS				

7. INFILTRATION BASIN

TILLING BOTTOM SAND LAYER				

8. OTHER PREVENTATIVE MAINTENANCE

PARKING LOT SWEEPING				
EMPTYING TRASH RECEPTACLES				

B. CORRECTIVE MAINTENANCE

WORK ITEM	OK (1)	ROUTINE (2)	URGENT (3)	COMMENTS (4)
1. REMOVAL OF DEBRIS AND SEDIMENT				
2. STRUCTURAL REPAIRS				
3. EMBANKMENTS AND SIDE SLOPES				
4. DEWATERING				
5. BASIN MAINTENANCE				
6. CONTROL OF MOSQUITOES				
7. EROSION REPAIR				
8. SNOW AND ICE REMOVAL				
9. OTHER				

C. AESTHETIC MAINTENANCE

WORK ITEM	OK (1)	ROUTINE (2)	URGENT (3)	COMMENTS (4)
1. GRAFFITI REMOVAL				
2. GRASS TRIMMING				
3. WEEDING				
4. OTHER				

1. The item checked is in good condition and the maintenance program is adequate.
2. The item checked required attention but does not present an immediate threat to the facility function or other facility components.
3. The item checked requires immediate attention to keep the facility operational or to prevent damage to other facility components.
4. Provide explanation and details if columns 2 or 3 are checked.

NOTES (refer to item number, if applicable):

____

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INSPECTIONS COMPLETED BY: ____

APPENDIX D

NJ STORMWATER BEST MANAGEMENT PRACTICE MANUAL: CHAPTER 8 MAINTENANCE AND RETROFIT OF STORMWATER MANAGEMENT MEASURES

CHAPTER 8

Maintenance and Retrofit of Stormwater Management Measures

Maintenance of Stormwater Management Measures

Research and experience have demonstrated that regular and thorough maintenance is necessary for stormwater management measures to perform effectively and reliably. They have also demonstrated that failure to perform such maintenance can lead to diminished performance, deterioration, and failure, in addition to a range of health and safety problems including mosquito breeding, vermin, and the potential for drowning. The potential for such problems to develop is accentuated by many of the very features and characteristics that allow stormwater management measures to do their job, including standing or slowing moving water, dense vegetation, forebays, trash racks, dams, and the need to continually function in all types of weather. As implied by their name, stormwater management measures are also expected to become the repositories for sediment, nutrients, trash, debris, and other pollutants targeted by the NJDEP Stormwater Management Rules. For this reason, stormwater management measures share maintenance requirements with more mundane items as vacuum cleaner bags, car motor filters, and floor mats, all of which require regular inspection and cleaning, sediment and debris removal, and periodic replacement.

In recognition of these needs and potential problems, the NJDEP Stormwater Management Rules require that a maintenance plan be developed for all stormwater management measures incorporated into the design of a major development. This maintenance plan must contain specific preventative and corrective maintenance tasks, schedules, cost estimates, and the name, address, and telephone number of the person or persons responsible for the measures' maintenance.

In accordance with the Rules, this section of Chapter 8 has been developed to provide guidelines for the development of such maintenance plans. Specific maintenance guidance for structural stormwater management measures is presented in *Chapter 9: Structural Stormwater Management Measures*. Additional maintenance information is also provided in the NJDEP Stormwater Management Facility Maintenance Manual, including maintenance tasks and equipment, inspection procedures and schedules, ownership responsibilities, and design recommendations to minimize and facilitate inspection and maintenance tasks.

Finally, it should be noted that a stormwater management measure that includes a dam as defined in the NJDEP Dam Safety Standards at N.J.A.C. 7:20 must also have an operations and maintenance manual for the dam as described at 7:20-1.11.

Maintenance Plan Contents

According to the NJDEP Stormwater Management Rules, all maintenance plans for stormwater management measures must include the following:

1. The name, address, and telephone number of the person or persons responsible for the preventative and corrective maintenance of the stormwater management measure. If the plan identifies a party other than the owner or developer as having responsibility for maintenance, i.e., a public entity or homeowners' association, the plan must include a copy of the other party's written agreement to assume this responsibility. This agreement must include a copy of any ordinance or regulation that requires the owner or developer to dedicate the stormwater management measure and/or its maintenance to the other party.
2. Specific preventative and corrective maintenance tasks such as removal of sediment, trash, and debris; mowing, pruning, and restoration of vegetation; restoration of eroded areas; elimination of mosquito breeding habitats; control of aquatic vegetation; and repair or replacement of damaged or deteriorated components. Detailed maintenance information for specific structural stormwater management measures is presented in Chapter 9. Maintenance needs of nonstructural measures are discussed in *Chapter 2: Low Impact Development Techniques*.
3. A schedule of regular inspections and tasks. Detailed inspection tasks and schedules for specific structural stormwater management measures are presented in Chapter 9.
4. Cost estimates of maintenance tasks, including sediment, trash, and debris removal.
5. Detailed logs of all preventative and corrective maintenance performed at the stormwater management measure, including all maintenance-related work orders.

In addition, as described in the NJDEP Stormwater Management Facility Maintenance Manual, the following items should also be included in the maintenance plan:

1. Maintenance equipment, tools, and supplies necessary to perform the various preventative and corrective maintenance tasks specified in the plan. Sources of specialized, proprietary, and nonstandard equipment, tools, and supplies should also be provided.
2. Recommended corrective responses to various emergency conditions that may be encountered at the stormwater management measure. It should be noted that, if the stormwater management measure includes a Class I or II dam as defined in the NJDEP Dam Safety Standards at N.J.A.C. 7:20, an emergency action plan for the dam is also required. See N.J.A.C. 7:20-1.7(f) for more information.
3. Maintenance, repair, and replacement instructions for specialized, proprietary, and nonstandard measure components, including manufacturers' product instructions and user manuals.
4. Procedures and equipment required to protect the safety of inspection and maintenance personnel.
5. Approved disposal and recycling sites and procedures for sediment, trash, debris, and other material removed from the measure during maintenance operations.
6. Originals or copies of manufacturers' warranties on pertinent measure components.
7. As-built construction plans of the stormwater management measure and copies of pertinent construction documents such as laboratory test results, permits, and completion certificates.

Maintenance Plan Considerations

In addition to the plan contents described above, a maintenance plan should address the following important aspects of stormwater management measure maintenance.

Access

All stormwater management measures' components must be readily accessible for inspection and maintenance. Therefore, trees, shrubs, and underbrush must be pruned or trimmed as necessary to maintain access to the stormwater management measure via roadways, paths, and ramps. This includes paths through perimeter vegetation to permanent pools, aquatic benches, and safety ledges to allow for the inspection and control of mosquito breeding. In addition, the exact limits of inspection and maintenance easements and rights-of-way should be specified on stormwater management measure plans and included in the maintenance plan.

Training of Maintenance Personnel

Maintenance training begins with a basic description of the purpose and function of the overall stormwater management measure and its major components. Such understanding will enable maintenance personnel to provide more effective component maintenance and more readily detect maintenance-related problems. Depending on the size, character, location, and components of a stormwater management measure, maintenance personnel may also require training in specialized inspection and maintenance tasks and/or the operation and care of specialized maintenance equipment. Training should also be provided in the need for and use of all required safety equipment and procedures.

Aesthetics

The impacts of the aesthetics of the stormwater management measures on the surrounding community should be included in the consideration for the design and selection of the stormwater management measure.

Required Maintenance Plan Procedures

Once the maintenance plan is completed, the NJDEP Stormwater Management Rules require that the following procedures be followed:

1. Copies of the maintenance plan must be provided to the owner and operator of the stormwater management measure. Copies must also be submitted to all reviewing agencies as part of each agency's approval process. In addition, a copy should be provided to the local mosquito control or extermination commission upon request.
2. The title and date of the maintenance plan and the name, address, and telephone number of the person with stormwater management measure maintenance responsibility as specified in the plan must be recorded on the deed of the property on which the measure is located. Any change in this information due, for example to a change in property ownership, must also be recorded on the deed.
3. The person with maintenance responsibility must evaluate the maintenance plan for effectiveness at least annually and revise as necessary.
4. A detailed, written log of all preventative and corrective maintenance performed at the stormwater management measure must be kept, including a record of all inspections and copies of maintenance-related work orders.
5. The person with maintenance responsibility must retain and, upon request, make available the maintenance plan and associated logs and other records for review by a public entity with administrative, health, environmental, or safety authority over the site.

Retrofit of Existing Stormwater Management Measures

Retrofitting can be defined as expanding, modifying, or otherwise upgrading existing stormwater management measures. As such, retrofitting stormwater management measures can reduce some of the adverse groundwater recharge and stormwater quantity and quality impacts caused by existing land developments. In many instances, existing stormwater management measures can be dramatically improved, and downstream water bodies protected, through effective retrofitting.

Beginning in the 1970s, many new developments were constructed with stormwater detention facilities. Many of these facilities were built to control the stormwater quantity impacts of 10-year, 25-year, and/or 100-year storms. However, smaller storm events that are typically responsible for the majority of stormwater quality and streambank erosion problems may not have been addressed. Therefore, retrofitting such facilities to also control these smaller storm events can begin to address these problems.

Another important benefit of retrofitting stormwater management facilities is the opportunity to correct site nuisances, maintenance problems, and aesthetic concerns. Retrofitting also allows a community to keep pace with new stormwater management regulations or objectives. It can help a community address a particular stormwater quantity or quality problem that has developed as a result of deficiencies in its existing or past stormwater regulations or a problem that has been identified through a regional plan or TMDL. Addressing such problems through the construction of new stormwater management measures at future land developments may be impractical or even impossible, leaving retrofitting as the only effective technique.

In addition to such basic considerations as need and cost, three important factors must be considered when evaluating retrofit possibilities: health and safety, effectiveness, and maintenance. All three should be thoroughly reviewed before undertaking a stormwater management measure retrofit to help justify the cost and effort and ensure the retrofitted measure's long-term success.

Health and Safety

A retrofit must not increase health and safety risks in any way. For example, the storage volume in an existing detention basin presently used for stormwater quantity control must not be reduced to provide new stormwater quality enhancement without ensuring that the lost quantity storage will not adversely increase peak basin outflows and cause downstream flooding or erosion. Similarly, an existing, well-functioning wet pond must not be converted to a constructed stormwater wetland for enhanced stormwater quality control if the potential for mosquito breeding will increase significantly without adequate additional control measures.

Effectiveness

In many retrofit situations, it may not be possible to upgrade the stormwater management measure to meet all current groundwater recharge and stormwater quality and quantity standards. This means that relative performance improvements for a range of retrofits must be evaluated to determine which one represents the optimum combination of effectiveness, viability, and cost. As a result, the final retrofit selected for an existing stormwater measure will have to be based on its relative rather than absolute effectiveness. In such relative determinations, both the costs and benefits of the evaluated retrofits become more influential factors than when an absolute performance standard is used.

Maintenance

It should be expected that if a retrofit will increase a stormwater management measure's pollutant removal capability, it will also increase the rate and total volume of sediment, trash, debris, and other stormwater pollution that will accumulate in the measure. In addition, the chemical or biological composition of this sediment may be of significantly lower quality, and potentially either hazardous or toxic, than the sediment previously captured. Finally, the retrofit may increase the number and/or complexity of components in an existing stormwater management measure. All of these factors can cause increases in the level, frequency, complexity, and/or cost of the present inspection and maintenance efforts performed at the stormwater management measure. Increased staffing, improved equipment, and more specialized training may be required to properly maintain the new, retrofitted measure. Therefore, the extent and impacts of any increased inspection and/or maintenance requirements should be determined and thoroughly evaluated.

Once a retrofit has been determined to be safe, effective, and manageable, two basic approaches can be followed: modify an existing stormwater management measure or construct a new or additional one. Basins designed primarily for flood control may be retrofitted to enhance stormwater quality and groundwater recharge benefits. For example, the pollutant removal rates of an existing detention basin can be improved by creating an extended detention wetland. However, as noted above, the retrofit must maintain the basin's existing flood and erosion control capabilities. As a result, the basin's total storage volume may need to be increased. In addition, new measures such as infiltration systems, permeable paving, and bioretention systems can be introduced at sites where the soil permeability and depth to the seasonal high water table are suitable. Areas for such new measures include parking lot islands, vacant land, and roadside swales.

In addition to structural measures, nonstructural stormwater management measures can be used to enhance the stormwater management of an existing development site. Roofs are one of the largest sources of concentrated runoff from commercial developments. Clean roof runoff can be directed by downspouts to a dry well, disconnecting a portion of the runoff from the storm sewer system and both reducing runoff volume and restoring groundwater recharge. Flat roofs can be retrofitted with vegetation, which can reduce the stormwater impacts of the building. Overflow parking areas and fire lanes can utilize pervious paving systems, which can also reduce runoff and enhance recharge. Vegetative filters can be incorporated into existing developments where runoff from paved or intensely managed turf areas can be discharged across the filters. This may require the removal or slotting of existing curbs along the edge of parking lots or roads. Parking lots with vegetated aisle dividers may be particularly amendable to this type of filter strip application.

In addition, catch basins and drain inlets that are part of a traditional curb and gutter stormwater collection system can be retrofitted with one of several different manufactured treatment devices that catch sediments, trash, organic matter, and other particulates. These proprietary devices are particularly useful in areas with limited space. Several varieties of manufactured treatment devices are available for installation at strategic locations near a discharge point or as a pre-treatment to an existing basin. Additional information regarding manufactured treatment devices is provided in *Chapter 9: Structural Stormwater Management Measures*.

Finally, education should be considered as a retrofit component. Control of household waste, fertilizers, and pesticides can dramatically reduce concentrations or problem pollutants that adversely affect downstream water quality. Prevention is most often the best method for eliminating pollutants from stormwater runoff. *Chapter 2: Low Impact Development Techniques* provides important information regarding stormwater pollution prevention.

References

Livingston E.H., H.E. Shaver, R.R. Horner and J.J. Skupien. May 1997. Institutional Aspects of Urban Runoff Management: A Guide for Program Development and Implementation. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

APPENDIX E

MANUFACTURER'S OPERATION AND MAINTENANCE PLAN FOR AQUA-PONIC STORMWATER BIOFILTRATION SYSTEM

INSPECTION & MAINTENANCE MANUAL

AQUA-**PONIC**™

Aqua-Ponic™ Stormwater Biofiltration System

Manufactured By:

AquaShield™
STORMWATER TREATMENT SOLUTIONS
www.AquaShieldInc.com

AquaShield,^{TM} Inc.
2733 Kanasita Drive
Suite 111
Chattanooga, TN 37343
(888) 344-9044
www.aquashieldinc.com

June 2020

INTRODUCTION

As the stormwater industry has matured there has been an ever-increasing movement toward the implementation of Low Impact Development (LID) products and practices as the preferred means to implement stormwater control measures within “green infrastructure” (GI) stormwater management programs. The Aqua-Ponic™ Stormwater Biofiltration System is now offered by AquaShield™, Inc. to meet the design challenges of LID principles along with enhanced aesthetics in an urban environment.

This Inspection & Maintenance (I&M) Manual includes information to better assist stakeholders with understanding the importance of implementing an effective program to ensure long-term functionality of an Aqua-Ponic™ system installation. The following aspects of an Aqua-Ponic™ system are described in this I&M manual:

- Aqua-Ponic™ Basics
- Mode of Operation
- Inspection and Maintenance.

AQUA-PONIC™ BASICS

Aqua-Ponic™ technology is a modular proprietary, permanent, post-construction biofiltration system designed to remove total suspended solids (TSS), Total (insoluble) Phosphorus, and heavy metals such as copper and zinc from stormwater runoff. A distinguishing feature of the Aqua-Ponic™ is its combination of filtration with the principles of ***hydroponics*** **-** a method of hydroculture for growing plants without soil by instead using mineral nutrient solutions in a water solvent. That is, the Aqua-Ponic™ uses stormwater runoff as a nutrient asset instead of a liability. Terrestrial plants are grown with only their roots exposed to the nutrient liquid while being physically supported by a plant stabilization filter medium. The hydroponic design provides a sustainable water supply to the vegetation during those periods of time when hot and/or dry conditions may prevail.

The Aqua-Ponic™ system utilizes hardy low-profile perennial vegetation such as native grasses, shrub grasses and/or ornamental flowering plants. A facility can utilize a single type or multiple types of plants to enhance the viewscape. It is important to specify plants that demonstrate viability within the climatic zone of a site installation.

MODE of OPERATION

The minimum 12-inch plant stabilization media layer within the Aqua-Ponic™ serves three operational roles by providing (1) pollutant filtration, (2) plant stabilization and (3) nutrient uptake. Figure 1 is an illustration of the Aqua-Ponic™ Biofiltration System. Design elements include a three (3)-inch top layer of pea gravel underlain by the plant stabilization filter bed. Water enters the system as sheet flow and then flows downward under gravity flow conditions through the pea gravel, filter bed and the associated root systems of the vegetation. The pea gravel layer serves to protect the underlying plant stabilization filter bed while dispersing the influent stormwater runoff across the treatment area. The filtered water then percolates further downward into the underlying water sump. A supporting and removeable perforated stainless-steel sheet underlies the filter bed. A post-filtration flow control orifice is placed across the outlet pipe opening in order to facilitate an even distribution of influent runoff across the filter treatment area. Crushed recycled landscaping glass can be used as an alternative to the top pea gravel layer which further enhances colorful viewscape options for the Aqua-Ponic™.

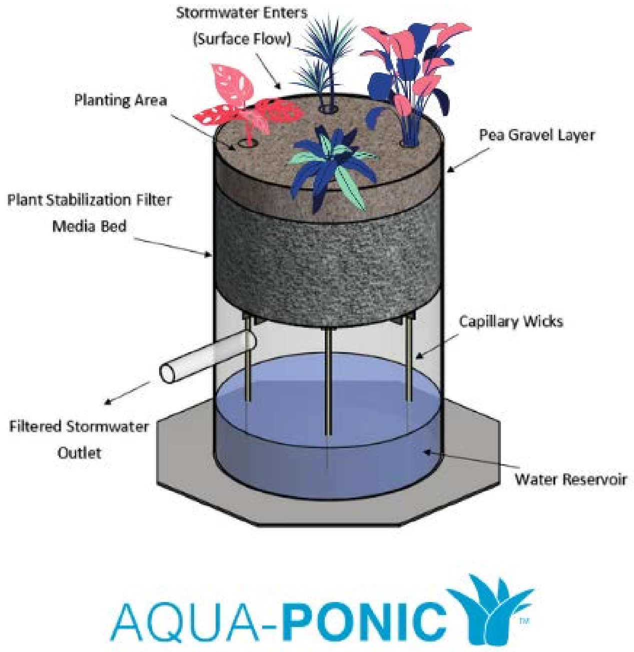


Figure 1. Diagram of Aqua-Ponic™ Biofiltration System.

The sump serves as a water reservoir for the vegetation during quiescent periods. A series of wicks are suspended from the base of the plant stabilization bed via rubber grommets (eyelets). The wicks extend downward to near the base of the sump. Using capillary action, water is wicked up to the plant stabilization filter bed which serves to provide a sustainable supply of water and any soluble nutrients and metals not trapped in the filter bed during a runoff event. Treated water in excess of the sump storage volume exits the system via the outlet opening just below the base of the filter bed.

Each Aqua-Ponic™ unit is constructed of lightweight and durable Polymer Coated Steel (PCS) to provide long term operational and structural functionality. Aqua-Ponic™ units are shipped with the inclusion of any perforated sheets and the capillary wicks in place according to the model size. The plant stabilization filter media is shipped simultaneously in separate containers. For aesthetic reasons it is the responsibility of others to choose either the pea gravel or any recycled glass landscaping stone for the top bed layer. It is also the responsibility of others to specify, acquire and plant the vegetation. AquaShield™ does not specify the plants for Aqua-Ponic™ systems but can assist where warranted.

INSPECTION & MAINTENANCE

Maintenance frequency for the Aqua-Ponic™ will ultimately be determined by site-specific pollutant loading conditions. Inspections of the, plants, top gravel layer and the upper portion of the plant stabilization filter media can be accomplished from the surface without special tools. AquaShield^{TM} recommends periodic inspections following installation to determine a site-specific maintenance cycle to ensure functionality of the media and the vegetation.

We recommend that periodic system inspections be performed to determine the pollutant and trash loading characteristics. In general, quarterly inspections should be performed during the first year of operation to better anticipate maintenance frequency in the first year and subsequent years of operation.

An Aqua-Ponic™ maintenance event should first determine any obvious signs of degradation, displacement, sediment or trash accumulation, or oil in the upper layers of the unit. The top gravel layer should be completely replaced and can be removed by shoveling or vacuuming. The top several inches of the underlying plant stabilization filter media may be replaced at the same time if warranted. Care should be taken not to damage the plants or disturb rootballs during limited media replacement. Care should also be taken when replacing a plant to avoid disturbing remaining plants.

Depending on site conditions, it may be necessary to remove all the media and all the plants and completely replace these components of the system. It is recommended that the wicks be replaced if a system is fully replaced with stabilization media and plants.

Sediment can accumulate in the base of the water supply sump over a period of time. After removing the pea gravel layer, the plants and the plant stabilization filter media bed, the perforated metal plate should be removed to access the water supply sump from the surface for the purpose of vacuuming water and any accumulated sediment. The wicking ropes should also be replaced at this time. The perforated metal plate with the new wicking ropes should be set in place prior to installing the plant stabilization filter media on top of the plate.

AquaShield™ can provide the plant stabilization filter media, wicks and any associated grommets. Although unlikely, the supporting stainless-steel plate can also be supplied by AquaShield™ if its replacement is necessary. While we recommend that the pea gravel be replaced as warranted, it may be feasible to wash the gravel during a maintenance event. However, in most cases it is more efficient to replace the pea gravel or any landscaping glass to avoid disposal of water that was used to clean either of those materials.

All I&M activities can be performed from the surface without the need for AquaShield^{TM} personnel to be present. We recommend that all materials removed during the maintenance process be handled and disposed in accordance with all applicable federal, state and local guidelines. Depending on the influent pollutant characteristics of the facility drainage area, it may be appropriate to perform Toxicity Characteristics Leaching Procedure (TCLP) analyses on representative samples of the spent filter media to ensure that the handling and disposition of materials complies with any applicable environmental regulations and practices.

Attached is a two-page Aqua-Ponic™ I&M Log to document service provider(s), activities and scheduling.

Next two pages include I&M Logs

AQUA-PONIC™ INSPECTION & MAINTENANCE LOG

MAINTENANCE COMPANY INFORMATION

Company Name: ______________________________

Street Address: ______________________________

City: ______________ State/Prov.:________ Zip/Postal Code: __________

Contact: ______________________ Title: ______________

Office Phone: ________________ Cell Phone: ________________

ACTIVITY LOG

Date of Cleaning: ________________

Time of Cleaning: Start: ________________ End: ________________

Date of Next Inspection: ____________

Floatable debris present: Yes No Action taken: ________________

____

Oil present: Yes No Action taken: ________________

Filter Media Needs Replacement: Yes No

Structural damage: Yes No Where: ________________

Clogging: Yes No Describe: ________________

Additional Comments and/or Actions to be Taken	**Time Frame**

AQUA-PONIC™

Inspection & Maintenance Schedule Log

First Year Post-Construction

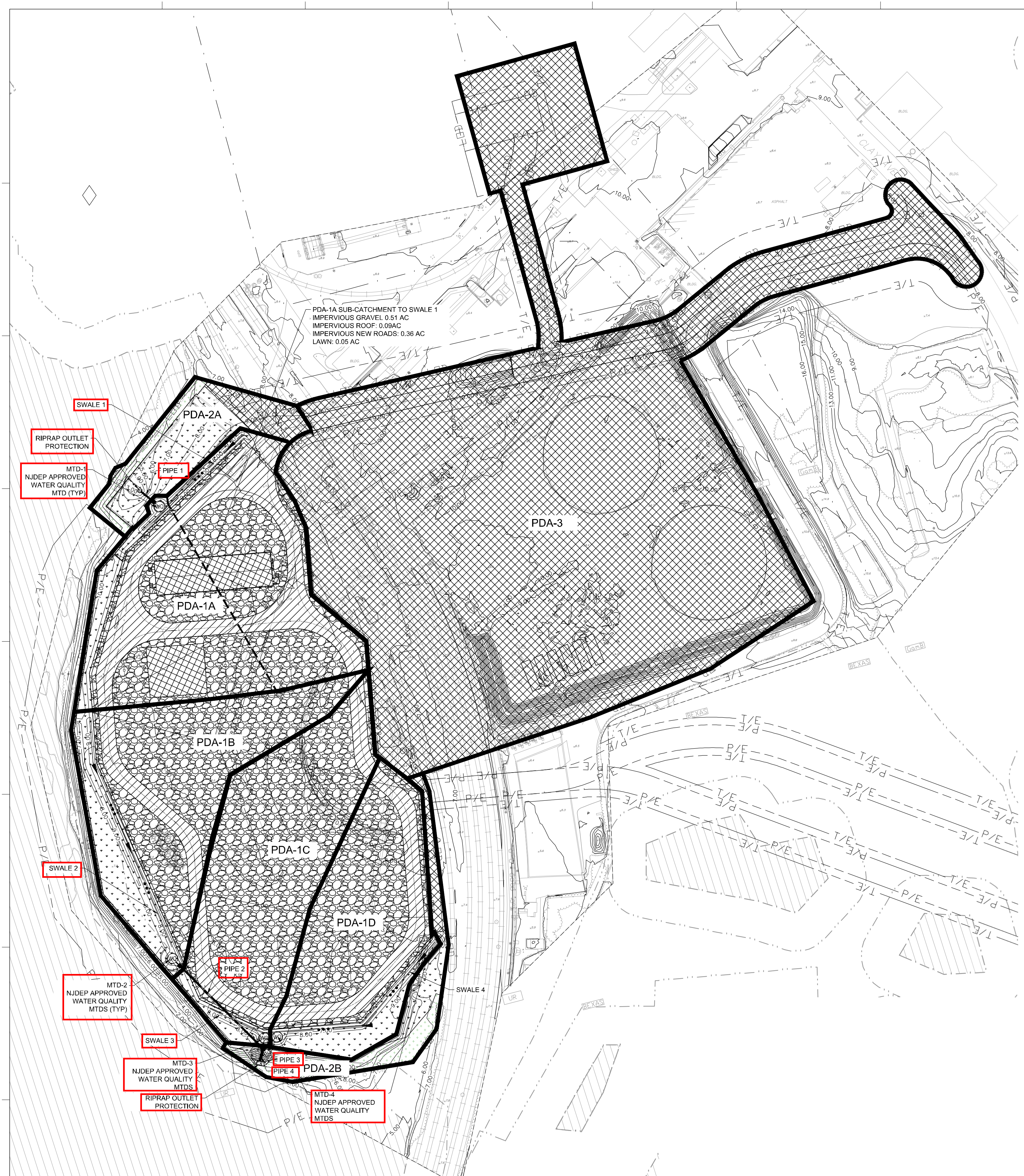
Date Installed/Activated: ____

	Month											
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Inspect and Clean as needed			X			X			X			X
Inspect Bypass and maintain as needed			X			X			X			X
Clean System*												X

Second and Subsequent Years Post-Construction

	Month											
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Inspect and Clean as needed												X
Inspect Bypass, maintain as needed												X
Clean System												X

APPENDIX F
FACILITIES MAP



Post-Development Areas

PDA-1A

Surface Cover	Area (SF)	Area (AC)	CN
Impervious-Gravel (B)	41,174	0.95	85
Impervious-Roofs & Unchanged	13,271	0.30	98
Impervious-New Roads	25,643	0.59	98
Wodded (B)	0	0.00	55
Wodded (D)	0	0.00	77
Lawn (B)	7,070	0.16	61
Total	87,158	2.00	

PDA-1B

Surface Cover	Area (SF)	Area (AC)	CN
Impervious-Gravel (B)	41,390	0.95	85
Impervious-Roofs & Unchanged	1,541	0.04	98
Impervious-New Roads	6,491	0.15	98
Wodded (B)	0	0.00	55
Wodded (D)	0	0.00	77
Lawn (B)	13,665	0.31	61
Total	63,087	1.45	

PDA-1C

Surface Cover	Area (SF)	Area (AC)	CN
Impervious-Gravel (B)	52,971	1.22	85
Impervious-Roofs & Unchanged	430	0.01	98
Impervious-New Roads	6,880	0.16	98
Wodded (B)	0	0.00	55
Wodded (D)	0	0.00	77
Lawn (B)	3,040	0.07	61
Total	63,321	1.45	

PDA-1D

Surface Cover	Area (SF)	Area (AC)	CN
Impervious-Gravel (B)	32,779	0.75	85
Impervious-Roofs & Unchanged	0	0.00	98
Impervious-New Roads	9,431	0.22	98
Wodded (B)	0	0.00	55
Wodded (D)	0	0.00	77
Lawn (B)	8,516	0.20	61
Total	50,726	1.16	

PDA-2A

Surface Cover	Area (SF)	Area (AC)	CN
Impervious-Gravel (B)	0	0.00	85
Impervious-Roofs & Unchanged	5,119	0.12	98
Impervious-New Roads	0	0.00	98
Wodded (B)	0	0.00	55
Wodded (D)	4,067	0.09	77
Lawn (B)	12,013	0.28	61
Total	21,199	0.49	

PDA-2B

Surface Cover	Area (SF)	Area (AC)	CN
Impervious-Gravel (B)	0	0.00	85
Impervious-Roofs & Unchanged	3,085	0.07	98
Impervious-New Roads	0	0.00	98
Wodded (B)	7,020	0.16	55
Wodded (D)	0	0.00	77
Lawn (B)	5,835	0.13	61
Total	15,940	0.37	

PDA-3

Surface Cover	Area (SF)	Area (AC)	CN
Impervious-Gravel (B)	0	0.00	85
Impervious-Roofs & Unchanged	330,591	7.59	98
Impervious-New Roads	0	0.00	98
Wodded (B)	0	0.00	55
Wodded (D)	0	0.00	77
Lawn (B)	0	0.00	61
Total	330,591	7.59	

TOTAL

Surface Cover	Area (SF)	Area (AC)	CN
Impervious-Gravel (B)	168,314	3.86	85
Impervious-Roofs & Unchanged	354,037	8.13	98
Impervious-New Roads	48,445	1.11	98
Wodded (B)	7,020	0.16	55
Lawn (B)	4,067	0.09	61
Total	632,022	14.51	

LEGEND

PDA-1A	DRAINAGE AREA ID
▨	NEW ROADS
▦	IMPERVIOUS
⬡	GRAVEL
⸪	LAWN
+	WOODS

BURNS McDONNELL

THE REGISTRANT OF THE NEWLY APPLIED SEAL ASSUMES RESPONSIBILITY FOR THE CHANGES AS INDICATED BY THE FOLLOWING REVISION NUMBER C.

KEVIN N. WARRENDER

N.J. PROFESSIONAL ENGINEER
LIC. NO. 24GE04640900
C.O.A. NO. 24GA28066400

Rev.	Date	Accep.	Appr.	Description
C	02DEC2022	LMG	KNW	NJDEP SUBMITTAL

OCW01 OFFSHORE WIND FARM - BL ENGLAND
POST DEVELOPMENT STORMWATER MANAGEMENT PLAN

CIVIL

Ocean Wind 1
An Ørsted & PSEG project

Drawn by	Accepted	Approved
02-DEC-2022 SMC	02-DEC-2022 KNW	02-DEC-2022 LRM

Scale: 1" = 50'
Size: 34X44
Ørsted Document No.: 07845287
Rev.: C
Supplier:
Supplier Document No. & Rev.:
PSEG Dwg No.:
Rev.:
RDS-PP code:

APPENDIX G
OPERATIONS AND MAINTENANCE PLAN
COST ESTIMATE

Client	*Ocean Wind 1*	Page	*1* of *1*
Project	Date 10/07/22	Made By	*L. Guerin*
	Offshore Wind Farm Substation, Upper Twp, NJ	Checked By	
	O&M COST ESTIMATE	Preliminary	Final

INSPECTION	UNITS	QUANTITY	UNIT COST	TOTAL COST
Quarterly Inspeciton for clogging, damage and sedimentation	Visit	4	$250.00	$1,000.00
Inspection for clogging, ponding, sedimentation after storm events exceeding 1-year	Visit	4	$250.00	$1,000.00
Annual inspection for erosion, scour & structural damage	Visit	1	$250.00	$250.00
Inspection of Manufactured Treatment Device	Visit	4	$250.00	$1,000.00
ANNUAL INSPECTION TOTAL COSTS				**$3,250.00**

PREVENTATIVE AND CORRECTIVE MAINTENANCE	UNITS	QUANTITY	UNIT COST	TOTAL COST
Lawn Care (mowing, trim, weeding, etc)	AC	1.4	$50.00	$70.00
Clean and Unblock FES	EA	4	$20.00	$80.00
Clean and Unblock basin inlets and outlets	EA	4	$50.00	$200.00
Re-establish Vegetative Cover	SF	500	$1.50	$750.00
AquaShield Maintenance on Aqua-Ponic Biofiltration Device	HR	8	$250.00	$2,000.00
Replace Riprap	SY	20	$40.00	$800.00

APPENDIX H – GEOTECHNICAL ENGINEERING REPORT

GEOTECHNICAL ENGINEERING REPORT

OCEAN WIND – BL ENGLAND SUBSTATION
UPPER TOWNSHIP, NEW JERSEY

Prepared For:

Burns & McDonnell
10 North Park Place, Suite 330
Morristown, New Jersey 07960

Prepared By:

Langan Engineering and Environmental Services, Inc.
300 Kimball Drive
Parsippany, New Jersey 07054

Victoria Rhodes

Ronald D. Boyer, P.E.
New Jersey Professional Engineer License No: 24GE04200300

10 October 2022

101010201
DRAFT

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INTRODUCTION

We have completed our geotechnical engineering investigation and study for the proposed Ocean Wind BL England Substation project located in Upper Township, New Jersey. The purpose of the investigation was to: 1) research and review available site information; 2) obtain subsurface information by excavating test pits, performing in-situ infiltration tests, drilling borings, and performing cone penetration tests at accessible site areas; and 3) provide recommendations for site preparation, earthwork, foundation design, and other geotechnical aspects of construction for the proposed development. No environmental investigation or sampling was performed as part of this investigation and study.

REPORT DATUM

The elevations and dimensions given in this report are approximate and are based on the coordinates provided in the plan "Figure 2: Boring Location Plan, OSW BLE Substation" provided in the Scope of Work document in the RFP dated 26 July 2022, and on survey points collected by Langan. Unless noted otherwise, the elevations given in this report are referenced to the specific datum set forth in the above-referenced table, which references the North American Vertical Datum of 1988 (NAVD88). The meridian is referenced to the New Jersey State Plane coordinate system NAD83.

SITE DESCRIPTION

The project site is located immediately west of the BL England Generating Station in Upper Township, New Jersey and is bound by the Generating Station structures to the northeast, railroad tracks to the east, and undeveloped wooded areas and wetlands to the south and west. An aerial photograph of the property is provided below and a site location plan is provided as Figure 1.

The majority of the site is covered with a surficial sandy fill layer. The site is reportedly a former coal-handling facility and coal was previously stockpiled in the majority of the site. At the time of this report, two 1-story buildings with approximate footprint areas of 400 square-feet (sq-ft) and 4,000 sq-ft and associated with former coal handling are still present at the western portion of the site. We understand that a tunnel associated with the existing coal conveyor belt exists at the western portion of the site. The existing building adjacent to the railroad tracks includes a below-grade stairwell. The stairwell reportedly extends at least 4 flights, or approximately 40 ft, below surface grade and was flooded at the time of our site observation. A concrete pad associated with the former conveyor belt exists at the central portion of the site.

Surface grades at the site are relatively flat and vary between approximate elevation (el) 6 and el 10. Surface grades within the site are lower than the surrounding site areas, and a short retaining wall separates the site from adjacent areas along the western and southern site limits.

Site Aerial (Google Maps)

PROPOSED DEVELOPMENT

We understand that the proposed development consists of an onshore greenfield AIS substation and an approximate 4.3-mile-long circuit of associated underground transmission lines to connect the future Ocean Wind offshore wind turbines to the US electrical grid. The proposed development will connect the new substation to the electric cable onshore landing site. An approximately 0.2-mile-long 138 kV below-grade interconnecting electric transmission line will connect the proposed substation to a riser structure adjacent to the existing Atlantic City Electric utility substation located within the adjacent BL England generating facility.

The proposed substation will consist of transformers, reactors, dynamic reactive compensation (DRC) buildings, a control house, equipment stands, circuit breakers, lightning masts and H-frame structures. The preliminary loads and allowable movements summarized in the table below were provided by Burns & McDonnell in the document "Scope of Work_Rev 8: Subsurface Investigation and Geotechnical Report, Ocean Wind, LLC – BLE Substation" dated 26 July 2022.

Structure	**Desired Foundation Type per RFP**	**Approximate Footprint Area (sq-ft)**	**Preliminary Loads**			**Maximum Allowable Vertical Movement (inches)**	**Maximum Allowable Lateral Movement (inches)**
			Compression (kips)	**Shear (kips)**	**Moment (kip-ft)**		
Control House	No preference	7,000	160	23	0	1.0	1.0
Equipment Stands	Spread Footing	64	16	6	80	1.0	1.0
Circuit Breakers	Slab-on-grade	150	25	5	30	1.0	1.0
H-Frame Deadends	Drilled Shaft	40	55	25	1,000	1.0	1.0
Lightning Masts	Drilled Shaft	20	5	5	50	1.0	1.0
Transformers/ Reactors	Pile-supported Mat	600	500	50	0	1.0	1.0

Existing Tunnel and Below-grade Structures

We understand that the existing tunnel and below-grade stairwell structures will be removed by the current property owner prior to commencing work on the proposed development described above. The structures will reportedly be removed in their entirety and replaced with approved, properly-compacted fill.

REVIEW OF AVAILABLE INFORMATION

We reviewed historic topographic maps, regional geologic information, and the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for the site vicinity. Pertinent information obtained from the above documents is summarized in the following paragraphs.

Historic Topographic Maps

We reviewed available historic United States Geologic Survey (USGS) Topographic Maps dated 1890 through 2019. The maps dated 1890 through 1972 show the western portion of the site to be within an historic marshland area. The map dated 1972 shows the railroad along the eastern border of the site and the constructed generating station. In the maps dated 1989 and 1994 the marshlands occupy a smaller portion of the site. Topographic maps dated 2014 through 2019 no longer show the marshland existing within the site, but show a coal stockpile occupying the majority of the site. A copy of the 1890 USGS map is provided in Figure 2 and all historic topographic maps are provided as Attachment A.

Historic Aerial Photographs

We reviewed available historic aerial photographs dated 1931 through 2017. The photographs dated 1931 through 1961 depict the site as undeveloped and partially vegetated. The 1974 through 2017 photographs show the constructed generating station northeast of the site and small structures constructed within the site. The historic aerial photographs are provided as Attachment B.

Regional Geology

According to the New Jersey Department of Environmental Protection (NJDEP) GeoWeb maps, a majority of the site is within the Salt-marsh and Estuarine deposits. The surficial geology consists of silt, sand, peat and clay. The eastern and southern portions of the site consist of sand, pebble gravel with minor silt, clay and peat of the Unit 3 Cape May Formation. A copy of the surficial geology map is provided as Figure 3A.

According to the NJDEP GeoWeb maps, the geology at the site consists of quartz sand of the Cohansey Formation. Bedrock at the site is expected to be at depths greater than 100 ft below surface grade. A copy of the geology map is provided as Figure 3B.

The site is located outside of any known karst and acid-producing soil areas.

Flood Map

According to the flood insurance rate map (Map No. 34009C0067F, dated October 5, 2017) published by the Federal Emergency Management Agency (FEMA), the majority of the site lies within "Zone X – no shading", which is defined as "areas determined to be outside the 0.2% annual chance floodplain". The northern and eastern portions of the site lie within "Zone X – with shading", which is defined as "areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square-mile; and areas protected by levees from 1% annual chance flood". The areas immediately surrounding the site lie within "Zone AE", which is defined as "areas with base flood elevation determined" with base flood elevations determined to be between el 8 and el 9. A copy of the referenced flood insurance rate map is provided as Figure 4.

SUBSURFACE INVESTIGATION

A geotechnical subsurface investigation was performed at the site in September 2022 under Langan supervision. The geotechnical subsurface investigation for this study consisted of drilling 16 borings, performing 12 cone penetration tests (CPTs), excavating 7 test pits, performing 7 single ring infiltration tests and completing field resistivity testing along 3 alignments.

Boring, CPT, test pit and field resistivity test locations were selected in general accordance with the coordinates provided in "Figure 2: Boring Location Plan, Orsted BLE England Substation" provided in the Scope of Work document included in the RFP dated 24 August 2022. The locations of all investigation points are shown in Figure 5A and Figure 5B. Logs of all 2022 Langan borings are included in Appendix A. The CPT report is provided as Attachment A. The field resistivity report is included as Attachment B.

Borings

Borings identified as B-3, B-4, B-5, B-7, B-9, B-12, B-14, B-17, B-20, B-21, B-22 and B-24 through B-28 were advanced 5 ft to 100 ft below the ground surface. Borings were drilled by Craig Geotechnical Drilling, Co., Inc. (Craig) using an ATV-mounted drill rig with mud-rotary drilling techniques.

Soil samples were obtained and Standard Penetration Tests (SPTs) were performed using a standard 2-inch outside-diameter split-spoon sampler driven by a 140-lb safety hammer in accordance with ASTM D1586. The safety hammer efficiency was assumed to be 60%. The hammer weight, hammer drop height and number of rope turns were verified in the field by our field engineer. Sampling and SPTs were performed continuously in the upper 12 ft and at 5-ft intervals thereafter. The boreholes were backfilled with soil cuttings and grouted using bentonite.

The borings were completed under the full-time observation of a field engineer from our office and under the direct supervision of our project Professional Engineer. Our field engineer maintained logs of the explorations, classified soil encountered, and obtained representative material samples.

The soil samples were classified in accordance with the Unified Soil Classification System (USCS). The soil samples were sent to our storage facility in Whippany, NJ for further classification and laboratory testing. The samples will be stored for 12 months from the date of investigation.

Groundwater Level Observations

Upon completion of each boring, the casing was left in the borehole for a period of 24 hours. The groundwater level within the borehole was then measured and recorded. The casing was removed and the borehole was backfilled as described above.

Groundwater level observation wells were also installed in the completed boreholes B-24 and B-27. The wells consisted of 20-ft-long, 2-inch-diameter (10-ft-solid and 10-ft-screened) PVC pipes. Groundwater levels were monitored throughout the field investigation. Upon completion of the investigation, the groundwater level observation well was removed and the boreholes were backfilled.

Cone Penetration Tests (CPTs)

Twelve CPTs identified as CPT-1, CPT-2, CPT-6, CPT-8, CPT-10, CPT-11, CPT-13, CPT-15, CPT-16, CPT-18, CPT-19 and CPT-23 were performed within the proposed development area by Craig using an integrated electronic piezo-cone. Seismic shear wave velocities were recorded in 3 CPTs. Pore Pressure Dissipation tests were performed in 2 CPTs. The CPT probes were advanced using a 20-ton truck-mounted cone penetration rig. The CPT equipment and procedures were in accordance with ASTM D5778.

The tip and sleeve resistances as well as dynamic porewater pressures were recorded every 2 inches during the CPTs. The CPTs were extended between approximately 47 ft and 52 ft below existing surface grades. In five locations where refusal was encountered at depths shallower than 10 ft below surface grade, the CPT was offset. The electronic data recorded was processed using the software CPe-IT to estimate common engineering parameters and to prepare CPT plots.

Seismic Shear-Wave Measurements (SCPT)

While performing CPTs, shear-wave velocity measurements were also recorded at 5 ft intervals in CPT-1, CPT-18 and CPT-19B. The shear-wave velocities were recorded using a geophone mounted in the piezo-cone and an up-hole digital oscilloscope.

Pore Pressure Dissipation Tests (PPD)

Pore pressure dissipation (PPD) tests were performed at 10 ft intervals in CPT-6 and CPT-23. During the tests, the piezo-cone and rods were decoupled from the rig and pore pressure variations were recorded over time.

Test Pits

Seven (7) exploratory test pits were excavated between 8 September and 12 September 2022 by Craig using a Kubota KX057-5 mini-excavator to confirm the classification of the upper soils for hydrologic soil group determinations. Profile test pits identified as TP-1 through TP-7 were performed throughout the project site and extended approximately 8 ft to 11 ft below existing surface grade. Upon completion, the profile test pits were backfilled with excavated materials and the backfill was lightly compacted with the excavator bucket.

Infiltration Tests

Seven (7) Single Ring Infiltrometer (SRI) infiltration tests were performed in test pits excavated by Craig between 8 September and 12 September 2022. Infiltration tests were performed immediately adjacent to the corresponding profile test pit locations within the proposed stormwater management areas. The infiltration tests were performed to measure the in-situ infiltration rates of the soils to determine the soil hydraulic conductivity.

The test pits were excavated to depths of approximately 4 ft below surface grades. Then, approximately 6-inch-diameter test rings were inserted into the soil at the bottom of the test pits. The infiltration tests were performed in general compliance with the New Jersey Stormwater Best Management Practices Manual dated April 2022.

Field Resistivity Testing

Field resistivity testing of subsurface soils was performed along three test alignments and two quality control alignments by our specialty geophysical subcontractor Hager-Richter Geoscience, Inc. (Hager-Richter). The approach and equipment used are summarized below.

Approach and Equipment

Field soil resistivity testing was conducted at locations selected by the Client in substantial conformance with procedures specified in ASTM G 57 and IEEE Standard No. 81, which requires use of the Wenner array in which four electrodes are inserted a short distance into the soil and adjacent electrodes are spaced an equal distance apart. The electrode spacing was designated "a". Electrical current "I" was injected in the outer electrodes. The potential "V" was measured between the two inner electrodes. The apparent resistivity "ρ_a" is estimated by the following equation:

$$\rho_a = 2 * \pi * a * (V/I)$$

An Advanced Geosciences, Inc. (AGI) Sting R8-IP resistivity meter was used to determine soil resistivity. This unit meets or exceeds the specifications of the instruments listed in the PSEG specification. This instrumentation consists of a Power Supply, Transmitter, and Receiver.

The Sting R8-IP provides for the following:

- It automatically reverses polarity of the injected current.
- It measures the electrode contact resistance, and, if too high in the judgment of the operator, the measurement of resistance can be discontinued and the contact resistance reduced to an acceptable level by pouring a small amount of salty water around the electrode.

- It repeats individual measurement for either an operator-specified number of times or until the standard deviation of the accumulated data is equal to or less than an operator specified percentage.
- It will perform automatic cancellation of stray voltages in the soils.

After the operator accepted the electrode resistance values and triggered the instrument to acquire data, the unit displayed the apparent resistivity, the resistance, the standard deviation of the data acquired, the injection current, and the number of measurements included in the average. If the operator was satisfied with the results, the a-spacing was changed and the survey continued. However, if the operator was not satisfied with the results, additional data was acquired (possibly with minor adjustments to one or more electrodes) until the operator was satisfied with the results.

Limitations of the Method

As with any of the electrical geophysical methods, soil resistivity data can be subject to interference from cultural features such as buildings, fences, underground utilities that are electrically conducting, and overhead power lines. The subsurface is three dimensional in character, and although the soil resistivity data are acquired along a straight line, the data can be affected by resistivity changes off-line.

GEOTECHNICAL LABORATORY TESTING

Soil samples from the 2022 Langan investigation were classified and examined in the field by a Langan geotechnical engineer. Representative samples were selected and tested to determine engineering properties and to confirm field classifications. The laboratory test results available at the time of this report are included in Appendix B. The laboratory tests included the following tests:

- Sieve and Hydrometer analyses (ASTM D422) and natural moisture content determinations (ASTM D2216)
- Atterberg Limit determinations (ASTM D4318)
- Organic content determinations (ASTM D2974)
- Unconfined Compressive Strength testing (ASTM D2166)
- Consolidation testing (ASTM D2435) *(Lab tests pending)*
- Modified Proctor testing (ASTM D1557)
- California Bearing Ratio (CBR) determinations (ASTM D1883)
- Corrosion Suite, including resistivity, reduction-oxidation (redox) potential, sulfide and sulfate, chloride, pH and moisture at select boring locations for composite samples from depths of up to 12 ft below existing surface grades

- Shelby Tube Hydraulic Conductivity testing
- Geothermal resistivity testing

SUBSURFACE CONDITIONS

Based on the results of the borings, test pits and CPTs performed for this study, the site subsurface conditions typically consist of a fill layer overlying natural soil strata consisting of upper silt/sand, clay and lower sand. The following sections describe the encountered strata and observed groundwater conditions. Simplified, graphical presentations of the subsurface conditions encountered within the borings are presented in Table 1 and a generalized subsurface profile is shown in Figure 6.

Surficial Materials and Fill

An approximately 6-inch-thick surface layer of topsoil was encountered at boring B-26.

An approximately 3-ft-thick to 9-ft-thick fill layer, typically consisting of orangish brown to dark gray sand with varying amounts of silt, clay, gravel, coal, wood and organic material, was encountered beneath the topsoil or at the surface of all borings. The fill was typically found to be loose to very dense, as evidenced by SPT N-values ranging from 4 blows per foot (bpf) to refusal (greater than 100 bpf) (average of 38 bpf).

In test pit TP-7, an approximately 2-inch-thick coal layer within the fill was encountered at approximately 2 ft below surface grade. Coal pieces were observed throughout the fill layer in the borings and test pits.

Typical index properties determined from laboratory testing performed on one sample from the fill layer are provided in the following table.

Results of Identification Tests (Fill)

Boring	Sample	Depth (ft)	Fines Content (%)
B-3	S-3	4-6	19.5
B-17	S-2	2-4	11.6

Upper Silt/Sand

Natural sand and silt deposits interbedded occasionally with thin layers of peat and clay were encountered immediately below the fill materials in all borings and CPTs at depths ranging from 3 ft to 9 ft below surface grade, corresponding to approximate el -0.5 to el 6.

These sand and silt soils generally consist of light brown to orangish brown to gray sand or silt with varying amounts of clay and gravel. These sand/silt soils were typically found to be very loose to very dense as evidenced by SPT N-values ranging from weight-of-hammer values (less than 1 bpf) to 82 bpf (average of 27 bpf).

The upper sand/silt soils are classified as SM, SP or ML per USCS. Typical index properties determined from laboratory testing performed on representative samples of soils obtained from this stratum are provided in the following table.

Results of Identification Tests (Upper Sand/Silt)

Boring	Sample	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Fines Content (%)	USCS Class.
B-3	S-7	15-17	-	-	-	4.7	SP
B-4	S-6B	11-12	-	-	-	56.5	ML
B-5	S-7	15-17	-	-	-	7.3	SP
B-12	S-10	30-32	-	-	-	31.7	SM
B-14	S-11	35-37	25	19	6	55.1	ML
B-22	S-6	10-12	-	-	-	41.4	SM
B-28	S-3	8-10	-	-	-	30.1	SM

Interbedded Upper Clay

In borings B-4, B-5, B-7, B-9, B-12, B-17, B-20, B-27 and B-28, and CPTs SCPT-1, CPT-2, CPT-2a, CPT-6, CPT-8a, CPT-10, CPT-11, CPT-13, SCPT-18, a 1-ft-thick to 10-ft-thick, gray to brown silty clay layer was encountered at depths ranging from 5.5 ft to 20 ft below surface grade, corresponding to approximate el -12 to el 0.

The clay was found to be very soft to stiff, as evidenced by SPT N-values ranging from weight-of-hammer values (less than 1 bpf) to 21 bpf. The unconfined compressive strengths (q_u values) as measured by the field pocket penetrometer, varied typically from 500 pounds per square foot (psf) to 3,500 psf. The unconfined compressive strength as measured by a laboratory test performed on a sample from B-27 was 1,150 psf.

The clay is classified as CL per USCS. Typical index properties determined from laboratory testing performed on representative samples obtained from the clay stratum are provided in the following table.

Results of Identification Tests (Upper Clay)

Boring	Sample	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Organic Content (%)	Natural Moisture Content (%)	Fines Content (%)	USCS Class.
B-17	S-6	10-12	33	17	16	-	24.3	-	CL
B-20	S-6	10-12	32	15	17	-	20.0	59.4	CL
B-27	U-1	12-14	26	15	11	3.63	26.9	78.2	CL

Thin Peat/Organic Silt

In borings B-4, B-5, B-14, B-17 and B-27 and test pits TP-2, TP-5 and TP-7, a 2-inch-thick to 3-ft-thick layer of peat or silt with organic material was encountered directly below the fill materials and above the upper sand/silt. The top of this layer was encountered at depths ranging from 4 ft to 9 ft below surface grade, corresponding to approximate el -0.5 to el 4.

Clay

A dark gray silty clay layer was encountered in all borings and CPTs at depths ranging from 30 ft to 35 ft below surface grade, corresponding to approximate el -23 to el -28. The clay layer was found to be approximately 5 ft to 15 ft thick.

This clay stratum was found to be very soft to stiff, as evidenced by SPT N-values ranging from weight-of-hammer values (less than 1 bpf) to 13 bpf. The unconfined compressive strengths (q_u values) as measured by the field pocket penetrometer varied typically from 500 pounds per square foot (psf) to 1,500 psf. The unconfined compressive strengths as measured by laboratory testing varied typically from 1,000 psf to 1,200 psf.

These cohesive soils are classified as CL per USCS. Typical index properties determined from laboratory testing performed on representative samples obtained from this clay stratum are provided in the following table.

Results of Identification Tests (Clay)

Boring	Sample	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Organic Content (%)	Natural Moisture Content (%)	Fines Content (%)	USCS Class.
B-4	S-11	35-37	37	18	19	-	-	81.9	CL
B-7	U-1	37-39	27	17	10	2.1	27.1	-	CL
B-17	U-1	37-39	32	17	15	-	-	-	CL
B-17	S-13	45-47	41	16	25	-	33.5	80.8	CL
B-20	U-1	37-39	-	-	-	2.46	31.2	-	-
B-22	U-1	32-34	*Lab tests pending*						
B-27	S-11	35-37	30	20	10	-	-	-	CL
B-28	U-5	37-39	*Lab tests pending*						

Lower Sand

A lower sand layer was encountered in all borings and CPTs below the clay layer at depths ranging from 39 ft to 50 ft below surface grade, corresponding to approximate el -40 to el -32.

These sandy soils consist of brown to gray sand with varying amounts of silt, gravel, clay and shells. These sandy soils were typically found to be loose to very dense as evidenced by SPT N-values ranging from 4 bpf to 88 bpf, excluding 29 split spoon refusal values, (average of 40 bpf). The SPT N-values in the lower sand were typically greater than 25 bpf.

The lower sand is classified as SM, SC or SP per USCS. Typical index properties determined from laboratory testing performed on representative samples obtained from the lower sand stratum are provided in the following table.

Results of Identification Tests (Lower Sand)

Boring	Sample	Depth (ft)	USCS Class.
B-7	S-14	50-52	SM
B-20	S-19	75-77	SM
B-22	S-14	50-52	SP
B-27	S-21	85-87	SM
B-28	S-17	80-82	SC

Groundwater

During our investigation, groundwater levels were measured in the completed boreholes approximately 24 hours after the completion of the boring. The 24-hour groundwater levels were typically measured to be at depths of approximately 4.5 ft to 7.5 ft below surface grade, or at approximately el -1 to el 5.

Groundwater was observed in the test pit excavations at depths of 7 ft to 10.5 ft below surface grade, or at approximately el -3.5 to el 0. Perched water seepage was observed in test pits TP-2 and TP-3 at 4 ft and 6 ft below surface grade, respectively, or at approximate el 0.5 to el 2.5.

Groundwater level observation wells were installed in completed boreholes B-24 and B-27. The stabilized groundwater level in the well in B-24 was measured to be at a depth of 7.5 ft below surface grade, or at approximate el 2.5. The stabilized groundwater level in the well in B-27 was measured to be at a depth of 6 ft below surface grade, or at approximate el 2.

Groundwater levels are subject to seasonal fluctuations. A summary of the groundwater level measurements in the borings and test pits is provided in Table 2A. A summary of the groundwater level measurements in the wells is provided in Table 2B.

Corrosion Test Results

The results of corrosion testing on samples of soil from borings B-17, B-22, B-24 and B-27 within depth intervals of 0 ft to 12 ft are shown in the table below. At the time of this report, the corrosion test results were not available.

Geothermal Resistivity Testing Results

Thermal resistivity tests were performed on undisturbed Shelby tube samples taken from borings B-24 and B-28 from a depth of 4 ft to 6 ft below surface grade. At the time of this report, the geothermal resistivity results were not available.

Infiltration Test Results

A summary of the profile boring observations, the seasonal high groundwater table determinations, and the results of the SRI testing are provided in Appendix D.

Hydraulic Soil Group Classification

In accordance with the New Jersey Stormwater Best Practices Manual, the Hydrologic Soil Group (HSG) has been evaluated at each test pit location based on the depth to observed groundwater level, observations of soil mottling (an indicator of the seasonal high water table (SHWT)), soil gradation, and laboratory tube permeameter testing of select soil samples.

The classification of the HSG has been determined in accordance with the NRCS National Engineering Handbook, Part 630 – Hydrology, Chapter 7 Hydrologic Soil Groups. The following table (Table 7-1: Criteria for Assignment of Hydrologic Soil Group) was used to determine the HSG at each test pit location.

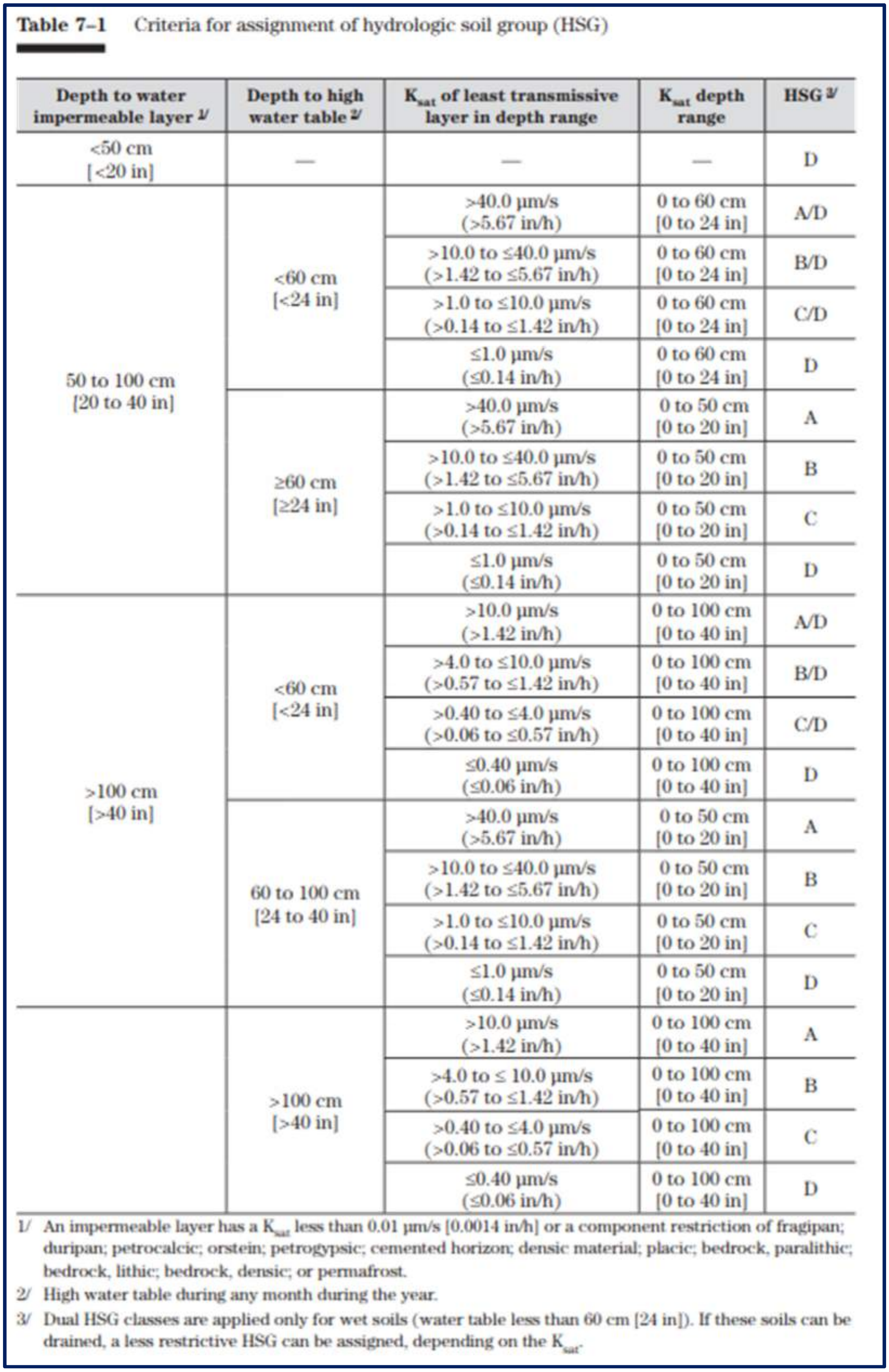


Table 7–1 Criteria for assignment of hydrologic soil group (HSG)

Depth to water impermeable layer 1/	Depth to high water table 2/	K_{sat} of least transmissive layer in depth range	K_{sat} depth range	HSG 3/
<50 cm [<20 in]	—	—	—	D
50 to 100 cm [20 to 40 in]	<60 cm [<24 in]	>40.0 μm/s (>5.67 in/h)	0 to 60 cm [0 to 24 in]	A/D
		>10.0 to ≤40.0 μm/s (>1.42 to ≤5.67 in/h)	0 to 60 cm [0 to 24 in]	B/D
		>1.0 to ≤10.0 μm/s (>0.14 to ≤1.42 in/h)	0 to 60 cm [0 to 24 in]	C/D
		≤1.0 μm/s (≤0.14 in/h)	0 to 60 cm [0 to 24 in]	D
	≥60 cm [≥24 in]	>40.0 μm/s (>5.67 in/h)	0 to 50 cm [0 to 20 in]	A
		>10.0 to ≤40.0 μm/s (>1.42 to ≤5.67 in/h)	0 to 50 cm [0 to 20 in]	B
		>1.0 to ≤10.0 μm/s (>0.14 to ≤1.42 in/h)	0 to 50 cm [0 to 20 in]	C
		≤1.0 μm/s (≤0.14 in/h)	0 to 50 cm [0 to 20 in]	D
>100 cm [>40 in]	<60 cm [<24 in]	>10.0 μm/s (>1.42 in/h)	0 to 100 cm [0 to 40 in]	A/D
		>4.0 to ≤10.0 μm/s (>0.57 to ≤1.42 in/h)	0 to 100 cm [0 to 40 in]	B/D
		>0.40 to ≤4.0 μm/s (>0.06 to ≤0.57 in/h)	0 to 100 cm [0 to 40 in]	C/D
		≤0.40 μm/s (≤0.06 in/h)	0 to 100 cm [0 to 40 in]	D
	60 to 100 cm [24 to 40 in]	>40.0 μm/s (>5.67 in/h)	0 to 50 cm [0 to 20 in]	A
		>10.0 to ≤40.0 μm/s (>1.42 to ≤5.67 in/h)	0 to 50 cm [0 to 20 in]	B
		>1.0 to ≤10.0 μm/s (>0.14 to ≤1.42 in/h)	0 to 50 cm [0 to 20 in]	C
		≤1.0 μm/s (≤0.14 in/h)	0 to 50 cm [0 to 20 in]	D
	>100 cm [>40 in]	>10.0 μm/s (>1.42 in/h)	0 to 100 cm [0 to 40 in]	A
		>4.0 to ≤ 10.0 μm/s (>0.57 to ≤1.42 in/h)	0 to 100 cm [0 to 40 in]	B
		>0.40 to ≤4.0 μm/s (>0.06 to ≤0.57 in/h)	0 to 100 cm [0 to 40 in]	C
		≤0.40 μm/s (≤0.06 in/h)	0 to 100 cm [0 to 40 in]	D

1/ An impermeable layer has a K_{sat} less than 0.01 μm/s [0.0014 in/h] or a component restriction of fragipan; duripan; petrocalcic; orstein; petrogypsic; cemented horizon; densic material; placic; bedrock, paralithic; bedrock, lithic; bedrock, densic; or permafrost.

2/ High water table during any month during the year.

3/ Dual HSG classes are applied only for wet soils (water table less than 60 cm [24 in]). If these soils can be drained, a less restrictive HSG can be assigned, depending on the K_{sat}.

The results of the HSG determination at each test pit location are summarized in the table below.

HSG Determination Summary Table

Test Pit	HSG Determination	Seasonal High Water Determination	Criteria	Remarks
TP-1	A	7 ft below surface grade	Depth to SHWT > 40 inches K_{sat} >1.42 in/hr	Groundwater encountered at 7 ft below surface grade
TP-2	A	4 ft below surface grade	Depth to SHWT > 40 inches K_{sat} >1.42 in/hr	Perched water observed at 4 ft below surface grade
TP-3	A	6 ft below surface grade	Depth to SHWT > 40 inches K_{sat} >1.42 in/hr	Perched water observed at 6 ft below surface grade
TP-4	A / D	1 ft below surface grade	Depth to SHWT < 24 inches K_{sat} >1.42 in/hr	Mottling observed 1 ft to 1.5 ft below surface grade
TP-5	A	10 ft below surface grade	Depth to SHWT > 40 inches K_{sat} >1.42 in/hr	Mottling observed 10 ft to 11 ft below surface grade
TP-6	B / D	1 ft below surface grade	Depth to SHWT < 24 inches 0.57 in/hr < K_{sat} ≤ 1.42 in/hr	Mottling observed 1 ft to 5 ft below surface grade
TP-7	A	9.5 ft below surface grade	Depth to SHWT > 40 inches K_{sat} >1.42 in/hr	Mottling observed 9.5 ft to 11 ft below surface grade

EVALUATION AND RECOMMENDATIONS

We understand that the existing tunnel and associated below-grade stairwell structures will be removed by the current property owner prior to work commencing for the proposed development. The structures will reportedly be removed in their entirety and replaced with approved, properly-compacted fill. If alternate methods of removal/abandonment of these structures are proposed, they should be brought to Langan's attention as soon as possible so that we can determine whether such changes affect our recommendations provided in the following sections.

We understand the proposed development consists of transformers, reactors, DRC buildings, a control house, equipment stands, circuit breakers, lightning masts and H-frame deadend structures. Based on the very light loads provided and on the subsurface conditions encountered in the borings, test pits and CPTs, we recommend the DRC buildings, the control house, circuit breakers and equipment stands be supported by shallow foundations. The existing fill materials and organic soils, in their current condition, are not suitable for foundation bearing. For the lightly loaded structures, the natural sandy/silty soils underlying the fill materials are suitable for foundation bearing. Ground improvement consisting of either 1) removal of the existing fill and organic soils and replacement with approved compacted fill, or 2) the installation of grouted compacted stone columns is required in conjunction with shallow foundation support of the lightly loaded structures.

For the heavily-loaded structures, including the H-frame deadends and lighting masts, the loads should be transferred below the fill, upper organic soils, and clay layer typically encountered at depths of approximately 39 ft to 50 ft below surface grade (approximate el -40 and el -32) using deep foundations deriving their support in the medium dense to very dense lower sand. We understand that the preferred foundation types for the H-frame deadends and lighting masts are drilled shafts, and that the preferred foundation types for the transformers and reactors are helical pile-supported mat foundations. Recommendations for deep foundation design and construction are provided in the following sections.

Our geotechnical recommendations for seismicity, ground improvement, design of shallow and deep foundations, slab support, and other geotechnical aspects of design and construction are presented below.

DESIGN RECOMMENDATIONS

The following sections discuss our recommendations for seismicity, the foundation systems, ground improvement and ground floor slab design.

Seismicity

The 2021 International Building Code NJ Edition (Building Code) assigns a seismic site class based on the type, thickness and average properties in the top 100 ft of bearing stratum. Seismic site-class values are given in accordance with Chapter 20 of ASCE 7 per the Building Code.

The bearing strata at the site typically consist of loose to very dense upper sand/silt and very soft to stiff clay overlying loose to very dense lower sand. Based on the results of the borings and CPTs, the majority of the site is classified as seismic site class D. Based on the results of boring B-28 performed near the existing substation, the northern portion of the site within the existing substation is classified as seismic site class E. The recommended seismic design parameters are summarized in the following tables.

Recommended Seismic Design Parameters for Majority of the Site

Seismic Parameters	Value at short period	Value at 1-second period
Mapped Spectral Response Acceleration *(in terms of gravitational acceleration, g)*	S_S= 0.117g	S_1= 0.039g
Seismic Site Class	Class D (stiff soil)	
Seismic Site Coefficients	F_A = 1.6	F_V = 2.4
Design spectral response acceleration, S_{DS}=2/3xFxS	S_{DS}=0.125g	S_{D1}=0.063g
Risk Category	IV	
Seismic Design Category	A	A

Recommended Seismic Design Parameters for Structures within Existing Substation

Seismic Parameters	Value at short period	Value at 1-second period
Mapped Spectral Response Acceleration *(in terms of gravitational acceleration, g)*	S_S= 0.117g	S_1= 0.039g
Seismic Site Class	Class E (soft clay soil)	
Seismic Site Coefficients	F_A = 2.4	F_V = 4.2
Design spectral response acceleration, S_{DS}=2/3xFxS	S_{DS}=0.188g	S_{D1}=0.11g
Risk Category	IV	
Seismic Design Category	C	C

Liquefaction Potential

Soils underlying the site are generally loose to very dense upper sand/silt and very soft to stiff clay overlying loose to very dense lower sand. The Building Code requires that non-cohesive granular soils below the groundwater table and up to 50 ft below the ground surface shall be evaluated. To evaluate liquefaction, normalized SPT values (N-values normalized for 60% energy efficiency) were plotted versus depth. The results are provided in Figure 7.

The method widely-known as the Seed & Idriss Simplified Procedure was utilized to evaluate if the subsurface granular soils below the groundwater table will remain stable during a seismic event or if ground improvement is required to mitigate the effects of liquefaction. All of the N-values fall in the non-liquefiable zone excluding five N-values at varying depths from varying borings.

Based on the typical subsurface conditions, soil liquefaction does not need to be considered in the design and liquefaction-induced settlements are not anticipated. Furthermore, we estimate seismically-induced settlements during an earthquake event to be less than 0.25 inches.

Shallow Foundation System with Ground Improvement

We recommend the proposed equipment stands and the proposed control house be supported on shallow foundations following ground improvement as described below.

The existing fill materials and organic soils, in their present conditions, are not suitable for conventional foundation support. The underlying natural sandy soil deposits are suitable for foundation bearing. Ground improvement consisting of removal of existing fill and organic soils and replacement with approved compacted fill or the installation of grouted rigid inclusions will be required to support the proposed structures on shallow foundations. A shallow foundation system consisting of spread, combined and strip footings, or a combination of these (or localized mat), should be used to support proposed equipment stands and the control house.

Removal and Replacement

Foundations should bear on undisturbed, natural, medium dense, competent sandy soils encountered below the unsuitable fill materials and organic soils, where present, or on approved, suitable engineered fill materials placed over undisturbed, natural, medium dense, competent sandy soils encountered below the unsuitable materials. We anticipate excavations up to 9 ft below existing surface grade will be required to reach competent undisturbed bearing materials. This option is most viable for conditions where the required excavation depths will be above the groundwater level.

Over-excavations to reach suitable bearing subgrades can be filled either by ¾-inch crushed stone wrapped in geofabric, or compacted granular structural fill.

Allowable Bearing Pressures and Lateral Resistance

The structures should be supported on cast-in-place concrete footings bearing on competent soils as identified above. Therefore, we recommend that the allowable bearing pressure for competent bearing materials and the coefficient of base friction, (f_c), between the cast-in-place concrete and the competent bearing materials be taken in accordance with the table below:

Bearing Material	Recommended Allowable Bearing Pressure, q_{all}	Recommended Coefficient of Base Friction, f_c
Natural undisturbed sandy soils	2 kips per square foot (ksf)	0.35 for bare concrete
Compacted structural fill placed over undisturbed sandy soils	2 ksf	0.35 for bare concrete
Subgrade improved by rigid inclusions and load transfer platform	2 ksf	0.35 for bare concrete

A factor of safety of 3 was utilized to develop the recommended allowable bearing pressure. Foundations should be placed a minimum of 3 ft below proposed ground surface elevation to achieve the recommended allowable bearing pressure with this factor of safety.

Lateral Resistance: If shallow foundation support is utilized, the proposed structure will be supported on cast-in-place concrete foundations bearing on the soil. Lateral resistance can be provided by the friction between the base of the foundation and the bearing material. We recommend that the allowable coefficient of base friction be taken as 0.35 between the cast-in-place concrete and the competent bearing materials identified above.

Uplift Capacity for Shallow Foundations

Small uplift loads can be resisted by the weight of the foundation. The weight of the soil above the foundation should be neglected. If large uplift capacities are required for structures supported by shallow foundations, soil anchors can be considered.

Minimum Dimensions and Frost Depth

All isolated and continuous footings should be a minimum of 3-ft-wide and 2-ft-wide, respectively. All footings bearing on soils should be placed at least 3 ft below exterior ground surface for frost protection.

Settlement Estimates

The total settlements at columns and differential settlements between adjacent columns are estimated to be less than 1 inch and 0.5 inches, respectively.

Positioning of Adjacent Foundations

The proposed shallow foundations should be located out of the influence zone of nearby foundations and walls to avoid inducing load on adjacent foundations (proposed or existing), below-grade walls and exposed retaining walls. For below-grade walls, the theoretical influence zone is defined as a 1 Horizontal (H) on 1 Vertical (V) theoretical line drawn upward from the base of the wall. For foundations, the theoretical influence is defined as a 1H on 1V line drawn downward from the edge of a footing. A schematic footing position detail is given in Figure 8.

Shallow Foundation Subgrade Preparation Procedures

All unsuitable subgrade materials including fill, organic soils, debris, and loose/soft soils below the theoretical influence line of the foundations should be excavated to reach competent natural bearing materials. The theoretical influence line is defined as a 1 H on 2 V line drawn downward from the edge of the proposed foundations. Upon completion of final excavation for all foundations, foundation subgrades should be compacted and leveled with a vibratory plate compactor having a static weight of not less than 0.5 tons, such as a Wacker DPU 6055 or equivalent.

Protective Sealer Concrete: The majority of the site soils are sandy and have low shrink/swell potential. Based on the Atterberg limits determinations made as part of geotechnical laboratory testing, the cohesive soils encountered at the site are considered “inactive” with low expansion potential. All exposed subgrades should be protected against weather and run-off water, which can soften the subgrades. Consideration should be given to seal the inspected foundation subgrades with a thin sealer layer after approval. The sealer layer can be either a 4-inch-thick layer of compacted dense graded aggregate (DGA) or a 2-inch-thick layer of lean concrete having 2,500 pounds per square inch (psi) 28-day compressive strength for protection against weather effects and disturbance during foundation construction. Properly compacted DGA or a lean concrete “mud mat” will minimize moisture intrusion and surficial disturbance during foundation rebar placement and formwork construction.

The Contractor should be responsible for maintaining all footing subgrades in their as-approved condition until footing concrete is placed and the excavations are properly backfilled. Rainwater, snow, ice or trash/debris should not be allowed to accumulate in the excavation. If subgrade areas become wet and disturbed, they may no longer be suitable for foundations. Footings should be constructed as soon as possible following subgrade approval by the geotechnical engineer to minimize possible deterioration.

Over-excavation Filling: Over-excavations, where needed, should be filled with granular compacted structural fill or compacted ¾-inch crushed stone (ASTM #57) fully wrapped with Mirafi 180N filter fabric. All subgrade preparation work should be performed under the supervision of a geotechnical engineer.

Special Inspections

A qualified geotechnical engineer, experienced in this type of work, should inspect and approve the foundation subgrades to verify that the subgrade materials are adequate to provide the recommended allowable bearing pressures. Any soft, loose, or unsuitable soils identified by the inspecting geotechnical engineer should be removed and replaced with approved compacted fill.

Ground Improvement

If removal and replacement of unsuitable soils with approved, compacted fill and excavation below the groundwater level is not desired, ground improvement consisting of rigid inclusions or rammed stone columns with a load transfer platform (LTP) can be installed to support the proposed equipment stands and the proposed control house on shallow foundations.

Rigid Inclusions or Rammed Stone Columns

Rigid inclusions (drilled grouted elements) consist of drilling a hollow auger through the fill and underlying unsuitable soil layers and filling the hole with a cement-based grout column using pressure through the hollow auger. The process of augering leaves the majority of the drilled soil in place, to minimize spoils generation. The elements essentially improve the ground conditions by providing a stiff composite ground mass. Minimal vibrations are generated during the advancement of these drilled elements. The rigid inclusions are typically 10 inches to 20 inches in diameter.

Rammed stone columns are also augered down to the suitable bearing material (similar to the grouted elements), however the borehole is then filled/raised with compacted lifts of stone aggregate from the bottom to the top using a down the hole vibrator suspended from a crane or specialty rig. Compaction of the aggregate lifts would generate vibrations, which should be taken into account. These columns will also improve the ground conditions by providing a stiff composite ground mass. These compacted aggregate elements can be utilized provided adequate measures are taken to mitigate the vibrations caused by the compaction of the aggregate lifts. These elements are typically 20 inches or greater in diameter.

The rigid inclusion elements or rammed stone column elements should be installed throughout ground improvement areas on a grid pattern that is spaced depending on the underlying soils, building and structure loads, slab loads and settlement criteria. A group of elements are also installed at each individual column location or structure location. The number of elements at each location will be dependent on the column loading. We anticipate that the elements will need to be installed at least 5 ft into the medium dense to very dense lower and the elements length will typically range from approximately 45 ft to 55 ft.

Load Transfer Platform (LTP)

After installing the improvement elements (rigid inclusions or stone columns), an LTP typically consisting of approximately 1 ft of compacted granular material (structural fill) should be placed between the top of the elements and the proposed foundations or slabs. The backfilling and compaction for the LTP should be performed in accordance with the requirements of the "Engineered Fill" section of this report and requirements from the specialty designer. The reuse of existing granular soils or on-site processed materials as part of the LTP can be evaluated by the specialty designer and the project geotechnical engineer.

General

The ground improvement design and implementation will have to be performed by a specialty subcontractor and should be designed to satisfy the recommendations provided in the "Foundation System" and "Ground Floor Slabs and Exterior Concrete Pads" sections of this report. The element diameter, spacing, grout mix/strength, locations, LTP thickness, fill requirements and phasing of work should be designed by a Professional Engineer licensed in New Jersey and should be submitted to the project geotechnical engineer for review. The ground improvement operations should be inspected by a qualified geotechnical engineer.

Mat Foundation Alternative

Mat foundations can be considered as an alternative to conventional shallow foundations. Based on available structural information, we assumed the total uniform pressure increase on the underlying bearing soils will be approximately 1 ksf. The total uniform pressure beneath the mat foundation is estimated to result in total mat foundation settlements of up to 0.5 inch. A portion of the estimated settlement is anticipated to occur during construction.

The modulus of subgrade reaction value (ks) is defined as applied pressure divided by the anticipated settlement. The initial modulus of subgrade reaction value for preliminary design purposes can be taken as 15 pounds per square inch per inch (pci). This initial ks value is based on the estimated applied pressure and corresponding settlement identified above and should be reevaluated after initial structural analysis. The modulus of subgrade reaction will need to be refined as the structural design of the mat foundation progresses.

Recommendations previously provided above for lateral resistance, uplift capacity, minimum dimensions and frost depth, positioning of adjacent foundations, subgrade preparation procedures and special inspections associated with shallow foundations also apply and should be followed for mat foundations.

Deep Foundation System (Drilled Shafts)

We anticipate that drilled shafts bearing in soil can achieve the required capacities for the proposed axial compressive, moment and shear loads for the proposed H-frame deadends and lighting masts.

Shaft portions through soil should be fully cased until concrete placement is performed, to prevent shaft sidewall collapse during shaft construction. Our recommended LPile and FAD Tools parameters for the proposed H-frame foundations based on the subsurface conditions encountered in borings B-24 and B-28 that can be used in the design are provided in Appendix E and are discussed below.

Heavily-loaded drilled shafts for the H-frame deadends should be installed to derive their load carrying capacity in suitable soils consisting of the medium dense to very dense lower sand soils beneath the fill, upper organic soils and clay layer. Based on the preliminary loads provided for the proposed H-frame deadends, we anticipate a 5-ft-diameter drilled shaft embedded 45 ft to 55 ft below surface grade, terminating a minimum of 5 ft below the clay layer can support each H-frame leg.

Lightly-loaded drilled shafts for the proposed lighting masts should be installed to derive their load carrying capacity from the upper sand beneath the fill layer and upper organic soils. Based on the preliminary loads provided for the proposed lighting masts, we anticipate a 4-ft-diameter drilled shaft embedded 15 ft to 25 ft below surface grade, can support each mast. The maximum bearing depths for the lightly-loaded drilled shafts should be taken as 25 ft below grade or 5 ft above the clay layer typically encountered at depths of approximately 39 ft to 50 ft (approximate el -40 to el -32).

Recommended soil ultimate skin friction values and allowable end-bearing resistance values are provided in Appendix C.

Adequate drilled shaft reinforcing should be designed to resist all axial, bending, tensile, and shear stresses and should be continuous for the length of the shaft. Minimum concrete 28-day compressive strength should be 4,500 lb/in^2.

Drilled shafts will produce soil spoils. Spoils can be reused at the site provided they meet the criteria for engineered fill outlined below.

Settlement Estimates

The total settlement at an individual drilled shaft is estimated to be less than 1 inch.

Special Inspection

A qualified geotechnical engineer, experienced in this type of work, should inspect and approve the drilled shafts to verify that the subgrade materials are consistent with the findings of the borings and the subgrade materials are adequate to provide the recommended design values.

Helical Pile Alternative

We understand helical piles of the sizes provided in the table below are being considered to support the proposed transformers and reactors. We anticipate properly designed helical piles installed to approximately 45 ft to 55 ft below surface grade can sustain the pile individual design compression and uplift capacities summarized in the table below. Helical piles should consist of a center shaft and helices with 50 ksi strength steel with the helices spaced a minimum of 3 ft on center along the pile shaft. The minimum center-to-center spacing between the helical piles should be at least 4 times the largest helix diameter. The uppermost helix should be embedded a minimum of 2 ft below the bottom of the clay layer.

Helical Pile Size	Individual Compression Capacity	Individual Uplift Capacity	Individual Lateral Capacity under Free Head Condition
4.5-inch-diameter round shaft with (3) 12-inch-diameter helices	30 tons	15 tons	1 ton
5.5-inch-diameter round shaft with (3) 16-inch-diameter helices	50 tons	25 tons	1.5 tons
9.63-inch-diameter round shaft with (2) 24-inch-diameter helices	75 tons	35 tons	3 tons
18-inch-diameter round shaft with (2) 36-inch-diameter helices	100 tons	50 tons	5 tons

Compression load tests should be performed to confirm the pile compression capacity and site-specific installation torque requirement. The compression load tests should be performed in accordance with the Quick Load Test Procedure requirements in ASTM D1143. Uplift load tests should be performed to confirm the pile uplift capacity. The uplift load tests should be performed in accordance with the Quick Load Test Procedure requirements in ASTM D3689.

Pile lateral capacity should be confirmed by performing lateral load testing in accordance with the requirements in ASTM D3966. Battered helical piles can also be considered to resist lateral loads.

All helical piles should be hot-dip galvanized for corrosion resistance with a coating thickness not less than 3.1 mils in accordance with ASTM A153 Class B-1. The yield strength of pile components should not be less than 50 ksi.

Helical piles should be embedded below the clay layer to transfer loads below the fill, upper organic soils, and clay layer typically encountered at depths of approximately 39 ft to 50 ft below surface grade (approximate el -40 and el -32) and derive their support in the medium dense to very dense lower sand. Some of the fill materials and upper sands were classified as medium dense to dense with N-values greater than 50 bpf. The smaller shaft diameters and helix sizes provided above may penetrate the medium dense to dense sands more easily and minimize the occurrences of early refusal or “spinning out” of helical piles.

Structural pile caps or mats will be required to support the at-grade components for structures supported by helical piles.

Settlement Estimates

The total settlement of individual helical piles are estimated to be less than 1 inch.

Special Inspection

A qualified geotechnical engineer, experienced in this type of work, should inspect and approve the helical piles to verify the installation procedures and observed torque resistance during installation are adequate to provide the recommended design values.

Soil Design Parameters

We reviewed the boring logs and lab data to develop soil design parameters for the subsurface strata encountered in borings B-24 and B-28. Geotechnical design parameters were developed for the design team for input into Foundation Analysis and Design Tools (FAD Tools) and LPile software programs. Our recommended parameters for each soil strata encountered in this boring are included in Appendix E. A description of the developed design parameters is provided in the following sections.

LPile

The p-y curve models were selected and parameters for each soil layer were developed for input into LPile. The following variables and parameters are provided for each soil layer:

- *p-y Curve Models* were specified from the internal LPile selections for each layer based on the soil classification.
- *Effective Unit Weight* is provided in pounds per cubic foot (pcf) based on soil type and groundwater conditions derived from the N-values obtained during SPT sampling and correlations provided in the MFAD User Guide.
- *Internal Friction Angle* is provided in degrees for non-cohesive soils derived from N-values obtained during SPT sampling and correlations provided in the MFAD User Guide.
- *Undrained Shear Strength* is provided in pounds per square-foot (psf) for cohesive soils derived from N-values obtained during SPT sampling and correlations provided in the MFAD User Guide.

Foundation Analysis and Design Tools (FAD Tools)

Parameters for each soil layer were developed for input into FAD 5.1 based on development guidance provided in Chapter 3 of the FAD Tools User Guide dated March 2014 (User Guide). The following parameters are provided for granular soils:

- *Internal Friction Angle* is provided in degrees for granular soils, derived from the N-values obtained during SPT sampling and correlations provided in the User Guide (Figure 3-3).
- *Deformation Modulus* is provided in ksi for granular soils, derived from the N-values obtained during SPT sampling and correlations provided in the User Guide (Figure 3-4).

Ground Floor Slabs and Exterior Concrete Pads

Ground floor slabs for the control house building and exterior concrete pads, including for the circuit breakers, can be designed as slab-on-grade construction using a design modulus of subgrade reaction of 150 pounds per cubic inch (pci) provided that the subgrade is adequately prepared and improved as described herein.

Stripping and Buried Rigid Obstructions

All surficial materials (topsoil) and deleterious materials (timber, metal, garbage) should be removed entirely from proposed building/structure footprints. Buried rigid obstructions (walls, foundations, pipes, slabs) if encountered, should be removed to at least 3 ft below the base of proposed ground floor slabs to prevent rigid spots.

Subgrade Preparation

Once the site grading, stripping and general/selective excavations are performed, the exposed subgrade should be proofrolled using a heavy smooth drum roller in accordance with the "Proofrolling" section of this report prior to placement of fill and bedding layers. All backfilling and compaction should be performed in accordance with the requirements of the "Backfilling and Compaction" section below.

Vapor Barrier and Bedding Layer

Once the subgrade is prepared and improved as described above, a 6-inch-thick layer of ¾-inch natural crushed stone should be placed immediately below the slab as a bedding layer, which will also serve as a capillary break. A plastic sheet vapor barrier should also be installed beneath the slab. The position of the vapor barrier should be chosen by the structural engineer in accordance with the latest ACI guidelines. The vapor barrier should not be less than 15-mil-thick and should conform to ASTM E 1745 Class A requirements. The vapor barrier and bedding layer should be coordinated with the environmental consultant, based on any identified environmental conditions.

Special Inspections

Slab bearing areas must be inspected and approved by a qualified geotechnical engineer prior to steel reinforcement or concrete placement. Any soft, loose, or unsuitable soils identified by the inspecting geotechnical engineer during proof-rolling should be removed and replaced with approved, compacted fill.

Joints

Construction and/or saw cut joints should be provided as necessary for crack control.

Lateral Earth Pressures

If any below-grade walls are proposed, they can be designed using an equivalent fluid pressure of 65 lbs/ft^3 where the structure provides lateral restraint at the top of the wall. This parameter presumes the retaining wall backfill meets the minimum requirements for approved compacted fill discussed below, that full drainage is provided behind the wall, and that there are not any surface surcharge or structure loads at the top of the wall. Adjustment of the pressures should be made by the designer where appropriate to consider these factors. Presuming the aforementioned fill, fill placement, and compaction requirements, a coefficient of at-rest earth pressure K_o = 0.5 can be used in evaluating surcharge loads transmitted to the wall.

For mass concrete poured against approved compacted soil subgrade, a coefficient of sliding friction of 0.35 can be used.

Passive resistance for approved compacted on-site soils can be calculated using an equivalent fluid unit weight of 180 lbs/ft^3, which includes a reduction factor of 2. Extreme care and proper construction sequencing must be taken during construction in areas where passive resistance is required for wall support. This includes filling simultaneously on both sides of the wall, and not performing future excavations without properly bracing the wall.

Pavement Design

From a geotechnical perspective, we anticipate the parking and access drive for the proposed development can consist of on-grade supported asphalt pavement, subsequent to pavement subgrade preparation consisting of proof-rolling of fill soils, and raising grades, where required, by placing approved compacted fill.

We have provided recommendations for asphalt pavement minimum sections for the proposed development based on estimated traffic loading for the proposed development that was provided to us and the anticipated subgrade soils. A California Bearing Ratio (CBR) value of 8 was used in our design. We have analyzed and designed the standard duty and heavy duty asphalt pavement section for the proposed development following the flexible pavement design guidelines given in the AASHTO Guide for Design of Pavement Structures. Refer to Appendix F for pavement design calculations.

The vehicular loading data used in the design calculations is based on preliminary values provided by the project team at the time of this report. If updated loading data becomes available, we can evaluate the pavement sections provided in this report and revise as necessary.

The following summarizes the data used in our design calculations:

Design Life = 20 years
Initial Serviceability = 4.2
Terminal Serviceability = 2.5
Reliability = 90%
Standard Deviation = 0.45
Vehicle Loading (Standard Duty) = 60,000 18-kip equivalent single axle loads
Vehicle Loading (Heavy Duty) = 1,000,000 18-kip equivalent single axle loads

Our calculations using the parameters shown above indicate the following pavement sections (which are equivalent to the minimum sections we typically recommend for similar developments) to be suitable for this project following the specified pavement subgrade preparation:

Recommended Standard Duty Asphalt Pavement Section

Material	Thickness
Bituminous Concrete Surface Course (9.5M64)	1 ½ inches
Bituminous Concrete Binder Course (19M64)	2 ½ inches
Dense Graded Aggregate Base Course	6 inches

Recommended Heavy Duty Asphalt Pavement Section

Material	Thickness
Bituminous Concrete Surface Course (12.5M64)	2 inches
Bituminous Concrete Base Course (25M64)	5 inches
Dense Graded Aggregate Base Course	8 inches

The recommended pavement sections use the Superpave mixes in accordance with NJDOT specifications.

For any paving outside the subject property limits, the minimum pavement sections specified by Upper Township, Cape May County, or NJDOT should be used.

Pavement subgrade preparation work should be inspected by a qualified geotechnical engineer. Should isolated areas exhibit unsuitable conditions, the isolated areas should be over-excavated to a depth as determined by the Geotechnical Engineer and immediately replaced with approved compacted fill or crushed stone.

CONSTRUCTION RECOMMENDATIONS

The following sections provide our construction recommendations, including site clearing and preparation, subgrade preparation, excavation, engineered fill, excavation for utilities and groundwater control during construction.

Site Clearing and Preparation

Prior to commencement of grading or fill placement, any miscellaneous trash, debris, or other unsuitable materials should be removed from the site. All debris should be properly disposed of off the site in accordance with applicable regulations. Below are our recommendations for demolition of the site utilities, and other site features:

- Any abandoned buried structures (i.e. foundations, slabs, walls, tanks, utilities, pits) below the proposed building/structure foundations should be removed completely. Any buried abandoned structure beneath the proposed slab should be removed at least 3 ft below the existing surface grade. No void or pit should be left beneath proposed slabs.

- Utilities associated with former development and designated for removal should be completely removed within the proposed building/structure footprints.

- Existing utilities located outside proposed building/structure footprints should be removed or abandoned in-place by complete filling with grout.

- Excavations made to remove foundation elements or utilities should be backfilled with approved compacted fill as discussed herein.

Clearing and grubbing of all trees (including removal of any associated root systems and stumps) and vegetation designated for removal should be performed. Topsoil should be completely stripped from proposed building footprints and 10 ft beyond building limits where accessible.

All clearing and stripping activities should be performed in strict accordance with the approved soil erosion and sediment control plan prepared for the project. All site demolition and site clearing operations should be performed in accordance with any environmental regulations and requirements established for the site as well as all Local, State, and Federal regulations. Dust control measures should be implemented during construction to limit the generation of airborne particulates.

All work should be performed so as not to adversely impact the existing and neighboring buildings, off-site structures, or utilities. Protection of these elements should be provided as necessary during the course of all construction activities at the site.

Subgrade Preparation

After performing the aforementioned site preparation work, and prior to placing compacted fill to raise site grades or constructing finished surfaces in on-grade supported areas (building slabs, pavement, and sidewalks), all site soil within the proposed development areas should be proofrolled in accordance with the "Proofrolling" section below.

If subgrade areas become wet and disturbed, the surficial soils may no longer be suitable for use in fill placement unless sufficiently dried. Should soft or unsuitable subgrade soils be observed as identified by the inspecting Geotechnical Engineer during construction and sufficient time to dry the material is not feasible, these materials should be excavated and replaced with approved compacted backfill.

Prior to constructing finished surfaces (building slabs, pavements), we also recommend that the subbase be proof-rolled using a fully loaded tri-axle dump truck and a heavy vibratory roller in the presence of a qualified geotechnical engineer. Soft areas identified during proof-rolling should be excavated and replaced with approved, compacted fill.

We also recommend that the site be graded and drainage swales and berms be used to convey surface runoff away from fill areas. During the cutting and filling, construction equipment should follow consistent traffic patterns throughout the site to minimize disturbance of the subgrade during wet periods.

The Contractor's ability to successfully work the site soils, combined with the weather conditions and the time of year during the site preparation and filling phases of construction, will have a significant impact on timely project completion. Care should be taken to prevent disturbance of the proof-rolled areas and softening of these materials prior to finished construction. At a minimum, all subgrade areas should be temporarily sloped and sealed by rolling with a smooth drum roller at the end of each working day, as necessary, so as to maximize surface water runoff, and minimize potential ponding and infiltration.

For building slab areas, the aggregate subbase material can be placed as soon as practical upon completing site grading and subgrade preparation work as a protective layer. Prior to floor slab construction, this aggregate subbase layer will have to be repaired, re-graded, and re-compacted.

Proofrolling

Proofrolling of soil subgrades within the proposed development area should be performed after removal of surficial materials, deleterious materials and completion of the excavations outlined in the "Ground Floor Slabs" section above. Proofrolling can be achieved by a minimum of 6 overlapping passes of a heavy vibratory drum compactor having a static drum weight of at least 5 tons and a fully loaded tri-axle 20-tons dump truck. Proofrolling should be performed in overlapping passes in both directions (perpendicular to each other).

Any areas exhibiting evidence of poor subgrade, such as rutting or weaving beneath the proofrolling equipment, or containing deleterious materials, should be removed to competent material and replaced with compacted structural fill. Requirements for compacted fill and its placement should be in accordance with the "Engineered Fill" section below.

Excavation

Typical excavations for foundations to reach proposed design grade are anticipated to extend approximately 3 ft to 9 ft below the existing surface grades. The excavations can be performed using conventional earthwork equipment.

Open-cut excavations seem feasible throughout the site. Excavation sides should be sloped, benched or braced properly in accordance with OSHA guidelines. Open-cut excavations, where feasible, should consist of stable slopes satisfying OSHA. The excavations are anticipated to be in sandy soils classified as the "Type C" OSHA soil type. The OSHA soil type should be reviewed and confirmed during construction by a qualified person.

Temporary excavation stability is a function of several factors including the presence of groundwater, the type and density of the various soil strata, the depth of excavation, surcharge loadings adjacent to the excavation, and the length of time and weather conditions while the excavation remains open. Sidewall instability should be expected when groundwater seepage is encountered and in areas of loose sandy soils, if any.

All excavations should be properly sloped and/or braced in conformance with applicable OSHA regulations including, but not limited to, temporary shoring, utilizing trench boxes and/or proper benching. The Contractor should be responsible for maintaining the stability of the soil excavations.

Groundwater Control During Construction

Groundwater was encountered in the groundwater level observation wells and the test pit excavations at depths ranging from 6 ft to 10.5 ft below surface grade, corresponding to approximate el -3.5 to el -2.

The majority of the excavations are anticipated to be above the measured groundwater levels recorded during the investigation. For shallow excavations, dewatering measures consisting of trenching and sump pumping during construction are anticipated to be required and sufficient to maintain a dry and workable site to control surface water.

However, some excavations are anticipated to extend below the groundwater level, and more substantial pumping effort in conjunction with continued maintenance of gravel sumps, seepage control, and erosion protection along the side slopes may be required. We recommend that the sump pits and sumps be installed in advance of proposed cuts in order to facilitate removal of groundwater ahead of time, making excavation easier and cleaner. If groundwater is encountered during the excavation, we recommend that the contractor install temporary perimeter ditches or other subsurface drains to collect or intercept groundwater to facilitate deeper excavation. Please note that the installation of closed sheeting may be necessary to facilitate dewatering and excavations for foundation subgrade preparation.

Cohesive on-site soils (silt and clay) and on-site sandy soils with significant fine soil particles are sensitive to moisture. Water should not be allowed to pond and sit over soil subgrades. Proper grading, trenching and periodic pumping will be needed to maintain the site in a dry and workable condition. The pumping, handling and discharge of all dewatering effluent should be performed in accordance with all applicable regulations and any environmental requirements for the site.

Engineered Fill

The recommended requirements for re-use of existing on-site soils and imported fill are discussed in the following sections and summarized in the table below.

Summary of Recommended Engineered Fill Properties

Soil Property	Existing On-site Soils	Imported Fill
Maximum Particle Size	6 inches	4 inches
Percent (by weight) Finer than the No. 200 Sieve	30%	15%
Liquid Limit / Plastic Limit	Not plastic	Not plastic

Reuse of Existing On-site Soils

The on-site soils having a maximum particle size of 6 inches in diameter can be used as compacted fill to raise grades or backfill foundation and utility excavations. The use of larger aggregate should only be done as approved by a qualified geotechnical engineer based on inspection of conditions encountered during construction.

Some of the on-site soils have a relatively high percentage of fines and are expected to be difficult to handle, place, and compact when they become excessively wet. The Contractor should make provisions to dry portions of the excavated material such as by discing/air drying and soil stabilization as necessary, prior to compaction to an acceptable moisture content as determined by the Geotechnical Engineer.

Excavated materials which are at acceptable moisture contents should be reused as fill as soon as possible to minimize exposure to weather. Stockpiled materials that are planned for reuse should be protected or sealed by the Contractor to keep the materials from becoming wet.

Imported Fill

Imported fill should consist of a relatively well-graded mixture of sand and gravel having a maximum particle size of 4 inches with not more than 15 percent (by weight) finer than the No. 200 sieve. The use of any imported fill containing a higher percentage of fines would need to be evaluated by a qualified geotechnical engineer during construction.

Suitable fill should be free of organics and other deleterious materials. The fill should be environmentally clean. "Clean fill" is defined as material to be used in a remedial action that meets all soil remediation standards, meets site-specific alternative standards or site-specific interim standards, does not contain extraneous debris or solid waste, and does not contain free liquids. This also includes any material that meets all criteria or action levels for contaminants without standards, available on the New Jersey Department of Environmental Protection's website at www.nj.gov/dep/srp.

Grain size distribution and Modified Proctor compaction tests (ASTM D1557) should be done on representative samples of the backfill and imported fill material proposed by the Contractor. Imported fill should be placed in accordance with the above-described procedure for on-site soils used as compacted fill.

Fill Placement and Compaction

Structural fill (i.e. beneath the building areas) should be placed in uniform lifts and compacted to at least 95 percent of the material's maximum dry density as determined by the Modified Proctor Compaction Test (ASTM D1557). Fill placed in landscape areas should be compacted to at least 92 percent of the material's maximum dry density as determined by the Modified Proctor Compaction Test (ASTM D1557). On-site soils and imported select fill should be placed in maximum 12-inch-thick loose lifts and compacted using a smooth drum vibratory roller having a minimum static drum weight of 1 ton.

Smaller compaction equipment (i.e. walk-behind trench roller or jumping jack compactor) and thinner lifts (maximum 6 to 8 inches thick) should be used in areas of limited maneuverability.

The water content at the time of compaction should be within 3 percentage points of the optimum water content. All fill placement should be subject to observation and testing by a qualified geotechnical engineer.

No fill material should be placed on areas where free water is standing, on frozen subgrade areas, or on surfaces which have not been approved by a qualified geotechnical engineer.

A summary of the recommended fill placement and compaction requirements is provided below.

Summary of Fill Placement and Compaction Requirements

	Structural Fill	Non-structural Fill
Maximum Lift Thickness	12 inches	18 inches
Moisture Content	Within 3 percentage points of optimum water content	Within 3 percentage points of optimum water content
Compaction	95% of material's max. dry density as determined by the Modified Proctor Compaction Test	92% of material's max. dry density as determined by the Modified Proctor Compaction Test

Utilities

Excavations will be required for the installation of proposed utilities and associated structures. All excavations should be properly sloped and/or braced in conformance with applicable OSHA regulations including, but not limited to, temporary shoring, utilizing trench boxes and/or proper benching.

Prior to construction, we recommend field locating any existing utilities that are to remain or that must be temporarily maintained during construction.

We expect site excavations for proposed utilities to be constructed in existing fill or native soils. Exposed utility trenches in soil should be proof-rolled with at least three (3) overlapping coverages of a double-drum walk-behind vibratory compactor such as a Wacker RT 82-SC or equivalent. Any soft or unstable areas identified by the proof-rolling should be removed and replaced with compacted fill. If unsuitable bearing material is encountered at the proposed utility subgrade elevation, we recommend that 1 ft of over-excavation and replacement with approved bedding material be performed beneath all utilities. The actual extent of removal should be determined by a qualified inspecting geotechnical engineer based on the ground conditions encountered at the time of excavation.

We recommend that a minimum 6-inch-thick layer of ¾-inch clean, crushed stone be placed above the soil subgrade as pipe bedding material. The remainder of the trench can be backfilled using approved on-site soils in accordance with the recommendations provided herein. Backfill in utility excavations should meet the previously discussed requirements for engineered fill, with fill placement and compaction performed as previously discussed.

CONSTRUCTION DOCUMENTS AND INSPECTION / QUALITY ASSURANCE

Technical specifications addressing earthwork and all other work related to foundations and site preparation/construction should be prepared by our firm. In addition, the foundation recommendations given herein should be included in the structural drawings for the project. Our firm should be provided with and review any Contractor submittals related to foundation work, site preparation, and soil importation for conformance with the recommendations given in this report.

During construction, it is critical that all geotechnical related work be performed under qualified geotechnical engineering inspection/monitoring/testing in order to ensure proper and timely implementation of the recommendations given in this report. We recommend that Langan perform this work to verify proper implementation of our recommendations and to maintain continuity of our responsibility for this project. Our field engineer would be able to immediately address unexpected or unusual conditions that may be encountered and provide remedial recommendations. This work includes: site preparation and proof-rolling, compacted fill placement, footing and slab subgrade preparation, drilled shaft installation, pavement subgrade preparation, utility construction and backfill placement, and asphalt paving.

OWNER AND CONTRACTOR OBLIGATIONS

The Contractor is responsible for construction quality control, which includes satisfactorily constructing the foundation system and any associated temporary works to achieve the design intent while not adversely impacting or causing loss of support to neighboring structures. Construction activities that can alter the existing ground conditions such as excavation, fill placement, foundation construction, ground improvement, shoring installation, dewatering, etc. can also potentially induce stresses, vibrations, and movements in nearby structures and utilities, and disturb occupants of nearby structures. Contractors working at the site must ensure that their activities will not adversely affect the performance of the structures and utilities, and will not disturb occupants of nearby structures. Contractors must also take all necessary measures to protect the existing structures during construction. By using this report, the Owner agrees that Langan will not be held responsible for any damage to adjacent structures.

The preparation and use of this report is based on the condition that the project construction contract between the Owner and their Contractor(s) will include: 1) Langan being added to the Project Wrap and/or Contractor’s General Liability insurance as an additional insured, and 2) language specifically stating the Foundation Contractor will defend, indemnify, and hold harmless the Owner and Langan against all claims related to disturbance or damage to adjacent structures or properties.

LIMITATIONS

The conclusions and recommendations provided in this report are based on subsurface conditions inferred from a limited number of borings, test pits and CPTs, as well as structural information provided by the project Owner. Recommendations provided are dependent upon one another and no recommendation should be followed independent of the others.

Any proposed changes in structures or their locations should be brought to Langan's attention as soon as possible so that we can determine whether such changes affect our recommendations. Information on subsurface strata and groundwater levels shown on the logs represent conditions encountered only at the locations indicated and at the time of investigation. If different conditions are encountered during construction, they should immediately be brought to Langan's attention for evaluation, as they may affect our recommendations.

This report has been prepared to assist the Owner, architect and structural engineer in the design process and is only applicable to the design of the specific project identified. The information in this report cannot be utilized or depended on by engineers or contractors who are involved in evaluations or designs of facilities (including underpinning, grouting, stabilization, etc.) on adjacent properties which are beyond the limits of that which is the specific subject of this report.

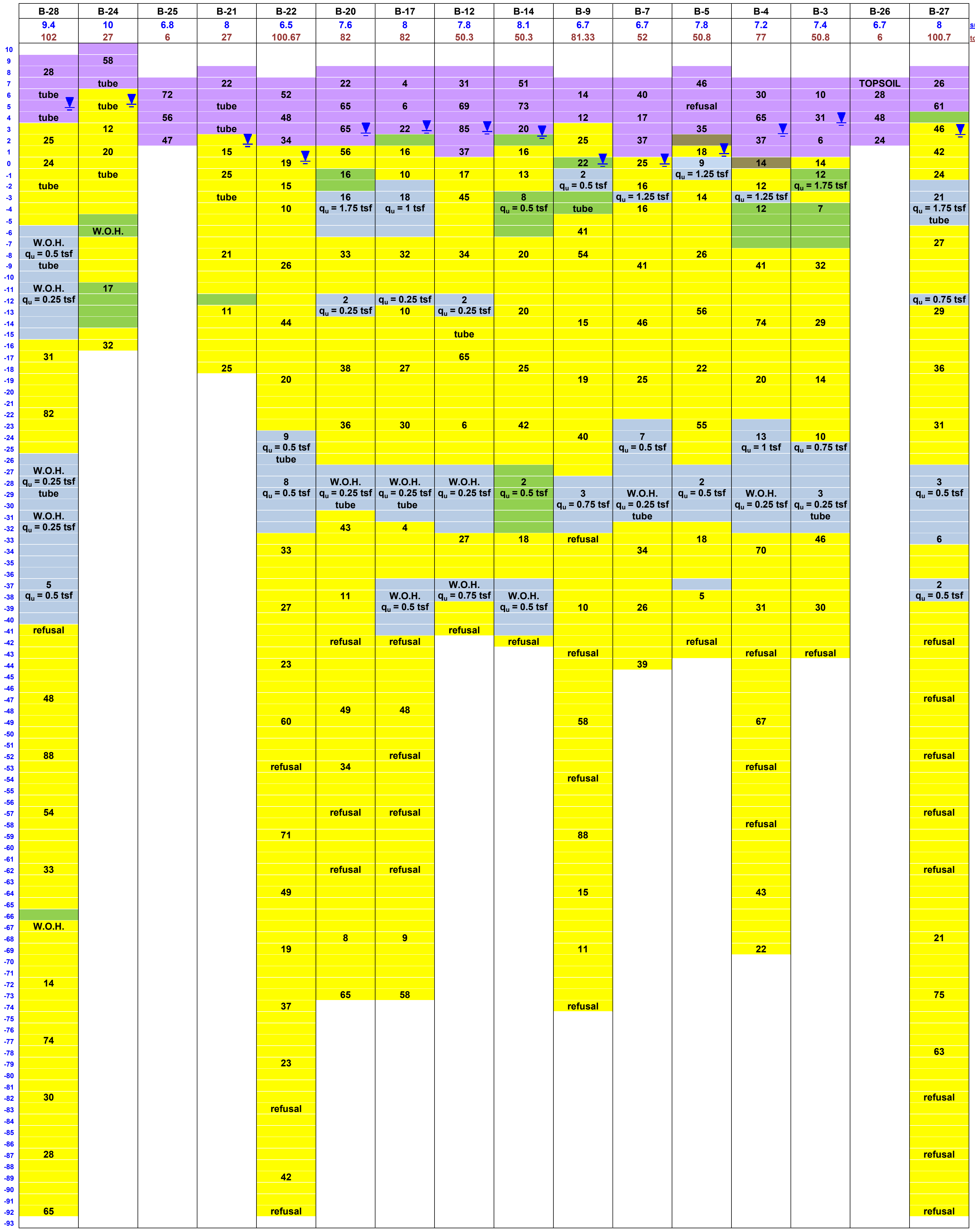
Environmental issues are outside the scope of this study and should be addressed in a separate study by qualified professionals.

\\langan.com\data\PAR\data2\101010201\Project Data_Discipline\Geotechnical\Reports\2022-09-14 BL England Geotechnical Report (Preliminary).docx

LIST OF TABLES

Ocean Wind - BL England Substation
Upper Township, New Jersey
#101010201

NORTH — **TABLE 1 - SUMMARY OF BORINGS (showing SPT N-Values in blows per foot)** — SOUTH



	B-28	B-24	B-25	B-21	B-22	B-20	B-17	B-12	B-14	B-9	B-7	B-5	B-4	B-3	B-26	B-27
surface elevation	9.4	10	6.8	8	6.5	7.6	8	7.8	8.1	6.7	6.7	7.8	7.2	7.4	6.7	8
total depth (feet)	102	27	6	27	100.67	82	82	50.3	50.3	81.33	52	50.8	77	50.8	6	100.7
10																
9		58														
8	28															
7		tube		22		22	4	31	51			46			TOPSOIL	26
6	tube		72		52					14	40		30	10	28	
5	▼	tube ▼		tube		65	6	69	73			refusal				61
4	tube		56		48					12	17		65	31 ▼	48	
3		12		tube		65 ▼	22 ▼	85 ▼	20 ▼			35	▼			46 ▼
2	25		47	▼	34					25	37		37	6	24	
1		20		15		56	16	37	16			18 ▼				42
0	24				19 ▼					22 ▼	25 ▼	9	14	14		
-1		tube		25		16	10	17	13	2		q_u = 1.25 tsf		12		24
-2	tube				15					q_u = 0.5 tsf	16		12	q_u = 1.75 tsf		
-3				tube		16	18	45	8		q_u = 1.25 tsf	14	q_u = 1.25 tsf			21
-4					10	q_u = 1.75 tsf	q_u = 1 tsf		q_u = 0.5 tsf	tube	16		12	7		q_u = 1.75 tsf
-5																tube
-6		W.O.H.								41						
-7	W.O.H.															27
-8	q_u = 0.5 tsf			21		33	32	34	20	54		26				
-9	tube				26						41		41	32		
-10																
-11	W.O.H.	17														
-12	q_u = 0.25 tsf					2	q_u = 0.25 tsf	2								q_u = 0.75 tsf
-13				11		q_u = 0.25 tsf	10	q_u = 0.25 tsf	20			56				29
-14					44					15	46		74	29		
-15								tube								
-16		32														
-17	31							65								
-18				25		38	27		25			22				36
-19					20					19	25		20	14		
-20																
-21																
-22	82															
-23						36	30	6	42			55				31
-24					9					40	7		13	10		
-25					q_u = 0.5 tsf						q_u = 0.5 tsf		q_u = 1 tsf	q_u = 0.75 tsf		
-26					tube											
-27	W.O.H.															
-28	q_u = 0.25 tsf				8	W.O.H.	W.O.H.	W.O.H.	2			2				3
-29	tube				q_u = 0.5 tsf	q_u = 0.25 tsf	q_u = 0.25 tsf	q_u = 0.25 tsf	q_u = 0.5 tsf	3	W.O.H.	q_u = 0.5 tsf	W.O.H.	3		q_u = 0.5 tsf
-30						tube	tube			q_u = 0.75 tsf	q_u = 0.25 tsf		q_u = 0.25 tsf	q_u = 0.25 tsf		
-31	W.O.H.										tube			tube		
-32	q_u = 0.25 tsf					43	4									
-33								27	18	refusal		18		46		6
-34					33						34		70			
-35																
-36																
-37	5							W.O.H.								2
-38	q_u = 0.5 tsf					11	W.O.H.	q_u = 0.75 tsf	W.O.H.			5				q_u = 0.5 tsf
-39					27		q_u = 0.5 tsf		q_u = 0.5 tsf	10	26		31	30		
-40																
-41	refusal							refusal								
-42						refusal	refusal		refusal			refusal				refusal
-43										refusal			refusal	refusal		
-44					23						39					
-45																
-46																
-47	48															refusal
-48						49	48									
-49					60					58			67			
-50																
-51																
-52	88						refusal									refusal
-53					refusal	34							refusal			
-54										refusal						
-55																
-56																
-57	54					refusal	refusal									refusal
-58													refusal			
-59					71					88						
-60																
-61																
-62	33					refusal	refusal									refusal
-63																
-64					49					15			43			
-65																
-66																
-67	W.O.H.															
-68						8	9									21
-69					19					11			22			
-70																
-71																
-72	14															
-73						65	58									75
-74					37					refusal						
-75																
-76																
-77	74															
-78																63
-79					23											
-80																
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-82	30															refusal
-83					refusal											
-84																
-85																
-86																
-87	28															refusal
-88																
-89					42											
-90																
-91																
-92	65				refusal											refusal
-93																

COLOR LEGEND	
🟪	FILL
🟨	SAND
🟦	CLAY
🟩	SILT
🟫	PEAT

NOTES
1 Subsurface information provided is generalized and is shown for illustration purposes only.
2 Refer to location plan for actual locations.
3 Refer to logs for actual soil descriptions and details.
4 The N-values tabulated in the table above are in blows/ft.

LEGEND

refusal	Split Spoon Refusal Value
16	SPT N-value
W.O.H.	Weight of Hammer
tube	Undisturbed Sample
qu	Unconfined compressive strength as measured in the field with a pocket penetrometer
▼	Measured Groundwater Level

TABLE 2A - SUMMARY OF GROUNDWATER LEVEL MEASUREMENTS IN BOREHOLES AND TEST PITS

Boring/Test Pit	**Approx. Surface Elevation at Boring/Test Pit Location**	**First**		**24 HR**		**REMARKS**
		DEPTH TO WATER (ft)	**WATER LEVEL EL.**	**DEPTH TO WATER (ft)**	**WATER LEVEL EL.**	
B-3	7.4	4.0	3.4	5.5	1.9	
B-4	7.2	6.0	1.2	5.2	2.0	
B-5	7.8	10.0	-2.2	7.5	0.3	
B-7	6.7	7.0	-0.3	7.5	-0.8	
B-9	6.7	6.0	0.7	7.4	-0.7	
B-12	7.8	6.0	1.8	5.8	2.0	
B-14	8.1	8.0	0.1	5.9	2.2	
B-17	8.0	15.0	-7.0	5.5	2.5	
B-20	7.6	8.0	-0.4	5.4	2.2	
B-21	8.0	8.0	0.0	6.6	1.4	
B-22	6.5	8.0	-1.5	6.8	-0.3	
B-24	10.0	10.0	0.0	4.9	5.1	
B-25	6.8	Not Encountered	-	Not Encountered	-	Boring terminated at 5 ft below surface grade.
B-26	6.7	Not Encountered	-	Not Encountered	-	Boring terminated at 5 ft below surface grade.
B-27	8.0	8.0	0.0	6.1	1.9	
B-28	9.4	6.0	3.4	4.5	4.9	
TP-1	6.8	7.0	-0.2			
TP-2	6.5	10.0	-3.5			Perched water seepage observed at 4 ft bgs.
TP-3	6.6	7.5	-0.9			Perched water seepage observed at 6 ft bgs.
TP-4	7.2	7.5	-0.3			
TP-5	8.2	-	-			Test pit terminated at 11 ft bgs. No groundwater seepage observed.
TP-6	9.0	-	-			Test pit terminated at 10.5 ft bgs. No groundwater seepage observed.
TP-7	8.4	10.5	-2.1			

NOTES

1- Groundwater levels were measured in the borings where first encountered and from within the boring 24 hours after completion of the boring.

2- Elevations are referenced to the North American Vertical Datum of 1988 (NAVD88).

Ocean Wind - BL England Substation

Upper Township, New Jersey

#101010201

TABLE 2B - SUMMARY OF GROUNDWATER LEVEL MEASUREMENTS IN WELLS

DATE	B-24 (OW)		B-27(OW)		REMARKS
	TOP OF WELL @ EL	10	TOP OF WELL @ EL	8	
	DEPTH TO WATER ft	WATER LEVEL ELEVATION ft	DEPTH TO WATER ft	WATER LEVEL ELEVATION ft	
20-Sep-22			-	-	Installed well in B-27
21-Sep-22			6.1	1.9	Pumped out drilling fluid from well in B-27
23-Sep-22	4.9	5.1	6.1	1.9	Installed well in B-24; pumped out drilling fluid.
26-Sep-22	7.5	2.5	6.2	1.8	

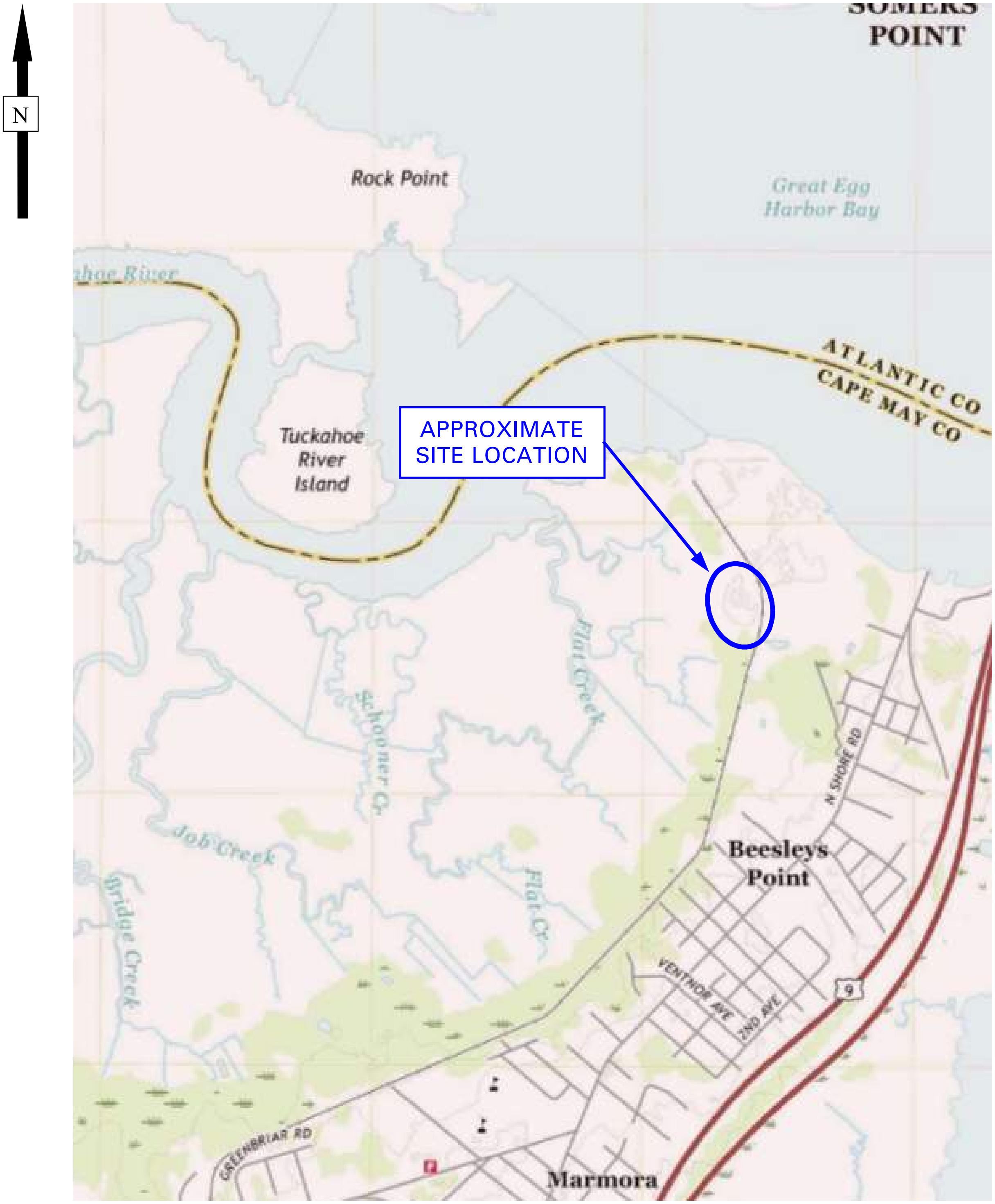
NOTES

1- Groundwater level observation wells were installed in completed boreholes B-24 and B-27.

2- The observation well in B-24 consisted of 2-inch-diameter, 10-ft-long screened PVC pipe and 10-ft-long solid riser.

3- The observation well in B-27 consisted of 2-inch-diameter, 10-ft-long screened PVC pipe and 10-ft-long solid riser.

LIST OF FIGURES



Source: United States Geological Survey (USGS) – Marmora Quadrangle 2019

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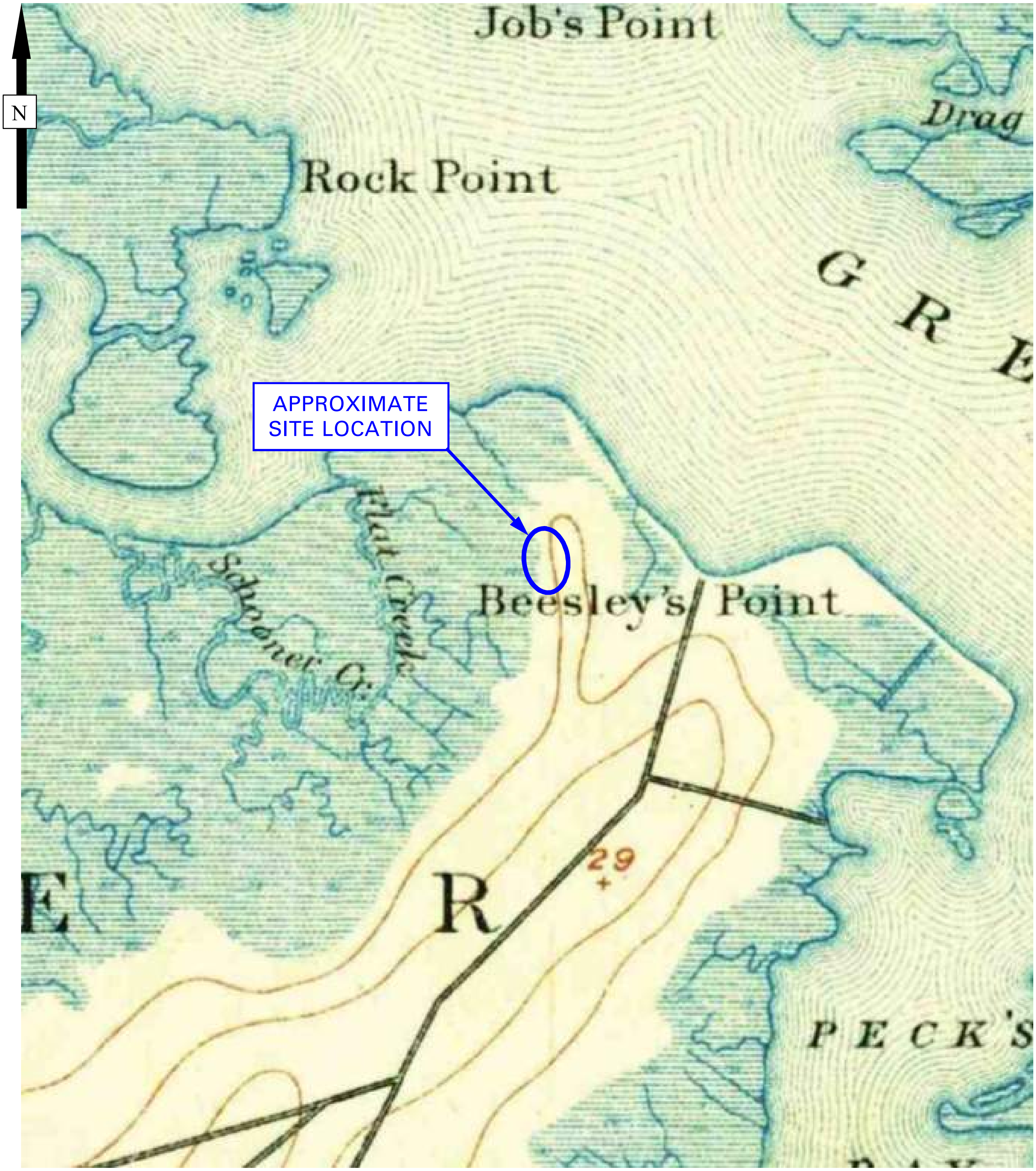
Ocean Wind – BL England Substation

SITE LOCATION MAP

UPPER TOWNSHIP **NEW JERSEY**

PROJECT NO.	SCALE	DATE	FIGURE
101010201	**N.T.S.**	**9/26/2022**	**1**



Source: USGS Map, Great Egg Harbor, NJ 1890

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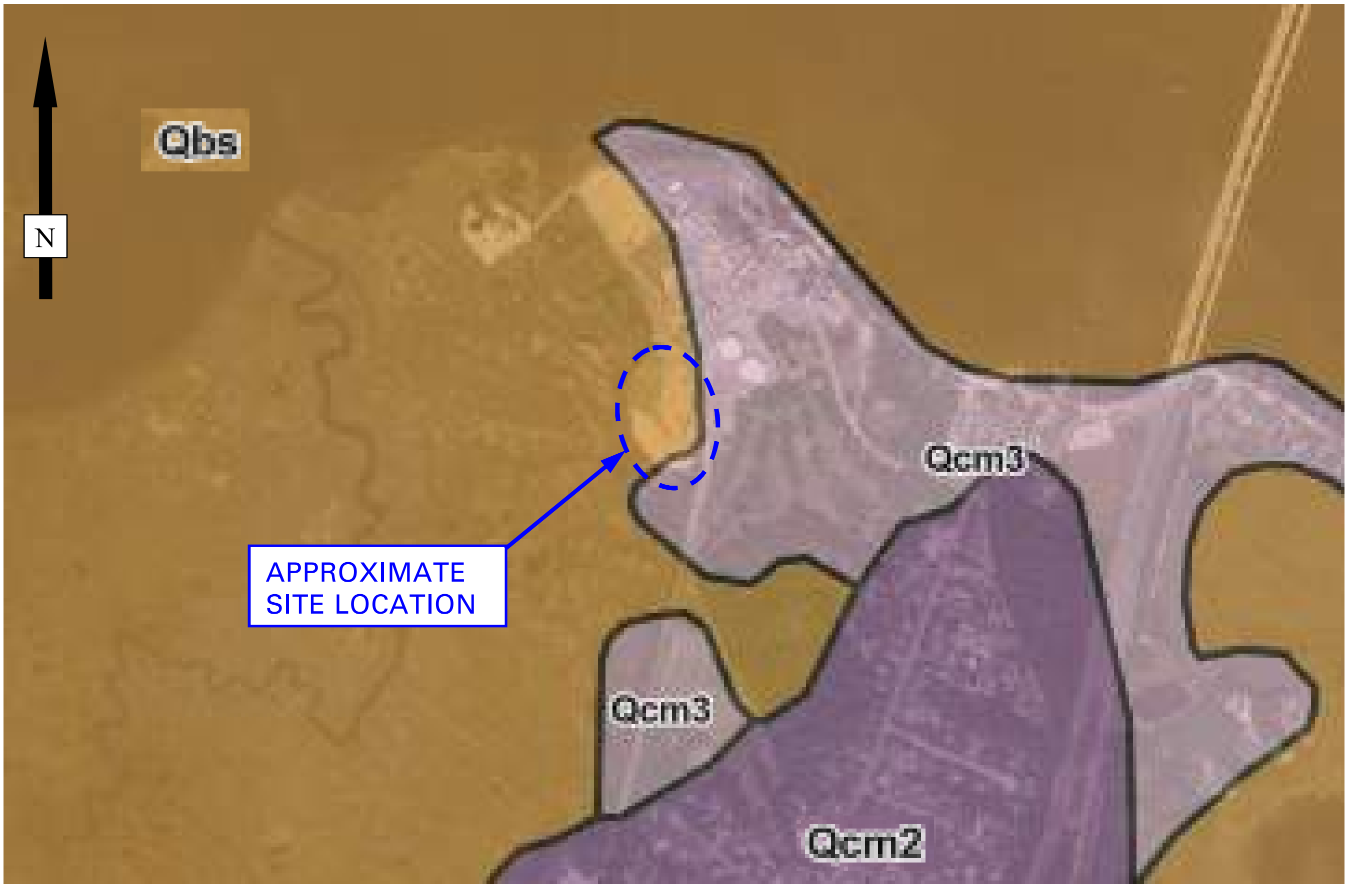
Ocean Wind – BL England Substation

HISTORIC USGS MAP

UPPER TOWNSHIP **NEW JERSEY**

PROJECT NO.	SCALE	DATE	FIGURE
101010201	**N.T.S.**	**9/26/2022**	**2**



LEGEND

🟪 Qcm2 – Cape May Formation (Unit 2) – Sand, pebble gravel, minor silt, clay, peat, and cobble gravel

🟪 Qcm3 – Cape May Formation (Unit 3) – Sand, pebble gravel, minor silt, clay and peat; yellow, reddish yellow, white, gray

🟧 Qbs – Salt-marsh and Estuarine Deposits – Silt, sand, peat, clay, minor pebble gravel; brown, dark brown, gray, black

Source: NJDEP, NJ-GeoWeb interactive maps

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SURFICIAL GEOLOGIC MAP

UPPER TOWNSHIP **NEW JERSEY**

PROJECT NO.	SCALE	DATE	FIGURE
101010201	**N.T.S.**	**9/26/2022**	**3A**

\\langan.com\data\PAR\data2\101010201\Project Data_Discipline\Geotechnical\Reports\Figures\Figure 3A - Surficial Geologic Map.docx

LEGEND

🟪	Tch – Cohansey Formation – quartz sand, medium to coarse grained

Source: NJDEP, NJ-GeoWeb interactive maps

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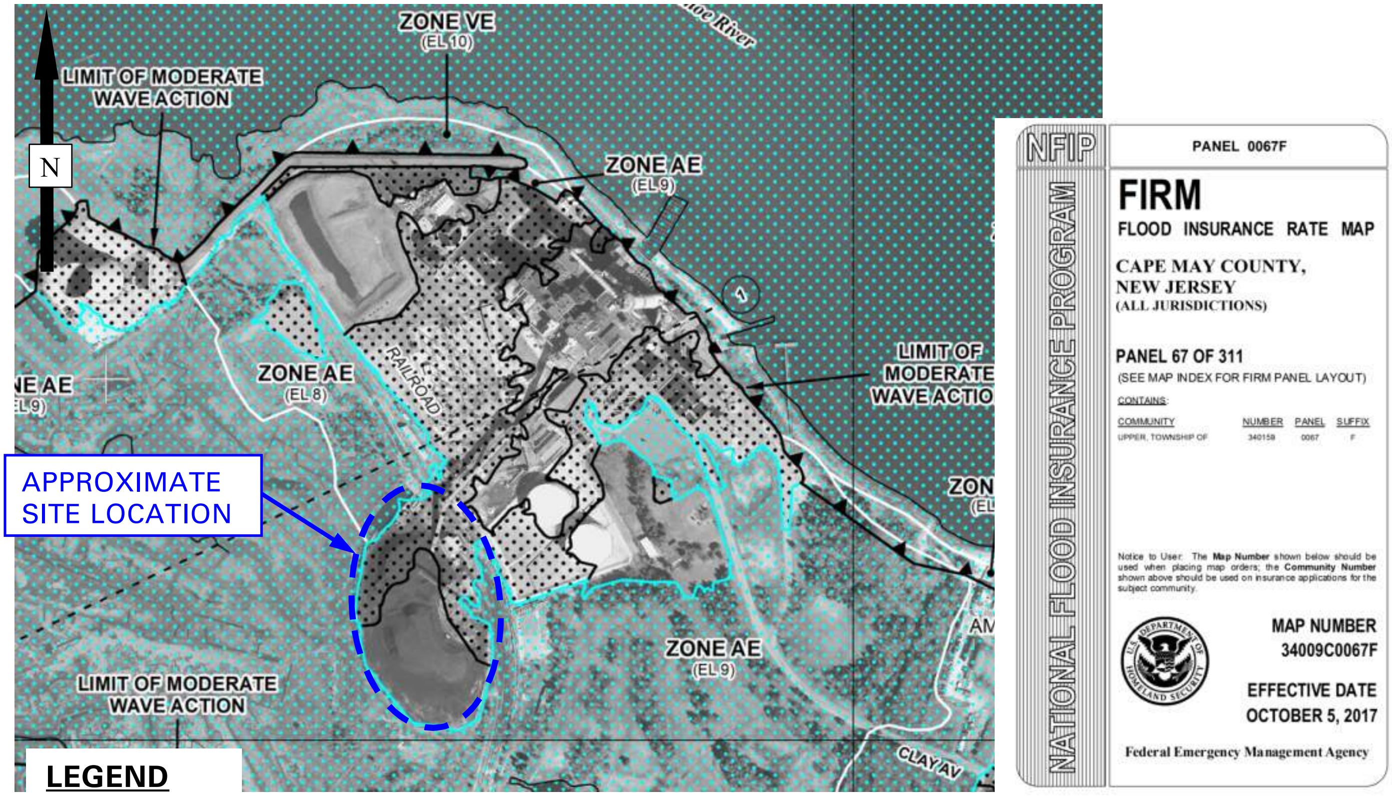
GEOLOGIC MAP

UPPER TOWNSHIP **NEW JERSEY**

PROJECT NO.	SCALE	DATE	FIGURE
101010201	**N.T.S.**	**9/26/2022**	**3B**



PANEL 0067F

FIRM

FLOOD INSURANCE RATE MAP

CAPE MAY COUNTY,
NEW JERSEY
(ALL JURISDICTIONS)

PANEL 67 OF 311
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
UPPER, TOWNSHIP OF	340159	0067	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
34009C0067F

EFFECTIVE DATE
OCTOBER 5, 2017

Federal Emergency Management Agency

LEGEND

▨	SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

▨	FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

▒ ZONE X	OTHER FLOOD AREAS Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
☐	OTHER AREAS
ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.
▧	COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
▧	OTHERWISE PROTECTED AREAS (OPAs)

―	1% annual chance floodplain boundary
─·─·─	New Jersey Flood Hazard Area Design Flood (NJFHADF)
―	0.2% annual chance floodplain boundary
— — —	Floodway boundary
— — —	Zone D boundary
•••••••••	CBRS and OPA boundary
═	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
▲ ▲ ▲	Limit of Moderate Wave Action
~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

Ⓐ——Ⓐ	Cross section line
㉓- - - -㉓	Transect line
— — —	Culvert, Flume, Penstock or Aqueduct
⟩═⟨	Road or Railroad Bridge
⟩—⟨	Footbridge
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
⁴²76⁰⁰⁰N	1000-meter Universal Transverse Mercator grid values, zone 18
600000 FT	5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection
DX5510 x	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 28, 2007

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
April 17, 2020 - to change Base Flood Elevations, to change Special Flood Hazard Areas, to update roads and road names, and to reflect updated topographic information

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

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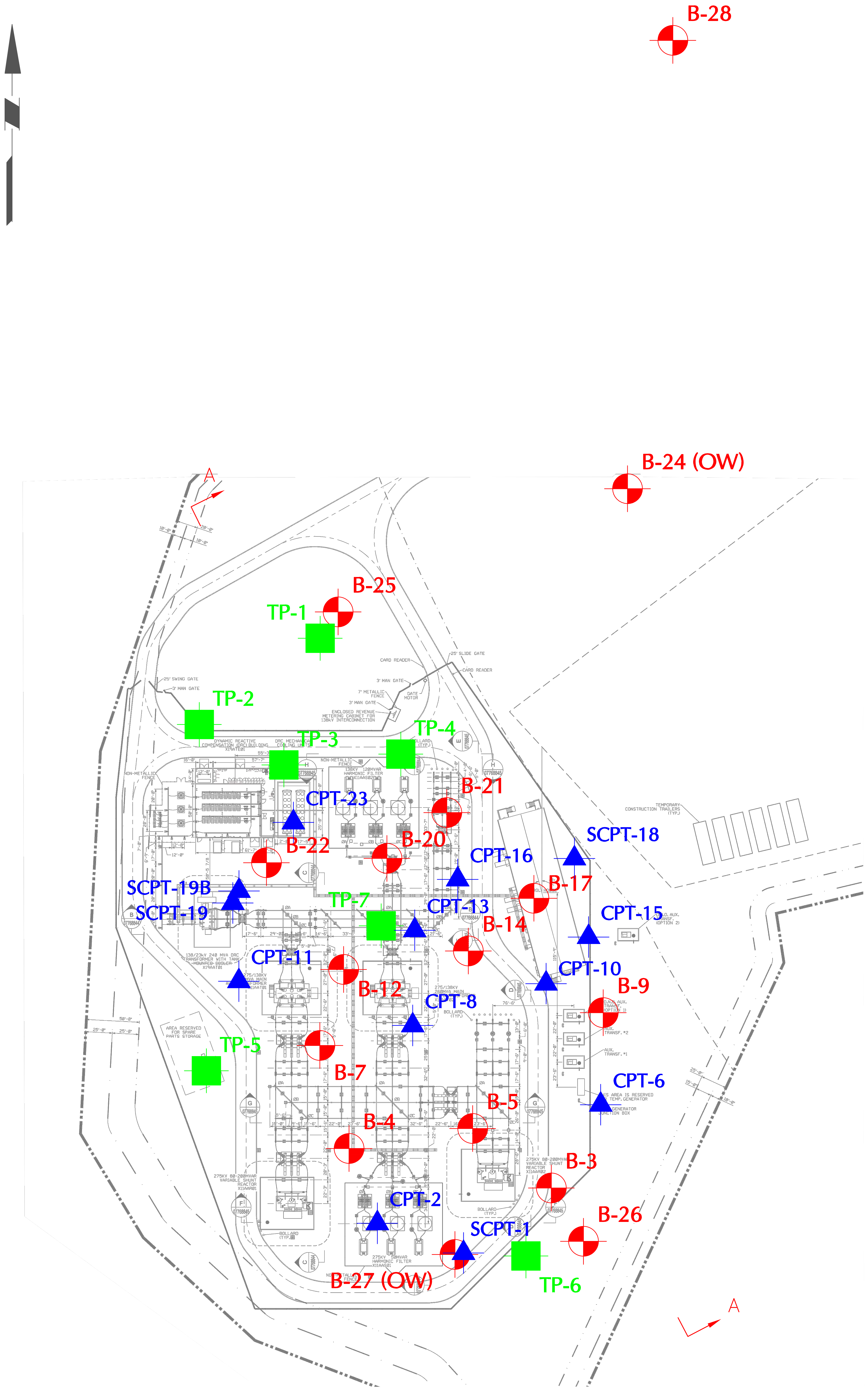
Ocean Wind – BL England Substation

FEMA FLOOD MAP

UPPER TOWNSHIP **NEW JERSEY**

PROJECT NO.	SCALE	DATE	FIGURE
101010201	N.T.S.	9/26/2022	4

\\langan.com\data\PAR\data2\101010201\Project Data_Discipline\Geotechnical\Reports\Figures\Figure 4 - FEMA Map.docx



NOTES

1. BASE PLAN TAKEN FROM DRAWING TITLED "SUBSTATION GENERAL ARRANGEMENT" DATED 21 SEPTEMBER 2022 PREPARED BY BURNS & MCDONNELL.
2. B-SERIES BORINGS WERE PERFORMED BY CRAIG TEST BORING, CO. (CRAIG) BETWEEN 12 SEPTEMBER AND 26 SEPTEMBER 2022 UNDER FULL-TIME OBSERVATION OF LANGAN.
3. CPT-SERIES AND SCPT-SERIES CONE PENETRATION TESTS (CPTS) WERE PERFORMED BY CRAIG BETWEEN 6 SEPTEMBER AND 8 SEPTEMBER 2022 UNDER FULL-TIME OBSERVATION OF LANGAN.
4. TP-SERIES TEST PITS WERE PERFORMED BY CRAIG BETWEEN 8 SEPTEMBER AND 12 SEPTEMBER 2022 UNDER FULL-TIME OBSERVATION OF LANGAN.
5. AS-BUILT BORING, CPT AND TEST PIT COORDINATES AND ELEVATIONS WERE COLLECTED USING A SURVEY-GRADE GPS UNIT. NORTHINGS AND EASTINGS PROVIDED ARE REFERENCED TO NJSPCS NAD83. ELEVATIONS PROVIDED ARE REFERENCED TO NAVD88.
6. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

LEGEND

B-3	APPROXIMATE BORING LOCATION
(OW)	GROUNDWATER LEVEL OBSERVATION WELL LOCATION
CPT-2	APPROXIMATE CPT LOCATION
SCPT-1	APPROXIMATE CPT LOCATION WITH SEISMIC TEST
TP-1 🟩	APPROXIMATE TEST PIT LOCATION
A A	SUBSURFACE PROFILE LOCATION

SURVEY AS-BUILT TABLE			
Boring/CPT/Test Pit Desgination	Northing	Easting	Elevation
	(NJSPCS NAD83)		(NAVD88)
SCPT-1	165160.243	453595.844	8.234
CPT-2	165188.238	453514.646	7.711
B-3	165221.47	453678.605	7.376
B-4	165258.592	453488.028	7.198
B-5	165277.447	453604.439	7.781
CPT-6	165299.881	453725.104	7.988
B-7	165355.657	453460.525	6.72
CPT-8	165374.558	453547.996	9.096
B-9	165386.547	453727.481	6.697
CPT-10	165413.881	453673.631	8.857
CPT-11	165416.178	453384.209	6.618
B-12	165427.215	453482.855	7.798
CPT-13	165464.163	453549.885	8.334
B-14	165444.608	453600.383	8.062
CPT-15	165457.768	453713.665	6.161
CPT-16	165512.013	453590.359	8.149
B-17	165494.268	453662.169	7.999
SCPT-18	165531.748	453700.348	6.801
SCPT-19	165489.822	453378.462	6.323
SCPT-19B	165501.173	453384.311	6.28
B-20	165531.803	453523.684	7.612
B-21	165574.932	453580.085	8.042
B-22	165527.765	453410.157	6.477
CPT-23	165565.706	453435.554	6.812
B-24	165879.926	453750.32	10.03
B-25	165763.91	453477.736	6.847
B-26	165171.254	453708.871	6.709
B-27	165158.866	453587.828	8.04
B-28	166302.135	453793.084	9.402
TP-1	165739.088	453460.813	6.793
TP-2	165657.971	453346.875	6.485
TP-3	165619.817	453426.561	6.616
TP-4	165630.008	453536.737	7.238
TP-5	165331.861	453353.6	8.172
TP-6	165157.457	453654.685	9.006
TP-7	165468.315	453518.276	8.399

60 0 30 60
SCALE: 1 INCH = 60 FEET

LANGAN
Langan Engineering and
Environmental Services, Inc.

300 Kimball Drive
Parsippany, NJ 07054

T: 973.560.4900 F: 973.560.4901 www.langan.com
NJ CERTIFICATE OF AUTHORIZATION NO. 24GA27996400

Project
OCEAN WIND - BL ENGLAND SUBSTATION
UPPER TOWNSHIP
CAPE MAY COUNTY NEW JERSEY

Drawing Title
BORING, CPT AND TEST PIT LOCATION PLAN

Project No. 101010201
Date 9/26/2022
Drawn By VAR
Checked By RDB
Figure 5A
Sheet 0 of 1

NOTES

1. AERIAL IMAGERY WAS ACQUIRED ON 26 SEPTEMBER 2022 VIA AUTODESK LIVE MAP DATA AND MICROSOFT BING MAPS PLATFORM API'S.
2. FIELD RESISTIVITY TESTING WAS PERFORMED BY HAGER-RICHTER GEOSCIENCE, INC. ON 12 SEPTEMBER AND 13 SEPTEMBER 2022 UNDER FULL-TIME OBSERVATION OF LANGAN.
3. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

LEGEND

LINE R1A	APPROXIMATE LOCATION OF FIELD RESISTIVITY TEST ALIGNMENT

150 0 75 150
SCALE: 1 INCH = 150 FEET

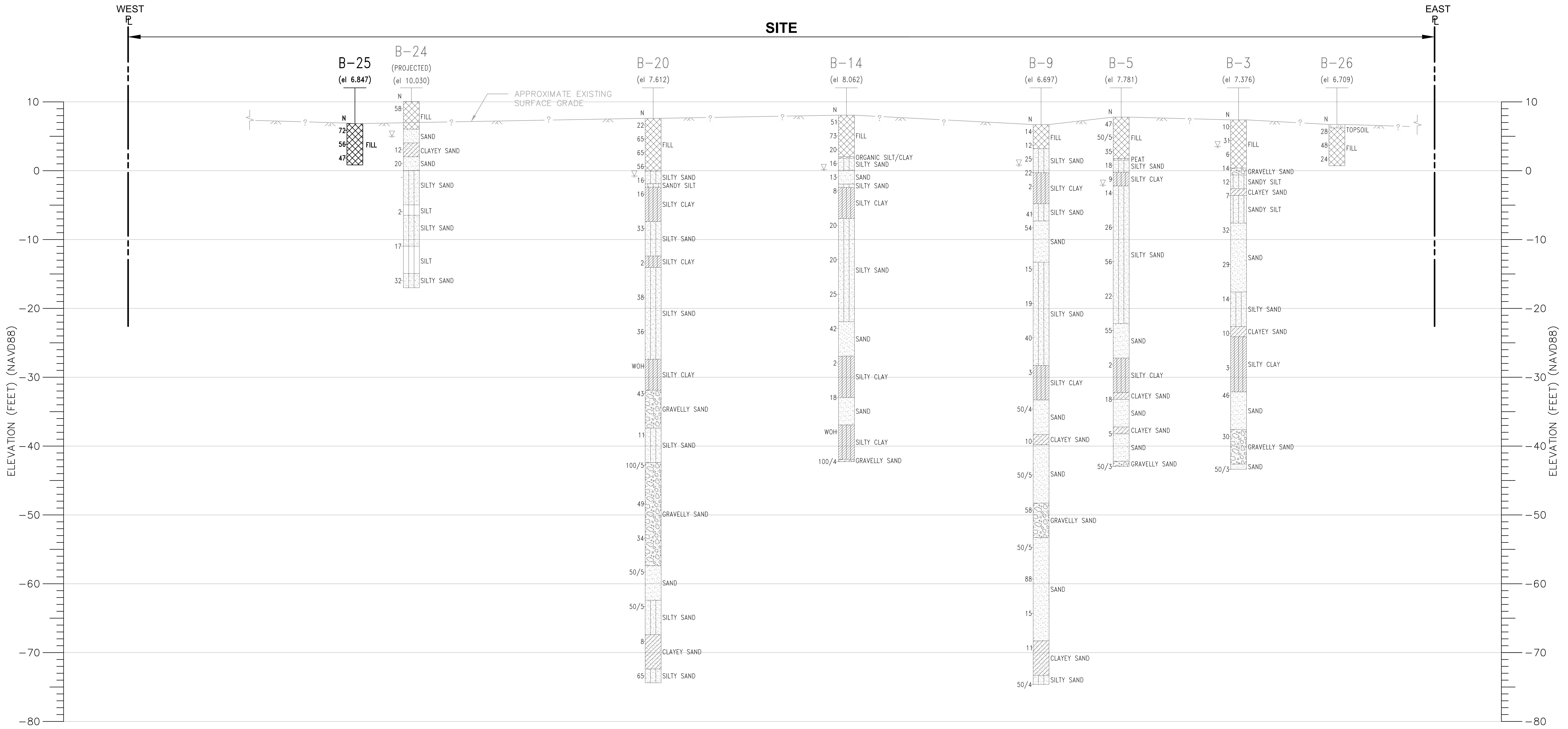
LANGAN
Langan Engineering and Environmental Services, Inc.
300 Kimball Drive
Parsippany, NJ 07054
T: 973.560.4900 F: 973.560.4901 www.langan.com
NJ CERTIFICATE OF AUTHORIZATION NO. 24GA27996400

Project
OCEAN WIND - BL ENGLAND SUBSTATION
UPPER TOWNSHIP
CAPE MAY COUNTY NEW JERSEY

Drawing Title
BORING, CPT AND TEST PIT LOCATION PLAN

Project No.	Figure
101010201	5B
Date 9/26/2022	
Drawn By VAR	
Checked By RDB	Sheet 0 of 1

LANGAN
Project No. 101010201



SUBSURFACE PROFILE A-A

VERTICAL SCALE: 1" = 8'

HORIZONTAL SCALE: NOT TO SCALE

NOTES:

1. THIS PROFILE REPRESENTS A GENERALIZED SOIL CROSS SECTION INTERPRETED FROM WIDELY SPACED BORINGS. SOIL AND GROUNDWATER MAY VARY IN TYPE, LOCATION, ELEVATION, AND ENVIRONMENTAL AND ENGINEERING PROPERTIES BETWEEN POINTS OF EXPLORATION. VARIATIONS IN SUBSURFACE CONDITIONS SHOULD BE EXPECTED BETWEEN BORINGS.
2. ALL BORING LOCATIONS ARE APPROXIMATE.
3. ALL ELEVATIONS ARE APPROXIMATE AND ARE IN REFERENCE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88) UNLESS OTHERWISE NOTED.
4. SEE APPENDIX A FOR BORING LOGS.

Legend

B-# (el. xx) — Borehole Number (elevation)

Borehole Legend

N — N-Value (Blowcounts)

▽ — Water Level Reading at time of drilling.

☒ FILL	⛆ SAND	▨ TOPSOIL	
▥ SANDY SILT	▨ CLAYEY SAND	▥ SILTY SAND	
▥ SILTY CLAY	▨ PEAT	☰ ORGANIC SILT/CLAY	
▨ GRAVELLY SAND			

8 0 4 8
VERTICAL SCALE: 1" = 8'

LANGAN
Langan Engineering and Environmental Services, Inc.
300 Kimball Drive
Parsippany, NJ 07054
T: 973.560.4900 F: 973.560.4901 www.langan.com
NJ CERTIFICATE OF AUTHORIZATION NO. 24GA27996400

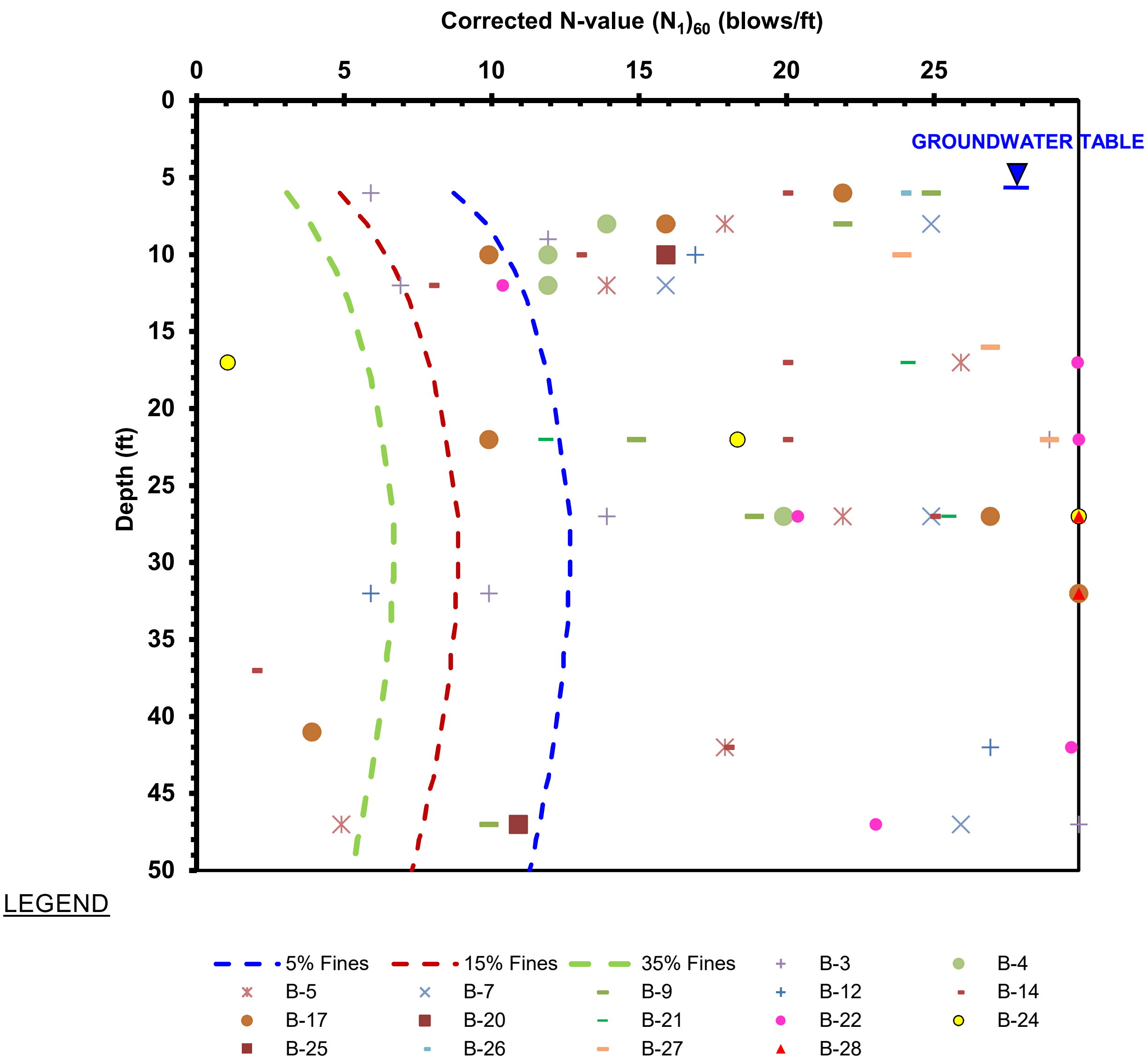
Project
OCEAN WIND - BL ENGLAND SUBSTATION
UPPER TOWNSHIP
CAPE MAY COUNTY NEW JERSEY

Drawing Title
SUBSURFACE PROFILE

Project No.
101010201
Date
10/06/2022
Drawn By
AC
Checked By
VAR

6

Project No. 101010201



NOTES

1. Corrected N-values are corrected SPT resistances in the upper 50 ft from within the proposed development area below the groundwater level.
2. Corrected N-values above groundwater and within cohesive non-liquefiable soils are not plotted.
3. Corrected N-values ≥ 30 blows/ft are plotted as 30 blows/ft.

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Abu Dhabi • Athens • Doha • Dubai • Istanbul

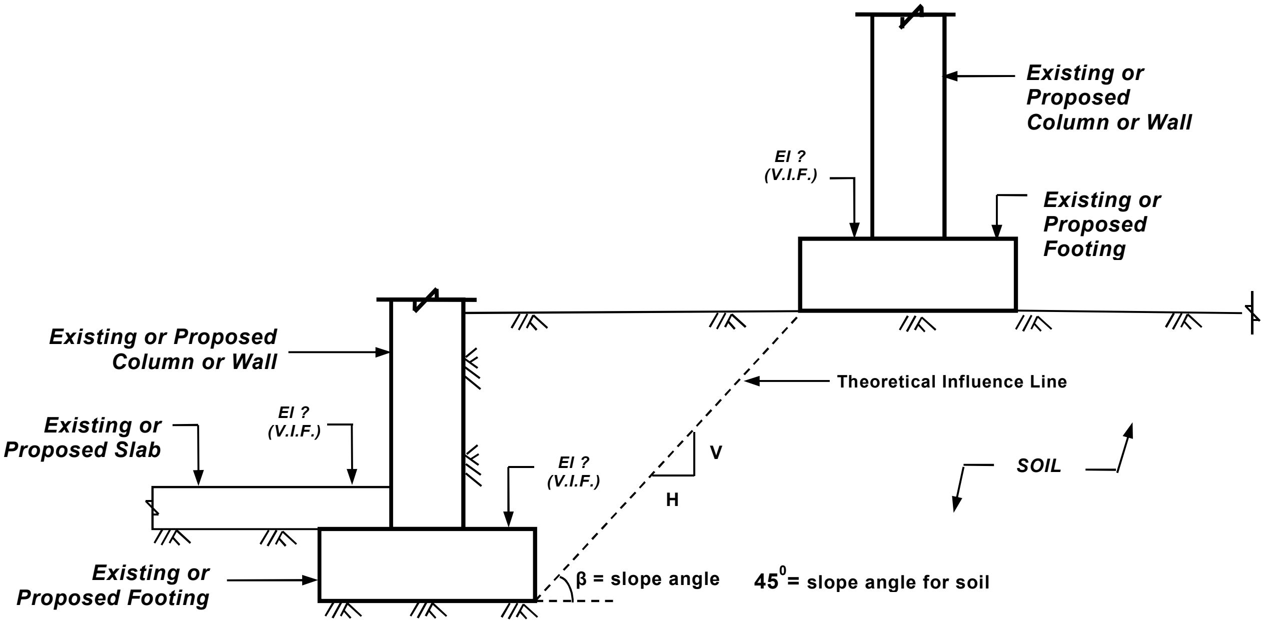
Ocean Wind – BL England Substation

SEED & IDRISS
LIQUEFACTION POTENTIAL PLOT

UPPER TOWNSHIP **NEW JERSEY**

PROJECT NO	SCALE	DATE	FIGURE
101010201	**N.T.S**	**10/5/2022**	**7**

EXISTING OR PROPOSED ADJACENT FOOTINGS



NOTES

1. The adjacent footing bearing on soil shall be positioned in a manner that the vertical distance between the wall and footing bases is equal to or less than the horizontal distance.

2. If the above recommendations are not satisfied, special measures reviewed by the geotechnical engineer are needed.

3. As-built conditions and elevations of existing foundations and walls should be verified in the field by the contractor.

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Abu Dhabi • Athens • Doha • Dubai • Istanbul

Ocean Wind – BL England Substation

POSITION DETAIL OF ADJACENT FOOTINGS

UPPER TOWNSHIP **NEW JERSEY**

PROJECT NO	SCALE	DATE	FIGURE
101010201	**N.T.S.**	**10/5/2022**	**8**

APPENDIX A

Logs of Borings

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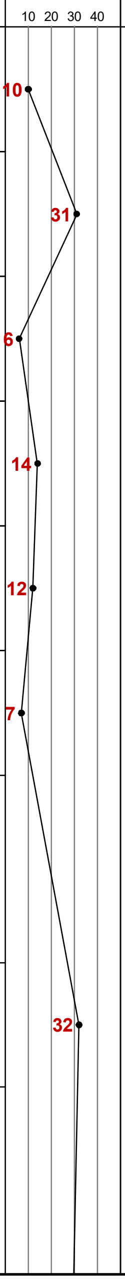
Log of Boring **B-3** Sheet 1 of 3

Project: Ocean Wind - BL England Substation		Project No.: 101010201	
Location: Upper Township, New Jersey		Elevation and Datum: Approx. El 7.376 (NAVD88)	
Drilling Company: Craig Geotechnical Drilling		Date Started: 09/19/2022	Date Finished: 09/19/2022
Drilling Equipment: ATV Rig		Completion Depth: 50.8 ft	Rock Depth: N.E.
Size and Type of Bit: 3-7/8in Tricone Roller Bit		Number of Samples: Disturbed 14; Undisturbed 1; Core -	
Casing Diameter (in): 4	Casing Depth (ft): 20	Water Level (ft.): First ▽ 4; Completion ▼ -; 24 HR. ▼ 5.5	
Casing Hammer: Automatic	Weight (lbs): 140; Drop (in): 30	Drilling Foreman: Leon Ellis	
Sampler: 2-inch-diameter split spoon; Shelby Tube		Field Engineer: Lei Xu	
Sampler Hammer: Safety	Weight (lbs): 140; Drop (in): 30		



Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+7.4	Orangish brown to black fine-coarse SAND, some silt, trace f-c gravel, some coal (moist) [FILL]	0	S-1A	SS	20	3 5	10	Started drilling at 12:42 PM on 9/19/2022. S-1 at 0ft
+6.4	Gray to orangish brown Sandy SILT, trace clay, trace fine gravel (moist) [FILL]	1	S-1B			5 7		
	Light brown fine-medium SAND, some silt, trace fine gravel (moist) [FILL]	2	S-2	SS	19	10 17 14 15	31	S-2 at 2ft
	Light brown fine-medium SAND, some silt (wet) [FILL] passing #200=19.5%	4	S-3	SS	16	5 2 4 4	6	Drilled to 4ft. S-3 at 4ft
	Light brown fine-medium SAND, some silt, trace clay (wet) [FILL]	6	S-4A	SS	20	4 6	14	S-4 at 6ft
+0.4	Gray to light brown fine-medium SAND, some fine gravel, some silt (wet)	7	S-4B			8 13		
-0.6	Gray to orangish brown SILT, some f-m sand, some clay (wet)	8	S-5	SS	14	6 6 6 5	12	Drilled to 8ft. S-5 at 8ft q_u=1.75 tsf (PP)
-2.6	Gray to orangish brown Clayey fine-coarse SAND, some silt, some fine gravel (wet)	10	S-6A	SS	20	5 4	7	S-6 at 10ft
-3.6	Orangish brown SILT, some f-m sand, trace clay (wet)	11	S-6B			3 3		
-7.6	Tannish gray fine-medium SAND, trace silt (wet) passing #200=4.7%	15	S-7	SS	13	7 15 17 10	32	Drilled to 15ft. S-7 at 15ft
		20						

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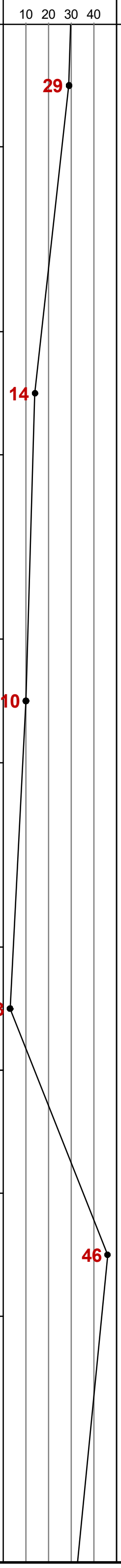
Log of Boring **B-3** Sheet 2 of 3

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 7.376 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-12.6	Tannish orange to brown fine-medium SAND, trace silt (wet)	20	S-8	SS	12	10 14 15 15	29	Drove casing to 20ft. Drilled to 20ft. S-8 at 20ft
-17.6	Tannish orange to brown fine-medium SAND, some silt (wet)	25	S-9	SS	14	10 7 7 5	14	Drilled to 25ft. S-9 at 25ft
-22.6	Orangish brown to light brown fine-coarse SAND, some clay, trace silt (wet)	30	S-10A	SS	15	5 5 5 3	10	Drilled to 30ft. S-10 at 30ft q_u=0.75 tsf (PP)
-24.1	Dark gray Silty CLAY, some f-m sand (wet)		S-10B					
	Dark gray Silty CLAY, trace f-m sand (wet)	35	S-11	SS	24	WOH 1 2 4	3	Drilled to 35ft. S-11 at 35ft q_u=0.25 tsf (PP)
	Dark gray Silty CLAY, trace f-m sand (wet)	37	U-1	ST	20			Drilled to 37ft. U-1 at 37ft
	Dark gray Silty CLAY, some f-m sand (wet)	39	S-12A	SS	20	3 15 31 33	46	S-12 at 39ft q_u=0.5 tsf (PP)
-32.1	Dark gray fine-coarse SAND, trace clay, trace silt, trace fine gravel (wet)		S-12B					
-37.6		45						



Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 7.376 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-37.6	Gray fine-coarse SAND, some f-c gravel, trace silt (wet)	45	S-13	SS	8	3 8 22 36	30	Drilled to 45ft. S-13 at 45ft
-42.6	Gray fine-coarse SAND, trace silt, trace fine gravel (wet)	50	S-14	SS	5	45 50/3	50/3	Drilled to 50ft. Rig chattering. S-14 at 50ft Finished drilling at 2:47 PM on 9/19/2022. Borehole grouted upon completion.
-43.4	End of Boring at 50.75 ft.							

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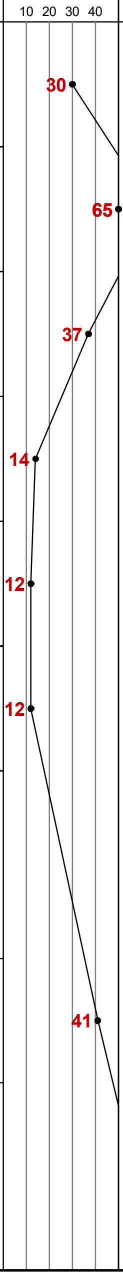
Log of Boring **B-4** Sheet 1 of 4

Project Ocean Wind - BL England Substation		Project No. 101010201	
Location Upper Township, New Jersey		Elevation and Datum Approx. El 7.198 (NAVD88)	
Drilling Company Craig Geotechnical Drilling		Date Started 09/15/2022	Date Finished 09/15/2022
Drilling Equipment ATV Rig		Completion Depth 77 ft	Rock Depth N.E.
Size and Type of Bit 3-7/8in Tricone Roller Bit		Number of Samples	Disturbed 19 Undisturbed - Core -
Casing Diameter (in) 4	Casing Depth (ft) 10	Water Level (ft.)	First ∇ 6 Completion ▼ - 24 HR. ▼ 5.2
Casing Hammer Automatic Weight (lbs) 140	Drop (in) 30	Drilling Foreman Leon Ellis	
Sampler 2-inch-diameter split spoon		Field Engineer Lei Xu	
Sampler Hammer Safety Weight (lbs) 140	Drop (in) 30		

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+7.2	Orangish brown fine-coarse SAND, some silt, trace clay, trace coal (moist) [FILL]	0	S-1A	SS	16	4 8	30	Started drilling at 9:39 AM on 9/15/2022. S-1 at 0ft
+6.2	Light brown to black fine-coarse SAND, some clay, some silt, trace f-c gravel, some coal (moist) [FILL]	1	S-1B			22 25		
+5.2	Light brown to gray fine-coarse SAND, some silt, some fine gravel, trace clay (moist) [FILL]	2	S-2	SS	20	28 37 28 28	65	S-2 at 2ft
	Light brown to gray fine-coarse SAND, some silt, some fine gravel, trace roots (moist) [FILL]	4	S-3	SS	15	19 21 16 12	37	Drilled to 4ft. S-3 at 4ft
	▼	5						
	∇ Light brown to gray fine-coarse SAND, some silt, some fine gravel (wet) [FILL]	6	S-4A	SS	18	17 7	14	S-4 at 6ft
-0.3	Dark gray fine-medium SAND, some silt, trace peat, trace organics (moist) Orangish brown to gray Silty fine SAND, some clay, trace organics (wet)	7.5	S-4B			7 15		2" thick peat at approx. 7.5 ft.
		8	S-5	SS	12	10 7 5 5	12	Drilled to 8ft. S-5 at 8ft
-2.8	Gray Silty CLAY, some f-m sand, trace roots (wet)	10	S-6A	SS	20	7 7	12	S-6 at 10ft. Drove casing to 10ft q_u=1.5 tsf (PP)
-3.8	Light brown to gray Sandy SILT, some clay (wet) passing #200=56.5%	11	S-6B			5 5		
-7.8	Orangish brown fine-medium SAND, trace silt (wet)	15	S-7	SS	15	12 16 25 20	41	Drilled to 15ft. S-7 at 15ft
		20						



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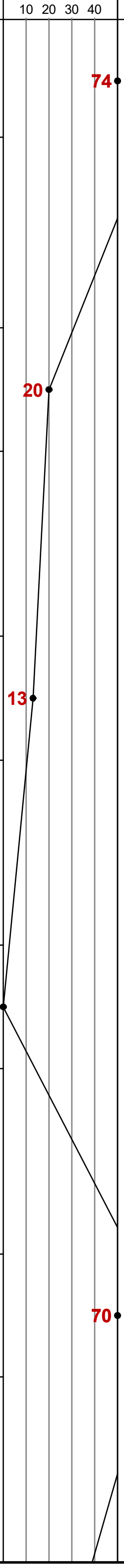
Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 7.198 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-12.8	Orangish brown to brown fine-medium SAND, trace silt (wet)	20	S-8	SS	15	25 32 42 50/5	74	Drilled to 20ft. S-8 at 20ft
-17.8	Orangish brown to gray fine-medium SAND, some silt (wet)	25	S-9	SS	16	11 9 11 11	20	Drilled to 25ft. S-9 at 25ft
	Orangish brown fine-coarse SAND, some silt (wet)	30	S-10A	SS	13	12 7 6 6	13	Drilled to 30ft. S-10 at 30ft q_u=1 tsf (PP)
-23.3	Orangish brown to dark gray Silty CLAY, trace fine sand (wet)		S-10B					
	Dark gray Silty CLAY, trace f-m sand (wet) passing #200=81.9% LL=37, PL=18, PI=19	35	S-11	SS	24	WOH WOH WOH 4		Drilled to 35ft. S-11 at 35ft q_u=0.25 tsf (PP)
-32.8	Gray fine-coarse SAND, trace silt, trace fine gravel (wet)	40	S-12	SS	13	15 31 39 44	70	Drilled to 40ft. S-12 at 40ft
-37.8		45						



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Log of Boring **B-4** Sheet 3 of 4

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 7.198 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-37.8	Gray Gravelly fine-coarse SAND, some silt, trace clay (wet)	45	S-13	SS	14	6 10 21 25	31	Drilled to 45ft. S-13 at 45ft
	Gray fine-coarse SAND, some fine gravel, trace silt (wet)	50	S-14	SS	6	51 50/4	50/4	Drilled to 50ft. S-14 at 50ft
	Gray fine-coarse SAND, some fine gravel, trace silt (wet)	55	S-15	SS	11	24 26 41 47	67	Drilled to 55ft. Rig chattering. S-15 at 55ft
-52.8	Gray fine-medium SAND, trace silt (wet)	60	S-16	SS	8	32 42 50/5	50/5	Drilled to 60ft. S-16 at 60ft
	Gray fine-medium SAND, trace silt (wet)	65	S-17	SS	6	48 50/3	50/3	Drilled to 65ft. S-17 at 65ft
		70						

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Log of Boring **B-4** Sheet 4 of 4

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 7.198 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-62.8	Gray fine-medium SAND, trace clay, trace silt (wet)	70	S-18	SS	7	20 21 22 19	43	Drilled to 70ft. S-18 at 70ft
-67.8	Gray fine-medium SAND, some silt, trace clay (wet)	75	S-19	SS	20	10 11 11 12	22	Drilled to 75ft. S-19 at 75ft
-69.8	End of Boring at 77 ft.	77						Finished drilling at 2:13 PM on 9/15/2022. Borehole grouted upon completion.

Depth Scale: 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95

N-Value (Blows/ft): 10 20 30 40

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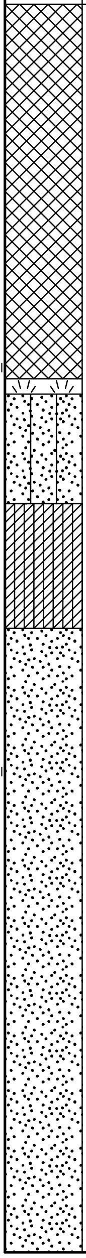
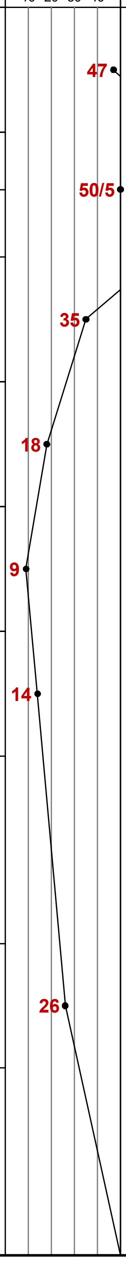
Log of Boring **B-5** Sheet 1 of 3

Project	Ocean Wind - BL England Substation	Project No.	101010201
Location	Upper Township, New Jersey	Elevation and Datum	Approx. El 7.781 (NAVD88)
Drilling Company	Craig Geotechnical Drilling	Date Started / Date Finished	09/19/2022 / 09/19/2022
Drilling Equipment	ATV Rig	Completion Depth / Rock Depth	50.8 ft / N.E.
Size and Type of Bit	3-7/8in Tricone Roller Bit	Number of Samples	Disturbed 14; Undisturbed -; Core -
Casing Diameter (in) / Casing Depth (ft)	4 / 20	Water Level (ft.)	First ▽ 10; Completion ▼ -; 24 HR. ▼ 7.5
Casing Hammer / Weight (lbs) / Drop (in)	Automatic / 140 / 30	Drilling Foreman	Leon Ellis
Sampler	2-inch-diameter split spoon	Field Engineer	Lei Xu
Sampler Hammer / Weight (lbs) / Drop (in)	Safety / 140 / 30		



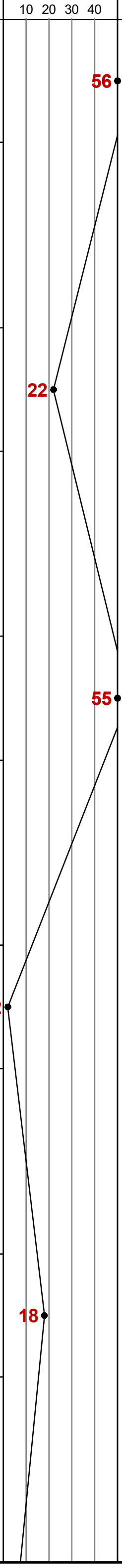


Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+7.8	Orangish brown fine-coarse SAND, some silt, trace clay, trace f-c gravel (moist) [FILL] Brown to black fine-coarse SAND, some silt, some f-c gravel, some coal (moist) [FILL]	0	S-1A S-1B	SS	15	5 21 26 31	47	Started drilling at 7:45 AM on 9/19/2022. S-1 at 0ft
	Brown fine-coarse SAND, some silt, some fine gravel (moist) [FILL]	2	S-2	SS	9	52 50/5	50/5	S-2 at 2ft
	Gray to brown fine-coarse SAND, some silt, some fine gravel, trace clay (moist) [FILL]	4	S-3	SS	15	9 21 14 8	35	Drilled to 4ft. S-3 at 4ft
+1.8 +1.5	Dark brown to black PEAT, some silt, trace f-m sand (moist) [PEAT] Gray Silty fine-medium SAND, trace organics, trace roots (moist) ▼	6	S-4A S-4B	SS	12	6 9 9 6	18	S-4 at 6ft
-0.2	Gray to orangish brown CLAY, some silt, some f-m sand (moist) ▽	8	S-5	SS	15	3 5 4 3	9	Drilled to 8ft. S-5 at 8ft q_u=1.25 tsf (PP)
-2.2	Gray to orangish brown Silty fine-medium SAND, some clay, trace roots (wet)	10	S-6	SS	15	5 8 6 8	14	S-6 at 10ft
	Gray to orangish fine-medium SAND, trace silt (wet) passing #200=7.3%	15	S-7	SS	10	8 10 16 19	26	Drilled to 15ft. S-7 at 15ft
		20						

Log of Boring **B-5** Sheet 2 of 3

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 7.781 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-12.2	Gray to orangish brown fine-medium SAND, trace silt (wet)	20	S-8	SS	12	22 29 27 34	56	Drove casing to 20ft. Drilled to 20ft. S-8 at 20ft
	Gray to orangish brown fine-medium SAND, trace silt (wet)	25	S-9	SS	14	10 12 10 10	22	Drilled to 25ft. S-9 at 25ft
	Gray to orangish brown fine-medium SAND, trace silt (wet)	30	S-10	SS	11	16 27 28 33	55	Drilled to 30ft. S-10 at 30ft
-27.2	Dark gray Silty CLAY, trace f-m sand (wet)	35	S-11	SS	24	2 1 1 3	2	Drilled to 35ft. S-11 at 35ft q_u=0.5 tsf (PP)
-32.2	Dark gray fine-medium SAND, some clay, some silt (wet)	40	S-12A	SS	17	2 3	18	Drilled to 40ft. S-12 at 40ft
-33.2	Gray fine-coarse SAND, trace silt, trace fine gravel (wet)	41	S-12B			15 23		
-37.2		45						



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Log of Boring **B-5** Sheet 3 of 3

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 7.781 (NAVD88)

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
▨	-37.2	Dark gray Silty CLAY, trace f-m sand (wet)	45	S-13A	SS	20	1 2		Drilled to 45ft. S-13 at 45ft
⁙	-38.2	Dark gray fine-coarse SAND, trace silt, trace f-c gravel (wet)	46	S-13B			3 14	5	
			47						
			48						
			49						
⁙	-42.2	Gray fine-coarse SAND, some fine gravel, trace silt (wet)	50	S-14	SS	6	62 50/3	50/3	Drilled to 50ft. S-14 at 50ft
	-43.0	End of Boring at 50.75 ft.	51						Finished drilling at 12:36 PM on 9/19/2022. Borehole grouted upon completion.
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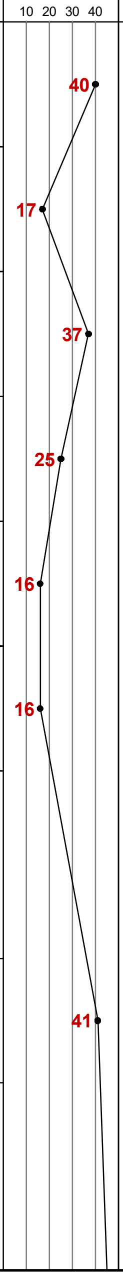
Log of Boring **B-7** Sheet 1 of 3

Project Ocean Wind - BL England Substation		Project No. 101010201	
Location Upper Township, New Jersey		Elevation and Datum Approx. El 6.72 (NAVD88)	
Drilling Company Craig Geotechnical Drilling		Date Started 09/13/2022	Date Finished 09/15/2022
Drilling Equipment ATV Rig		Completion Depth 52 ft	Rock Depth N.E.
Size and Type of Bit 3-7/8in Tricone Roller Bit		Number of Samples: Disturbed 14; Undisturbed 1; Core -	
Casing Diameter (in) 4	Casing Depth (ft) 13	Water Level (ft.): First ▽ 7; Completion ▼ -; 24 HR. ▼ 7.5	
Casing Hammer Automatic; Weight (lbs) 140; Drop (in) 30		Drilling Foreman Leon Ellis	
Sampler 2-inch-diameter split spoon; Shelby Tube			
Sampler Hammer Safety; Weight (lbs) 140; Drop (in) 30		Field Engineer Lei Xu	

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+6.7	Orangish brown to reddish brown fine-coarse SAND, some clay, some silt, trace fine gravel (moist) [FILL]	0	S-1A	SS	15	3 23	40	Started drilling at 12:59 PM on 9/13/2022. S-1 at 0ft
+6.2	Gray to orangish brown fine-coarse SAND, some silt, some fine gravel, trace coal (moist) [FILL]	1	S-1B			17 20		
	Gray to orangish brown fine-medium SAND, some silt, trace coal (moist) [FILL]	2	S-2	SS	12	12 10 7 12	17	S-2 at 2ft
	Gray to orangish brown fine-coarse GRAVEL, trace silt, trace f-c sand (moist) [FILL]	4	S-3	SS	1	18 18 19 19	37	Drove casing to 4ft. Drilled to 4ft. S-3 at 4ft Only a few gravel pieces recovered in S-3.
	Gray to orangish brown fine-coarse SAND, some silt, some fine gravel (moist) [FILL]	6	S-4A	SS	24	17 12	25	S-4 at 6ft
-0.3	Gray to dark gray fine-medium SAND, some silt, trace peat, trace roots (wet)	7 ▽ ▼	S-4B			13 21		
	Gray to light brown Silty fine-medium SAND, trace clay (wet)	8	S-5	SS	8	7 9 7 8	16	Drilled to 8ft. Rig chattering. S-5 at 8ft
-3.3	Gray to light brown CLAY, some fine sand, some silt (wet)	10	S-6A	SS	15	14 8	16	S-6 at 10ft. Drove casing to 10ft q_u=1.25 tsf (PP)
-4.3	Gray to light brown fine-medium SAND, some clay, some silt (wet)	11	S-6B			8 15		
		13						Drove casing to 13ft
-8.3	Gray to light brown fine-medium SAND, some silt (wet)	15	S-7	SS	12	13 19 22 21	41	Drilled to 15ft. S-7 at 15ft
		17						Stooped at 2:00 PM on 9/13/2022. Contintuted at 7:30 AM on 9/15/2022.
-13.3		20						



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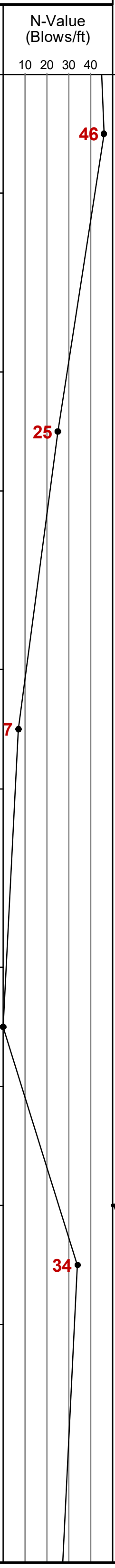
Log of Boring **B-7** Sheet 2 of 3

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 6.72 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-13.3	Orangish brown fine-medium SAND, trace silt (wet)	20	S-8	SS	10	13 26 20 11	46	Drilled to 20ft. S-8 at 20ft
-18.3	Orangish brown fine-medium SAND, some silt (wet)	25	S-9	SS	13	6 9 16 14	25	Drilled to 25ft. S-9 at 25ft
-23.3	Dark gray Silty CLAY, trace fine sand (wet)	30	S-10	SS	24	2 4 3 3	7	Drilled to 30ft. S-10 at 30ft q_u=0.5 tsf (PP)
	Dark gray Silty CLAY, trace fine sand (wet)	35	S-11	SS	24	WOH WOH WOH 2		Drilled to 35ft. S-11 at 35ft q_u=0.25 tsf (PP)
	Dark gray Silty CLAY, trace f-m sand (wet) wc=27.1% organic content=2.1% LL=27, PL=17, PI=10	37	U-1	ST	24			Drilled to 37ft. U-1 at 37ft
-31.8	? ? ? ? Gray to white fine-coarse SAND, some f-c gravel, trace silt (wet)	39	S-12	SS	8	5 13 21 14	34	Difficult push from 38.5 to 39ft. S-12 at 39ft
-38.3		45						



Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 6.72 (NAVD88)

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
▨	-38.3	Dark gray fine-coarse SAND, some clay, some silt (wet)	45	S-13A	SS	15	3 5		Drilled to 45ft. S-13 at 45ft
⁙	-39.3	Dark gray fine-coarse SAND, some fine gravel, trace silt (wet)	46	S-13B			21 34	26	
			47						
			48						
			49						
▨	-43.3	Dark gray fine-coarse SAND, some clay, trace silt, trace f-c gravel (wet) passing #200=28.0%	50	S-14	SS	15	13 26 13 15	39	Drilled to 50ft. Rig chattering. S-14 at 50ft 1" thick clay seams observed within sand.
			51						
	-45.3	End of Boring at 52 ft.	52						Finished drilling at 9:30 AM on 9/15/2022. Borehole grouted upon completion.
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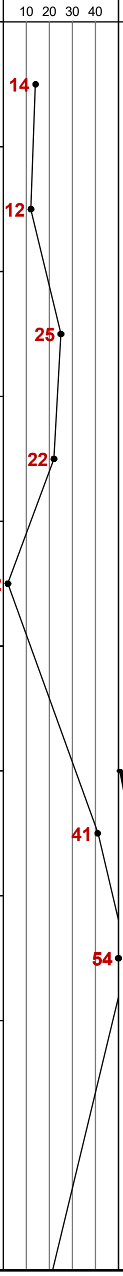
Log of Boring **B-9** Sheet 1 of 4

Project Ocean Wind - BL England Substation		Project No. 101010201	
Location Upper Township, New Jersey		Elevation and Datum Approx. El 6.697 (NAVD88)	
Drilling Company Craig Geotechnical Drilling		Date Started 09/20/2022	Date Finished 09/20/2022
Drilling Equipment ATV Rig		Completion Depth 81.3 ft	Rock Depth N.E.
Size and Type of Bit 3-7/8in Tricone Roller Bit		Number of Samples: Disturbed 20 · Undisturbed 1 · Core -	
Casing Diameter (in) 4	Casing Depth (ft) 15	Water Level (ft.): First ▽ 6 · Completion ▼ - · 24 HR. ▽ 7.4	
Casing Hammer Automatic · Weight (lbs) 140 · Drop (in) 30		Drilling Foreman Leon Ellis	
Sampler 2-inch-diameter split spoon; Shelby Tube		Field Engineer Lei Xu	
Sampler Hammer Safety · Weight (lbs) 140 · Drop (in) 30			

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+6.7	Orangish brown to black fine-coarse SAND, some silt, trace coal (moist) [FILL]	0	S-1A	SS	16	6 5	14	Started drilling at 8:12 AM on 9/20/2022. S-1 at 0ft
+5.7	Orangish brown to dark brown fine-coarse SAND, trace silt, trace fine gravel (moist) [FILL] Orangish brown to dark gray fine-coarse SAND, trace clay, trace silt, trace fine gravel (moist) [FILL]	1	S-1B			9 9		
		2	S-2A	SS	15	8 5 7	12	S-2 at 2ft
+3.2	Gray to orangish fine-medium SAND, some silt (moist)	3	S-2B			14		
	Gray to orangish brown fine-medium SAND, some silt, trace roots (moist)	4	S-3	SS	16	12 12 13 12	25	Drilled to 4ft. Drove casing to 4ft. S-3 at 4ft
	▽ Gray to orangish brown fine-medium SAND, some silt, trace clay (wet)	6	S-4A	SS	18	8 7	22	S-4 at 6ft q_u=0.5 tsf (PP)
-0.3	▼ Gray to brown SILT, some clay, trace f-m sand (wet)	7	S-4B			15 19		
	Gray to light brown Silty CLAY, some f-m sand (wet)	8	S-5	SS	24	2 1 1 2	2	Drilled to 8ft. S-5 at 8ft q_u=0.5 tsf (PP)
	Gray to light brown Clayey SILT, some f-m sand (wet)	10	U-1	ST	20			Drilled to 10ft. U-1 at 10ft Slightly difficult push from 11.5 to 12 ft. Sand observed at bottom of tube.
-4.8	? ? ? ? Orangish brown fine-medium SAND, some silt (wet)	12	S-6	SS	12	4 19 22 36	41	S-6 at 12ft
-7.3	Orangish brown to brown fine-medium SAND, trace silt (wet)	14	S-7	SS	10	25 24 30 35	54	S-7 at 14ft Drove casing to 15ft
-13.3		20						



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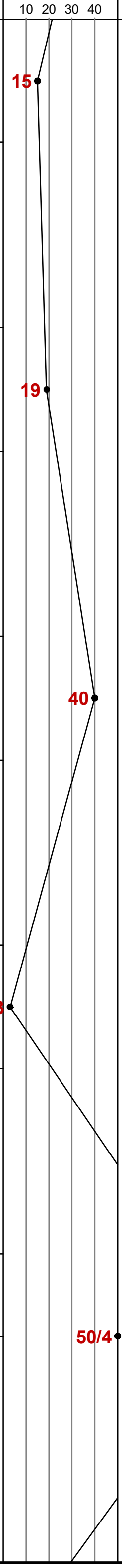
Project: Ocean Wind - BL England Substation

Project No.: 101010201

Location: Upper Township, New Jersey

Elevation and Datum: Approx. El 6.697 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-13.3	Orangish brown to gray fine-medium SAND, some silt (wet)	20	S-8	SS	9	12 9 6 11	15	Drilled to 20ft. S-8 at 20ft
	Orangish brown fine-medium SAND, some silt (wet)	25	S-9	SS	12	5 8 11 19	19	Drilled to 25ft. S-9 at 25ft
	Orangish brown to gray fine-medium SAND, some silt (wet)	30	S-10	SS	8	18 24 16 15	40	Drilled to 30ft. S-10 at 30ft
-28.3	Orangish brown to dark gray Silty CLAY, some fine sand (wet)	35	S-11	SS	24	2 1 2 3	3	Drilled to 35ft. S-11 at 35ft q_u=0.75 tsf (PP)
-33.3	Gray fine-coarse SAND, trace silt, trace fine gravel (wet)	40	S-12	SS	6	22 37 50/4	50/4	Drilled to 40ft. S-12 at 40ft
-38.3		45						



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Log of Boring **B-9** Sheet 3 of 4

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 6.697 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-38.3	Dark gray fine-medium SAND, some clay, some silt (wet)	45	S-13A	SS	20	3 2 8	10	Drilled to 45ft. S-13 at 45ft q_u=0.5 tsf (PP) 1 to 2" thick clay seams observed within sand in S-13A.
-39.8	Dark gray fine-medium SAND, trace silt (wet)		S-13B			12		
	Gray to light brown fine-medium SAND, trace silt (wet)	50	S-14	SS	6	31 50/5	50/5	Drilled to 50ft. S-14 at 50ft
-48.3	Gray to light brown fine-coarse SAND, some fine gravel, trace silt (wet)	55	S-15	SS	9	24 30 28 25	58	Drilled to 55ft. S-15 at 55ft
-53.3	Gray to light brown fine-medium SAND, trace silt (wet)	60	S-16	SS	6	22 35 50/5	50/5	Drilled to 60ft. S-16 at 60ft
	Gray to light brown fine-medium SAND, trace silt (wet)	65	S-17	SS	7	29 43 45 50/5	88	Drilled to 65ft. S-17 at 65ft
		70						

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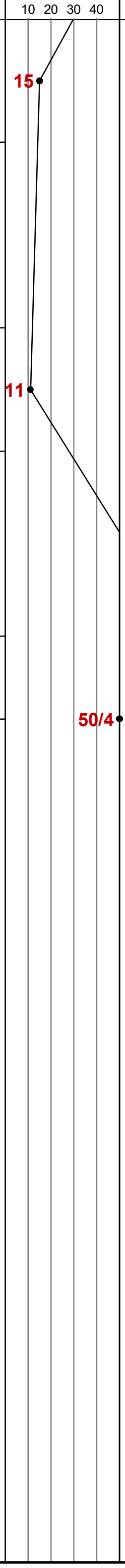
Log of Boring **B-9** Sheet 4 of 4

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 6.697 (NAVD88)

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
░	-63.3	Gray to light brown fine-coarse SAND, trace silt (wet)	70	S-18	SS	11	6 7 8 15	15	Drilled to 70ft. S-18 at 70ft
▨	-68.3	Dark gray fine-medium SAND, some clay, some silt (wet)	75	S-19	SS	24	4 4 7 14	11	Drilled to 75ft. S-19 at 75ft
░	-73.3	Dark gray fine-medium SAND, some silt (wet)	80	S-20	SS	10	33 47 50/4	50/4	Drilled to 80ft. S-20 at 80ft
	-74.6	End of Boring at 81.33 ft.							Finished drilling at 12:24 PM on 9/20/2022. Borehole grouted upon completion.



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Log of Boring **B-12** Sheet 1 of 3

Project	Ocean Wind - BL England Substation	Project No.	101010201
Location	Upper Township, New Jersey	Elevation and Datum	Approx. El 7.798 (NAVD88)
Drilling Company	Craig Geotechnical Drilling	Date Started / Date Finished	09/22/2022 / 09/22/2022
Drilling Equipment	ATV Rig	Completion Depth / Rock Depth	50.3 ft / N.E.
Size and Type of Bit	3-7/8in Tricone Roller Bit	Number of Samples	Disturbed 14 / Undisturbed 1 / Core -
Casing Diameter (in) / Casing Depth (ft)	4 / 13	Water Level (ft.)	First ▽ 6 / Completion ▼ - / 24 HR. ▼ 5.8
Casing Hammer / Weight (lbs) / Drop (in)	Automatic / 140 / 30	Drilling Foreman	Leon Ellis
Sampler	2-inch-diameter split spoon; Shelby Tube	Field Engineer	Lei Xu
Sampler Hammer / Weight (lbs) / Drop (in)	Safety / 140 / 30		

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+7.8	Orangish brown fine-coarse SAND, some silt, trace coal, trace f-c gravel (moist) [FILL]	0	S-1A	SS	16	5 9		Started drilling at 8:05 AM on 9/22/2022. S-1 at 0ft
+6.8	Light brown to gray fine-coarse SAND, some silt, trace fine gravel (moist) [FILL]	1	S-1B			22 31	31	
	Light brown to gray fine-coarse SAND, some silt, trace clay, trace fine gravel (moist) [FILL]	2	S-2	SS	17	40 30 39 50/4	69	S-2 at 2ft
	Light brown to gray fine-coarse SAND, some silt, some f-c gravel (moist) [FILL]	4	S-3	SS	14	31 41 44 41	85	Drilled to 4ft. S-3 at 4ft
	Light brown to dark gray fine-coarse SAND, some silt, some f-c gravel (wet) [FILL]	6	S-4	SS	12	26 23 14 12	37	S-4 at 6ft
-0.2	Light brown to gray fine-medium SAND, trace silt, trace roots (wet)	8	S-5	SS	12	7 7 10 14	17	Drilled to 8ft. S-5 at 8ft
	Orangish brown fine-coarse SAND, trace silt (wet)	10	S-6	SS	11	20 21 24 36	45	S-6 at 10ft
		13						Drove casing to 13ft
-7.2	Orangish brown to gray fine-medium SAND, some silt (wet)	15	S-7	SS	10	13 16 18 18	34	Drilled to 15ft. S-7 at 15ft
-12.2		20						

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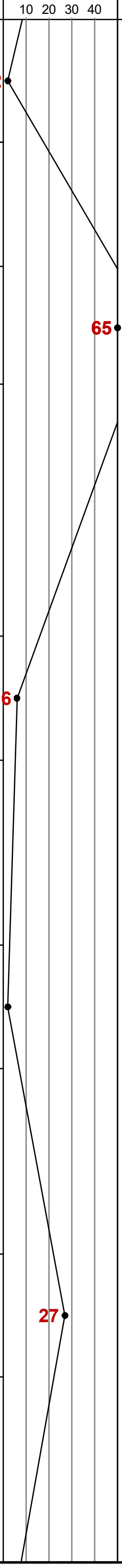
Log of Boring **B-12** Sheet 2 of 3

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 7.798 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-12.2	Grayish brown Silty CLAY, some f-m sand (wet)	20	S-8	SS	21	1 1 1 1	2	Drilled to 20ft. S-8 at 20ft q_u=0.25 tsf (PP) 2 to 3" sand seams observed within clay in S-8.
-14.2	Gray to light brown Clayey fine-medium SAND, some silt (wet)	22	U-1	ST	6			Drilled to 22ft. U-1 at 22ft. No clay recovery within U-1.
-16.2	Gray to brown fine-medium SAND, some silt (wet)	24	S-9	SS	20	20 29 36 50/5	65	S-9 at 24ft
	Dark gray fine-medium SAND, some clay, some silt (wet) passing #200=31.7%	30	S-10	SS	20	2 3 3 3	6	Drilled to 30ft. S-10 at 30ft 2 to 3" thick clay seams observed within sand in S-10
-27.2	Dark gray Silty CLAY, trace fine sand (wet)	35	S-11	SS	24	WOH WOH 2 3		Drilled to 35ft. S-11 at 35ft q_u=0.25 tsf (PP)
-32.2	Dark gray Sandy CLAY, some silt (wet)	40	S-12A	SS	20	1 6	27	Drilled to 40ft. S-12 at 40ft q_u=0.5 tsf (PP)
-33.2	Gray fine-coarse SAND, some fine gravel, trace clay, trace silt (wet)	41	S-12B			21 31		
-37.2		45						



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Log of Boring **B-12** Sheet 3 of 3

Project: Ocean Wind - BL England Substation

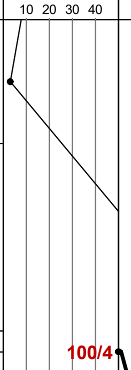
Project No.: 101010201

Location: Upper Township, New Jersey

Elevation and Datum: Approx. El 7.798 (NAVD88)

Elev. (ft)	Sample Description	Number	Type	Recov. (in)	Penetr. resist BL/6in	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-37.2	Dark gray Silty CLAY, trace f-m sand (wet)	S-13A	SS	24	WOH WOH 3	Drilled to 45ft. S-13 at 45ft q_u=0.75 tsf (PP)
-38.7	Dark gray fine-medium SAND, some clay, trace silt (wet)	S-13B			7	
-42.2	Gray Gravelly fine-coarse SAND, trace silt (wet)	S-14	SS	3	100/4	Drilled to 50ft. Rig chattering from 48 to 50 ft. S-14 at 50ft Finished drilling at 10:46 AM on 9/22/2022. Borehole grouted upon completion.
-42.5	End of Boring at 50.33 ft.					

Depth Scale: 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70



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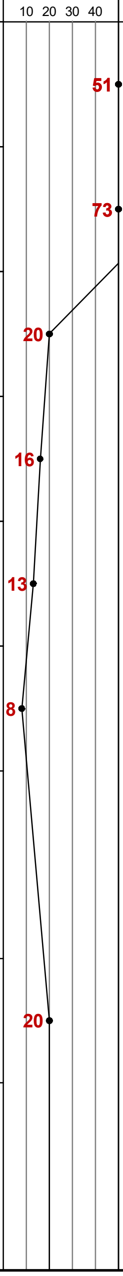
Log of Boring **B-14** Sheet 1 of 3

Project: Ocean Wind - BL England Substation	Project No.: 101010201
Location: Upper Township, New Jersey	Elevation and Datum: Approx. El 8.062 (NAVD88)
Drilling Company: Craig Geotechnical Drilling	Date Started: 09/21/2022 — Date Finished: 09/21/2022
Drilling Equipment: ATV Rig	Completion Depth: 50.3 ft — Rock Depth: N.E.
Size and Type of Bit: 3-7/8in Tricone Roller Bit	Number of Samples: Disturbed 14 — Undisturbed - — Core -
Casing Diameter (in): 4 — Casing Depth (ft): 13	Water Level (ft.): First ▽ 8 — Completion ▼ - — 24 HR. ▼ 5.9
Casing Hammer: Automatic — Weight (lbs): 140 — Drop (in): 30	Drilling Foreman: Leon Ellis
Sampler: 2-inch-diameter split spoon	
Sampler Hammer: Safety — Weight (lbs): 140 — Drop (in): 30	Field Engineer: Lei Xu

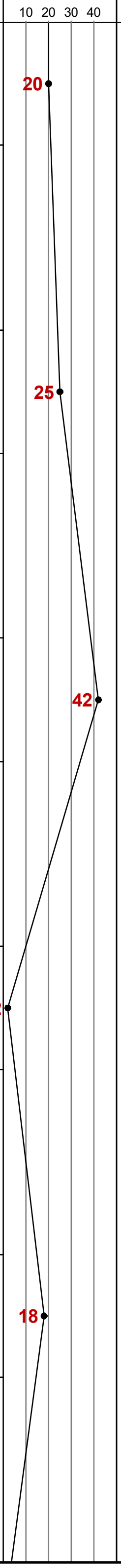
Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+8.1	Orangish brown fine-coarse SAND, some silt, some f-c gravel, trace coal, trace clay (moist) [FILL]	0	S-1	SS	15	7 14 37 40	51	Started drilling at 10:56 AM on 9/21/2022. S-1 at 0ft
	Orangish brown fine-coarse SAND, some silt, some f-c gravel (moist) [FILL]	2	S-2	SS	18	38 37 36 35	73	S-2 at 2ft
	Orangish brown fine-coarse SAND, trace silt, trace fine gravel (moist) [FILL]	4	S-3	SS	9	11 10 10 10	20	Drilled to 4ft. S-3 at 4ft
+2.1	Dark brown SILT, some peat, trace f-m sand (moist)	6	S-4A	SS	12	9 7 9 10	16	S-4 at 6ft
+1.8	Dark brown to gray fine-medium SAND, some silt (moist)		S-4B					
+0.1	Gray fine-medium SAND, trace silt, trace roots (wet)	8	S-5	SS	10	6 7 6 7	13	Drilled to 8ft. S-5 at 8ft
-1.9	Gray fine-medium SAND, some silt, trace roots (wet)	10	S-6A	SS	16	8 4 4 4	8	S-6 at 10ft q_u=0.5 tsf (PP)
-2.4	Gray to orangish brown Clayey SILT, some fine sand (wet)		S-6B					
		13						Drove casing to 13ft.
-6.9	Gray to orangish fine-medium SAND, some silt, trace clay (wet)	15	S-7	SS	12	4 9 11 16	20	Drilled to 15ft. S-7 at 15ft



LANGAN Log of Boring **B-14** Sheet 2 of 3

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 8.062 (NAVD88)

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	-11.9	Gray to orangish brown fine-medium SAND, some silt (wet)	20	S-8	SS	11	2 10 10 16	20	Drilled to 20ft. S-8 at 20ft
		Gray to orangish brown Silty fine-medium SAND (wet)	25	S-9	SS	15	11 13 12 11	25	Drilled to 25ft. S-9 at 25ft
	-21.9	Gray to orangish brown fine-medium SAND, trace silt (wet)	30	S-10	SS	10	17 24 18 11	42	Drilled to 30ft. S-10 at 30ft
	-26.9	Dark gray Sandy SILT, some clay (wet) passing #200=55.1% LL=25, PL=19, PI=6	35	S-11	SS	24	WOH 1 1 1	2	Drilled to 35ft. S-11 at 35ft q_u=0.5 tsf (PP)
		Dark gray Sandy SILT, some clay (wet)	40	S-12A	SS	20	WOH 3 15 22	18	Drilled to 40ft. S-12 at 40ft q_u=0.25 tsf (PP)
	-32.9	Gray fine-coarse SAND, trace silt (wet)	41	S-12B					
	-36.9		45						



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Log of Boring **B-14** Sheet 3 of 3

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 8.062 (NAVD88)

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
▨	-36.9	Dark gray Silty CLAY, trace f-m sand (wet)	45	S-13	SS	24	WOH WOH WOH 2		Drilled to 45ft. S-13 at 45ft q_u=0.5 tsf (PP)
			46						
			47						
			48						
			49						
⁘	-41.9 -42.3	Gray Gravelly fine-coarse SAND, some silt (wet)	50	S-14	SS	3	100/4	100/4	Drilled to 50ft. S-14 at 50ft Finished drilling at 2:16 PM on 9/21/2022. Borehole grouted upon completion.
		End of Boring at 50.33 ft.	51						
			52						
			53						
			54						
			55						
			56						
			57						
			58						
			59						
			60						
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Log of Boring **B-17** Sheet 1 of 4

Project	Ocean Wind - BL England Substation	Project No.	101010201
Location	Upper Township, New Jersey	Elevation and Datum	Approx. El 7.999 (NAVD88)
Drilling Company	Craig Geotechnical Drilling	Date Started / Date Finished	09/20/2022 / 09/21/2022
Drilling Equipment	ATV Rig	Completion Depth / Rock Depth	82 ft / N.E.
Size and Type of Bit	3-7/8in Tricone Roller Bit	Number of Samples	Disturbed 20; Undisturbed 1; Core -
Casing Diameter (in)	4; Casing Depth (ft) -	Water Level (ft.)	First ▽ 15; Completion ▼ -; 24 HR. ▼ 5.5
Casing Hammer	Automatic; Weight (lbs) 140; Drop (in) 30	Drilling Foreman	Leon Ellis
Sampler	2-inch-diameter split spoon; Shelby Tube		
Sampler Hammer	Safety; Weight (lbs) 140; Drop (in) 30	Field Engineer	Lei Xu

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+8.0	Orangish brown to black fine-coarse SAND, some silt, trace coal, trace clay (moist) [FILL]	0	S-1	SS	12	1 2 2 2	4	Started drilling at 12:35 PM on 9/20/2022. S-1 at 0ft
	Orangish brown to gray fine-coarse SAND, some f-c gravel, some silt, trace coal, trace clay (moist) [FILL] passing #200=11.6%	2	S-2	SS	10	3 3 3 11	6	S-2 at 2ft
	Orangish brown fine-coarse SAND, some silt, trace fine gravel (moist) [FILL]	4	S-3A	SS	15	15 16 6 7	22	Drilled to 4ft. S-3 at 4ft
+2.2	Dark brown SILT, some peat, trace f-m sand (moist)		S-3B					
+2.0	Gray fine-medium SAND, some silt, trace peat, trace roots (wet)	6	S-4	SS	11	7 10 6 6	16	S-4 at 6ft
	Gray fine-coarse SAND, some silt, trace wood, trace roots (wet)	8	S-5A	SS	15	2 7 3 4	10	Drilled to 8ft. S-5 at 8ft
-1.5	Gray to orangish brown Silty CLAY, some f-m sand (moist)		S-5B					
	Gray to orangish brown Silty CLAY, some f-m sand (moist) wc=24.3% LL=33, PL=17, PI=16	10	S-6	SS	14	7 7 11 7	18	S-6 at 10ft q_u=1 tsf (PP)
-7.0	Grayish brown to orangish brown fine-medium SAND, some silt (wet)	15	S-7	SS	11	8 15 17 19	32	Stopped drilling for the day at 1:33 PM on 9/20/2022. Resumed drilling at 7:26 AM on 9/21/2022. Drilled to 15ft. S-7 at 15ft
-12.0		20						

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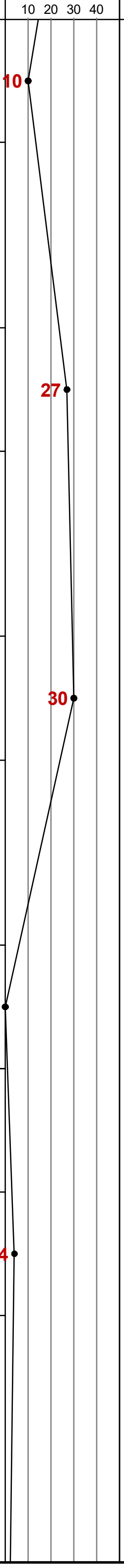
Log of Boring **B-17** Sheet 2 of 4

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 7.999 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-12.0	Light brown to orangish brown Silty CLAY, some f-m sand (wet)	20	S-8A	SS	16	WOH 1	10	Drilled to 20ft. S-8 at 20ft q_u=0.25 tsf (PP)
-13.0	Light brown to orangish brown fine-medium SAND, some silt (wet)	21	S-8B			9 18		
	Brown to orangish fine-medium SAND, some silt (wet)	25	S-9	SS	15	19 14 13 14	27	Drilled to 25ft. S-9 at 25ft
-22.0	Gray to orangish brown fine-coarse SAND, trace silt (wet)	30	S-10	SS	8	18 19 11 9	30	Drilled to 30ft. S-10 at 30ft
-27.0	Dark gray Silty CLAY, some f-m sand (wet)	35	S-11	SS	24	1 WOH WOH WOH		Drilled to 35ft. S-11 at 35ft q_u=0.25 tsf (PP)
	Dark gray Silty CLAY, some f-m sand (wet)	37	U-1	ST	24			Drilled to 37ft. U-1 at 37ft
	Dark gray Silty CLAY, some f-m sand (wet)	39	S-12A	SS	24	WOH 2	4	S-12 at 39ft q_u=0.25 tsf (PP)
-32.5	Dark gray fine-coarse SAND, some clay, some silt (wet)	40.5	S-12B			2 2		
-37.0		45						



LANGAN Log of Boring **B-17** Sheet 3 of 4

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 7.999 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-37.0	Dark gray Silty CLAY, some f-m sand, trace shells (wet) wc=33.5% passing #200=80.8% LL=41, PL=16, PI=25	45	S-13	SS	24	WOH WOH 2 3		Drilled to 45ft. S-13 at 45ft q_u=.50 tsf (PP)
-42.0	Gray fine-coarse SAND, some fine gravel, some silt (wet)	50	S-14	SS	3	100/4	100/4	Drilled to 50ft. S-14 at 50ft
	Gray fine-coarse SAND, some fine gravel, trace silt (wet)	55	S-15	SS	8	24 25 23 20	48	Drilled to 55ft. S-15 at 55ft
-52.0	Gray fine-medium SAND, trace silt (wet)	60	S-16	SS	9	29 47 50/4	50/4	Drilled to 60ft. S-16 at 60ft
	Gray fine-medium SAND, trace silt (wet)	65	S-17	SS	7	23 36 50/3	50/3	Drilled to 65ft. S-17 at 65ft

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Log of Boring **B-17** Sheet 4 of 4

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 7.999 (NAVD88)

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	-62.0	Gray fine-medium SAND, trace silt (wet)	70	S-18	SS	6	41 50/5	50/5	Drilled to 70ft. S-18 at 70ft
	-67.0	Dark gray Clayey fine-medium SAND, some silt (wet)	75	S-19	SS	24	3 4 5 7	9	Drilled to 75ft. S-19 at 75ft
	-72.0	Gray to dark gray fine-medium SAND, some silt, trace clay (wet)	80	S-20	SS	20	8 21 37 40	58	Drilled to 80ft. S-20 at 80ft
	-74.0	End of Boring at 82 ft.	82						Finished drilling at 10:30 AM on 9/21/2022 Borehole grouted upon completion.

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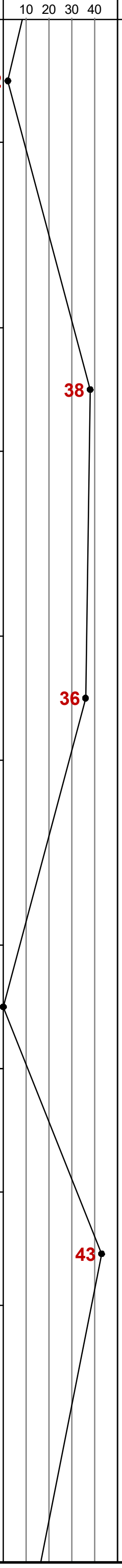
Log of Boring **B-20** Sheet 1 of 4

Project: Ocean Wind - BL England Substation
Project No.: 101010201
Location: Upper Township, New Jersey
Elevation and Datum: Approx. El 7.612 (NAVD88)
Drilling Company: Craig Geotechnical Drilling
Date Started: 09/23/2022
Date Finished: 09/23/2022
Drilling Equipment: ATV Rig
Completion Depth: 82 ft
Rock Depth: N.E.
Size and Type of Bit: 3-7/8in Tricone Roller Bit
Number of Samples: Disturbed 20; Undisturbed 1; Core -
Casing Diameter (in): 4
Casing Depth (ft): 13
Water Level (ft.): First ▽ 8.5; Completion ▼ -; 24 HR. ▼ 5.4
Casing Hammer: Automatic; Weight (lbs) 140; Drop (in) 30
Drilling Foreman: Leon Ellis
Sampler: 2-inch-diameter split spoon; Shelby Tube
Sampler Hammer: Safety; Weight (lbs) 140; Drop (in) 30
Field Engineer: Lei Xu

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+7.6	Orangish brown to light brown fine-coarse SAND, some silt, trace coal, trace clay, trace f-c gravel (moist) [FILL]	0	S-1	SS	16	6 10 12 11	22	Started drilling at 9:06 AM on 9/23/2022. S-1 at 0ft
+5.6	Black fine-coarse SAND, some coal, some silt, some fine gravel (moist) [FILL]	2	S-2A	SS	15	22 34 31 40	65	S-2 at 2ft
+5.4	Orangish brown to dark fine-coarse SAND, some silt, some f-c gravel, trace coal (moist) [FILL]	3	S-2B					
	Orangish brown to dark gray fine-coarse SAND, some silt, some f-c gravel, trace clay (moist) [FILL] ▼	4	S-3	SS	13	17 27 38 38	65	Drilled to 4ft. S-3 at 4ft
	Orangish brown to dark gray fine-coarse SAND, some silt, some f-c gravel, trace clay (wet) [FILL]	6	S-4A	SS	13	48 21 35 37	56	S-4 at 6ft
-0.1	Gray to dark brown fine-coarse SAND, some silt, some peat (moist)		S-4B					
	Light brown fine-coarse SAND, some silt, some fine gravel (wet) ▽	8	S-5A	SS	12	6 10 6 5	16	Drilled to 8ft. S-5 at 8ft
-1.9	Light brown to gray SILT, some fine sand, trace clay, trace roots (wet)		S-5B					
-2.4	Light brown to gray Sandy CLAY, some silt (wet) wc=20.0% passing #200=59.4% LL=32, PL=15, PI=17	10	S-6	SS	16	14 8 8 7	16	S-6 at 10ft q_u=1.75 tsf (PP)
		13						Drove casing to 13ft
-7.4	Orangish brown to gray fine-medium SAND, some silt (wet)	15	S-7	SS	12	15 14 19 18	33	Drilled to 15ft. S-7 at 15ft
-12.4		20						

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 7.612 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-12.4	Orangish brown Silty CLAY, trace fine sand (wet)	20	S-8A	SS	20	WOH 1 1	2	Drilled to 20ft. S-8 at 20ft q_u=0.25 tsf (PP)
-14.1	Brown to gray Silty fine-medium SAND, trace clay (wet)		S-8B			9		
	Brown to gray fine SAND, some silt (wet)	25	S-9	SS	10	17 20 18 14	38	Drilled to 25ft. S-9 at 25ft
	Brown to gray fine-medium SAND, some silt (wet)	30	S-10	SS	11	12 17 19 11	36	Drilled to 30ft. S-10 at 30ft
-27.4	Dark gray Silty CLAY (wet)	35	S-11	SS	24	WOH WOH WOH WOH		Drilled to 35ft. S-11 at 35ft q_u=0.25 tsf (PP)
	Dark gray Silty CLAY, trace f-m sand (wet) wc=31.2% organic content=2.46% LL=32, PL=17, PI=15	37	U-1	ST	24			Drilled to 37ft. U-1 at 37ft
	Dark gray Silty CLAY, trace f-m sand (wet)	39	S-12A	SS	20	1 7	43	S-12 at 39ft q_u=0.5 tsf (PP)
-31.9	Dark gray fine-coarse SAND, some f-c gravel, some clay, trace silt (wet)		S-12B			36 50/4		
-37.4		45						



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Log of Boring **B-20** Sheet 3 of 4

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 7.612 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-37.4	Dark gray fine-coarse SAND, some silt, trace clay, trace fine gravel (wet)	45	S-13	SS	12	3 5 6 13	11	Drilled to 45ft. S-13 at 45ft
-42.4	Gray to light brown fine-coarse SAND, some fine gravel, trace silt (wet)	50	S-14	SS	3	100/5	100/5	Drilled to 50ft. S-14 at 50ft
	Gray to light brown fine-coarse SAND, some fine gravel, trace silt (wet)	55	S-15	SS	6	30 27 22 18	49	Drilled to 55ft. S-15 at 55ft
	Gray to light brown Gravelly fine-coarse SAND, trace silt (wet)	60	S-16	SS	9	17 12 22 29	34	Drilled to 60ft. S-16 at 60ft
-57.4	Gray to light brown fine-medium SAND, trace silt (wet)	65	S-17	SS	6	26 50/5	50/5	Drilled to 65ft. S-17 at 65ft
-62.4		70						

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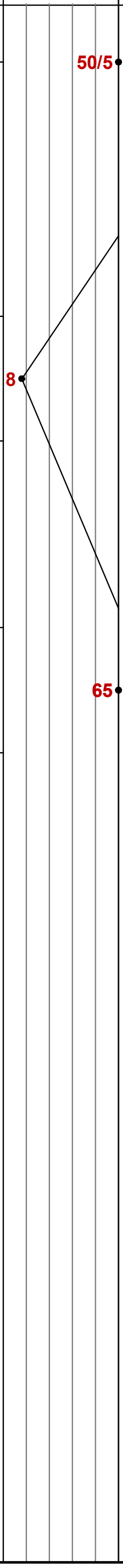
Log of Boring **B-20** Sheet 4 of 4

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 7.612 (NAVD88)

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	-62.4	Gray to light brown fine-medium SAND, some silt, trace fine gravel (wet)	70	S-18	SS	5	31 50/5	50/5	Drilled to 70ft. S-18 at 70ft
	-67.4	Light brown fine-medium SAND, some clay, some silt (wet) passing #200=23.9%	75	S-19	SS	20	6 4 4 4	8	Drilled to 75ft. S-19 at 75ft
	-72.4	Light gray fine-medium SAND, some silt, trace clay (wet)	80	S-20	SS	13	16 28 37 43	65	Drilled to 80ft. S-20 at 80ft
	-74.4	End of Boring at 82 ft.	82						Finished drilling at 12:40 PM on 9/23/2022. Borehole grouted upon completion.

Depth Scale: 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95



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Log of Boring **B-21** Sheet 1 of 2

Project	Ocean Wind - BL England Substation	Project No.	101010201
Location	Upper Township, New Jersey	Elevation and Datum	Approx. El 8.042 (NAVD88)
Drilling Company	Craig Geotechnical Drilling	Date Started / Date Finished	09/23/2022 / 09/23/2022
Drilling Equipment	ATV Rig	Completion Depth / Rock Depth	27 ft / N.E.
Size and Type of Bit	3-7/8in Tricone Roller Bit	Number of Samples	Disturbed 6 / Undisturbed 3 / Core -
Casing Diameter (in)	4 / Casing Depth (ft) -	Water Level (ft.)	First ▽ 8 / Completion ▼ - / 24 HR. ▼ 6.6
Casing Hammer	Automatic / Weight (lbs) 140 / Drop (in) 30	Drilling Foreman	Leon Ellis
Sampler	2-inch-diameter split spoon; Shelby Tube		
Sampler Hammer	Safety / Weight (lbs) 140 / Drop (in) 30	Field Engineer	Lei Xu

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+8.0	Orangish brown fine-coarse SAND, some silt, trace coal, trace clay, trace fine gravel (moist) [FILL]	0	S-1	SS	24	8 10 12 17	22	Started drilling at 7:35 AM on 9/23/2022. S-1 at 0ft
	Gray to orangish brown fine-coarse SAND, some silt, some f-c gravel (moist) [FILL]	2	U-1	ST	12			Drilled to 2ft. U-1 at 2ft (Geothermal sample) Two 6" recovery tubes collected
	Gray to orangish brown fine-coarse SAND, some silt, trace f-c gravel (moist) [FILL]	4	U-2	ST	6			U-2 at 4ft (Geothermal sample) One 6" recovery tube collected
+2.0	Gray to orangish brown fine-coarse SAND, some silt (moist) ▼	6	S-2	SS	12	6 7 8 11	15	Drilled to 6ft. S-2 at 6ft
	▽ Orangish brown fine-medium SAND, some silt (wet)	8	S-3	SS	15	16 10 15 13	25	S-3 at 8ft
	Orangish brown fine-medium SAND, some silt (wet)	10	U-3	ST	6			U-3 at 10ft (Geothermal sample) One 6" recovery tube collected
	Gray fine-medium SAND, some silt (wet)	15	S-4	SS	14	7 8 13 12	21	Drilled to 15ft. S-4 at 15ft
-12.0		20						

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Log of Boring **B-21** Sheet 2 of 2

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 8.042 (NAVD88)

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	-12.0	Orangish brown SILT, some f-m sand, some clay (wet)	20	S-5A	SS	20	WOH 4	11	Drilled to 20ft. S-5 at 20ft q_u=0.25 tsf (PP)
	-13.0	Gray fine-medium SAND, some silt (wet)	21	S-5B			7 9		
			22						
			23						
			24						
		Brown fine-medium SAND, some silt (wet)	25	S-6	SS	16	10 13 12 14	25	Drilled to 25ft. S-6 at 25ft
			26						
	-19.0	End of boring at 27 ft.	27						Finished drilling at 9:04 AM on 9/23/2022. Borehole grouted upon completion.
			28						
			29						
			30						
			31						
			32						
			33						
			34						
			35						
			36						
			37						
			38						
			39						
			40						
			41						
			42						
			43						
			44						
			45						

N-Value scale: 10 20 30 40

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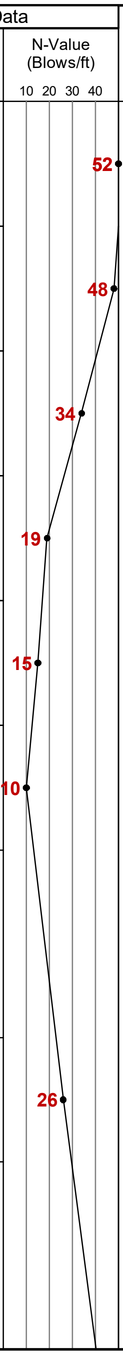
Log of Boring **B-22** Sheet 1 of 5

Project	Ocean Wind - BL England Substation	Project No.	101010201
Location	Upper Township, New Jersey	Elevation and Datum	Approx. El 6.477 (NAVD88)
Drilling Company	Craig Geotechnical Drilling	Date Started: 09/12/2022	Date Finished: 09/13/2022
Drilling Equipment	ATV Rig	Completion Depth: 100.7 ft	Rock Depth: N.E.
Size and Type of Bit	3-7/8in Tricone Roller Bit	Number of Samples	Disturbed: 24 Undisturbed: 1 Core: -
Casing Diameter (in): 4	Casing Depth (ft): 10	Water Level (ft.)	First: ▽ 6 Completion: ▼ - 24 HR.: ▼ 6.8
Casing Hammer: Automatic	Weight (lbs): 140 Drop (in): 30	Drilling Foreman	Leon Ellis
Sampler	2-inch-diameter split spoon; Shelby Tube		
Sampler Hammer: Safety	Weight (lbs): 140 Drop (in): 30	Field Engineer	Lei Xu



MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+6.5	Orangish brown fine-coarse SAND, some silt, trace coal (moist) [FILL]	0	S-1A	SS	20	3 25	52	Started drilling at 8:10 AM on 9/12/2022. S-1 at 0ft
	+5.5	Light gray to brown fine-coarse SAND, some silt, some f-c gravel, trace coal (moist) [FILL]	1	S-1B			27 28		
		Light brown to gray fine-coarse SAND, some silt, some f-c gravel, trace coal (moist) [FILL]	2	S-2	SS	20	21 22 26 29	48	S-2 at 2ft
		Light brown fine-coarse SAND, some f-c gravel, trace silt (moist) [FILL]	4	S-3	SS	20	33 17 17 17	34	Drove casing to 4ft. Drilled to 4ft. Moderate rig chattering. S-3 at 4ft
	+0.5	Gray to light brown fine-coarse SAND, some silt, trace clay, trace peat, trace roots (moist to wet)	6 ▽ ▼	S-4	SS	12	10 10 9 7	19	S-4 at 6ft
		Gray to light brown fine-medium SAND, some silt, trace roots (wet)	8	S-5	SS	11	4 8 7 6	15	Drilled to 8ft. Wood/twig observed in wash. S-5 at 8ft
		Gray to light brown Silty fine-medium SAND, trace clay (wet) passing #200=41.4%	10	S-6	SS	12	4 5 5 6	10	S-6 at 10ft. Drove casing to 10ft.
		Gray to orangish brown fine-medium SAND, some silt (wet)	15	S-7	SS	16	7 12 14 13	26	Drilled to 15ft. S-7 at 15ft
	-13.5		20						

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Log of Boring **B-22** Sheet 2 of 5

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 6.477 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-13.5	Gray to orangish brown fine-medium SAND, trace silt (wet)	20	S-8	SS	14	20 22 22 24	44	Drilled to 20ft. S-8 at 20ft
-18.5	Grayish brown fine-medium SAND, some silt (wet)	25	S-9	SS	12	11 11 9 7	20	Drilled to 25ft. S-9 at 25ft
-23.5	Orangish brown fine-medium SAND, some clay, some silt (wet)	30	S-10A	SS	20	5 6	9	Drilled to 30ft. S-10 at 30ft q_u=0.5 tsf (PP)
-24.5	Orangish brown to gray Silty CLAY, some f-m sand (wet)	31	S-10B			3 5		
	Dark gray Silty CLAY, trace f-m sand (wet)	32	U-1	ST	24			Drilled to 32ft. U-1 at 32ft
	Dark gray Silty CLAY, trace f-m sand (wet)	34	S-11	SS	22	1 4 4 4	8	S-11 at 34ft q_u=0.5 tsf (PP)
-33.8	Dark gray Silty CLAY, some f-c sand (wet)	40	S-12A	SS	17	11 11	33	Drilled to 40ft. S-12 at 40ft q_u=0.5 tsf (PP)
	Gray fine-coarse SAND, some fine gravel, trace silt, trace shells (wet)		S-12B			22 26		
-38.5		45						

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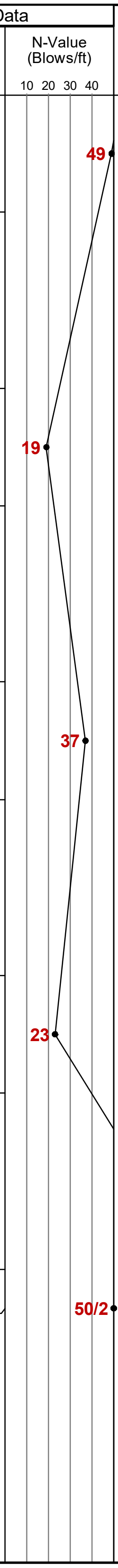
Log of Boring **B-22** Sheet 3 of 5

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 6.477 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-38.5	Dark gray Clayey fine-coarse SAND, trace silt (wet)	45	S-13A	SS	19	5 13	27	Drilled to 45ft. S-13 at 45ft
-39.5	Dark gray fine-coarse SAND, some fine gravel, trace clay, trace silt, trace shells (wet)	46	S-13B			14 13		
	Dark gray fine-coarse SAND, some fine gravel, trace silt, trace shells (wet) passing #200=8.3%	50	S-14	SS	12	9 10 13 14	23	Drilled to 50ft. S-14 at 50ft
	Gray to light brown fine-coarse SAND, some fine gravel, trace silt (wet)	55	S-15	SS	8	20 32 28 28	60	Drilled to 55ft. S-15 at 55ft
	Gray to light brown fine-coarse SAND, some fine gravel, some silt (wet)	60	S-16	SS	6	23 50/5	50/5	Drilled to 60ft. Slight rig chattering. S-16 at 60ft Stopped drilling for the day at 2:13 PM on 9/12/2022. Resumed drilling at 7:18 AM on 9/13/2022.
-58.5	Gray fine-medium SAND, trace silt (wet)	65	S-17	SS	10	19 32 39 50/3	71	Drilled to 65ft. S-17 at 65ft
		70						

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 6.477 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-63.5	Gray fine-medium SAND, trace silt (wet)	70	S-18	SS	11	21 23 26 22	49	Drilled to 70ft. S-18 at 70ft
-68.5	Gray fine-coarse SAND, some silt, trace fine gravel (wet)	75	S-19	SS	9	11 10 9 10	19	Drilled to 75ft. S-19 at 75ft
	Gray fine-medium SAND, some silt, some clay (wet)	80	S-20	SS	10	9 18 19 16	37	Drilled to 80ft. S-20 at 80ft 2" thick clay observed within sand.
-78.5	Gray fine-medium SAND, some clay, some silt, trace fine gravel (wet)	85	S-21	SS	12	18 12 11 12	23	Drilled to 85ft. S-21 at 85ft 1" thick clay seams observed within sand.
-83.5	Gray fine-coarse SAND, some fine gravel, trace silt (wet)	90	S-22	SS	6	67 50/2	50/2	Drilled to 90ft. S-22 at 90ft
-88.5		95						



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Log of Boring **B-22** Sheet 5 of 5

Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 6.477 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-88.5	Gray to light brown fine-medium SAND, trace silt (wet)	95	S-23	SS	10	19 17 25 48	42	Drilled to 95ft. S-23 at 95ft
-93.5	Gray fine-coarse SAND, some fine gravel, trace silt (wet)	100	S-24	SS	5	57 50/2	50/2	Drilled to 100ft. S-24 at 100ft Finished drilling at 4:37 PM on 9/13/2022. Borehole grouted upon completion.
-94.2	End of Boring at 100.67 ft.							

Depth Scale: 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120

N-Value scale: 10 20 30 40

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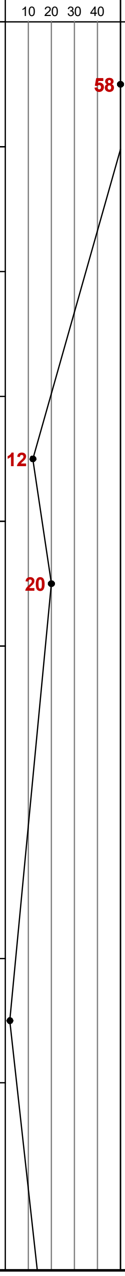
Log of Boring **B-24 (OW)** Sheet 1 of 2

Project	Ocean Wind - BL England Substation	Project No.	101010201
Location	Upper Township, New Jersey	Elevation and Datum	Approx. El 10.03 (NAVD88)
Drilling Company	Craig Geotechnical Drilling	Date Started	09/22/2022
		Date Finished	09/22/2022
Drilling Equipment	ATV Rig	Completion Depth	27 ft
		Rock Depth	N.E.
Size and Type of Bit	3-7/8in Tricone Roller Bit	Number of Samples	Disturbed 6 Undisturbed 3 Core -
Casing Diameter (in)	4	Water Level (ft.)	First ▽ 10 Completion ▼ - 24 HR. ▼ 4.9
Casing Depth (ft)	13		
Casing Hammer	Automatic	Drilling Foreman	Leon Ellis
Weight (lbs)	140		
Drop (in)	30		
Sampler	2-inch-diameter split spoon; Shelby Tube	Field Engineer	Lei Xu
Sampler Hammer	Safety		
Weight (lbs)	140		
Drop (in)	30		

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+10.0	Black fine-coarse SAND, some coal, some silt, some f-c gravel (moist) [FILL]	0	S-1	SS	15	8 23 35 48	58	Started drilling at 11:37 AM on 9/22/2022. S-1 at 0ft
	Dark gray to light brown fine-medium SAND, some silt (moist) [FILL]	2	U-1	ST	12			Drilled to 2ft. U-1 at 2ft (Geothermal sample) Two 6" recovery tubes collected
+6.0	Light brown fine-medium SAND, trace silt, (moist to wet)	4	U-2	ST	12			U-2 at 4ft (Geothermal sample) One 6" and one 5" recovery tubes collected
+4.0	Orangish brown fine-coarse SAND, some clay, trace silt (moist)	6	S-2	SS	8	4 6 6 11	12	Drilled to 6ft. S-2 at 6ft
+2.0	Orangish brown fine-medium SAND, trace silt (moist)	8	S-3	SS	9	14 10 10 10	20	S-3 at 8ft
0.0	Dark gray to light brown fine-coarse SAND, some silt, some fine gravel (wet)	10	U-3	ST	6			U-3 at 10ft (Geothermal sample) One 6" recovery tube collected
		13						Drove casing to 13ft
-5.0	Light brown SILT, some fine sand, some clay (wet)	15	S-4A	SS	24	WOH WOH 2 7		Drilled to 15ft. S-4 at 15ft
-6.5	Light brown to gray fine-medium SAND, some silt (wet)		S-4B					



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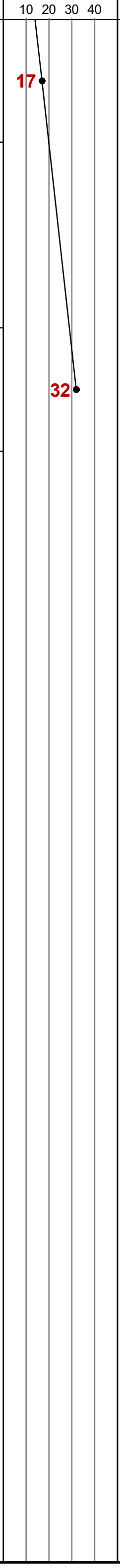
Log of Boring **B-24 (OW)** Sheet 2 of 2

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 10.03 (NAVD88)

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Sample Data: Type	Sample Data: Recov. (in)	Sample Data: Penetr. resist BL/6in	Sample Data: N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	-10.0	Gray fine-medium SAND, some silt (wet)	20	S-5A	SS	20	14 13	17	Drilled to 20ft. S-5 at 20ft
	-11.0	Orangish brown SILT, some f-m sand, some clay (wet)	21	S-5B			4 4		
	-15.0	Gray to orangish brown fine-medium SAND, some silt (wet)	25	S-6	SS	15	10 13 19 20	32	Drilled to 25ft. S-6 at 25ft
	-17.0	End of Boring at 27 ft.	27						Finished drilling at 1:25 PM on 9/22/2022. Installed groundwater level observation well (10' screen + 10' riser). Removed well on 9/26/22. Borehole grouted upon completion.



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Log of Boring **B-25** Sheet 1 of 1

Project Ocean Wind - BL England Substation		Project No. 101010201			
Location Upper Township, New Jersey		Elevation and Datum Approx. El 6.847 (NAVD88)			
Drilling Company Craig Geotechnical Drilling		Date Started 09/22/2022		Date Finished 09/22/2022	
Drilling Equipment ATV Rig		Completion Depth 6 ft		Rock Depth N.E.	
Size and Type of Bit 2-7/8in Tricone Roller Bit		Number of Samples	Disturbed 3	Undisturbed -	Core -
Casing Diameter (in) 4	Casing Depth (ft) -	Water Level (ft.)	First ▽ -	Completion ▼ -	24 HR. ▼ -
Casing Hammer Automatic	Weight (lbs) 140 Drop (in) 30	Drilling Foreman Leon Ellis			
Sampler 2-inch-diameter split spoon		Field Engineer Lei Xu			
Sampler Hammer Safety	Weight (lbs) 140 Drop (in) 30				

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
▨	+6.8	Orangish brown fine-coarse SAND, some silt, trace clay, trace f-c gravel (moist) [FILL]	0	S-1A	SS	18	35 51	72	Started drilling at 10:58 AM on 9/22/2022. S-1 at 0ft
▨	+6.3	Black fine-coarse SAND, some coal, some silt, some f-c gravel (moist) [FILL]	1	S-1B			21 26		
▨	+4.8	Brown fine-coarse SAND, some silt, some f-c gravel, trace coal, trace clay (moist) [FILL]	2	S-2	SS	15	33 25 31 30	56	S-2 at 2ft
▨		Brown fine-coarse SAND, some silt, some f-c gravel, trace coal (moist) [FILL]	4	S-3	SS	17	19 23 24 24	47	Drilled to 4ft. S-3 at 4ft
	+0.8	End of Boring at 6 ft.	6						Finished drilling at 11:18 AM on 9/22/2022. Borehole grouted upon completion.

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Log of Boring **B-26** Sheet 1 of 1

Project Ocean Wind - BL England Substation		Project No. 101010201	
Location Upper Township, New Jersey		Elevation and Datum Approx. El 6.709 (NAVD88)	
Drilling Company Craig Geotechnical Drilling		Date Started 09/20/2022	Date Finished 09/20/2022
Drilling Equipment ATV Rig		Completion Depth 6 ft	Rock Depth N.E.
Size and Type of Bit 3-7/8in Tricone Roller Bit		Number of Samples	Disturbed 3 / Undisturbed - / Core -
Casing Diameter (in) 4	Casing Depth (ft) -	Water Level (ft.)	First ▽ - / Completion ▼ - / 24 HR. ▼ -
Casing Hammer Automatic / Weight (lbs) 140	Drop (in) 30	Drilling Foreman Leon Ellis	
Sampler 2-inch-diameter split spoon		Field Engineer Lei Xu	
Sampler Hammer Safety / Weight (lbs) 140	Drop (in) 30		

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+6.7	Orangish brown to black fine-coarse SAND, some silt, trace coal, some roots (moist) [TOPSOIL - approx. 6" thick]	0	S-1A	SS	14	3 9		Started drilling at 7:35 AM on 9/20/2022. S-1 at 0ft
+6.2	Black fine-coarse SAND, some coal, some silt, trace f-c gravel (moist) [FILL]	1	S-1B			19 28	28	
+4.7	Gray to black fine-coarse SAND, some silt, trace coal, trace clay, trace f-c gravel (moist) [FILL]	2	S-2	SS	18	28 27 21 24	48	S-2 at 2ft
	Gray to black fine-coarse SAND, some silt, trace coal, trace clay, trace f-c gravel (moist) [FILL]	4	S-3	SS	15	13 7 17 20	24	Drilled to 4ft. S-3 at 4ft
+0.7	End of boring at 6 ft.	6						Finished drilling at 8:02 AM on 9/20/2022. Borehole grouted upon completion.

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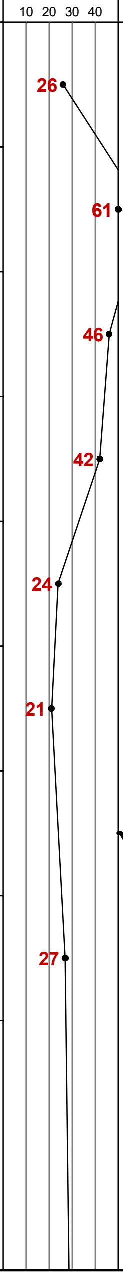
Log of Boring **B-27 (OW)** Sheet 1 of 5

Project	Ocean Wind - BL England Substation		Project No.	101010201	
Location	Upper Township, New Jersey		Elevation and Datum	Approx. El 8.04 (NAVD88)	
Drilling Company	Craig Geotechnical Drilling		Date Started	09/16/2022	Date Finished 09/16/2022
Drilling Equipment	ATV Rig		Completion Depth	100.7 ft	Rock Depth N.E.
Size and Type of Bit	3-7/8in Tricone Roller Bit		Number of Samples	Disturbed 24 Undisturbed 1	Core -
Casing Diameter (in)	4	Casing Depth (ft) 18	Water Level (ft.)	First ▽ 8 Completion ▼ -	24 HR. ▼ 6.1
Casing Hammer	Automatic	Weight (lbs) 140 Drop (in) 30	Drilling Foreman	Leon Ellis	
Sampler	2-inch-diameter split spoon; Shelby Tube		Field Engineer	Lei Xu	
Sampler Hammer	Safety	Weight (lbs) 140 Drop (in) 30			

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
+8.0	Orangish brown to black fine-coarse SAND, some silt, trace clay, trace f-c gravel, some coal (moist) [FILL]	0	S-1	SS	20	9 8 18 16	26	Started drilling at 7:36 AM on 9/16/2022. S-1 at 0ft
	Light brown to dark brown fine-coarse SAND, some silt, some f-c gravel, trace coal (moist) [FILL]	2	S-2	SS	14	27 31 30 43	61	S-2 at 2ft
+4.0	Dark brown SILT, some peat, some organics, trace f-c sand (moist)	4	S-3A S-3B	SS	18	5 21 25 25	46	Drilled to 4ft. S-3 at 4ft
+3.4	Dark gray fine-medium SAND, some silt, trace peat, trace organics, trace roots (moist)	5						
	Dark brown Silty fine-medium SAND, trace organics, trace roots (moist)	▼ 6	S-4	SS	11	31 22 20 24	42	S-4 at 6ft
	Gray Silty fine-medium SAND, trace clay, some roots (wet)	▽ 8	S-5A S-5B	SS	19	8 8 16 18	24	Drilled to 8ft. Wood/twig observed in wash. S-5 at 8ft
-1.0	Gray fine-medium SAND, trace silt, trace fine gravel (wet)	9						
-2.0	Orangish gray fine-medium SAND, some silt, trace clay (wet)	10	S-6A S-6B	SS	24	28 11 10 13	21	S-6 at 10ft q_u=1.75 tsf (PP)
-2.5	Orangish brown to gray Silty CLAY, some f-m sand (wet)	11						
	Orangish brown to gray Silty CLAY, some f-m sand, trace fine gravel (wet) wc=26.9% organic content=3.63% LL=26, PL=15, PI=11	12	U-1	ST	24			Drilled to 12ft. U-1 at 12ft. Sand observed at bottom of tube. Drove casing to 13ft
-5.0	? ? ? ?	13						
	Gray to orangish brown fine-medium SAND, some clay, some silt (wet)	14	S-7A S-7B	SS	20	3 14 13 19	27	S-7 at 14ft
-6.5	Brown to gray fine-medium SAND, trace silt (wet)	15						
		16						
		17						
		18						Drove casing to 18ft
		19						
-12.0		20						



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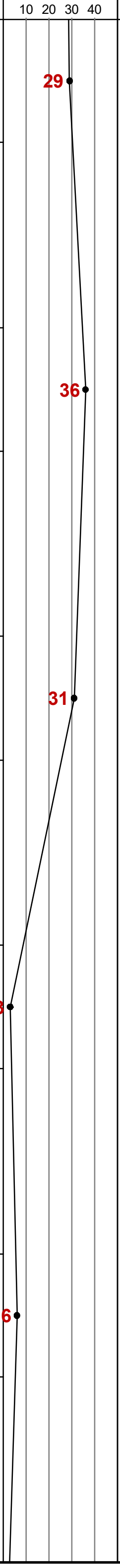
Log of Boring **B-27 (OW)** Sheet 2 of 5

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 8.04 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-12.0	Brown to gray Silty CLAY, some f-m sand (wet)	20	S-8A	SS	16	8 15	29	Drilled to 20ft. S-8 at 20ft q_u=0.75 tsf (PP)
-12.5	Brown to gray fine-medium SAND, some silt (wet)		S-8B			14 14		
-17.0	Brown to gray fine-medium SAND, trace silt (wet)	25	S-9	SS	10	22 21 15 13	36	Drilled to 25ft. S-9 at 25ft
	Gray fine-medium SAND, trace silt (wet)	30	S-10	SS	11	12 16 15 17	31	Drilled to 30ft. S-10 at 30ft
-27.0	Dark gray Silty CLAY, trace f-m sand (wet) LL=30, PL=20, PI=10	35	S-11	SS	24	WOH 2 1 1	3	Drilled to 35ft. S-11 at 35ft q_u=0.5 tsf (PP)
-32.0	Dark gray Sandy CLAY, some silt (wet)	40	S-12A	SS	18	2 2 4	6	Drilled to 40ft. S-12 at 40ft q_u=0.5 tsf (PP)
-33.5	Dark gray fine-coarse SAND, trace clay, trace silt, trace fine gravel (wet)		S-12B			15		
-37.0		45						



LANGAN Log of Boring **B-27 (OW)** Sheet 3 of 5

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 8.04 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-37.0	Dark gray Silty CLAY, trace fine sand (wet)	45	S-13A	SS	24	WOH WOH 2		Drilled to 45ft. S-13 at 45ft q_u=0.5 tsf (PP)
-38.5	Dark gray Clayey fine-coarse SAND, some silt (wet)		S-13B			4		
-42.0	Gray fine-coarse SAND, some fine gravel, trace silt (wet)	50	S-14	SS	4	73 50/2	50/2	Drilled to 50ft. Moderate rig chattering from 49 to 50 ft. S-14 at 50ft
	Gray fine-coarse SAND, some silt, some fine gravel (wet)	55	S-15	SS	6	25 50/5	50/5	Drilled to 55ft. S-15 at 55ft
-52.0	Gray fine-medium SAND, trace silt (wet)	60	S-16	SS	5	45 50/3	50/3	Drilled to 60ft. S-16 at 60ft
	Gray fine-medium SAND, trace silt (wet)	65	S-17	SS	7	27 43 50/4	50/4	Drilled to 65ft. S-17 at 65ft
		70						

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Log of Boring **B-27 (OW)** Sheet 4 of 5

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 8.04 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-62.0	Gray fine-medium SAND, trace silt (wet)	70	S-18	SS	8	29 51 50/5	50/5	Drilled to 70ft. S-18 at 70ft
-67.0	Gray fine-medium SAND, some silt, trace clay (wet)	75	S-19	SS	17	6 10 11 14	21	Drilled to 75ft. S-19 at 75ft
-72.0	Gray fine-medium SAND, some silt (wet)	80	S-20	SS	11	25 33 42 48	75	Drilled to 80ft. S-20 at 80ft
	Gray fine-medium SAND, some silt (wet) passing #200=12.3%	85	S-21	SS	8	9 21 42 50/3	63	Drilled to 85ft. S-21 at 85ft
-82.0	Light brown fine-coarse SAND, some fine gravel, trace silt (wet)	90	S-22	SS	8	68 50/3	50/3	Drilled to 90ft. S-22 at 90ft
-87.0		95						

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Log of Boring **B-27 (OW)** Sheet 5 of 5

Project: Ocean Wind - BL England Substation

Project No.: 101010201

Location: Upper Township, New Jersey

Elevation and Datum: Approx. El 8.04 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-87.0	Light brown to gray fine-coarse SAND, trace silt, trace fine gravel (wet)	95	S-23	SS	8	31 47 50/4	50/4	Drilled to 95ft. Rig chattering. S-23 at 95ft
	Light brown fine-medium SAND, trace silt, trace fine gravel (wet)	100	S-24	SS	6	98 50/2	50/2	Drilled to 100ft. S-24 at 100ft
-92.6	End of Boring at 100.67 ft.							Finished drilling at 1:27 PM on 9/16/2022. Installed groundwater level observation well (10' screen + 10' riser). Removed well on 9/26/22. Borehole grouted upon completion.

Depth Scale: 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120

N-Value scale: 10 20 30 40

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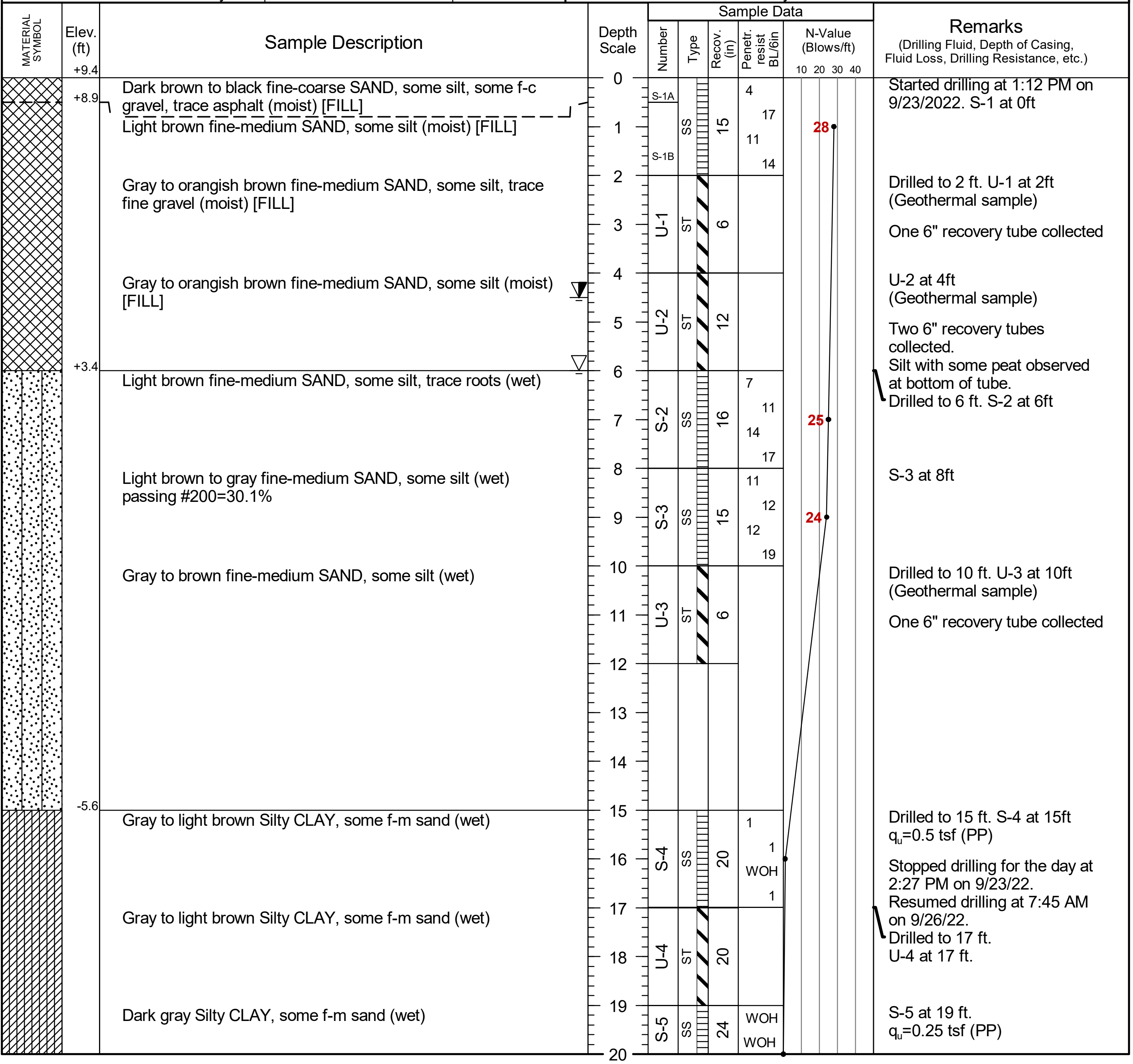
Log of Boring **B-28** Sheet 1 of 5

Project: Ocean Wind - BL England Substation	Project No.: 101010201
Location: Upper Township, New Jersey	Elevation and Datum: Approx. El 9.402 (NAVD88)
Drilling Company: Craig Geotechnical Drilling	Date Started: 09/23/2022 — Date Finished: 09/26/2022
Drilling Equipment: ATV Rig	Completion Depth: 102 ft — Rock Depth: N.E.
Size and Type of Bit: 3-7/8in Tricone Roller Bit	Number of Samples — Disturbed: 21 — Undisturbed: 5 — Core: -
Casing Diameter (in): 4 — Casing Depth (ft): -	Water Level (ft.) — First ▽ 6 — Completion ▼ - — 24 HR. ▼ 4.5
Casing Hammer: Automatic — Weight (lbs): 140 — Drop (in): 30	Drilling Foreman: Leon Ellis
Sampler: 2-inch-diameter split spoon; Shelby Tube	
Sampler Hammer: Safety — Weight (lbs): 140 — Drop (in): 30	Field Engineer: Lei Xu/Manny Guzman



Elev. (ft)	Depth Scale	Sample Description
+9.4	0	Dark brown to black fine-coarse SAND, some silt, some f-c gravel, trace asphalt (moist) [FILL]
+8.9		Light brown fine-medium SAND, some silt (moist) [FILL]
	2	Gray to orangish brown fine-medium SAND, some silt, trace fine gravel (moist) [FILL]
	4	Gray to orangish brown fine-medium SAND, some silt (moist) [FILL]
+3.4	6	Light brown fine-medium SAND, some silt, trace roots (wet)
	8	Light brown to gray fine-medium SAND, some silt (wet) passing #200=30.1%
	10	Gray to brown fine-medium SAND, some silt (wet)
-5.6	15	Gray to light brown Silty CLAY, some f-m sand (wet)
	17	Gray to light brown Silty CLAY, some f-m sand (wet)
	19	Dark gray Silty CLAY, some f-m sand (wet)

Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)
S-1A S-1B	SS	15	4 17 11 14	28
U-1	ST	6		
U-2	ST	12		
S-2	SS	16	7 11 14 17	25
S-3	SS	15	11 12 12 19	24
U-3	ST	6		
S-4	SS	20	1 1 WOH 1	
U-4	ST	20		
S-5	SS	24	WOH WOH	

Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

Started drilling at 1:12 PM on 9/23/2022. S-1 at 0ft

Drilled to 2 ft. U-1 at 2ft (Geothermal sample)

One 6" recovery tube collected

U-2 at 4ft (Geothermal sample)

Two 6" recovery tubes collected.

Silt with some peat observed at bottom of tube.

Drilled to 6 ft. S-2 at 6ft

S-3 at 8ft

Drilled to 10 ft. U-3 at 10ft (Geothermal sample)

One 6" recovery tube collected

Drilled to 15 ft. S-4 at 15ft q_u=0.5 tsf (PP)

Stopped drilling for the day at 2:27 PM on 9/23/22.

Resumed drilling at 7:45 AM on 9/26/22.

Drilled to 17 ft.

U-4 at 17 ft.

S-5 at 19 ft. q_u=0.25 tsf (PP)

Log of Boring **B-28** Sheet 2 of 5

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 9.402 (NAVD88)

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
▨	-10.6		20	S-5	SS	24	WOH 1		
⁙	-15.6	Gray fine-medium SAND, some silt (moist)	25	S-6	SS	16	11 12 19 18	31	Drilled to 25 ft. S-6 at 25 ft.
⁙	-20.6	Orangish brown fine-coarse SAND, trace silt (wet)	30	S-7	SS	10	50 40 42 40	82	Drilled to 30 ft. S-7 at 30 ft.
▨	-25.6	Dark gray Silty CLAY, some f-m sand (wet)	35	S-8	SS	24	WOH WOH WOH WOH		Drilled to 35 ft. S-8 at 35 ft. q_u=0.25 tsf (PP)
		Dark gray Silty CLAY, some f-m sand (wet)	37	U-5	ST	24			Drilled to 37 ft. U-5 at 37 ft.
		Dark gray Silty CLAY, trace f-c sand (wet)	39	S-9	SS	24	WOH WOH WOH 2		S-9 at 39 ft. q_u=0.25 tsf (PP)
			45						

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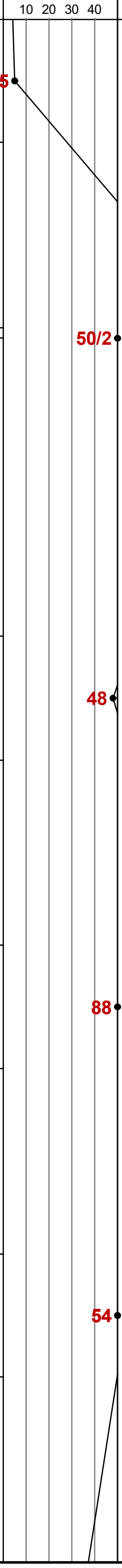
Project Ocean Wind - BL England Substation	Project No. 101010201
Location Upper Township, New Jersey	Elevation and Datum Approx. El 9.402 (NAVD88)

Elev. (ft)	Sample Description	Depth Scale	Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
-35.6	Dark gray Silty CLAY, some f-c sand (wet)	45	S-10	SS	24	WOH 2 3 5	5	Drilled to 45 ft. S-10 at 45 ft. q_u=0.5 tsf (PP)
-40.6	No Recovery	50	S-11	SS	0	50/2	50/2	Drilled to 50 ft. S-11 at 50 ft.
	Light gray fine-coarse SAND, some fine gravel, trace silt (wet)	55	S-12	SS	7	32 28 20 13	48	Drilled to 55 ft. S-12 at 55 ft.
-50.6	Light gray fine-medium SAND, trace silt (wet)	60	S-13	SS	8	37 43 45 43	88	Drilled to 60 ft. S-13 at 60 ft.
	Light gray fine-medium SAND, trace silt (wet)	65	S-14	SS	10	29 27 27 28	54	Drilled to 65 ft. S-14 at 65 ft.
		70						



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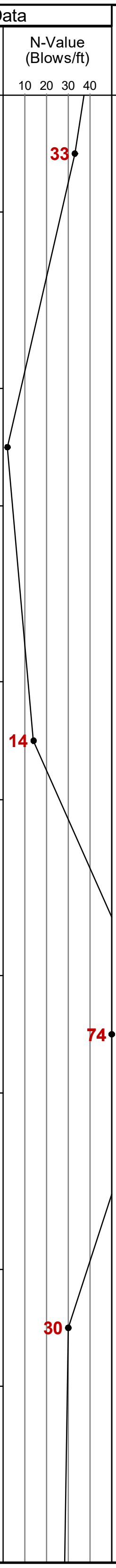
Log of Boring **B-28** Sheet 4 of 5

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 9.402 (NAVD88)



MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	-60.6	Light gray fine-medium SAND, trace silt (wet)	70	S-15	SS	6	14 17 16 13	33	Drilled to 70 ft. S-15 at 70 ft.
	-65.6	Light brown SILT, some f-m sand, some clay (wet)	75	S-16A	SS	16	WOH WOH		Drilled to 75 ft. S-16 at 75 ft.
	-66.6	Dark gray Silty fine-medium SAND, trace clay (wet)	76	S-16B			2 7		
	-70.6	Dark gray Clayey fine-medium SAND, some silt (wet) passing #200=45.9%	80	S-17	SS	18	11 5 9 16	14	Drilled to 80 ft. S-17 at 80 ft.
	-75.6	Light gray fine-medium SAND, some silt (wet)	85	S-18	SS	13	26 36 38 37	74	Drilled to 85 ft. S-18 at 85 ft.
	-80.6	Light gray fine-medium SAND, trace silt (wet)	90	S-19	SS	11	10 15 15 10	30	Drilled to 90 ft. S-19 at 90 ft.
	-85.6		95						

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Log of Boring **B-28** Sheet 5 of 5

Project	Project No.
Ocean Wind - BL England Substation	101010201
Location	**Elevation and Datum**
Upper Township, New Jersey	Approx. El 9.402 (NAVD88)

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Sample Data Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	-85.6	Dark gray fine-coarse SAND, some silt (wet)	95	S-20	SS	10	14 13 15 15	28	Drilled to 95 ft. S-20 at 95 ft.
			96 97 98 99						
	-90.6	Dark gray fine-medium SAND, trace silt (wet)	100	S-21	SS	13	22 30 35 30	65	Drilled to 100 ft. S-21 at 100 ft.
			101						
	-92.6	End of Boring at 102 ft.	102						Completed boring at 2:00 on 9/27/22. Borehole grouted upon completion.
			103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120						

APPENDIX B

Logs of Test Pits

LOG OF TEST PIT TP-1

Sheet 1 of 1

PROJECT NAME Ocean Wind - BL England Substation	PROJECT NUMBER 101010201	DATE 9/9/2022
LOCATION Upper Township, New Jersey	ELEVATION Approx. el 6.793 (NAVD88)	
EXCAVATION CONTRACTOR Craig Geotechnical Drilling, Co., Inc.	DEPTH 8 ft	WATER LEVEL - First 7.5 ft ∇ WATER LEVEL - Completion 7 ft ▼
EQUIPMENT Kubota KX057-5 Mini Excavator	FOREMAN Eladio Cruz	LANGAN PERSONNEL Lei Xu

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
▩	+6.8	Orangish brown f-c SAND, some silt, trace coal, trace f-c gravel (moist) [FILL]	0	S1	GRAB	Started at 10:48 am on 9/9/2022.
▩	+5.8	Black f-c SAND, some silt, some coal, some f-c gravel, trace wood, trace roots (moist) [FILL]	1	S2	GRAB	U-1 at 1 ft bgs. Wood fragments from 1 to 2.5 ft bgs. Moderate difficulty digging from 1 to 7 ft bgs.
			2			
▩	+4.3	Gray f-m SAND, some silt, trace f-c gravel, trace coal, trace roots (moist) [FILL]				Twigs and roots from 2.5 to 3 ft bgs.
			3	S3	GRAB	Collected bucket sample B-1 at 3 ft bgs.
			4			Single ring at 4 ft bgs.
▩	+1.8	Grayish brown to light brown f-c SAND, some f-c gravel, trace coal, trace silt (moist) [FILL]	5	S4	GRAB	
			6			
░	-0.2	Gray f-m SAND, some silt, some roots (moist to wet) ▼ ∇	7	S5	GRAB	Groundwater seepage at 7 ft 8 inches bgs. Water stabilized at 7 ft bgs in 15 min.
	-1.2	Bottom of test pit at 8 ft.	8			Finished at 11:40 am on 9/9/2022. Test pit backfilled upon completion.
			9			
			10			
			11			
			12			
			13			
			14			
			15			

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LOG OF TEST PIT TP-2

Sheet 1 of 1

PROJECT NAME Ocean Wind - BL England Substation	PROJECT NUMBER 101010201	DATE 9/12/2022
LOCATION Upper Township, New Jersey	ELEVATION Approx. el 6.485 (NAVD88)	
EXCAVATION CONTRACTOR Craig Geotechnical Drilling, Co., Inc.	DEPTH 10 ft	WATER LEVEL - First 4 ft ▽ WATER LEVEL - Completion 10 ft ▼
EQUIPMENT Kubota KX057-5 Mini Excavator	FOREMAN Eladio Cruz	LANGAN PERSONNEL Emmanuel Carreno Guzman

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
	+6.5	Reddish brown f-c SAND, some silt, trace f-c gravel, trace plastic (moist) [FILL]	0	S1	GRAB	Started on 9/12/2022. Easy digging 0 to 2 ft bgs.
			1			U-1 at 1 ft bgs.
	+4.5	Black f-c SAND, some coal, some silt (moist) [FILL]	2	S2	GRAB	Buried coal at 2 to 4.5 ft bgs. Moderate difficulty digging at 2 to 4.5 ft bgs.
			3			
		▽	4			Perched water on south sidewall at 4 ft bgs. Single ring performed at 4 ft.
	+1.5	Black PEAT, some silt, some organics, trace clay (moist) [PEAT]	5	S3	GRAB	Easy digging at 5 to 10 ft bgs. Large amount of organics 5 to 8 ft bgs.
			6			
			7			
	-1.5	Gray f-m SAND, some silt, trace clay, trace organics (moist)	8	S4	GRAB	Slight gray mottling at 8 to 10 ft bgs.
			9			
	-3.5	▼ Bottom of test pit at 10 ft.	10			Slight water seepage at 10 ft bgs. Finished at 9:49 am on 9/12/2022. Test pit backfilled upon completion.
			11			
			12			
			13			
			14			
			15			

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LOG OF TEST PIT TP-3

Sheet 1 of 1

PROJECT NAME Ocean Wind - BL England Substation	PROJECT NUMBER 101010201	DATE 9/8/2022
LOCATION Upper Township, New Jersey	ELEVATION Approx. el 6.616 (NAVD88)	
EXCAVATION CONTRACTOR Craig Geotechnical Drilling, Co., Inc.	DEPTH 10 ft	WATER LEVEL - First 6 ft ∇ WATER LEVEL - Completion 7.5 ft ▼
EQUIPMENT Kubota KX057-5 Mini Excavator	FOREMAN Eladio Cruz	LANGAN PERSONNEL Lei Xu

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
▨	+6.6	Orangish brown f-c SAND, some silt, trace fine gravel, trace coal (moist) [FILL]	0	S1	GRAB	Started at 7:48am on 9/8/2022. U-1 from 0.5 to 1.25 ft bgs.
▨	+5.1	Light brown to gray f-c SAND, some f-c gravel, trace silt (moist) [FILL]		S2	GRAB	Moderate difficulty digging from 1.5 ft bgs to Single ring at 4 ft bgs. Hole collapse starting at 5 ft bgs.
⁙	+0.6	∇ Light brown to gray f-c SAND, trace f-c gravel, trace silt, trace wood (wet) ▼	6	S3	GRAB	Perched groundwater seepage observed from 6 to 7.5 ft bgs. Roots encountered from 7.5 to 9 ft bgs. Moderate difficulty digging from 7.5 to 9 ft bgs.
⁙	-1.4	Gray f-m SAND, some silt, some roots (moist)	8	S4	GRAB	
⁙	-2.4	Gray to light brown f-c SAND, trace silt, trace fine gravel, trace roots (moist to wet)	9	S5	GRAB	
	-3.4	Bottom of test pit at 10 ft.	10			Finished at 8:11 am on 9/8/2022. Test pit backfilled upon completion. Water seepage still observed at 7.5 ft upon backfill.

Depth Scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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LOG OF TEST PIT TP-4

Sheet 1 of 1

PROJECT NAME Ocean Wind - BL England Substation	PROJECT NUMBER 101010201	DATE 9/12/2022	
LOCATION Upper Township, New Jersey	ELEVATION Approx. el 7.238 (NAVD88)		
EXCAVATION CONTRACTOR Craig Geotechnical Drilling, Co., Inc.	DEPTH 10 ft	WATER LEVEL - First 7.5 ft ∇	WATER LEVEL - Completion - ▼
EQUIPMENT Kubota KX057-5 Mini Excavator	FOREMAN Eladio Cruz	LANGAN PERSONNEL Emmanuel Carreno Guzman	

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
▨	+7.2	Reddish brown f-c SAND, some silt, trace clay, trace f-c gravel, trace wood (moist) [FILL]	0	S1	GRAB	Started at 8:08 am on 9/12/2022. Easy digging from 0 to 2.75 ft bgs.
▨	+6.2	Grayish orangish brown SILT, some f-c sand, trace clay, trace wood (moist) [FILL]	1	S2	GRAB	Gray mottling 1 to 1.5 ft bgs. U-1 at 1ft bgs.
▨	+5.7	Orangish brown f-c SAND, some silt, some f-c gravel, trace roots (moist) [FILL]	2	S3	GRAB	Debris encountered from 1 to 1.5 ft bgs.
▨	+4.5	Gray f-c SAND, some f-c gravel, some silt, trace roots, trace plastic, trace wood (moist) [FILL]	3	S4	GRAB	Moderate difficulty digging 2.75 to 6 ft bgs.
░	+3.5	Reddish brown Silty f-c SAND, some f-c gravel (moist)	4 5	S5	GRAB	Single ring performed at 4 ft.
░	+1.2	Orangish gray f-m SAND, some silt, trace clay, trace organics (wet) ∇	6 7 8 9	S6	GRAB	Easy digging 6 to 10 ft bgs. Orange mottling at 6 ft bgs. Water seepage at 7.5 ft bgs.
	-2.8	Bottom of test pit at 10 ft.	10 11 12 13 14 15			Finished at 8:55 am on 9/12/2022. Test pit backfilled upon completion.

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LOG OF TEST PIT TP-5

Sheet 1 of 1

PROJECT NAME Ocean Wind - BL England Substation	PROJECT NUMBER 101010201	DATE 9/8/2022
LOCATION Upper Township, New Jersey	ELEVATION Approx. el 8.173 (NAVD88)	
EXCAVATION CONTRACTOR Craig Geotechnical Drilling, Co., Inc.	DEPTH 11 ft	WATER LEVEL - First - ▽ WATER LEVEL - Completion - ▼
EQUIPMENT Kubota KX057-5 Mini Excavator	FOREMAN Eladio Cruz	LANGAN PERSONNEL Lei Xu

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
▩	+8.2	Orangish brown to black f-c SAND, some silt, trace f-c gravel, trace coal (moist) [FILL]	0	S1	GRAB	Started at 10:40am on 9/8/2022.
▩	+7.2	Black f-c SAND, some silt, some coal, trace f-c gravel, trace rubber, trace metal, trace plastic (moist) [FILL]	1			Coal fragments encountered from 1 to 7.5 ft bgs. U-1 at 1 ft bgs.
			2			
			3	S2	GRAB	
			4			Single ring at 4 ft bgs.
			5			
			6			
▩	+1.2	Light brown to black f-m SAND, some silt, some roots, trace coal (moist) [FILL]	7	S3	GRAB	
ψ	-0.3	Black PEAT, some silt (moist)	8			Large amount of roots and root fibers from 8.5 to 10 ft bgs.
			9	S4	GRAB	
⁘	-1.8	Gray to light brown f-m SAND, some silt, trace roots (moist)	10	S5	GRAB	Faint mottling observed from 10 to 11 ft bgs.
	-2.8	Bottom of test pit at 11 ft.	11			Max reach at 11 ft bgs. Finished at 11:03 am on 9/8/2022. Test pit backfilled upon completion. No groundwater seepage observed.
			12			
			13			
			14			
			15			

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LOG OF TEST PIT TP-6

Sheet 1 of 1

PROJECT NAME Ocean Wind - BL England Substation	PROJECT NUMBER 101010201	DATE 9/8/2022
LOCATION Upper Township, New Jersey	ELEVATION Approx. el 9.006 (NAVD88)	
EXCAVATION CONTRACTOR Craig Geotechnical Drilling, Co., Inc.	DEPTH 10.5 ft	WATER LEVEL - First - ▽ WATER LEVEL - Completion - ▼
EQUIPMENT Kubota KX057-5 Mini Excavator	FOREMAN Eladio Cruz	LANGAN PERSONNEL Lei Xu

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
▨	+9.0	Orangish brown to reddish brown f-c SAND, some silt, trace f-c gravel, trace roots (moist) [FILL]	0	S1	GRAB	Started at 1:01 pm on 9/8/2022.
▨	+8.0	Light brown to gray f-m SAND, some silt, trace f-c gravel, trace coal, trace wood, trace clay (moist) [FILL]	1			Faint mottling from 1 to 5 ft bgs. U-1 at 1 ft bgs.
▨			2	S2	GRAB	Collected bucket sample B-1 at 2 to 3 ft bgs.
▨			3			
▨			4			Single ring at 4 ft bgs.
░	+4.0	Black f-c SAND, some f-c gravel, some silt, some coal (moist)	5			Moderate difficulty digging from 5 to 7 ft bgs.
░			6			
░	+2.0	Dark gray f-c SAND, some silt, some f-c gravel, trace coal, trace clay (wet)	7			Easy digging from 7 to 10 ft bgs. Hole kept collapsing from 7 ft bgs to bottom of the excavation.
░			8	S4	GRAB	
░			9			
░	-1.0	Gray to light brown f-m SAND, some silt, trace fine gravel (moist to wet)	10	S3	GRAB	
	-1.5	Bottom of test pit at 10.5 ft.				Max reach at 10.5 ft bgs. No water seepage observed. Finished at 1:26 pm on 9/8/2022. Test pit backfilled upon completion.
			11			
			12			
			13			
			14			
			15			

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LOG OF TEST PIT TP-7

Sheet 1 of 1

PROJECT NAME Ocean Wind - BL England Substation	PROJECT NUMBER 101010201		DATE 9/9/2022
LOCATION Upper Township, New Jersey	ELEVATION Approx. el 8.399 (NAVD88)		
EXCAVATION CONTRACTOR Craig Geotechnical Drilling, Co., Inc.	DEPTH 11 ft	WATER LEVEL - First 10.5 ft ▽	WATER LEVEL - Completion 10.2 ft ▼
EQUIPMENT Kubota KX057-5 Mini Excavator	FOREMAN Eladio Cruz		LANGAN PERSONNEL Lei Xu

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
▨	+8.4	Orangish brown Silty f-m SAND, trace f-c gravel, trace clay (moist) [FILL]	0	S1	GRAB	Started at 8:09 am on 9/9/2022. U-1 at 0.5 ft bgs.
▨	+6.9	Gray to brown to black f-c SAND, some f-c gravel, trace silt, trace clay, trace coal, trace wood, trace rubber (moist) [FILL]	1			
			2	S2	GRAB	2 inch thick coal fragment seam at 2 ft bgs. Moderate difficulty digging from 2 to 5 ft bgs.
			3			
			4			Single ring at 4 ft bgs.
▨	+3.4	Gray to brown f-c SAND, some f-c gravel, trace silt, trace wood (moist) [FILL]	5			Difficult digging from 5 to 9 ft bgs. Cemented soil from 5 to 9 ft bgs.
			6	S3	GRAB	
			7			
			8			
	-0.6	Dark brown to black PEAT some silt, some roots (moist)	9	S4	GRAB	
░	-1.1	Gray to brown f-m SAND, trace silt, trace roots (moist to wet) ▼ ▽				Faint mottling from 9.5 to the bottom of the excavation.
			10	S5	GRAB	Water stabilized at 10.2 ft bgs. Moderate ground water seepage from 10.5 ft bgs.
	-2.6	Bottom of test pit at 11 ft.	11			Max reach at 11 ft bgs. Finished at 8:57 am on 9/9/2022. Test pit was backfilled upon completion.
			12			
			13			
			14			
			15			

APPENDIX C

Infiltration Test Results

101010201
Ocean Wind - BL England Substation
Upper Township, New Jersey

9/19/2022

TABLE 1 - SUMMARY OF PROFILE TEST PITS AND INFILTRATION TESTING RESULTS

Profile Test ID	Profile Test Pit	Profile Pit Completion Date	Existing Surface Grade	Approximate Profile Pit Bottom		Approximate Observed Top of Soil Mottling Layer		Approximate Bottom of Observed Soil Mottling Layer		Observed Groundwater Level or Water Seepage		Determined Seasonal High Groundwater	Type of Infiltration Test	Infiltration Test Depth	Infiltration Test Elevation	Measured Hydraulic Conductivity	Infiltration Test Completion Date	Remarks
			(el)	(ft)	(el)	(ft)	(el)	(ft)	(el)	(ft)	(el)	(el)		(ft)	(el)	(inch/hour)		
TP-1	Test Pit	9/9/2022	6.8	8	-1.2	-	NE	-	NE	7	-0.2	-0.2	Single Ring	4	2.8	Less than 1	9/9/2022	
TP-2	Test Pit	9/12/2022	6.5	10	-3.5	8	-1.5	10	-3.5	10	-3.5	-1.5	Single Ring	4	2.5	0.6	9/12/2022	
TP-3	Test Pit	9/8/2022	6.6	10	-3.4	-	NE	-	NE	6	0.6	0.6	Single Ring	4	2.6	1.9	9/8/2022	
TP-4	Test Pit	9/12/2022	7.2	10	-2.8	6	1.2	6	1.2	7.5	-0.3	1.2	Single Ring	4	3.2	0.7	9/12/2022	
TP-5	Test Pit	9/8/2022	8.2	11	-2.8	10	-1.8	11	-2.8	-	NE	-1.8	Single Ring	4	4.2	Less than 1	9/8/2022	
TP-6	Test Pit	9/8/2022	9.0	10.5	-1.5	1	8	5	4	-	NE	8.0	Single Ring	4	5	Less than 1	9/9/2022	
TP-7	Test Pit	9/9/2022	8.4	11	-2.6	9.5	-1.1	11	-2.6	10.5	-2.1	-1.1	Single Ring	4	4.4	0.41	9/9/2022	
												-						

NOTES

1 The infiltration tests were performed per Chapter 12, Subsection A5: Single Ring Infiltration Test provided in the April 2022 NJSBMP Manual.

2 Infiltration tests were performed at depths chosen by Burns & McDonnell.

3 Refer to profile test pit and single ring infiltration test logs for details.

4 The elevations and depths provided in this table are approximate.

101010201
Ocean Wind - BL England Substation
Upper Township, New Jersey

FIELD SINGLE RING INFILTRATION TEST

IT-1

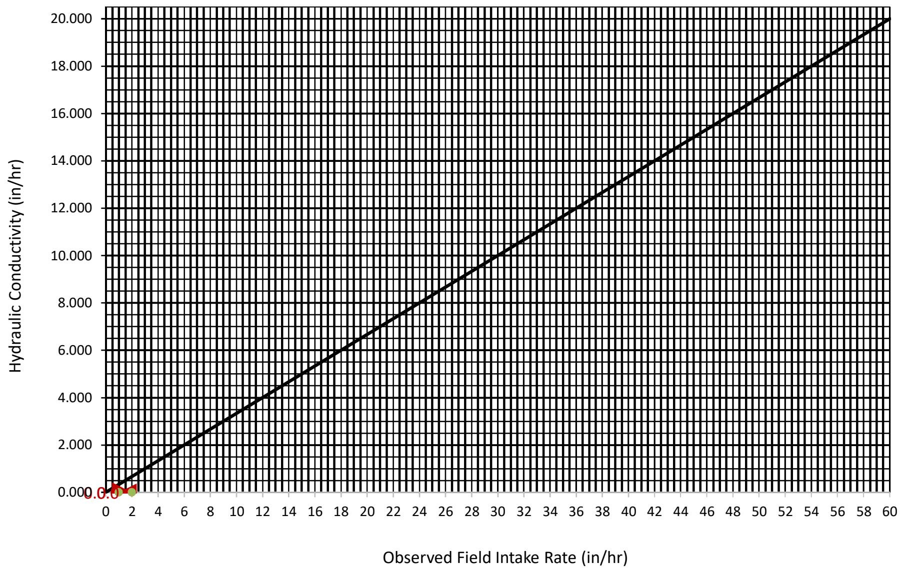
	Water Refill	Start Time	Water Level Reading (inches)	Elaspse Time to Drop 1 inch (hr:min:sec)	Elapse Time To Drop 1 Inch (sec)
PRE-SOAK	X	12:13 PM	3	-	-
	-		2	Exceeded 1hr	>3600
	-		1		
	-		0		
TEST #1	X	13:13 PM	3	-	-
			2	Exceeded 1hr	>3600
TEST #2	X	14:15 PM	3	-	-
			2	Exceeded 1hr	>3600
TEST #3					
TEST #4					
TEST #5					
TEST #6					
TEST #7					
TEST #8					
TEST #9					
TEST #10					
TEST #11					

Average Observed Field Intake Rate (sec/inch)	>3600
Average Observed Field Intake Rate (inch/hr)	<1
Hydraulic Conductivity (inch/hr)	**Less than 1** (see graph)

COORESPONDING PROFILE PIT	**TP-1**	
DATE OF INFILTRATION TEST:	**9/9/2022**	
WEATHER DURING INFILTRATION TEST:		
EXISTING SURFACE ELEVATION (el):	**6.8**	
TEST DEPTH:	**4**	**ft**
TEST ELEVATION (el):	**2.8**	
APPROXIMATE TOP OF RING (el):	**3.1**	
APPROXIMATE TOP OF BOTTOM (el):	**2.6**	

🟨	input
🟦	output
🟧	result

Single Ring Test Conversion of
Observed Field Intake Rate to Hydraulic Conductivity



When the observed field intake rate is greater than 60 in/hr, the hydraulic conductivity shall be reported as "greater than 20 in/hr." When the observed field intake rate is less than 1 in/hr, the hydraulic conductivity shall be reported as "less than 1 in/hr."

NOTES:

1 Test stratum consisted of predominately f-m SAND, some silt.
2 Test performed per Chapter 12, Subsection A5: Single Ring Infiltration Test of the November 2020 NJSBMP Manual

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101010201
Ocean Wind - BL England Substation
Upper Township, New Jersey

FIELD SINGLE RING INFILTRATION TEST

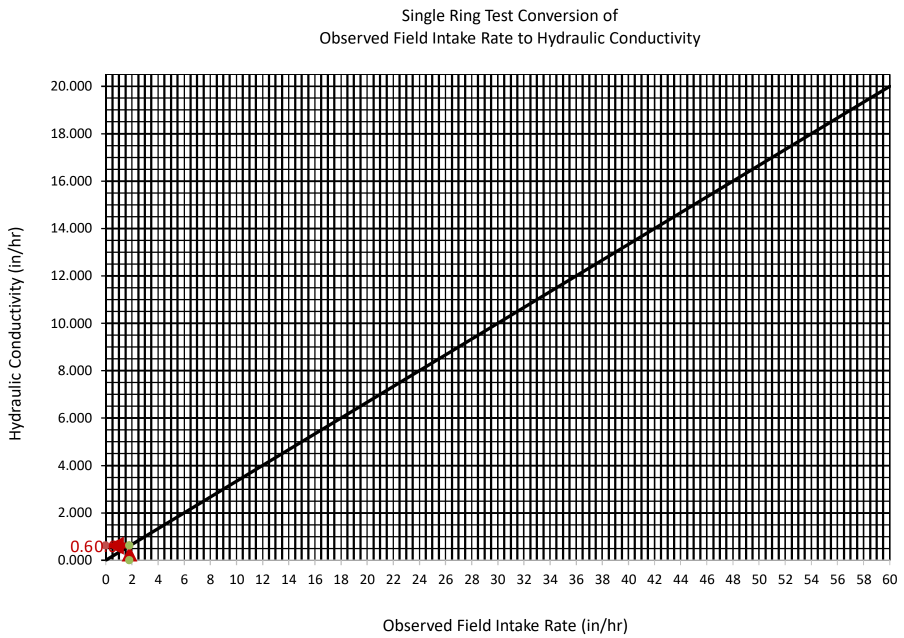
IT-2

	Water Refill	Start Time	Water Level Reading (inches)	Elaspse Time to Drop 1 inch (hr:min:sec)	Elapse Time To Drop 1 Inch (sec)
PRE-SOAK	X	10:16 AM	3		
	-		2	0:14:38.6	878.6
	-		1	0:18:31.4	1111.4
	-		0	0:25:31.2	1531.2
TEST #1	X	11:13 AM	3		
			2	0:28:42.7	1722.7
TEST #2	X	11:43 AM	3		
			2	0:35:10.6	2110.6
TEST #3	X	12:20 PM	3		
			2	0:35:10.4	2110.4
TEST #4					
TEST #5					
					`
TEST #6					
TEST #7					
TEST #8					
TEST #9					
TEST #10					
TEST #11					

Average Observed Field Intake Rate (sec/inch)	1981.2
Average Observed Field Intake Rate (inch/hr)	1.8
Hydraulic Conductivity (inch/hr)	0.6 (see graph)

COORESPONDING PROFILE PIT	TP-2
DATE OF INFILTRATION TEST:	9/12/2022
WEATHER DURING INFILTRATION TEST:	
EXISTING SURFACE ELEVATION (el):	6.5
TEST DEPTH:	4 ft
TEST ELEVATION (el):	2.5
APPROXIMATE TOP OF RING (el):	2.8
APPROXIMATE TOP OF BOTTOM (el):	2.3

🟨	input
⬜	output
🟧	result



When the observed field intake rate is greater than 60 in/hr, the hydraulic conductivity shall be reported as "greater than 20 in/hr." When the observed field intake rate is less than 1 in/hr, the hydraulic conductivity shall be reported as "less than 1 in/hr."

NOTES:

1 Test stratum consisted of predominately f-c SAND, some silt.
2 Test performed per Chapter 12, Subsection A5: Single Ring Infiltration Test of the November 2020 NJSBMP Manual

101010201

Ocean Wind - BL England Substation

Upper Township, New Jersey

FIELD SINGLE RING INFILTRATION TEST

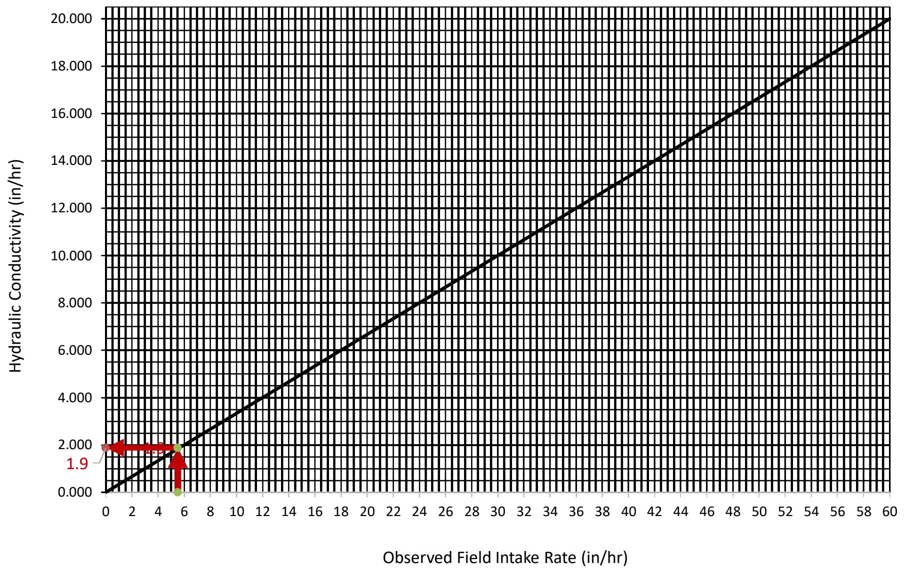
IT-3

	Water Refill	Start Time	Water Level Reading (inches)	Elaspse Time to Drop 1 inch (hr:min:sec)	Elapse Time To Drop 1 Inch (sec)
PRE-SOAK	X	8:58 AM	3		
	-		2	0:07:03.0	423.0
	-		1	0:11:28.0	688.0
	-		0	0:26:30.0	1590.0
TEST #1	X	9:45 AM	3		
			2	0:10:46.0	646.0
TEST #2	X	9:56 AM	3		
			2	0:10:55.0	655.0
TEST #3	X	10:08 AM	3		
			2	0:10:55.0	655.0
TEST #4	X	10:20 AM	3		
			2	0:10:55.0	655.0
TEST #5					
TEST #6					
TEST #7					
TEST #8					
TEST #9					
TEST #1					
TEST #11					

COORESPONDING PROFILE PIT	TP-3	
DATE OF INFILTRATION TEST:	9/8/2022	
WEATHER DURING INFILTRATION TEST:		
EXISTING SURFACE ELEVATION (el):	6.6	
TEST DEPTH:	4	ft
TEST ELEVATION (el):	2.6	
APPROXIMATE TOP OF RING (el):	2.9	
APPROXIMATE TOP OF BOTTOM (el):	2.4	

🟨	input
🟦	output
🟧	result

Single Ring Test Conversion of
Observed Field Intake Rate to Hydraulic Conductivity



Average Observed Field Intake Rate (sec/inch)	652.8
Average Observed Field Intake Rate (inch/hr)	5.5
Hydraulic Conductivity (inch/hr)	1.9

(see graph)

When the observed field intake rate is greater than 60 in/hr, the hydraulic conductivity shall be reported as “greater than 20 in/hr.” When the observed field intake rate is less than 1 in/hr, the hydraulic conductivity shall be reported as “less than 1 in/hr.”

NOTES:

1 Test stratum consisted of predominately f-c SAND, trace silt.

2 Test performed per Chapter 12, Subsection A5: Single Ring Infiltration Test of the November 2020 NJSBMP Manual

101010201
Ocean Wind - BL England Substation
Upper Township, New Jersey

FIELD SINGLE RING INFILTRATION TEST

IT-4

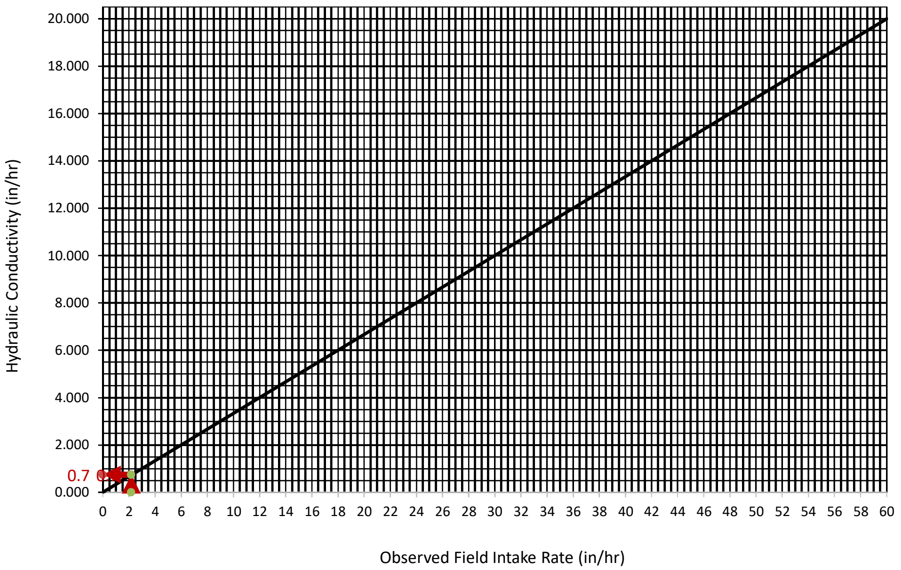
	Water Refill	Start Time	Water Level Reading (inches)	Elaspse Time to Drop 1 inch (hr:min:sec)	Elapse Time To Drop 1 Inch (sec)
PRE-SOAK	X	9:00 AM	3		
	-		2	0:09:30.2	570.2
	-		1	0:14:10.8	850.8
	-		0	0:25:28.7	1528.7
TEST #1	X	9:52 AM	3		
			2	0:25:27.7	1527.7
TEST #2	X	10:19 AM	3		
			2	0:26:32.9	1592.9
TEST #3	X	10:47 AM	3		
			2	0:28:46.5	1726.5
TEST #4	X	11:16 AM	3		
			2	0:28:47.0	1727.0
TEST #5					
					`
TEST #6					
TEST #7					
TEST #8					
TEST #9					
TEST #10					
TEST #11					

Average Observed Field Intake Rate (sec/inch)	1643.5
Average Observed Field Intake Rate (inch/hr)	2.2
Hydraulic Conductivity (inch/hr)	**0.7** (see graph)

COORESPONDING PROFILE PIT **TP-4**
DATE OF INFILTRATION TEST: **9/12/2022**
WEATHER DURING INFILTRATION TEST:
EXISTING SURFACE ELEVATION (el): **7.2**
` TEST DEPTH: **4** **ft**
TEST ELEVATION (el): **3.2**
APPROXIMATE TOP OF RING (el): **3.5**
APPROXIMATE TOP OF BOTTOM (el): **3.0**

🟨 input
⬜ output
🟧 result

Single Ring Test Conversion of
Observed Field Intake Rate to Hydraulic Conductivity



When the observed field intake rate is greater than 60 in/hr, the hydraulic conductivity shall be reported as "greater than 20 in/hr." When the observed field intake rate is less than 1 in/hr, the hydraulic conductivity shall be reported as "less than 1 in/hr."

NOTES:

1 Test stratum consisted of predominately Silty f-c SAND.
2 Test performed per Chapter 12, Subsection A5: Single Ring Infiltration Test of the November 2020 NJSBMP Manual

101010201

Ocean Wind - BL England Substation

Upper Township, New Jersey

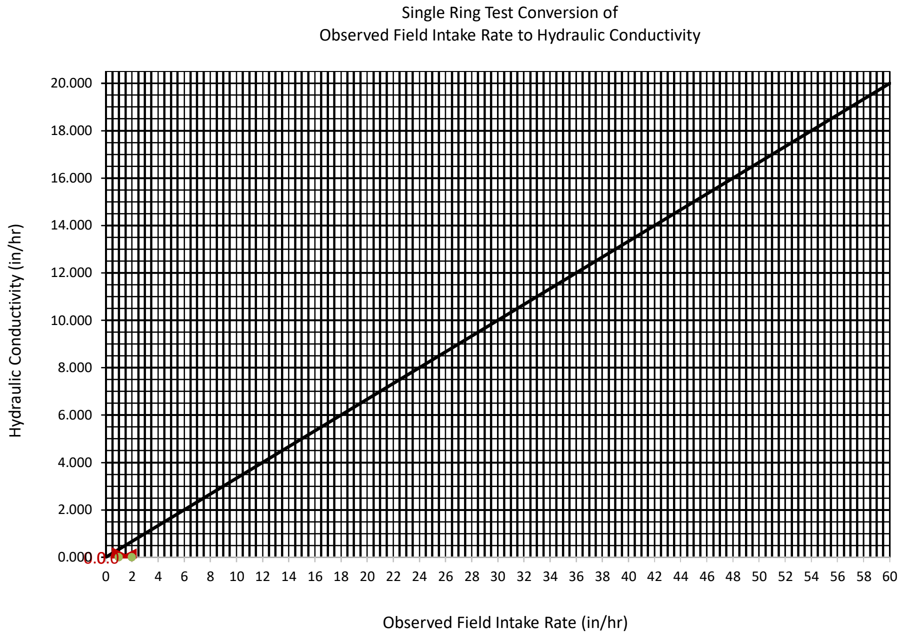
FIELD SINGLE RING INFILTRATION TEST

IT-5

	Water Refill	Start Time	Water Level Reading (inches)	Elaspse Time to Drop 1 inch (hr:min:sec)	Elapse Time To Drop 1 Inch (sec)
PRE-SOAK	X	11:30 AM	3	-	-
	-		2	Exceeded 1hr	>3600
	-		1		
	-		0		
TEST #1	X	12:31 PM	3	-	-
			2	Exceeded 1hr	>3600
TEST #2	X	13:33 PM	3	-	-
			2	Exceeded 1hr	>3600
TEST #3					
TEST #4					
TEST #5					
					`
TEST #6					
TEST #7					
TEST #8					
TEST #9					
TEST #10					
TEST #11					

COORESPONDING PROFILE PIT: **TP-5**
DATE OF INFILTRATION TEST: **9/8/2022**
WEATHER DURING INFILTRATION TEST:
EXISTING SURFACE ELEVATION (el): **8.2**
TEST DEPTH: **4** **ft**
TEST ELEVATION (el): **4.2**
APPROXIMATE TOP OF RING (el): **4.5**
APPROXIMATE TOP OF BOTTOM (el): **4.0**

🟨 input
🟦 output
🟧 result



Average Observed Field Intake Rate (sec/inch)	>3600
Average Observed Field Intake Rate (inch/hr)	<1
Hydraulic Conductivity (inch/hr)	**Less than 1**

(see graph)

When the observed field intake rate is greater than 60 in/hr, the hydraulic conductivity shall be reported as “greater than 20 in/hr.” When the observed field intake rate is less than 1 in/hr, the hydraulic conductivity shall be reported as “less than 1 in/hr.”

NOTES:

1 Test stratum consisted of predominately f-c SAND, some silt.

2 Test performed per Chapter 12, Subsection A5: Single Ring Infiltration Test of the November 2020 NJSBMP Manual

101010201

Ocean Wind - BL England Substation

Upper Township, New Jersey

FIELD SINGLE RING INFILTRATION TEST

IT-6

	Water Refill	Start Time	Water Level Reading (inches)	Elaspse Time to Drop 1 inch (hr:min:sec)	Elapse Time To Drop 1 Inch (sec)
PRE-SOAK	X	7:42 AM	3	-	-
	-		2	Exceeded 1hr	>3600
	-		1		
	-		0		
TEST #1	X	8:44 AM	3	-	-
			2	Exceeded 1hr	>3600
TEST #2	X	9:45 AM	3	-	-
			2	Exceeded 1hr	>3600
TEST #3					
TEST #4					
TEST #5					
					`
TEST #6					
TEST #7					
TEST #8					
TEST #9					
TEST #10					
TEST #11					

Average Observed Field Intake Rate (sec/inch)	>3600
Average Observed Field Intake Rate (inch/hr)	<1
Hydraulic Conductivity (inch/hr)	**Less than 1**

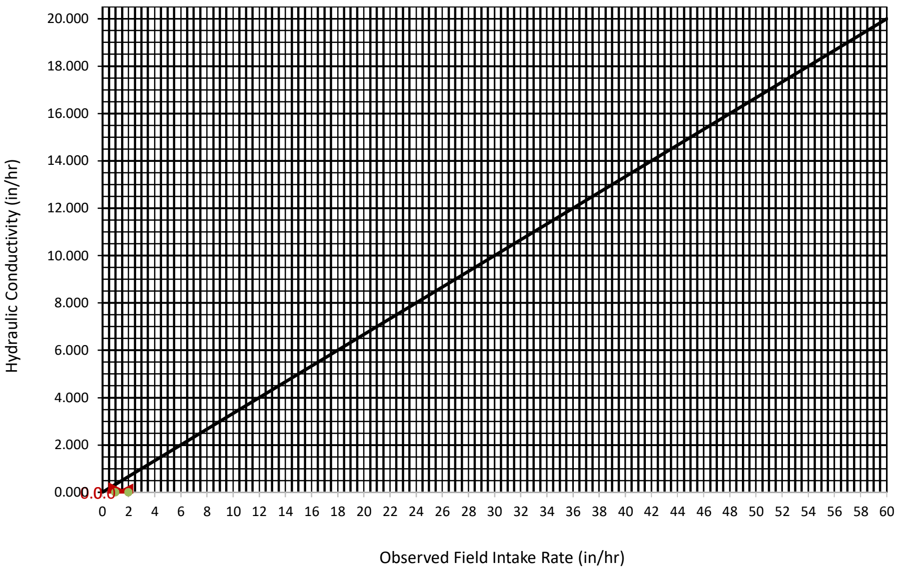
(see graph)

COORESPONDING PROFILE PIT	**TP-6**
DATE OF INFILTRATION TEST:	**9/9/2022**
WEATHER DURING INFILTRATION TEST:	
EXISTING SURFACE ELEVATION (el):	**9.0**
TEST DEPTH:	**4** ft
TEST ELEVATION (el):	**5.0**
APPROXIMATE TOP OF RING (el):	**5.3**
APPROXIMATE TOP OF BOTTOM (el):	**4.8**

`

🟨	input
⬜	output
🟧	result

Single Ring Test Conversion of
Observed Field Intake Rate to Hydraulic Conductivity



When the observed field intake rate is greater than 60 in/hr, the hydraulic conductivity shall be reported as "greater than 20 in/hr." When the observed field intake rate is less than 1 in/hr, the hydraulic conductivity shall be reported as "less than 1 in/hr."

NOTES:

1 Test stratum consisted of predominately f-m SAND, some silt.

2 Test performed per Chapter 12, Subsection A5: Single Ring Infiltration Test of the November 2020 NJSBMP Manual

101010201
Ocean Wind - BL England Substation
Upper Township, New Jersey

FIELD SINGLE RING INFILTRATION TEST

IT-7

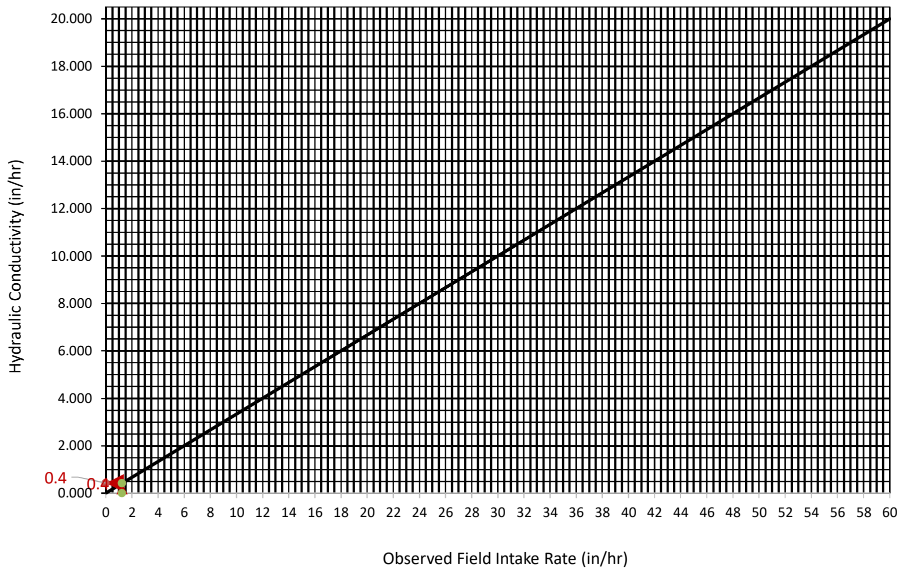
	Water Refill	Start Time	Water Level Reading (inches)	Elaspse Time to Drop 1 inch (hr:min:sec)	Elapse Time To Drop 1 Inch (sec)
PRE-SOAK	X	9:15 AM	3		
	-		2	0:36:38.0	2198.0
	-		1	0:35:22.0	2122.0
	-		0	0:44:57.0	2697.0
TEST #1	X	11:12 AM	3		
			2	0:48:10.0	2890.0
TEST #2	X	12:03 AM	3		
			2	0:48:10.0	2890.0
TEST #3	X	12:51 AM	3		
			2	0:48:10.0	2890.0
TEST #4					
TEST #5					
TEST #6					
TEST #7					
TEST #8					
TEST #9					
TEST #10					
TEST #11					

Average Observed Field Intake Rate (sec/inch)	2890.0
Average Observed Field Intake Rate (inch/hr)	1.2
Hydraulic Conductivity (inch/hr)	**0.4** (see graph)

COORESPONDING PROFILE PIT	**TP-7**
DATE OF INFILTRATION TEST:	**9/9/2022**
WEATHER DURING INFILTRATION TEST:	
EXISTING SURFACE ELEVATION (el):	**8.4**
TEST DEPTH:	**4** **ft**
TEST ELEVATION (el):	**4.4**
APPROXIMATE TOP OF RING (el):	**4.7**
APPROXIMATE TOP OF BOTTOM (el):	**4.2**

🟨	input
⬜	output
🟧	result

Single Ring Test Conversion of
Observed Field Intake Rate to Hydraulic Conductivity



When the observed field intake rate is greater than 60 in/hr, the hydraulic conductivity shall be reported as "greater than 20 in/hr." When the observed field intake rate is less than 1 in/hr, the hydraulic conductivity shall be reported as "less than 1 in/hr."

NOTES:

1 Test stratum consisted of predominately f-c SAND, trace silt, trace clay.

2 Test performed per Chapter 12, Subsection A5: Single Ring Infiltration Test of the November 2020 NJSBMP Manual

APPENDIX D

Geotechnical Laboratory Testing Results

RSA GEOLAB

1017 Greeley Ave N
Union, NJ 07083
908-964-0786
www.RSAGeolab.com

Letter of Transmittal

Date: 10-3-22 Job No.: 869 Lab Log: 22-1945

Attention:
Victoria Rhodes
Langan Engineering & Environmental Services
300 Kimball Drive, 4th Floor
Parsippany, NJ 07054

CC:

Re:
BL England, Upper Township, NJ
Proj. No. 101010201

Sample(s) ID: **B-3 S-3 thru B-28 S-17** (19 samples)

Dear Ms. Rhodes,

Please find attached results for the samples referenced above. The following lab testing was performed:

- ASTM D422 Washed Sieve Analysis (13 tests)
- ASTM D2216 Moisture Content (3 tests)
- ASTM D4318 Atterberg Limits (6 tests)
- ASTM D422 Sieve & Hydrometer Analysis (4 tests)

Regards,
RSA Geolab, LLC

Remarks: If you have any questions, please call 908-964-0786.

Signed: ______________

Dr. Raza S. Ahmed
President RSA Geolab, LLC

RSA GEOLAB

1017 Greeley Ave N
Union, NJ 07083
908-964-0786
www.RSAGeolab.com

MOISTURE CONTENT (ASTM D2216)

Project: BL England
Upper Township, NJ

Project #: 869

Client: Langan Eng. & Env. Svcs., Inc.
Project#101010201

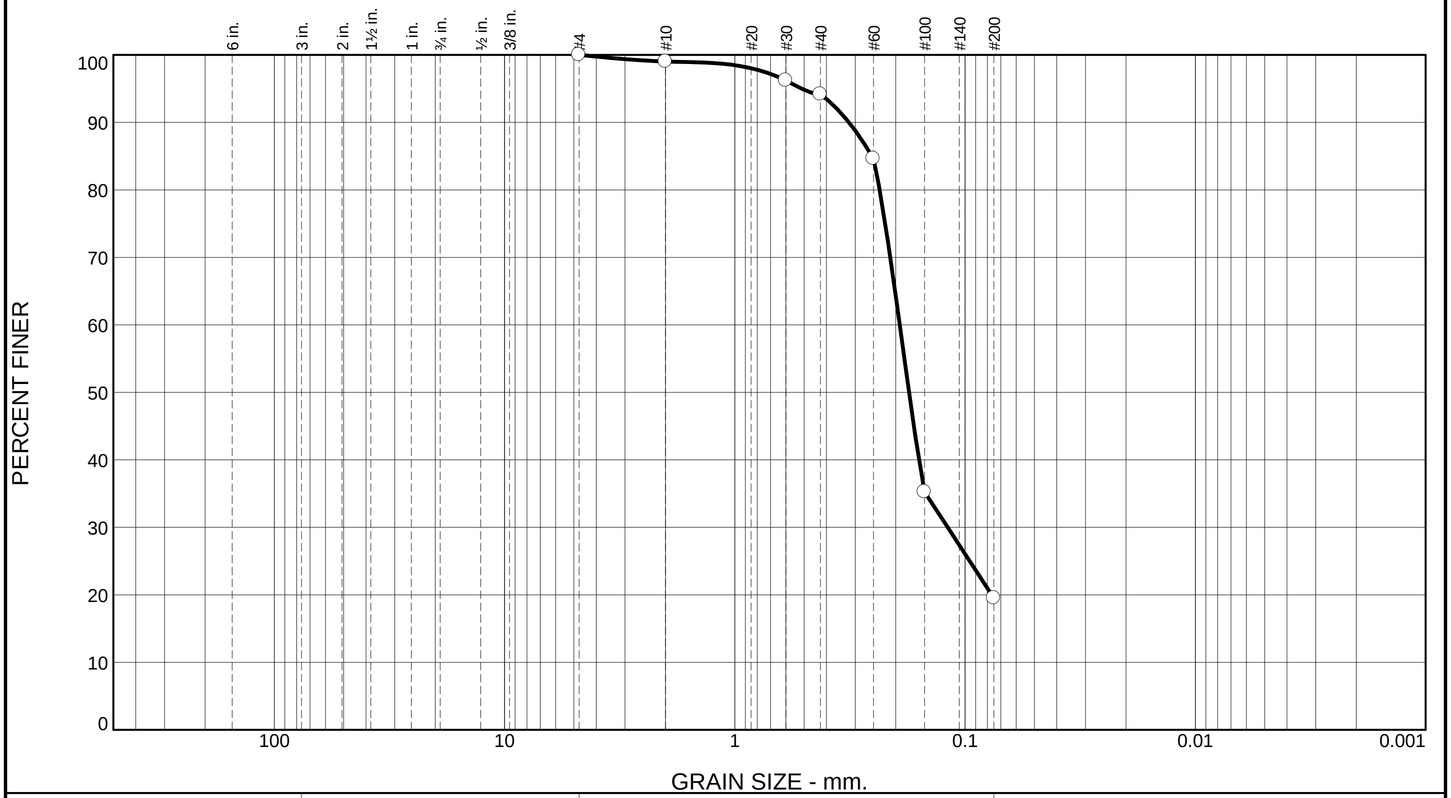
Date: 10-3-22

HOLE #/ SAMPLE #	B-17 S-6	B-17 S-13	B-20 S-6			
DEPTH	10-12'	45-47'	10-12'			
WET WGT. + TARE (gms.)	188.3	98.0	185.7			
DRY WGT. + TARE (gms.)	152.9	75.2	156.0			
WGT. WATER (gms.)	35.4	22.8	29.7			
TARE (gms.)	7.2	7.1	7.4			
DRY WGT. (gms.)	145.7	68.1	148.6			
MOISTURE CONTENT (%)	**24.3**	**33.5**	**20.0**			

HOLE #/ SAMPLE #						
DEPTH						
WET WGT. + TARE (gms.)						
DRY WGT. + TARE (gms.)						
WGT. WATER (gms.)						
TARE (gms.)						
DRY WGT. (gms.)						
MOISTURE CONTENT (%)						

Performed by: MF Entered by: KH Checked by: KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.0	4.8	74.7	19.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.0		
#30	96.2		
#40	94.2		
#60	84.6		
#100	35.2		
#200	19.5		

* (no specification provided)

Material Description

Yellow

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3195 D_{85}= 0.2537 D_{60}= 0.1922
D_{50}= 0.1752 D_{30}= 0.1190 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: B-3 S-3 4-6'

Date: 10-3-22

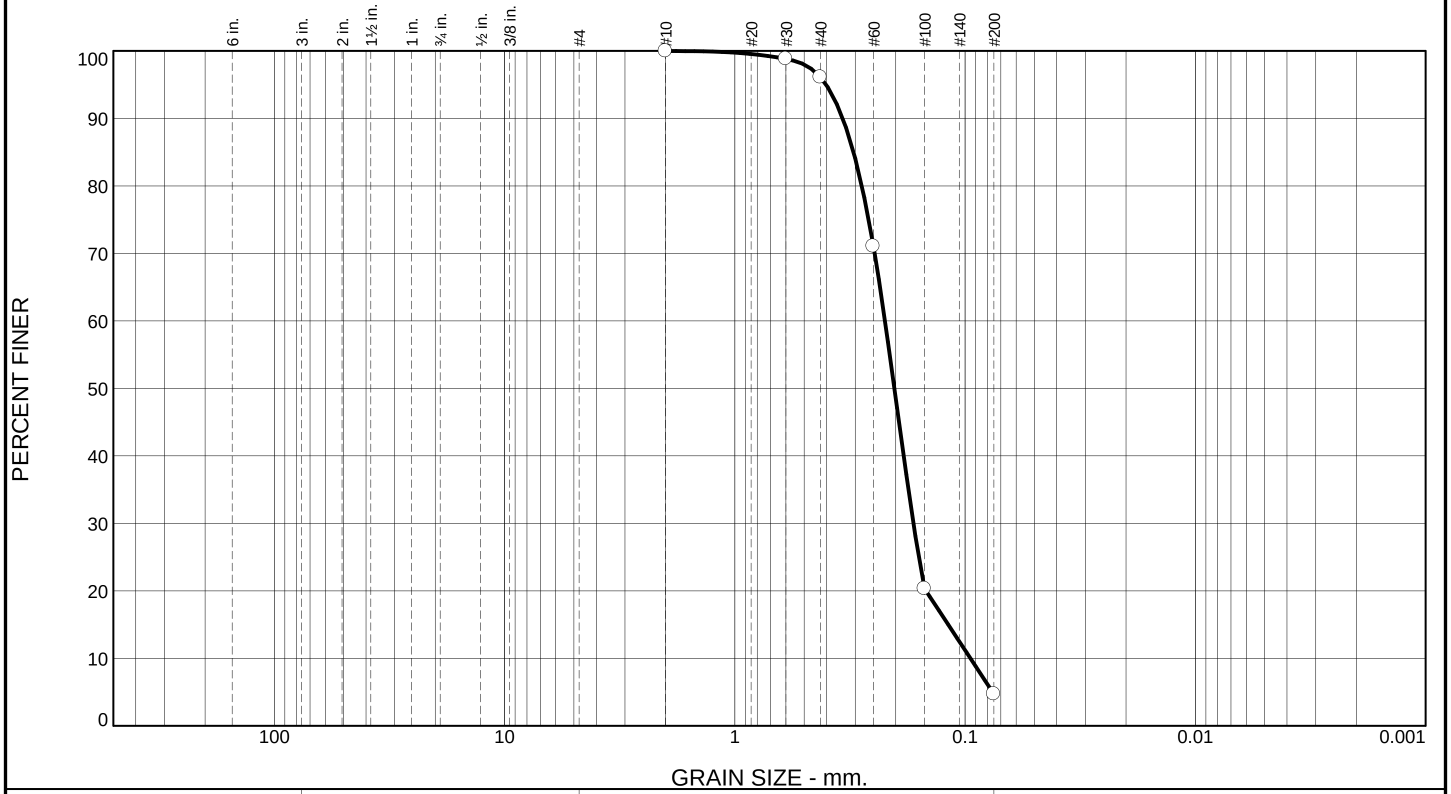
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
				3.9	91.4	4.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	98.8		
#40	96.1		
#60	71.1		
#100	20.3		
#200	4.7		

* (no specification provided)

Material Description

Light Gray, Yellow

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3400	D_{85}= 0.3053	D_{60}= 0.2228
D_{50}= 0.2028	D_{30}= 0.1676	D_{15}= 0.1184
D_{10}= 0.0949	C_u= 2.35	C_c= 1.33

Classification

USCS= AASHTO=

Remarks

Sample Number: B-3 S-7 15-17'

Date: 10-3-22

RSA Geolab

Union, New Jersey

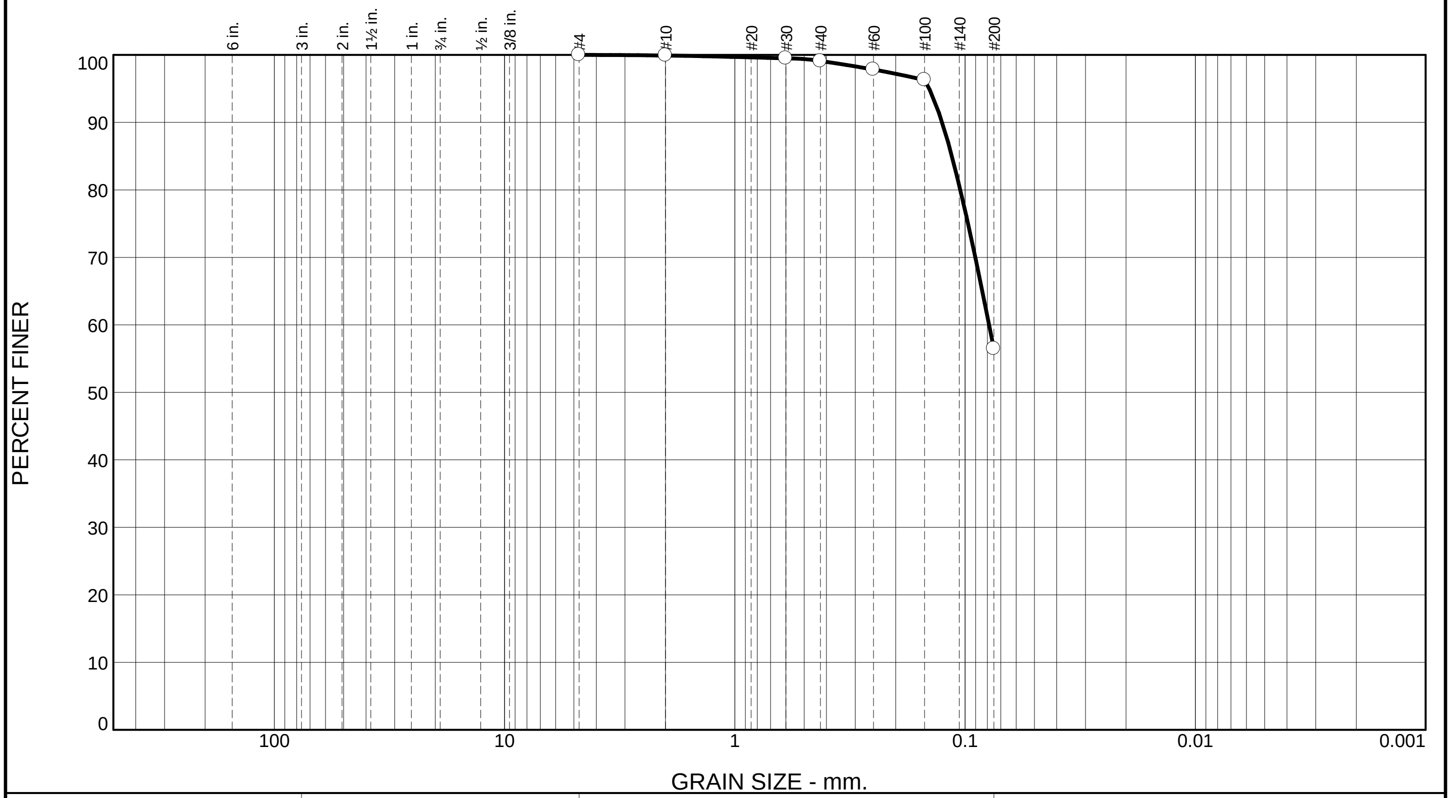
Client: Langan Engineering

Project: BL England, Upper Township, NJ
Project#101010201

Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.8	42.6	56.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#30	99.5		
#40	99.1		
#60	97.8		
#100	96.3		
#200	56.5		

* (no specification provided)

Material Description

Light Gray, Olive Yellow

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1259 D_{85}= 0.1142 D_{60}= 0.0787
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: B-4 S-6B 11-12'

Date: 10-3-22

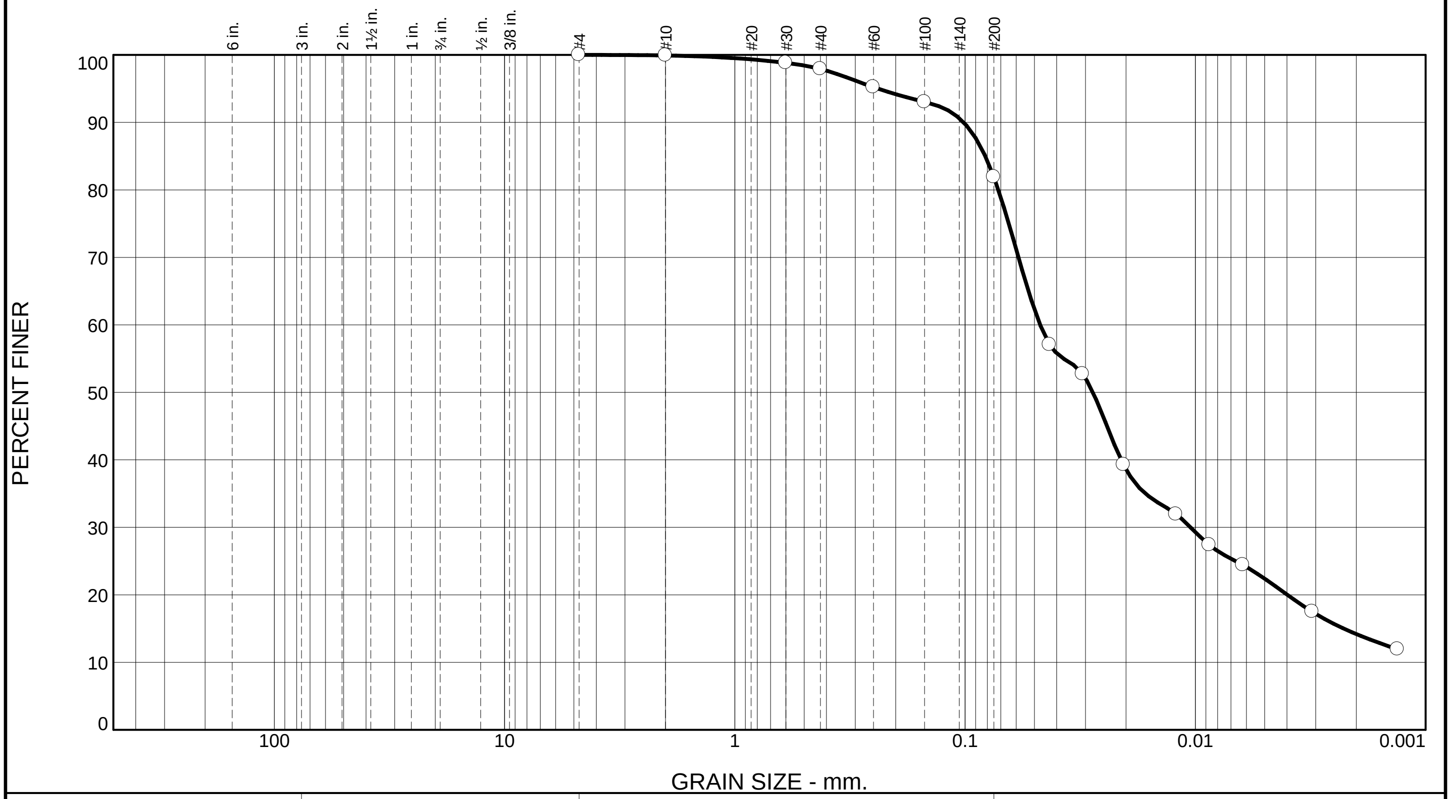
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	2.0	16.0	59.5	22.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#30	98.8		
#40	97.9		
#60	95.2		
#100	93.0		
#200	81.9		

* (no specification provided)

Material Description

Dark Gray lean clay with sand

Atterberg Limits

PL= 18 LL= 37 PI= 19

Coefficients

D_{90}= 0.1015 D_{85}= 0.0817 D_{60}= 0.0472
D_{50}= 0.0279 D_{30}= 0.0105 D_{15}= 0.0023
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(15)

Remarks

Sample Number: B-4 S-11 35-37'

Date: 10-3-22

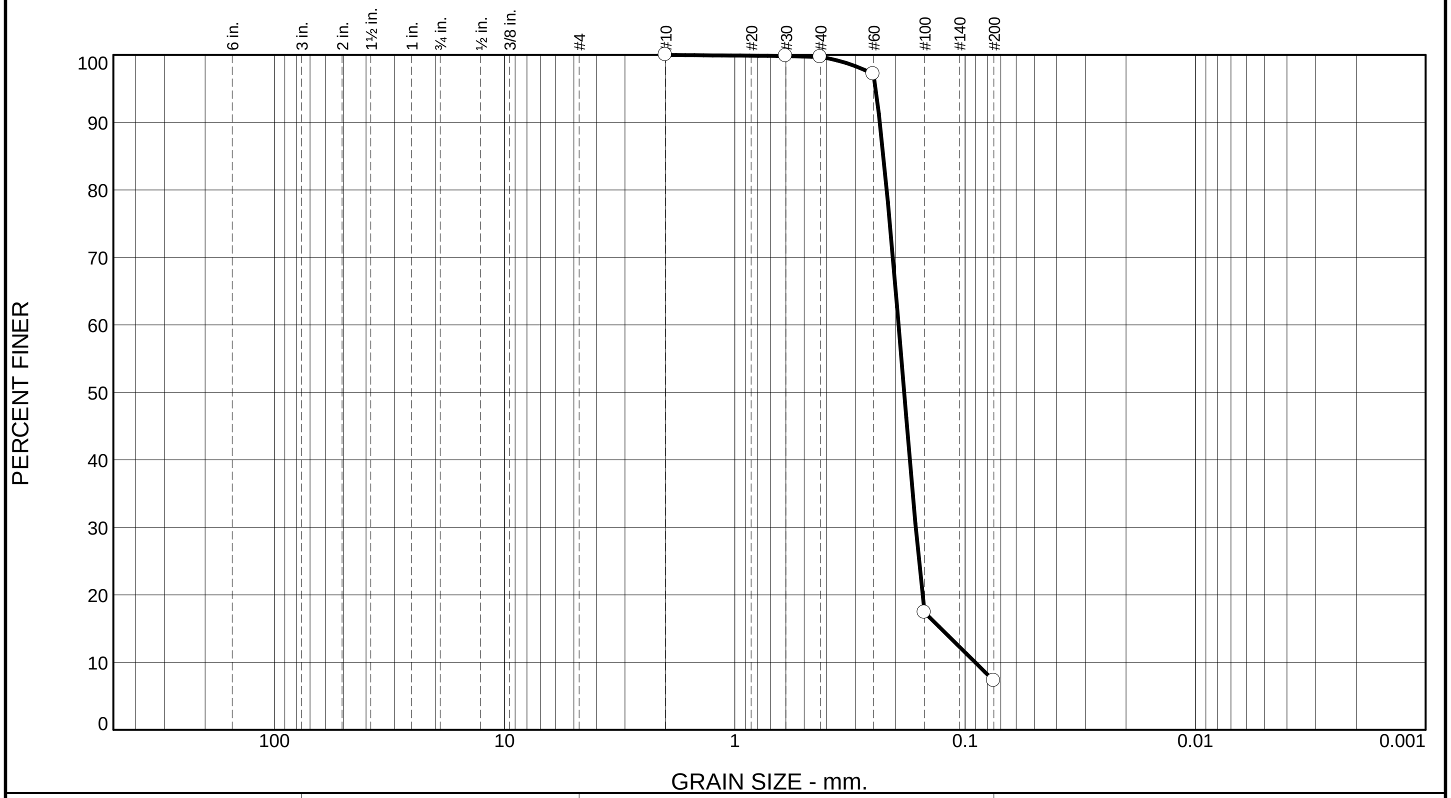
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
				0.3	92.4	7.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.8		
#40	99.7		
#60	97.2		
#100	17.4		
#200	7.3		

* (no specification provided)

Material Description

Light Gray

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2346 D_{85}= 0.2262 D_{60}= 0.1945
D_{50}= 0.1840 D_{30}= 0.1638 D_{15}= 0.1273
D_{10}= 0.0904 C_u= 2.15 C_c= 1.52

Classification

USCS= AASHTO=

Remarks

Sample Number: B-5 S-7 15-17'

Date: 10-3-22

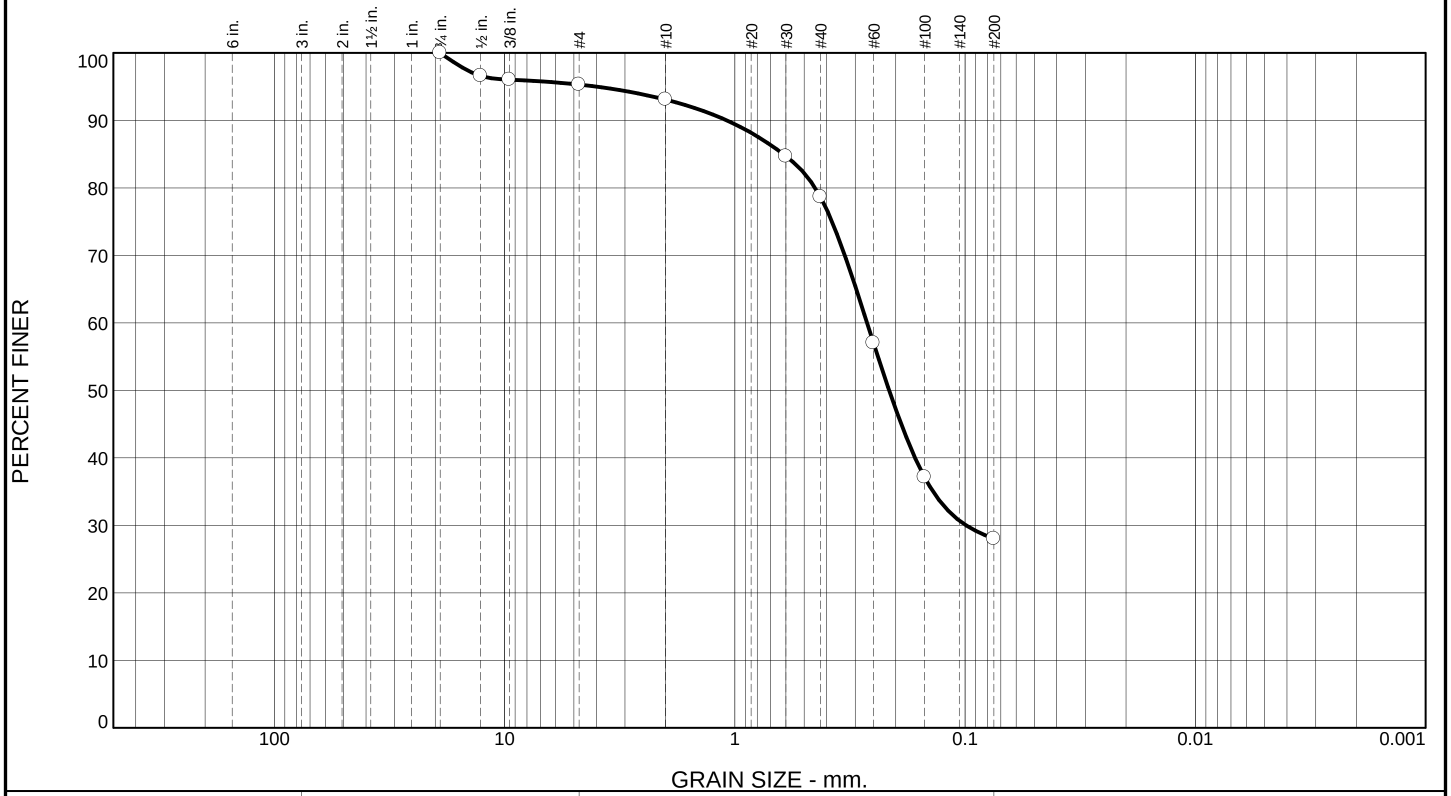
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.7	2.2	14.4	50.7	28.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	96.6		
.375	96.0		
#4	95.3		
#10	93.1		
#30	84.7		
#40	78.7		
#60	57.0		
#100	37.1		
#200	28.0		

* (no specification provided)

Material Description

Light Brownish Gray

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.0836 D_{85}= 0.6164 D_{60}= 0.2666
D_{50}= 0.2137 D_{30}= 0.0991 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: B-7 S-14 50-52'

Date: 10-3-22

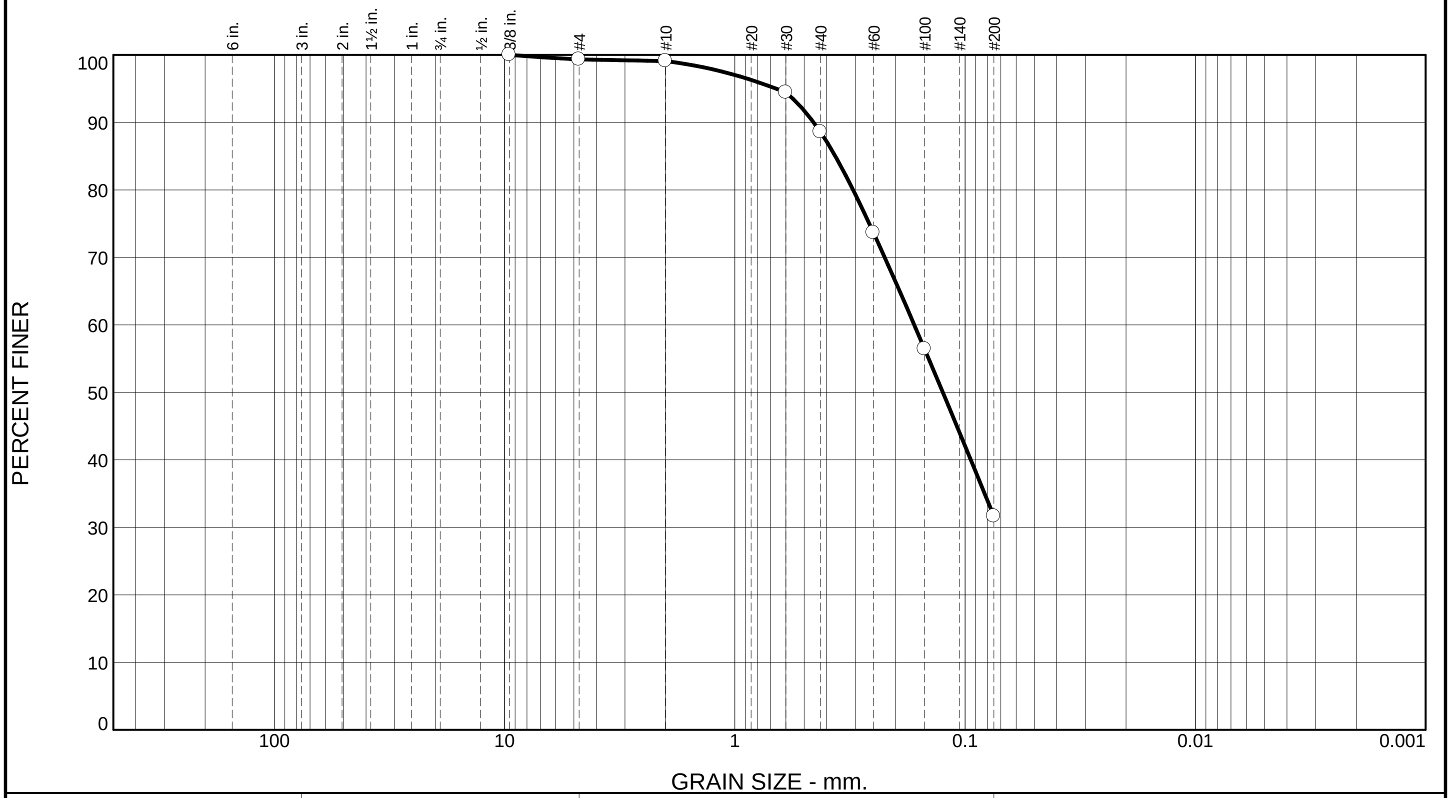
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	0.2	10.5	56.9	31.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.3		
#10	99.1		
#30	94.4		
#40	88.6		
#60	73.7		
#100	56.4		
#200	31.7		

* (no specification provided)

Material Description

Dark Gray

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4548 D_{85}= 0.3662 D_{60}= 0.1662

D_{50}= 0.1250 D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: B-12 S-10 30-32'

Date: 10-3-22

RSA Geolab

Union, New Jersey

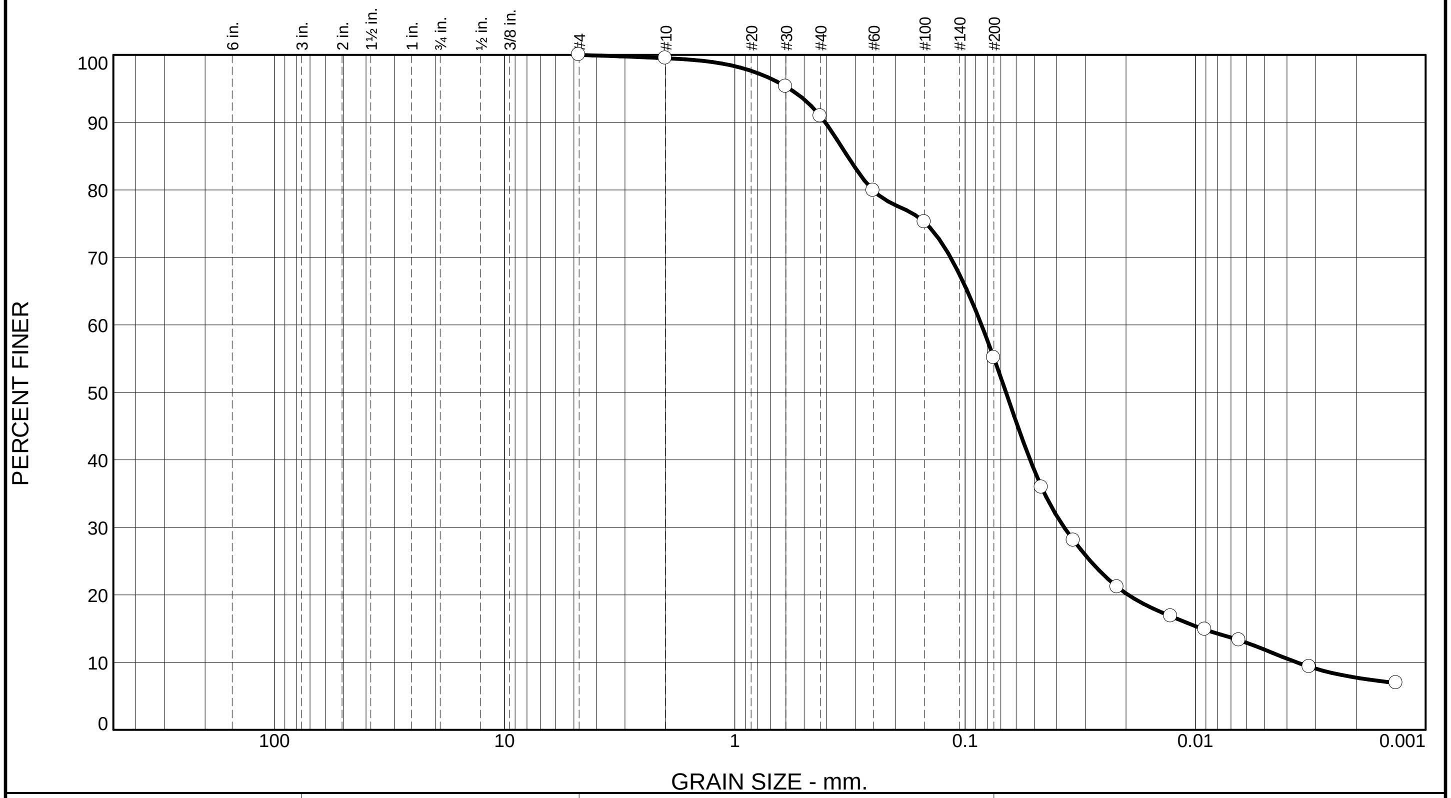
Client: Langan Engineering

Project: BL England, Upper Township, NJ
Project#101010201

Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.5	8.6	35.8	43.2	11.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.5		
#30	95.3		
#40	90.9		
#60	79.9		
#100	75.2		
#200	55.1		

* (no specification provided)

Material Description

Dark Gray sandy silty clay

Atterberg Limits

PL= 19
LL= 25
PI= 6

Coefficients

D_{90}= 0.4051
D_{85}= 0.3240
D_{60}= 0.0849
D_{50}= 0.0665
D_{30}= 0.0371
D_{15}= 0.0093
D_{10}= 0.0036
C_u= 23.36
C_c= 4.47

Classification

USCS= CL-ML
AASHTO= A-4(1)

Remarks

Sample Number: B-14 S-11 35-37'

Date: 10-3-22

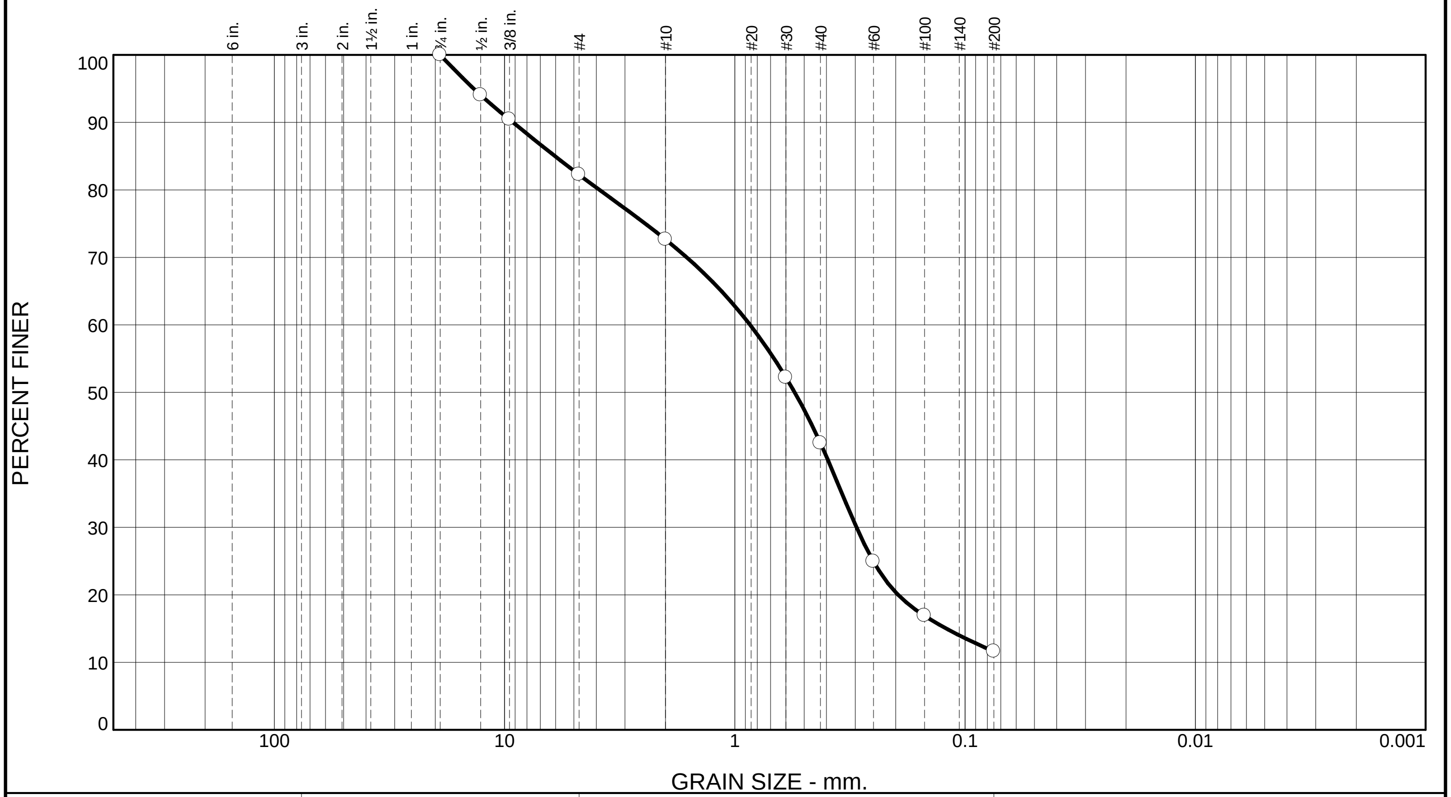
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869
Figure

Tested By: VS
Checked By: KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	17.7	9.7	30.1	30.9	11.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	94.0		
.375	90.4		
#4	82.3		
#10	72.6		
#30	52.2		
#40	42.5		
#60	24.9		
#100	16.9		
#200	11.6		

* (no specification provided)

Material Description

Brownish Yellow, Yellow

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 9.1938 D_{85}= 6.0400 D_{60}= 0.8586
D_{50}= 0.5498 D_{30}= 0.2963 D_{15}= 0.1207
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: B-17 S-2 2-4'

Date: 10-3-22

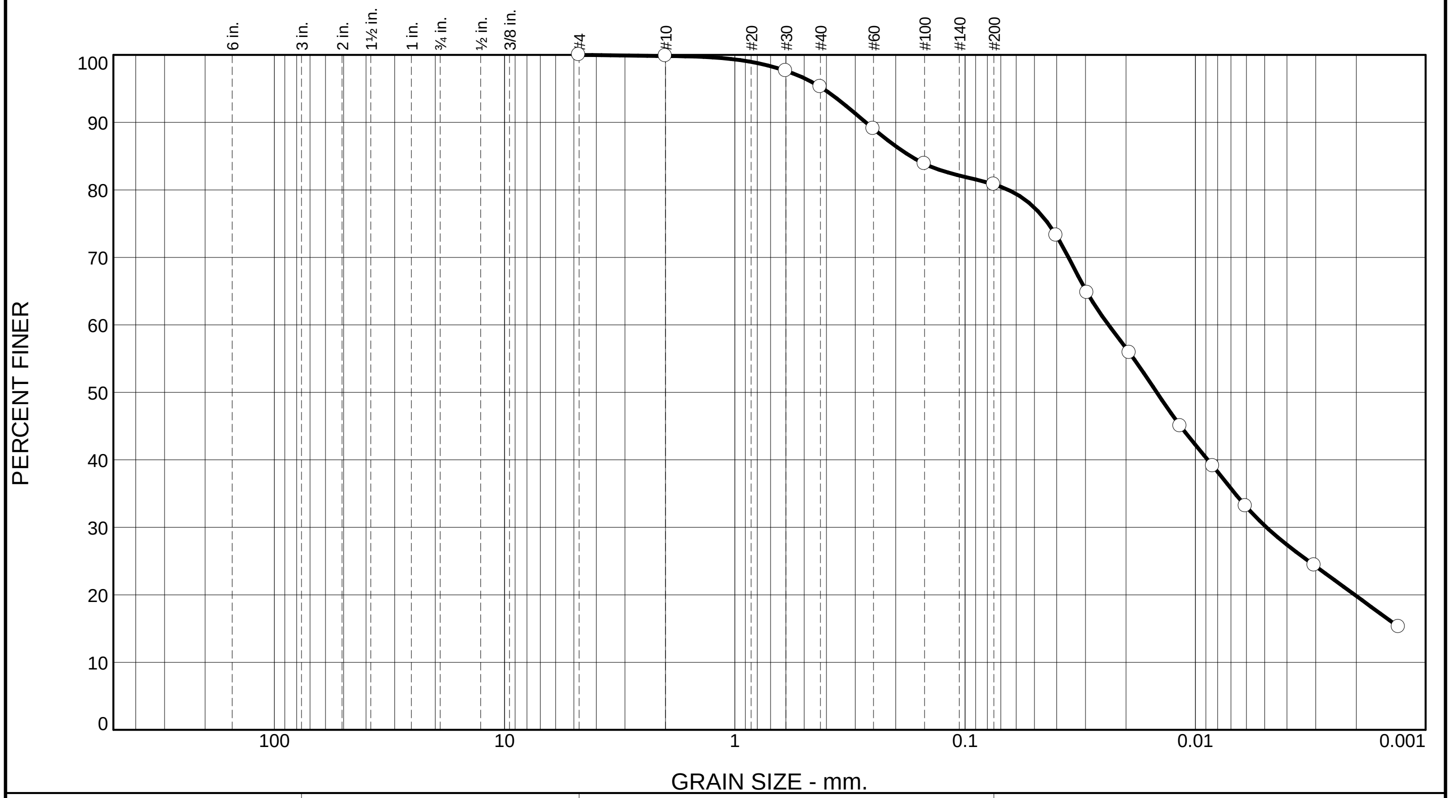
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	4.6	14.4	50.5	30.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#30	97.6		
#40	95.2		
#60	89.1		
#100	83.9		
#200	80.8		

* (no specification provided)

Material Description

Dark Gray lean clay with sand

Atterberg Limits

PL= 16 LL= 41 PI= 25

Coefficients

D_{90}= 0.2697 D_{85}= 0.1726 D_{60}= 0.0238
D_{50}= 0.0147 D_{30}= 0.0049 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(19)

Remarks

Sample Number: B-17 S-13 45-47'

Date: 10-3-22

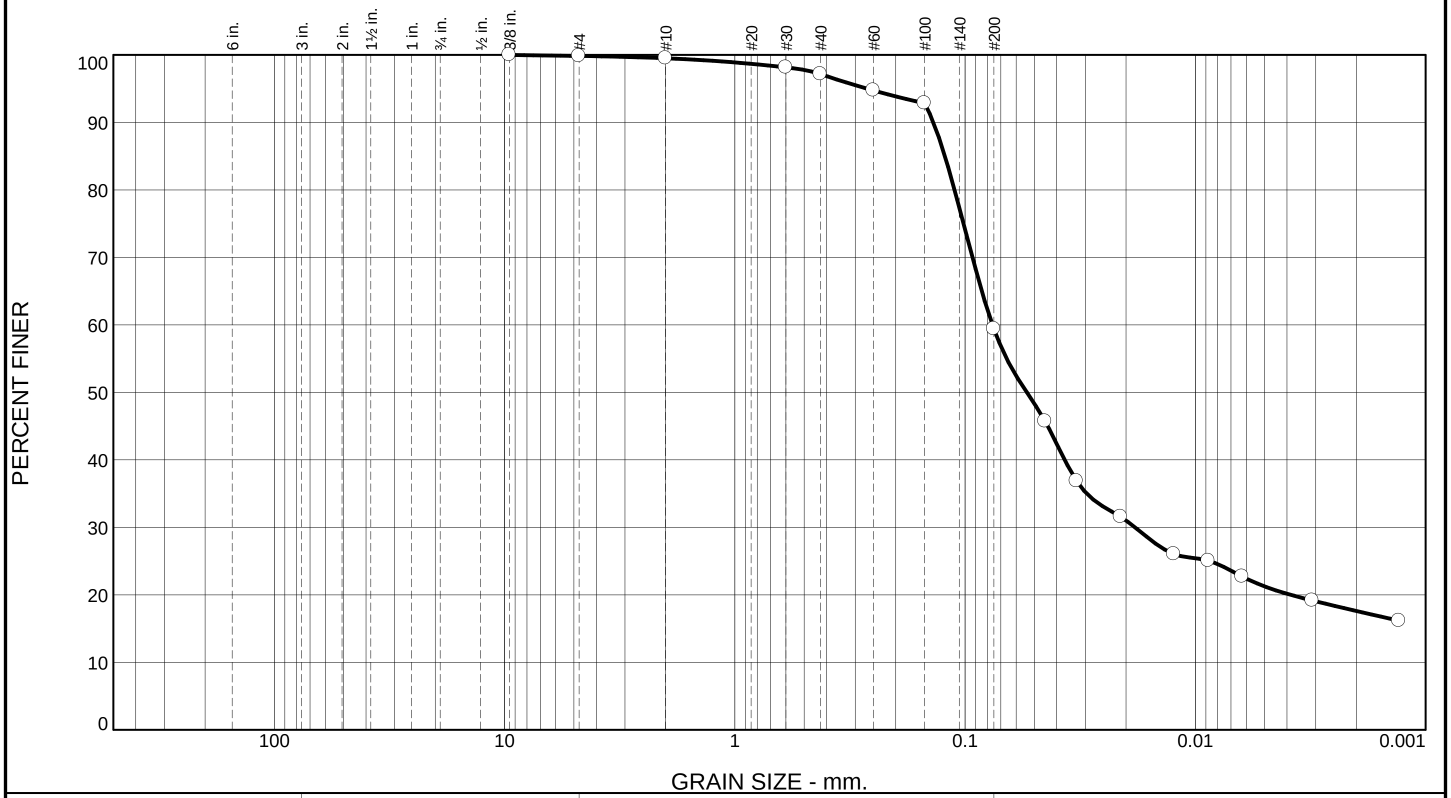
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.4	2.3	37.8	38.2	21.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.9		
#10	99.5		
#30	98.2		
#40	97.2		
#60	94.7		
#100	92.8		
#200	59.4		

* (no specification provided)

Material Description

Light Gray, Brownish Yellow sandy lean clay

Atterberg Limits

PL= 15 LL= 32 PI= 17

Coefficients

D_{90}= 0.1372 D_{85}= 0.1224 D_{60}= 0.0761
D_{50}= 0.0539 D_{30}= 0.0183 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(7)

Remarks

Sample Number: B-20 S-6 10-12'

Date: 10-3-22

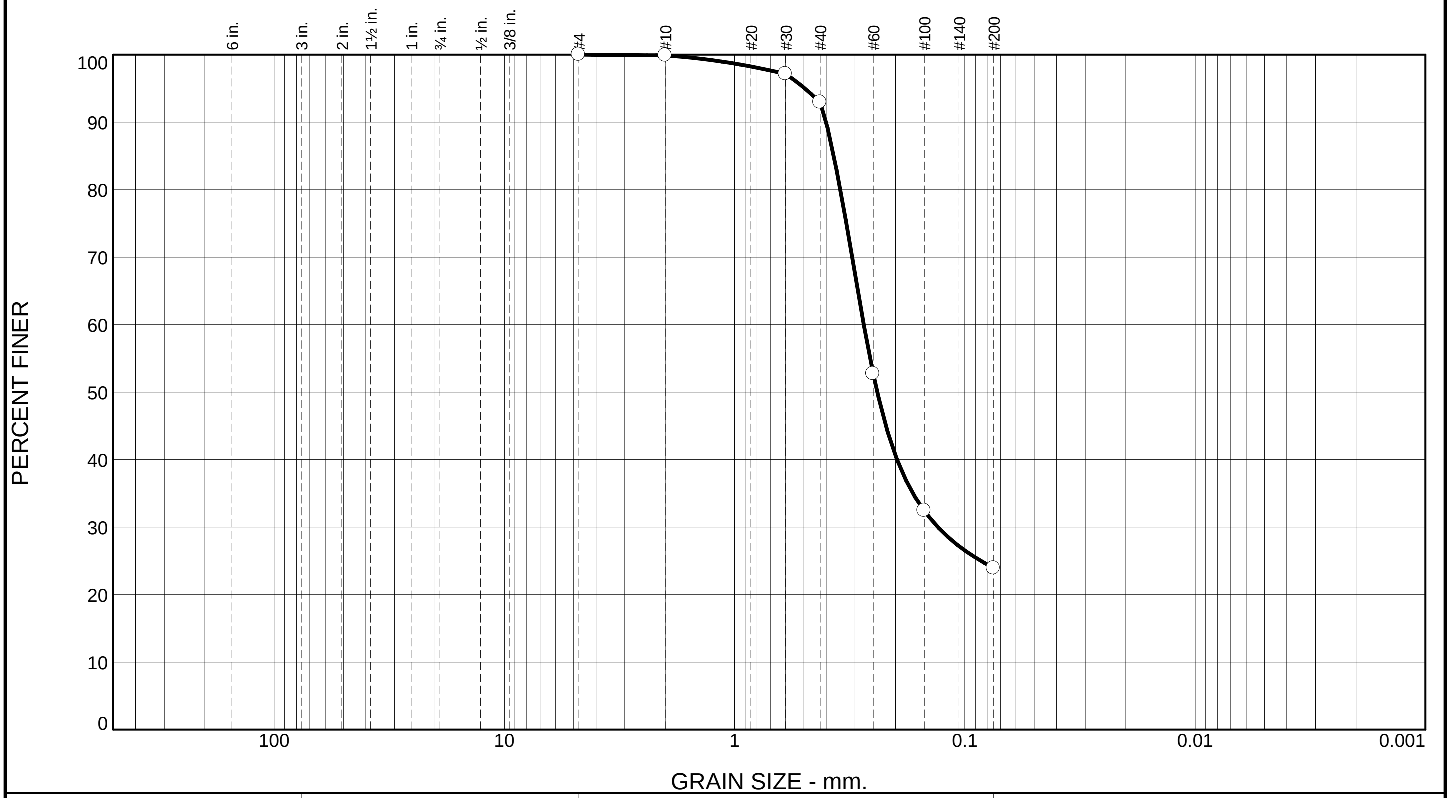
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	7.0	69.0	23.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#30	97.1		
#40	92.9		
#60	52.7		
#100	32.4		
#200	23.9		

* (no specification provided)

Material Description

White

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4008 D_{85}= 0.3710 D_{60}= 0.2747
D_{50}= 0.2401 D_{30}= 0.1310 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: B-20 S-19 75-77'

Date: 10-3-22

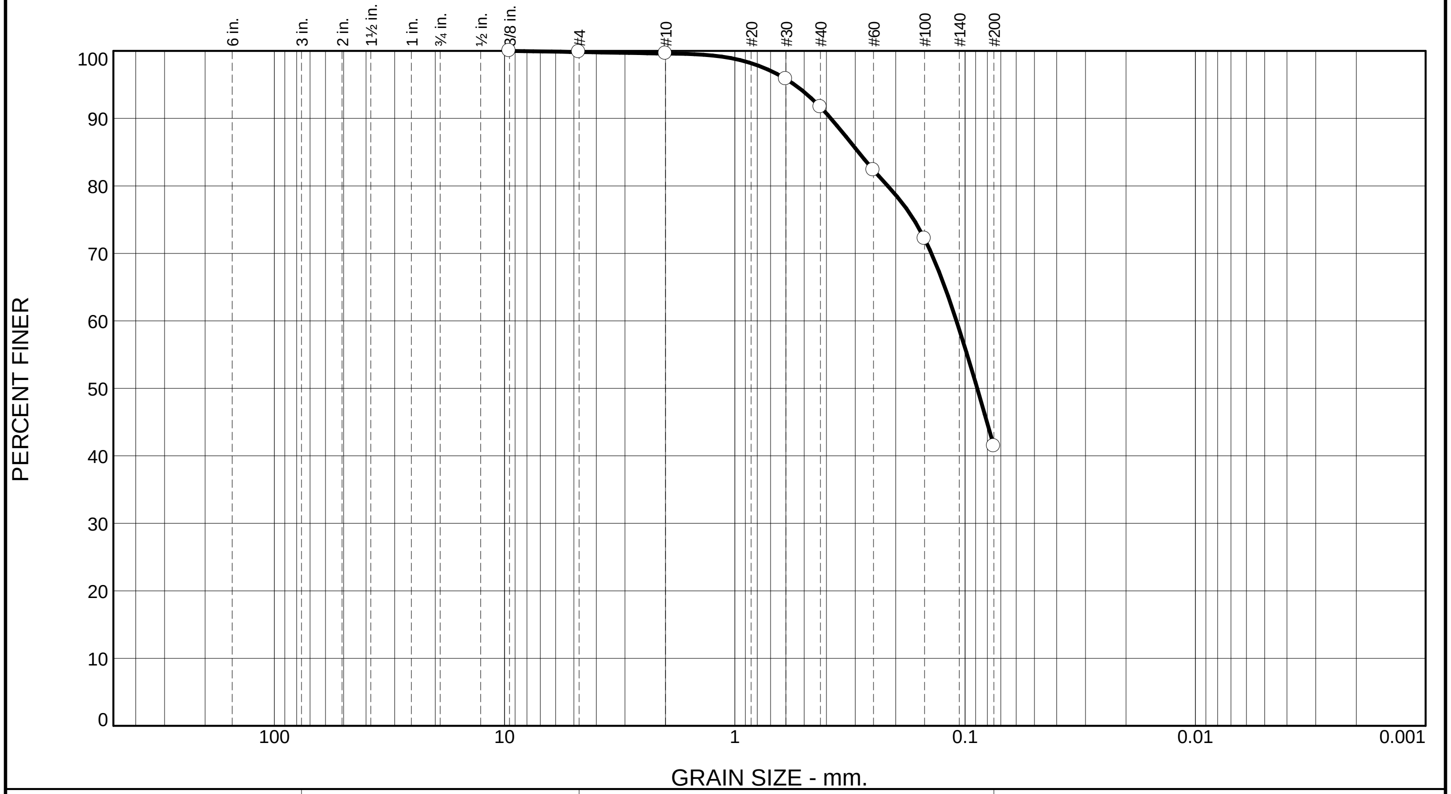
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.2	7.9	50.3	41.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.8		
#10	99.6		
#30	95.8		
#40	91.7		
#60	82.3		
#100	72.2		
#200	41.4		

* (no specification provided)

Material Description

Light Gray, Olive Yellow

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3830 D_{85}= 0.2905 D_{60}= 0.1090
D_{50}= 0.0886 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: B-22 S-6 10-12'

Date: 10-3-22

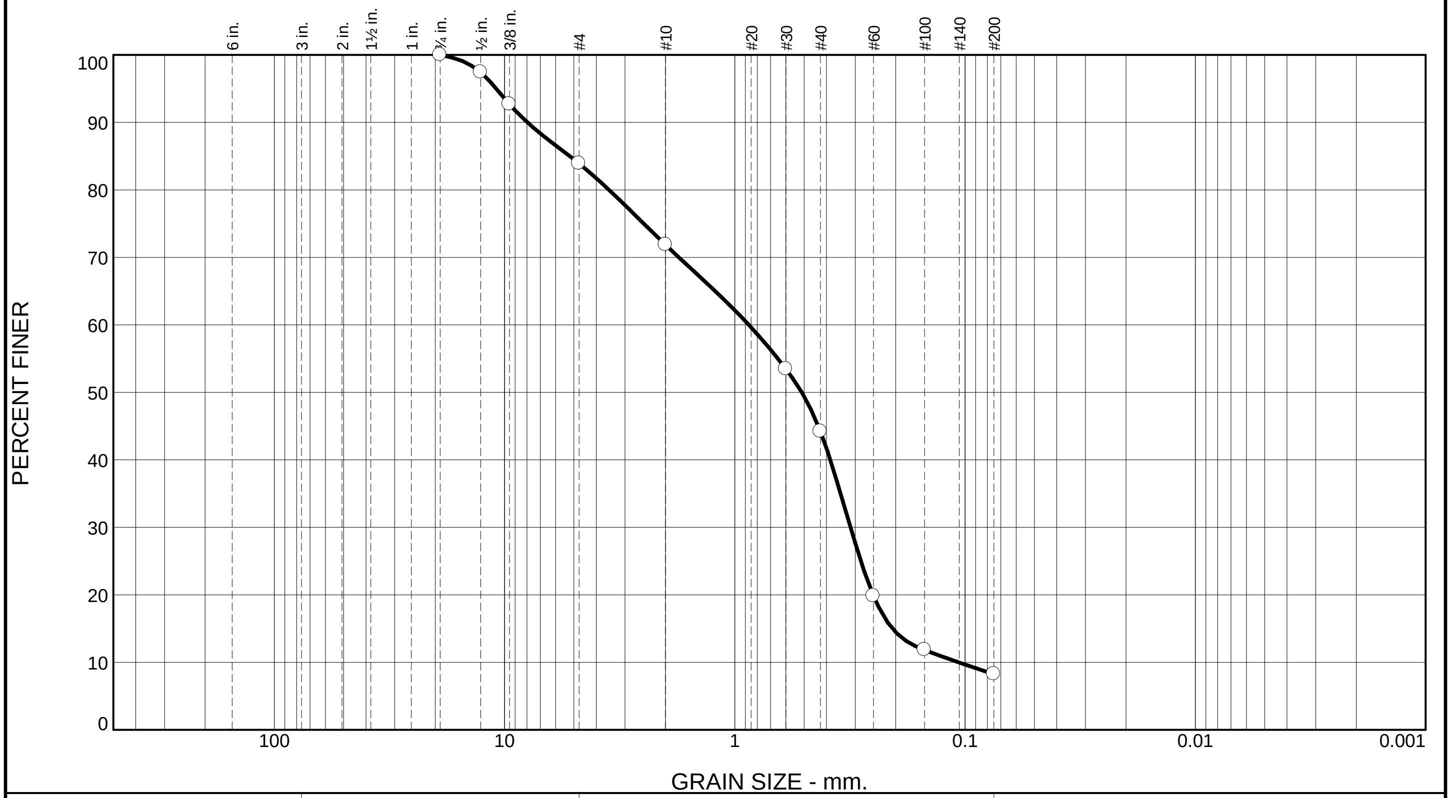
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	16.1	12.0	27.7	35.9	8.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.4		
.375	92.7		
#4	83.9		
#10	71.9		
#30	53.4		
#40	44.2		
#60	19.8		
#100	11.8		
#200	8.3		

* (no specification provided)

Material Description

Light Brownish Gray

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 7.9599	D_{85}= 5.2118	D_{60}= 0.8696
D_{50}= 0.5121	D_{30}= 0.3146	D_{15}= 0.2068
D_{10}= 0.1068	C_u= 8.14	C_c= 1.07

Classification

USCS= AASHTO=

Remarks

Sample Number: B-22 S-14 50-52'

Date: 10-3-22

RSA Geolab

Union, New Jersey

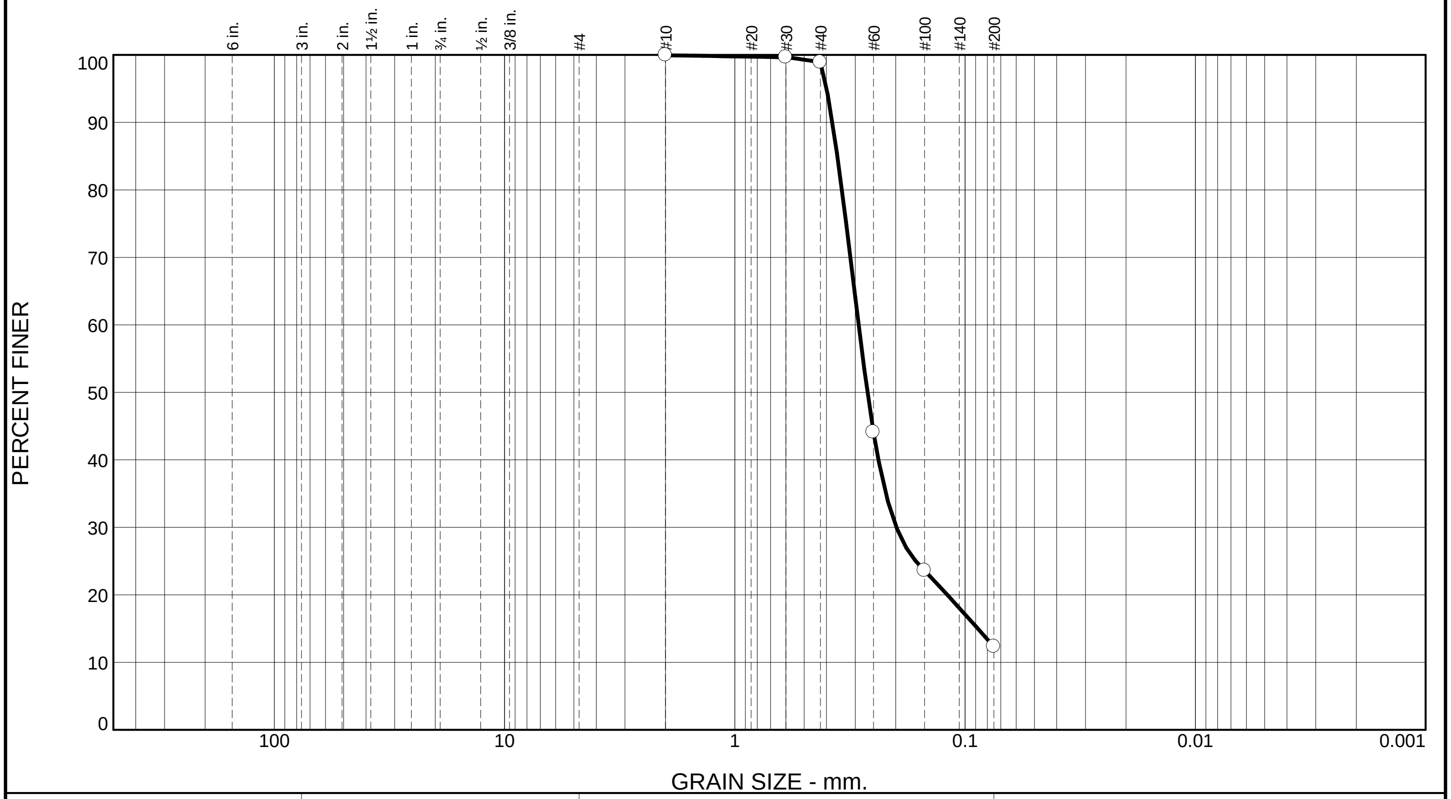
Client: Langan Engineering

Project: BL England, Upper Township, NJ
Project#101010201

Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
				1.1	86.6	12.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.7		
#40	98.9		
#60	44.1		
#100	23.6		
#200	12.3		

* (no specification provided)

Material Description

Light Gray

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3769 D_{85}= 0.3586 D_{60}= 0.2900
D_{50}= 0.2655 D_{30}= 0.1988 D_{15}= 0.0881
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: B-27 S-21 85-87'

Date: 10-3-22

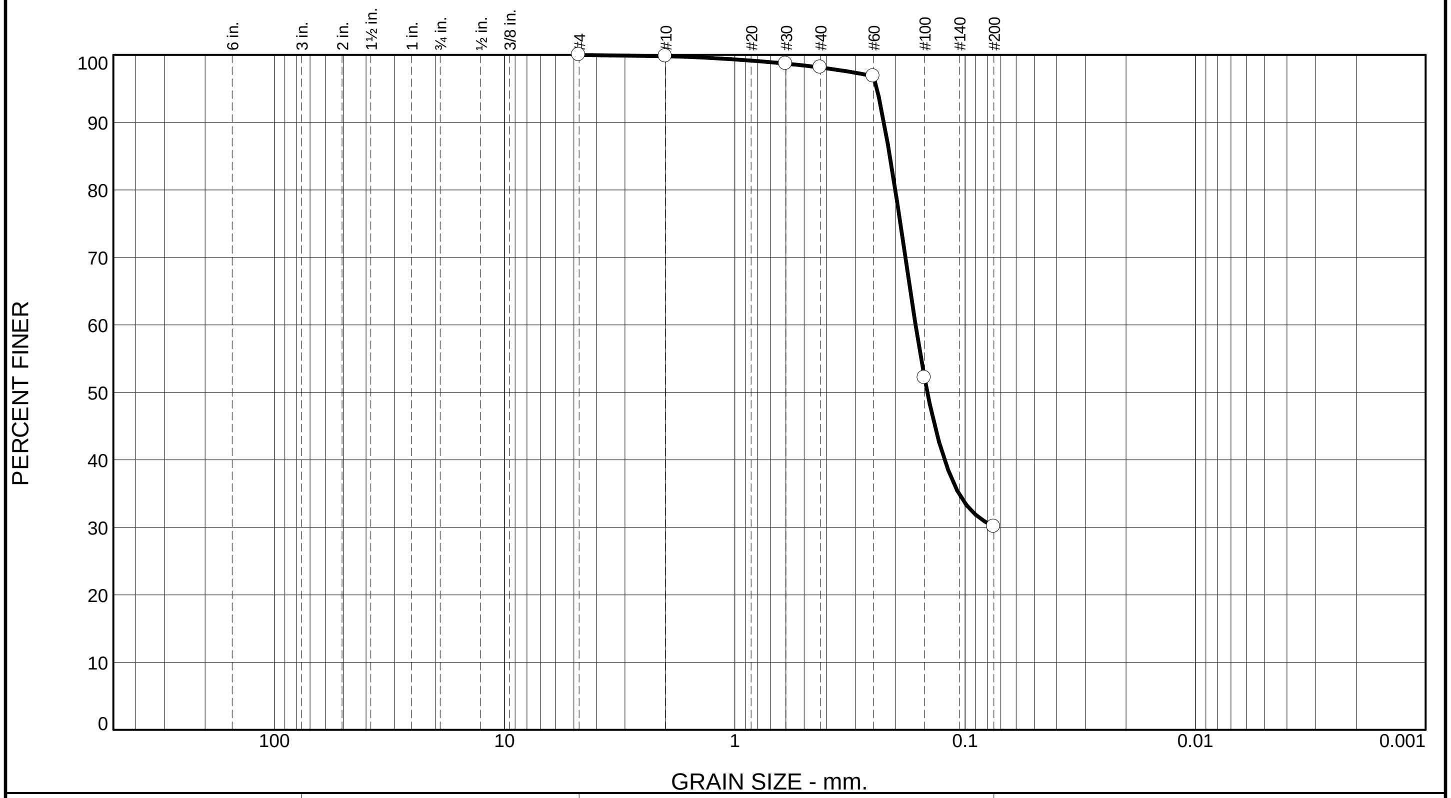
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England, Upper Township, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	1.7	68.0	30.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#30	98.7		
#40	98.1		
#60	96.9		
#100	52.2		
#200	30.1		

* (no specification provided)

Material Description

Olive Yellow

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2251 D_{85}= 0.2121 D_{60}= 0.1641

D_{50}= 0.1458 D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: B-28 S-3 8-10'

Date: 10-3-22

RSA Geolab

Union, New Jersey

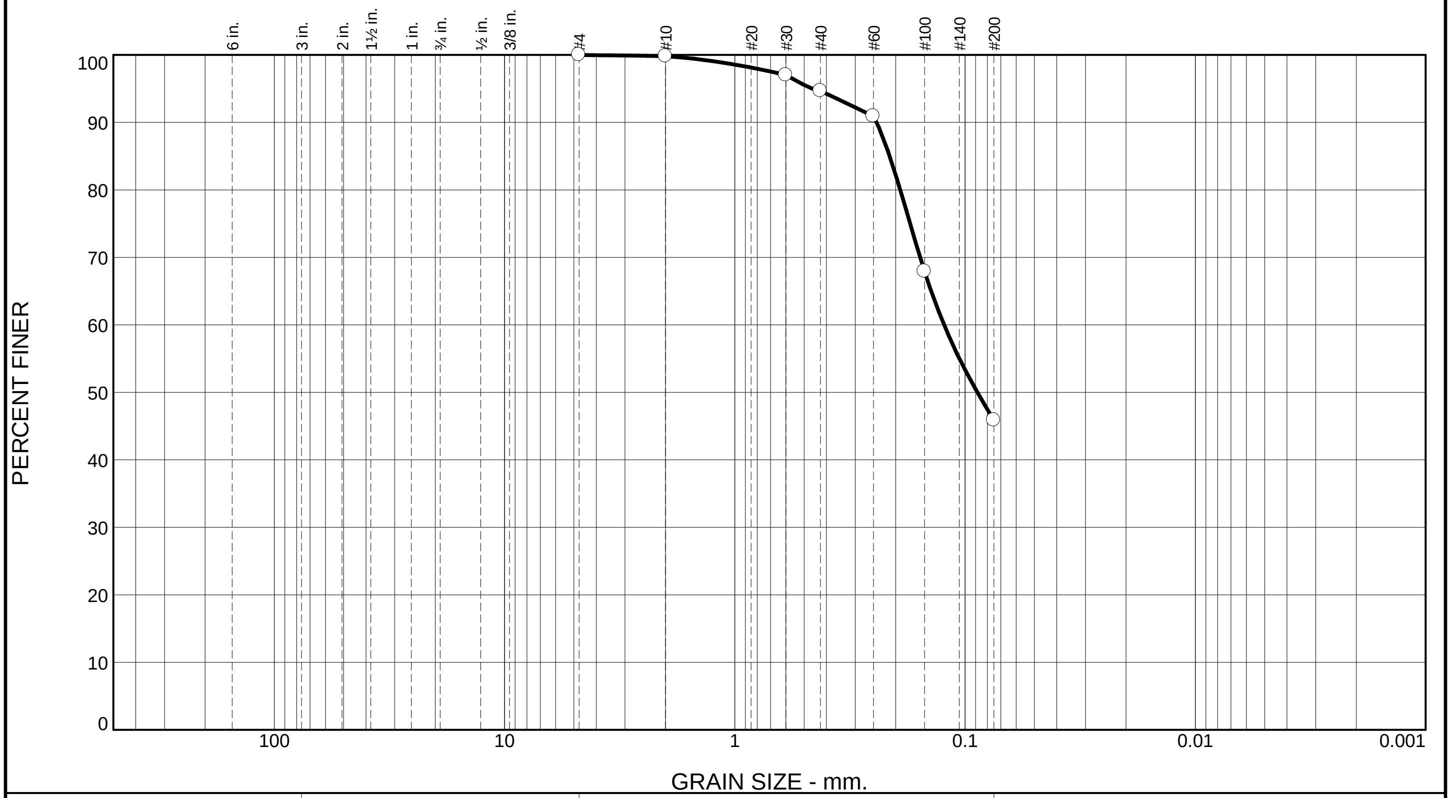
Client: Langan Engineering

Project: BL England, Upper Township, NJ
Project#101010201

Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	5.1	48.8	45.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#30	97.0		
#40	94.7		
#60	90.9		
#100	67.9		
#200	45.9		

* (no specification provided)

Material Description

Dark Gray

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2424	D_{85}= 0.2126	D_{60}= 0.1234
D_{50}= 0.0884	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: B-28 S-17 80-82'

Date: 10-3-22

RSA Geolab

Union, New Jersey

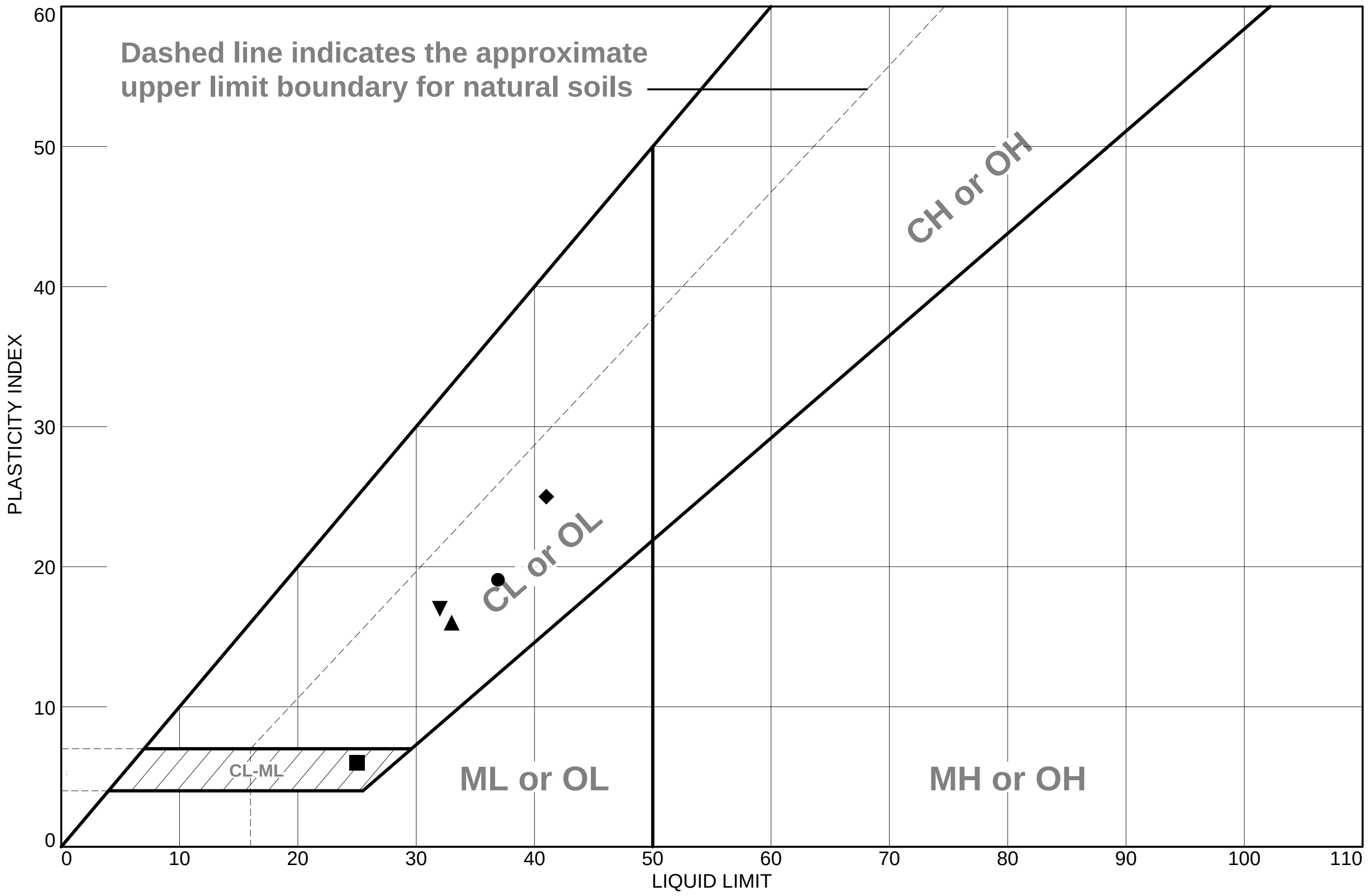
Client: Langan Engineering

Project: BL England, Upper Township, NJ
Project#101010201

Project No: 869 **Figure**

Tested By: VS **Checked By:** KP

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Gray lean clay with sand	37	18	19	97.9	81.9	CL
■	Dark Gray sandy silty clay	25	19	6	90.9	55.1	CL-ML
▲	Gray, Yellow Clay & Silt, smoe cmf Sand (visual)	33	17	16			
◆	Dark Gray lean clay with sand	41	16	25	95.2	80.8	CL
▼	Light Gray, Brownish Yellow sandy lean clay	32	15	17	97.2	59.4	CL

Project No. 869 **Client:** Langan Engineering

Project: BL England, Upper Township, NJ

Project#101010201

●**Sample Number:** B-4 S-11 35-37'

■**Sample Number:** B-14 S-11 35-37'

▲**Sample Number:** B-17 S-6 10-12'

◆**Sample Number:** B-17 S-13 45-47'

▼**Sample Number:** B-20 S-6 10-12'

RSA Geolab

Union, New Jersey

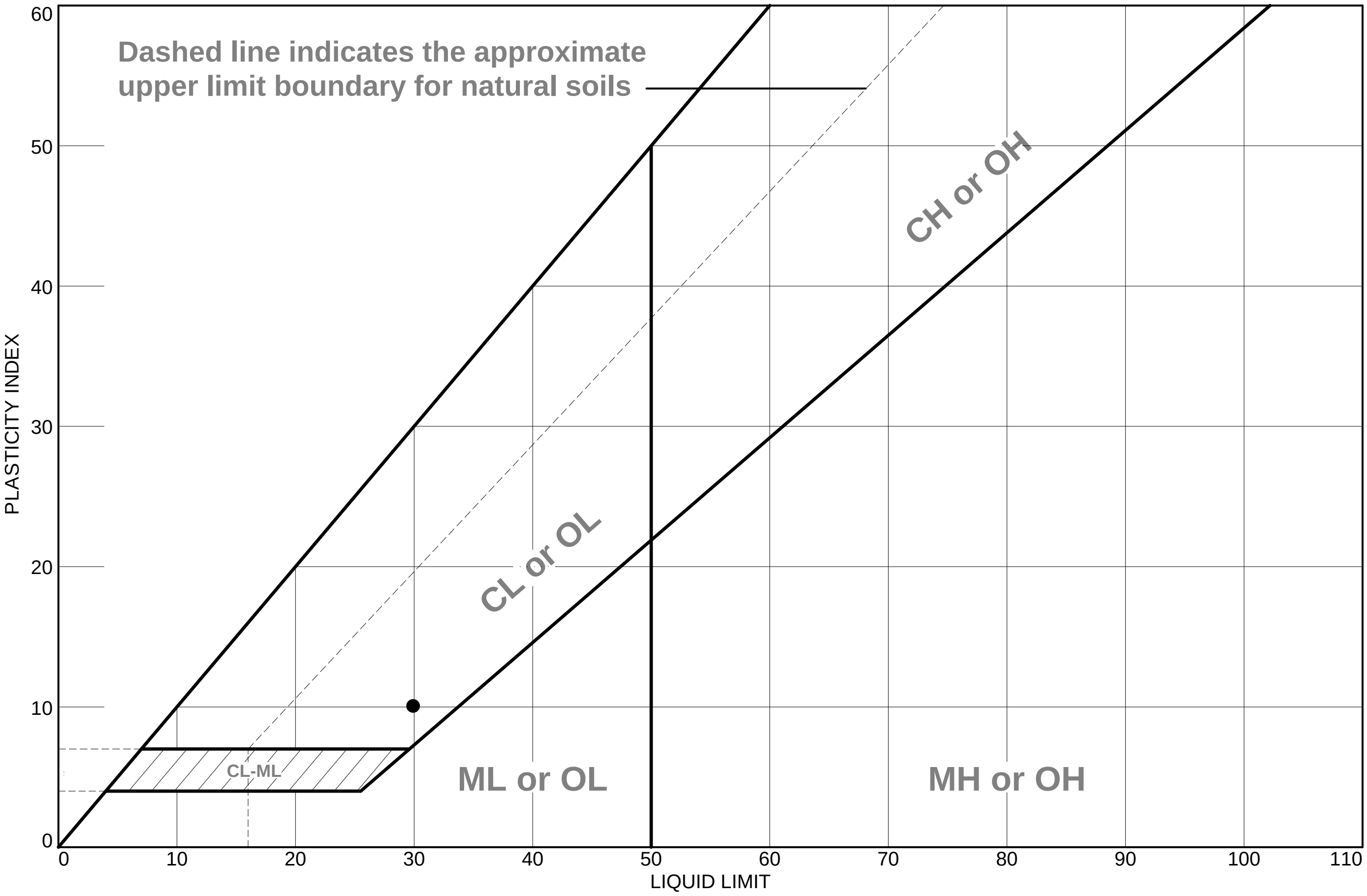
Remarks:

●10-3-22

Figure

Tested By: VS **Checked By:** KP

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Gray Clay & Silt, little cmf Sand (visual)	30	20	10			

Project No. 869 **Client:** Langan Engineering

Project: BL England, Upper Township, NJ

Project#101010201

●**Sample Number:** B-27 S-11 35-37'

Remarks:

●10-3-22

RSA Geolab

Union, New Jersey

Figure

Tested By: VS **Checked By:** KP

RSA GEOLAB

1017 Greeley Ave N
Union, NJ 07083
908-964-0786
www.RSAGeolab.com

Letter of Transmittal

Date: 10-7-22 Job No.: 869 Lab Log: 22-1948

Attention: Victoria Rhodes
Langan Engineering & Environmental Services
300 Kimball Drive, 4th Floor
Parsippany, NJ 07054

CC:

Re: BL England, Upper Township, NJ
Proj. No. 101010201

Sample(s) ID: **B-7 U-1, B-20 U-1, B-27 U-1**

Dear Ms. Rhodes,

Please find attached results for the samples referenced above. The following lab testing was performed:

- ASTM D422 Sieve & Hydrometer Analysis (B-27 U-1 only)
- ASTM D2216 Moisture Content
- ASTM D2974 Organic Content
- ASTM D4318 Atterberg Limits
- ASTM D2166 Unconfined Compressive Strength

Regards,
RSA Geolab, LLC

Remarks: If you have any questions, please call 908-964-0786.

Signed: ____________________

Dr. Raza S. Ahmed
President RSA Geolab, LLC

RSA GEOLAB

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908-964-0786
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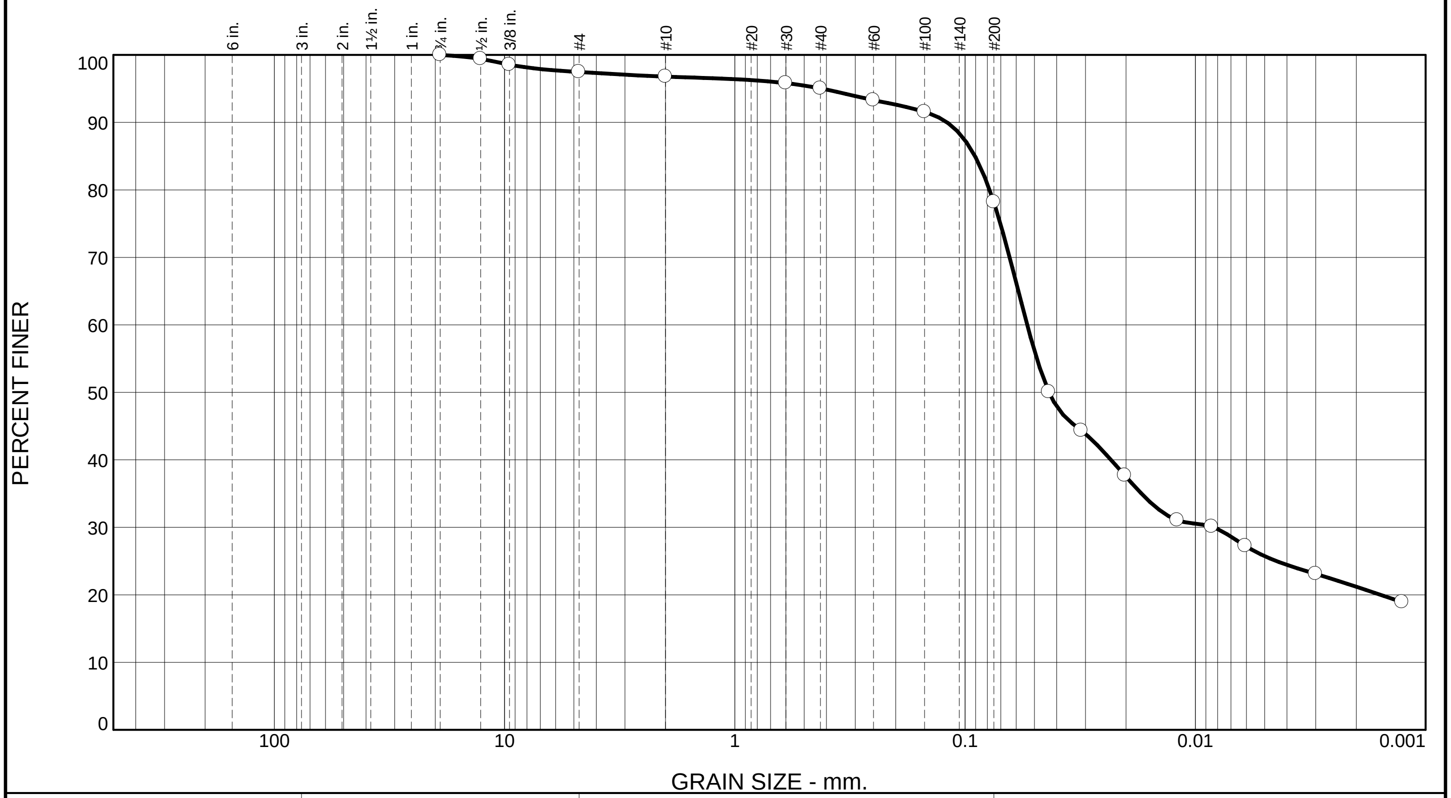
MOISTURE CONTENT (ASTM D2216)/ LOSS ON IGNITION (ASTM D2974)

Project: BL England
Upper Township, NJ
Project #: 869
Client: Langan Eng. & Env. Svcs., Inc.
Project#101010201
Date: 10-7-22

HOLE #/ SAMPLE #	B-7 U-1	B-20 U-1	B-27 U-1			
DEPTH	37-39'	37-39'	12-14'			
WET WGT. + TARE (gms.)	1250.1	1191.2	1109.9			
DRY WGT. + TARE (gms.)	983.6	907.8	874.3			
WGT. WATER (gms.)	266.5	283.4	235.6			
TARE (gms.)	0.0	0.0	0.0			
DRY WGT. (gms.)	983.6	907.8	874.3			
MOISTURE CONTENT (%)	**27.1**	**31.2**	**26.9**			
OVEN DRIED SAMPLE + TARE (gms.)	101.54	110.42	66.16			
AFTER IGNITION SAMPLE + TARE (gms.)	100.50	109.11	64.89			
LOSS ON IGNITION (gms.)	1.04	1.31	1.27			
TARE (gms.)	52.04	57.14	31.18			
INITIAL WGT. OF OVEN DRIED SAMPLE (gms.)	49.50	53.28	34.98			
ORGANIC CONTENT (%)	**2.10**	**2.46**	**3.63**			

Performed by: MF Entered by: KH Checked by: KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.5	0.7	1.8	16.8	52.5	25.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.4		
.375	98.6		
#4	97.5		
#10	96.8		
#30	95.8		
#40	95.0		
#60	93.3		
#100	91.6		
#200	78.2		

* (no specification provided)

Material Description

Yellow, Gray lean clay with sand

Atterberg Limits

PL= 15 LL= 26 PI= 11

Coefficients

D_{90}= 0.1197 D_{85}= 0.0906 D_{60}= 0.0537
D_{50}= 0.0432 D_{30}= 0.0083 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(6)

Remarks

Sample Number: B-27 U-1 12-14'

Date: 10-7-22

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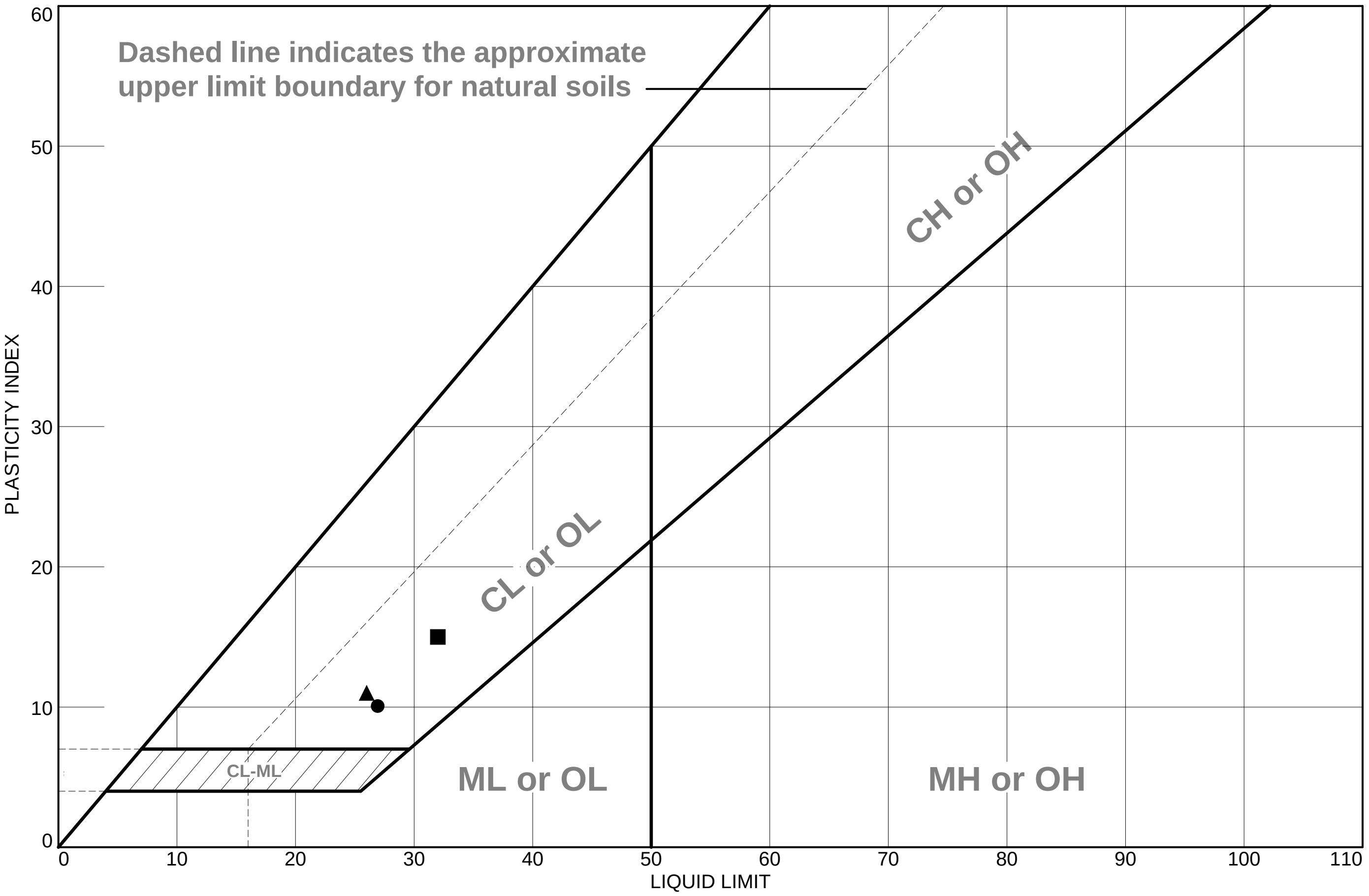
Client: Langan Engineering
Project: BL England, Upper Township, NJ
Proj.#101010201
Project No: 869 **Figure**

Tested By: EE **Checked By:** KP

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Olive Gray Clay & Silt, trace cmf Sand (visual)	27	17	10			
■	Dark Olive Gray Clay & Silt, trace cmf Sand (visual)	32	17	15			
▲	Yellow, Gray lean clay with sand	26	15	11	95.0	78.2	CL

Project No. 869 **Client:** Langan Engineering

Project: BL England, Upper Township, NJ

Proj.#101010201

●**Sample Number:** B-7 U-1 37-39'

■**Sample Number:** B-20 U-1 37-39'

▲**Sample Number:** B-27 U-1 12-14'

Remarks:

●10-7-22

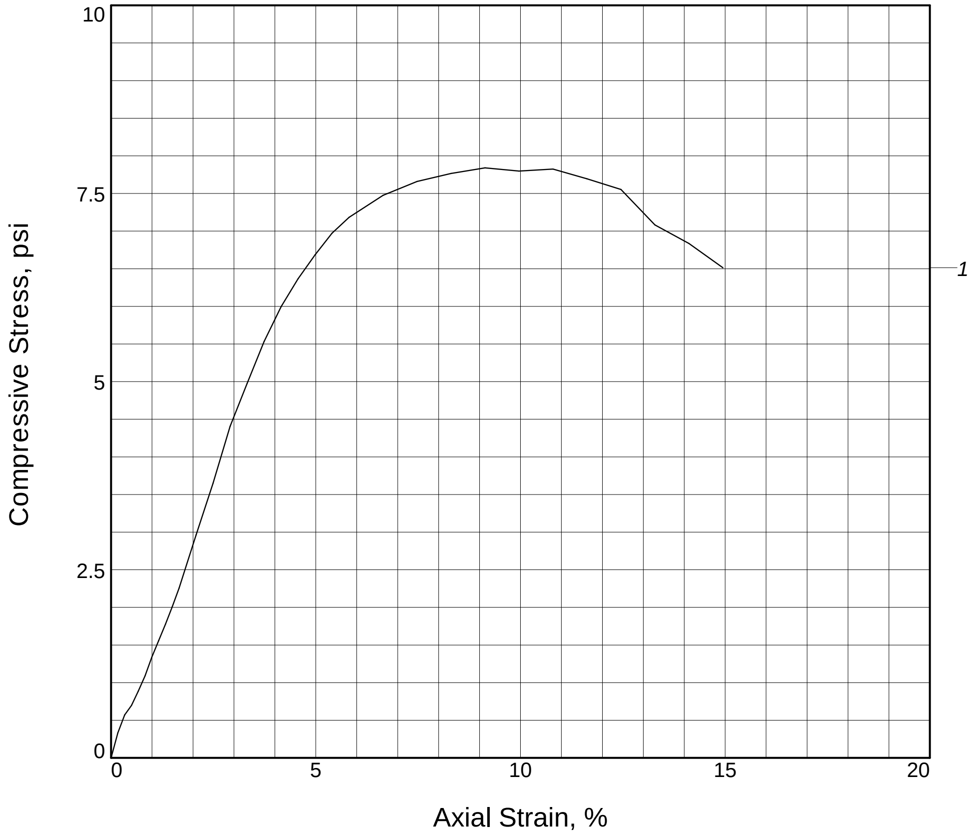
RSA Geolab

Union, New Jersey

Figure

Tested By: ER **Checked By:** KP

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	7.84			
Undrained shear strength, psi	3.92			
Failure strain, %	9.1			
Strain rate, in./min.	0.050			
Water content, %	27.1			
Wet density, pcf	125.9			
Dry density, pcf	99.1			
Saturation, %	104.3			
Void ratio	0.7015			
Specimen diameter, in.	2.83			
Specimen height, in.	6.02			
Height/diameter ratio	2.13			

Description: Dark Olive Gray Clay & Silt, trace cmf Sand (visual)

LL = 27	**PL =** 17	**PI =** 10	**Assumed GS=** 2.7	**Type:** ASTM D2166

Project No.: 869
Date Sampled: 10-7-22
Remarks:

Figure ________

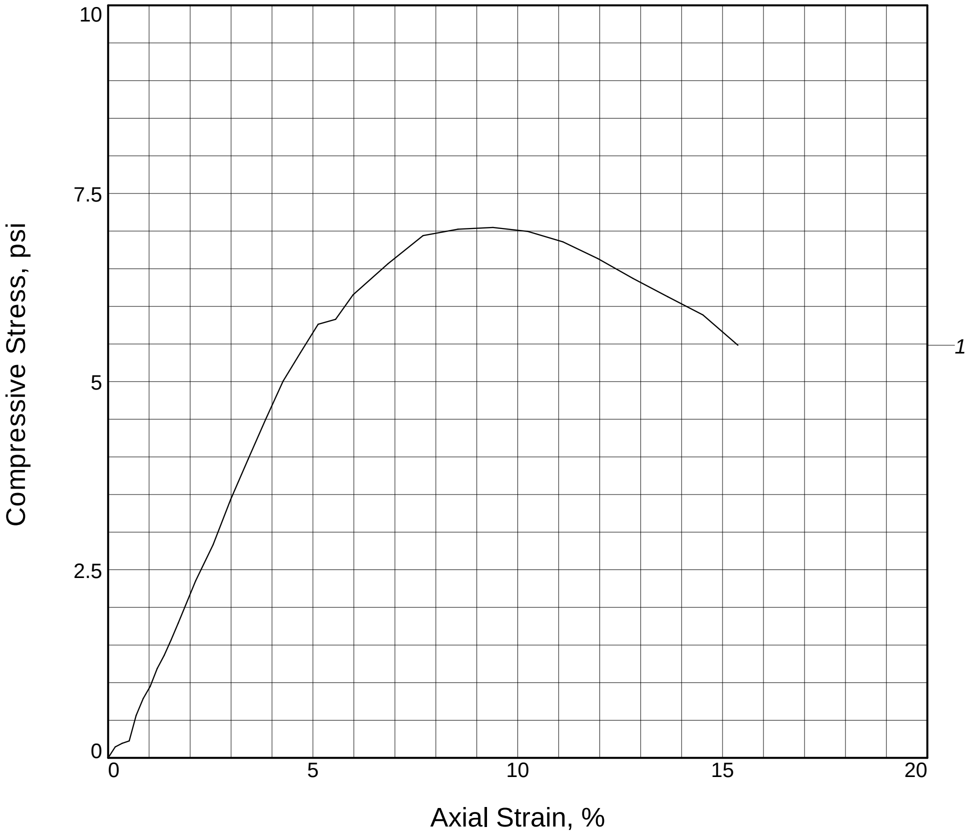
Client: Langan Engineering

Project: BL England, Upper Township, NJ
Proj.#101010201
Sample Number: B-7 U-1 37-39'

UNCONFINED COMPRESSION TEST
RSA Geolab
Union, New Jersey

Tested By: AO **Checked By:** KP

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	7.05			
Undrained shear strength, psi	3.52			
Failure strain, %	9.4			
Strain rate, in./min.	0.050			
Water content, %	31.2			
Wet density, pcf	125.9			
Dry density, pcf	95.9			
Saturation, %	111.4			
Void ratio	0.7568			
Specimen diameter, in.	2.80			
Specimen height, in.	5.85			
Height/diameter ratio	2.09			

Description: Dark Olive Gray Clay & Silt, trace cmf Sand (visual)

LL = 32	**PL =** 17	**PI =** 15	**Assumed GS=** 2.7	**Type:** ASTM D2166

Project No.: 869

Date Sampled: 10-7-22

Remarks:

Figure ________

Client: Langan Engineering

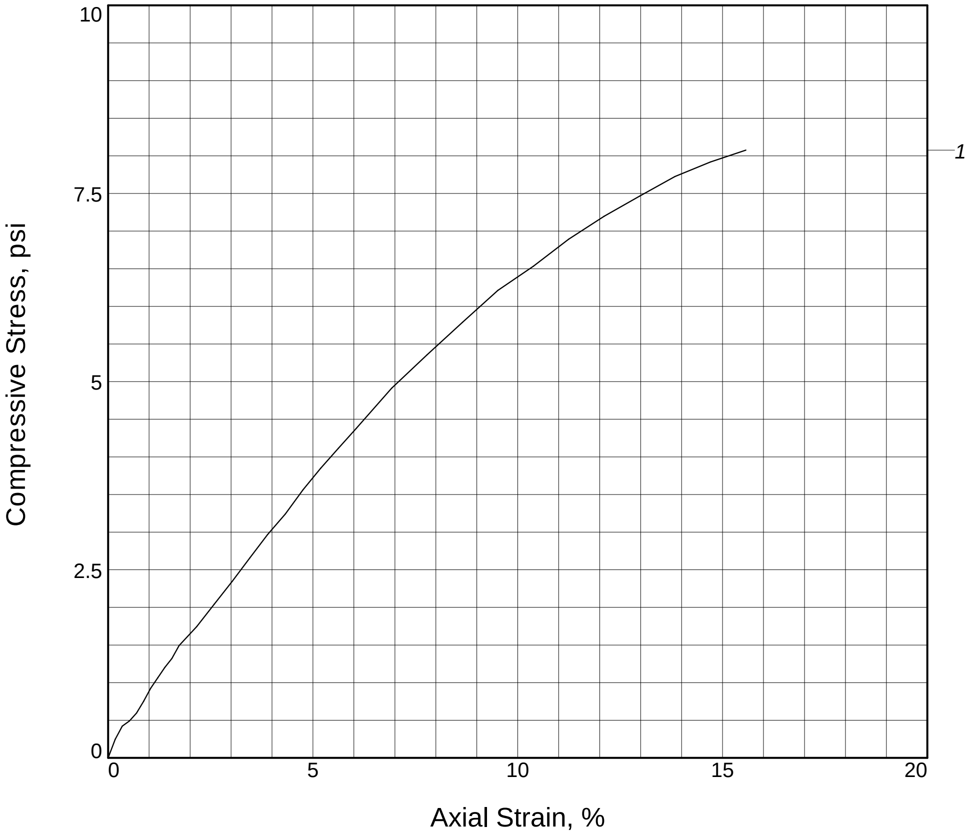
Project: BL England, Upper Township, NJ
Proj.#101010201

Sample Number: B-20 U-1 37-39'

UNCONFINED COMPRESSION TEST
RSA Geolab
Union, New Jersey

Tested By: AO **Checked By:** KP

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	8.08			
Undrained shear strength, psi	4.04			
Failure strain, %	15.6			
Strain rate, in./min.	0.050			
Water content, %	26.9			
Wet density, pcf	129.1			
Dry density, pcf	101.7			
Saturation, %	110.6			
Void ratio	0.6577			
Specimen diameter, in.	2.69			
Specimen height, in.	5.78			
Height/diameter ratio	2.15			

Description: Yellow, Gray lean clay with sand

LL = 26	**PL =** 15	**PI =** 11	**Assumed GS=** 2.7	**Type:** ASTM D2166

Project No.: 869
Date Sampled: 10-7-22
Remarks:

Figure ________

Client: Langan Engineering

Project: BL England, Upper Township, NJ
Proj.#101010201
Sample Number: B-27 U-1 12-14'

UNCONFINED COMPRESSION TEST
RSA Geolab
Union, New Jersey

Tested By: AO **Checked By:** KP

Unconfined Compression Test
ASTM D2166

Post Test Sketch

Client: Langan Engineering

L#22- 1948

Project: BL England (#101010201)

Date: 10-7-2022

Sample: B-7, U-1, 37'-39'

Remarks: Shelby Tube Sample

Tested by: AO
Checked by: KP

Unconfined Compression Test
ASTM D2166

Post Test Sketch

Client: Langan Engineering

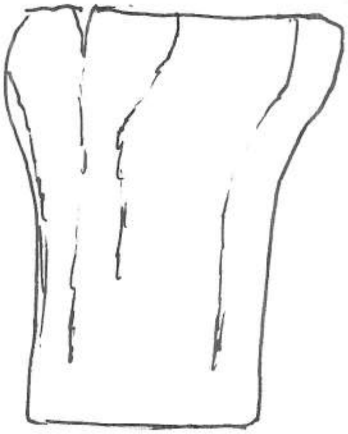
L#22- 1948

Project: BL England (#101010201)

Date: 10-7-2022

Sample: B-20, U-1, 37'-39'

Remarks: Shelby Tube Sample



Tested by: AO
Checked by: KP

RSA GEOLAB

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www.RSAGeolab.com

Unconfined Compression Test
ASTM D2166

Post Test Sketch

Client: Langan Engineering

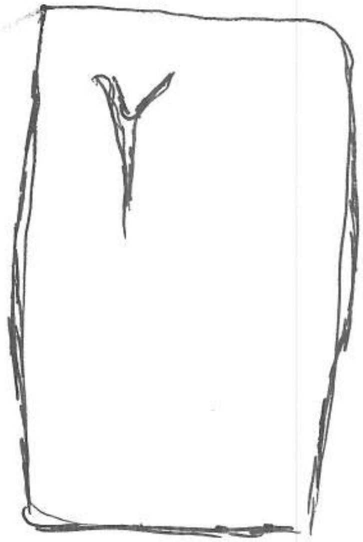
L#22- 1948

Project: BL England (#101010201)

Date: 10-7-2022

Sample: B-27, U-1, 12'-14'

Remarks: Shelby Tube Sample



Tested by: AO
Checked by: KP

RSA GEOLAB

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Union, NJ 07083
908-964-0786
www.RSAGeolab.com

Letter of Transmittal

Date: 10-7-22 Job No.: 869 Lab Log: 22-1943

Attention: Victoria Rhodes
Langan Engineering & Environmental Services
300 Kimball Drive, 4th Floor
Parsippany, NJ 07054

CC:

Re: BL England, Upper Township, NJ
Proj. No. 101010201

Sample(s) ID: **TP-1 BULK-1, TP-6 BULK-1**

Dear Ms. Rhodes,

Please find attached results for the samples referenced above. The following lab testing was performed:

- ASTM D422 Washed Sieve Analysis
- ASTM D2216 Moisture Content
- ASTM D1883 California Bearing Ratio
- ASTM D1557 Modified Proctor

Regards,
RSA Geolab, LLC

Remarks: If you have any questions, please call 908-964-0786.

Signed: ____________________

Dr. Raza S. Ahmed
President RSA Geolab, LLC

RSA GEOLAB

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Union, NJ 07083
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MOISTURE CONTENT (ASTM D2216)

Project: BL England
Upper Township, NJ
Client: Langan Eng. & Env. Svcs., Inc.
Project#101010201

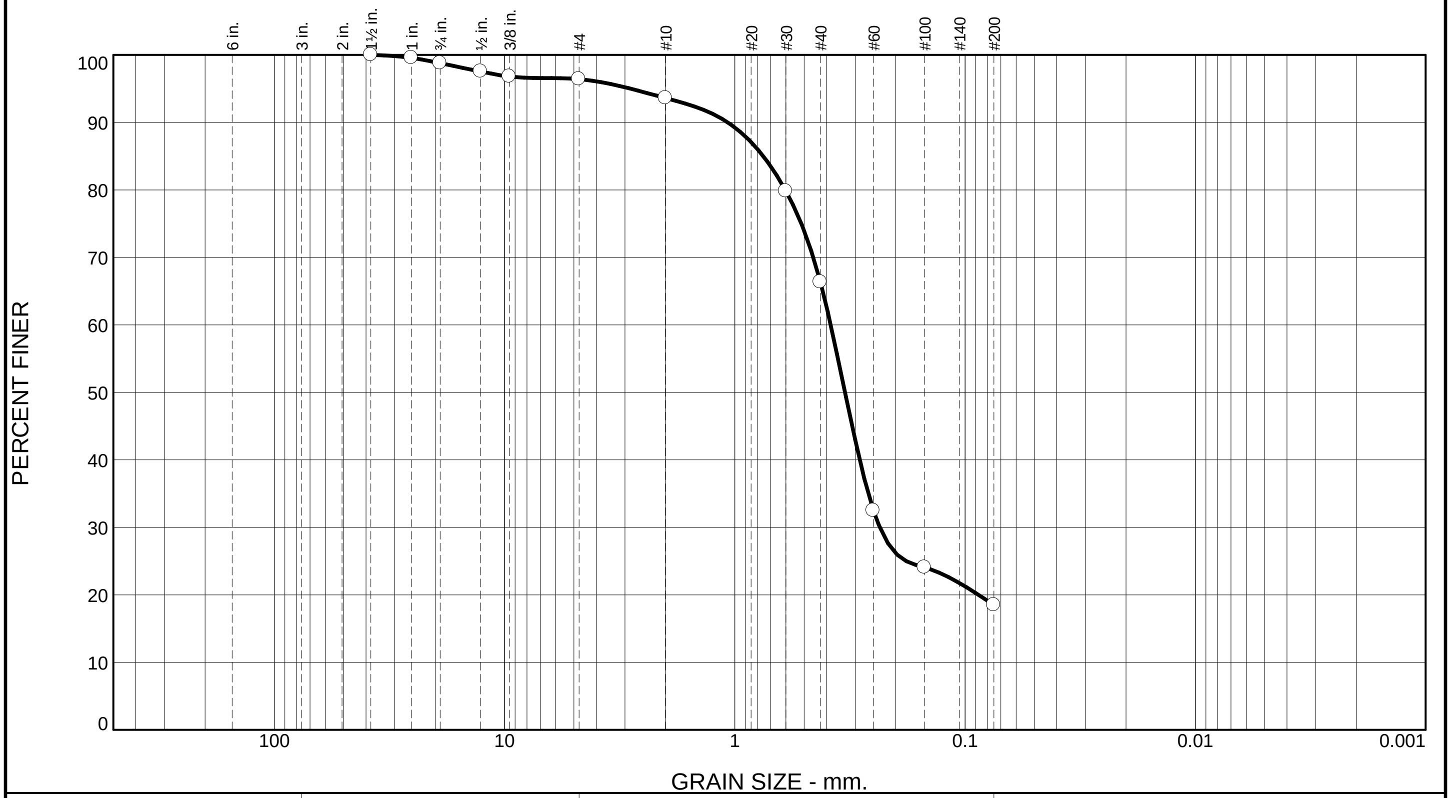
Project #: 869
Date: 10-7-22

HOLE #/ SAMPLE #	TP-1 BULK-1	TP-6 BULK-1				
DEPTH	3'	2.5'				
WET WGT. + TARE (gms.)	12040.0	12114.0				
DRY WGT. + TARE (gms.)	11004.0	11040.0				
WGT. WATER (gms.)	1036.0	1074.0				
TARE (gms.)	500.0	888.0				
DRY WGT. (gms.)	10504.0	10152.0				
MOISTURE CONTENT (%)	**9.9**	**10.6**				

HOLE #/ SAMPLE #						
DEPTH						
WET WGT. + TARE (gms.)						
DRY WGT. + TARE (gms.)						
WGT. WATER (gms.)						
TARE (gms.)						
DRY WGT. (gms.)						
MOISTURE CONTENT (%)						

Performed by: MF Entered by: KH Checked by: KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.2	2.4	2.8	27.3	47.8	18.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	99.6		
.75	98.8		
.5	97.5		
.375	96.8		
#4	96.4		
#10	93.6		
#30	79.8		
#40	66.3		
#60	32.5		
#100	24.1		
#200	18.5		

* (no specification provided)

Material Description

Brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.0745 D_{85}= 0.7526 D_{60}= 0.3837

D_{50}= 0.3323 D_{30}= 0.2348 D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: TP-1 BULK-1 3'

Date: 10-7-22

RSA Geolab

Union, New Jersey

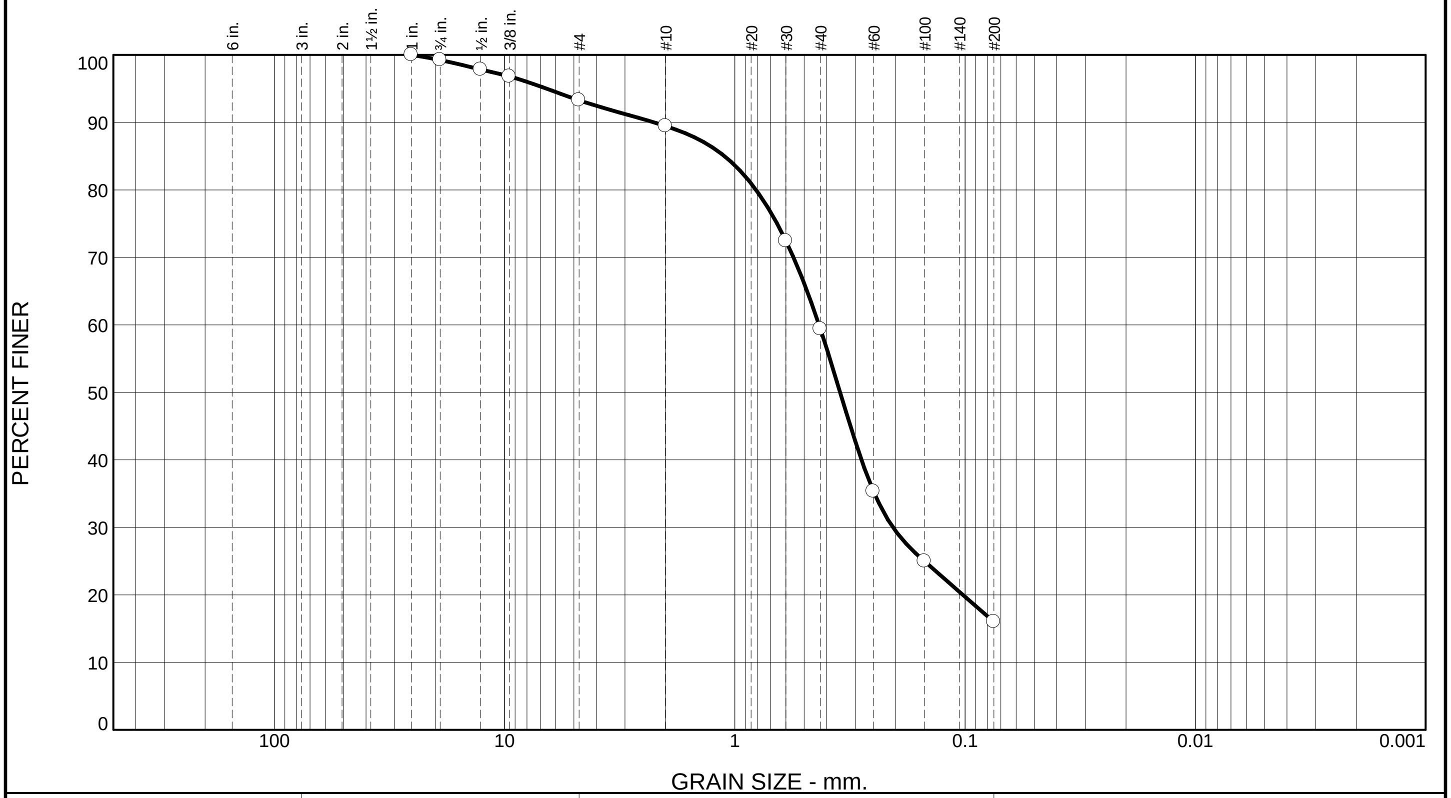
Client: Langan Engineering

Project: BL England, Upper Township, NJ
Proj.#101010201

Project No: 869 **Figure**

Tested By: EE **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.8	5.9	3.8	30.1	43.4	16.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	99.2		
.5	97.8		
.375	96.8		
#4	93.3		
#10	89.5		
#30	72.4		
#40	59.4		
#60	35.3		
#100	25.0		
#200	16.0		

* (no specification provided)

Material Description

Olive Brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.2481 D_{85}= 1.1091 D_{60}= 0.4308
D_{50}= 0.3491 D_{30}= 0.2058 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: TP-6 BULK-1 2.5'

Date: 10-7-22

RSA Geolab

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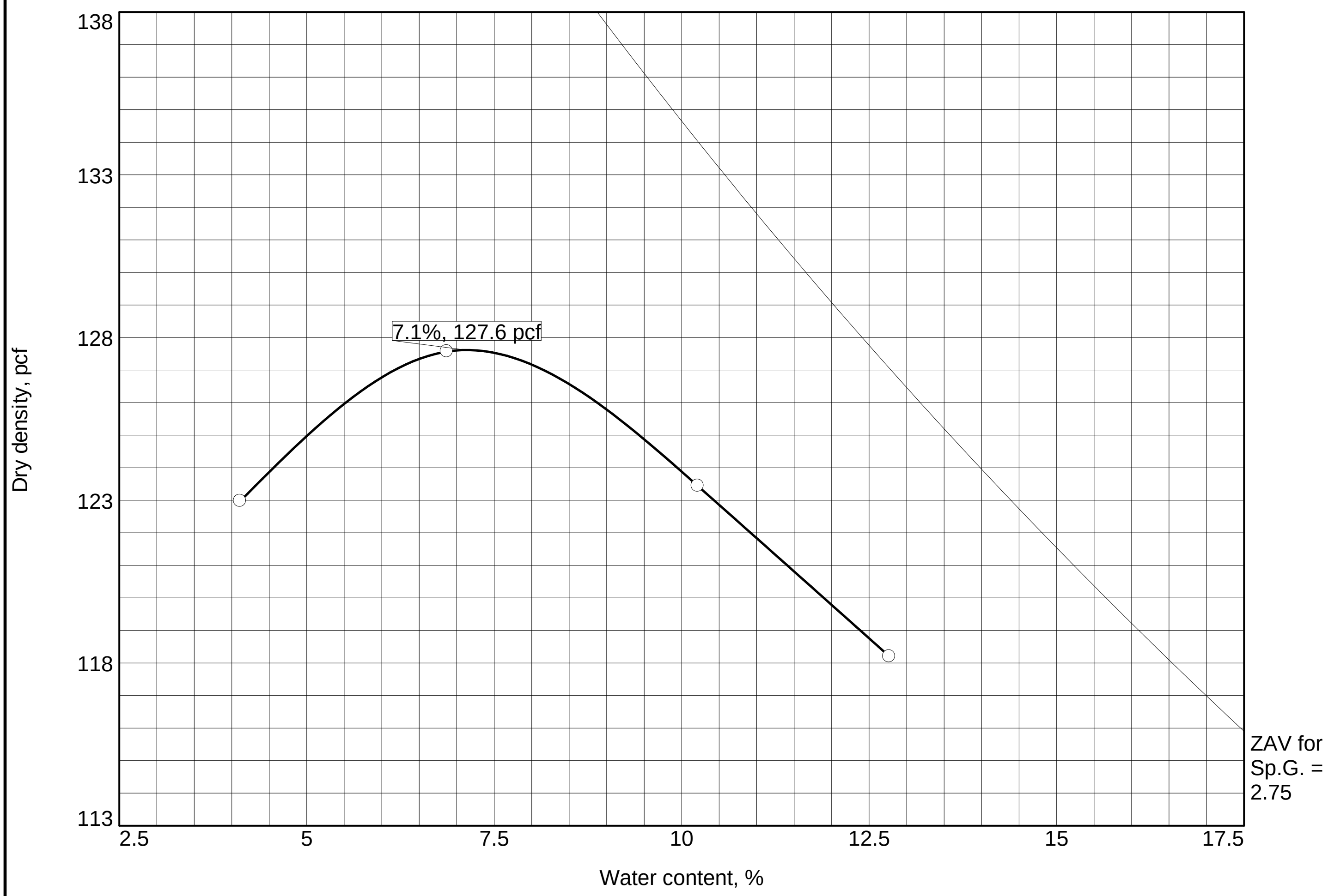
Client: Langan Engineering
Project: BL England, Upper Township, NJ
Proj.#101010201
Project No: 869 **Figure**

Tested By: EE **Checked By:** KP

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
				2.75			3.2	18.5

ROCK CORRECTED TEST RESULTS	UNCORRECTED
Maximum dry density = 127.6 pcf	126.5 pcf
Optimum moisture = 7.1 %	7.4 %

MATERIAL DESCRIPTION

Brown

Project No. 869 **Client:** Langan Engineering

Project: BL England, Upper Township, NJ

Proj.#101010201

○**Sample Number:** TP-1 BULK-1 3'

RSA Geolab

Union, New Jersey

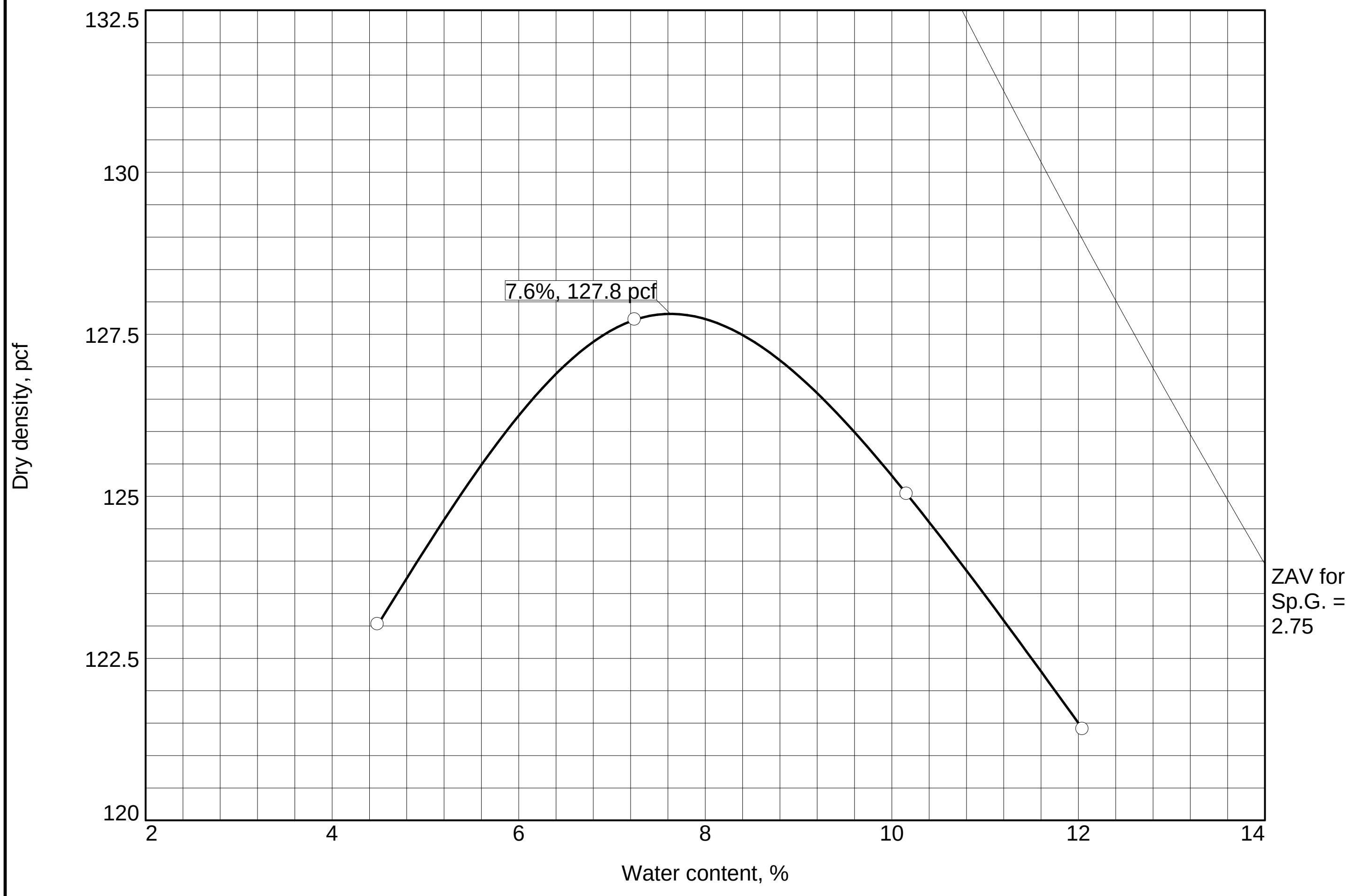
Remarks:

SG Assumed. Machine tested.
10-7-22

Figure

Tested By: EE **Checked By:** KP

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
				2.75			3.2	16.0

ROCK CORRECTED TEST RESULTS	UNCORRECTED
Maximum dry density = 127.8 pcf	126.7 pcf
Optimum moisture = 7.6 %	7.9 %

MATERIAL DESCRIPTION

Olive Brown

Project No. 869 **Client:** Langan Engineering
Project: BL England, Upper Township, NJ
Proj.#101010201
○**Sample Number:** TP-6 BULK-1 2.5'

RSA Geolab

Union, New Jersey

Remarks:
SG Assumed. Machine tested.
10-7-22

Figure

Tested By: EE **Checked By:** KP

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CALIFORINIA BEARING RATIO
ASTM D1883

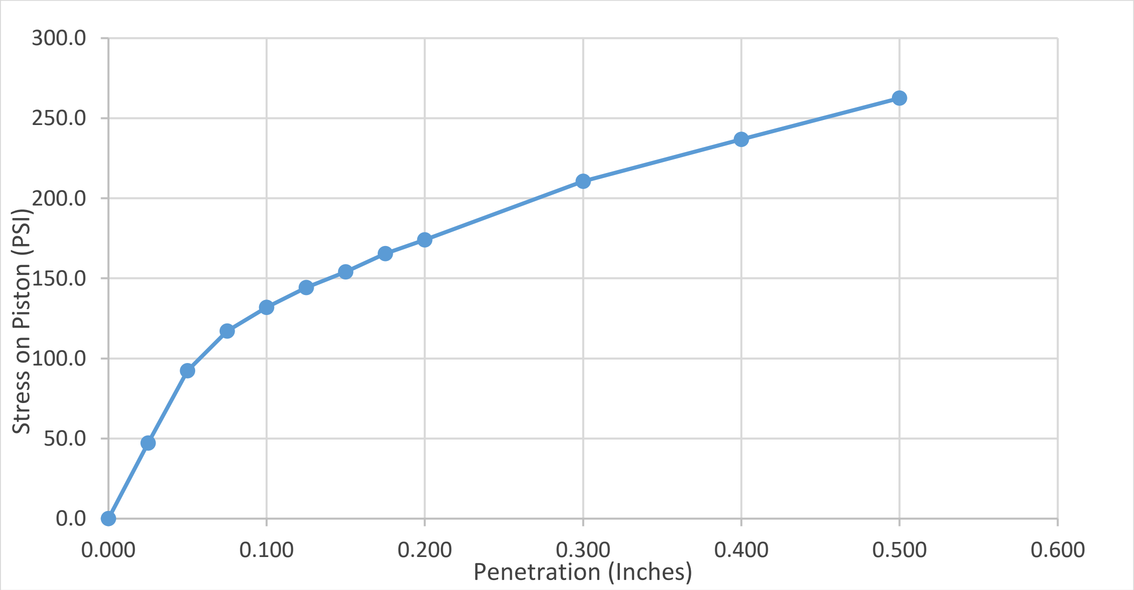
Project:	BL England, Upper Township, NJ Project#101010201	Project No.:	869
		Lab Log #:	22-1943
Client:	Langan Engineering	Date:	10-7-22

Sample: TP-1 BULK-1 3'
Recompacted 95% MDD of ASTM D1557

	Moisture Content	Dry Density:	121.28	pcf (initial)
		CBR Soaked?	Yes	
Initial:	7.3 %	Soak Period	96	hrs.
Final:	10.7 %	Surcharge Wt:	10	lbs.
Final (Top 1"):	12.0 %	Swell:	0.09	%

Rate of Penetration: 0.05 in./min.

Penetration (inches)	Load lbs.	Corrected Load (lbs)	Stress (psi)	C.B. Ratio
0.000	0	0	0.0	
0.025	141	141	47.2	
0.050	276	276	92.4	
0.075	350	350	117.2	
0.100	394	394	131.9	13.19
0.125	431	431	144.3	
0.150	460	460	154.0	
0.175	494	494	165.4	
0.200	520	520	174.1	11.61
0.300	629	629	210.6	
0.400	707	707	236.7	
0.500	784	784	262.5	



Tested By: MF   Entered By: KH   Checked By: KP

EM\NY-GL\CBR\Langan BLEng TP1

RSA GEOLAB

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www.RSAGeolab.com

CALIFORINIA BEARING RATIO
ASTM D1883

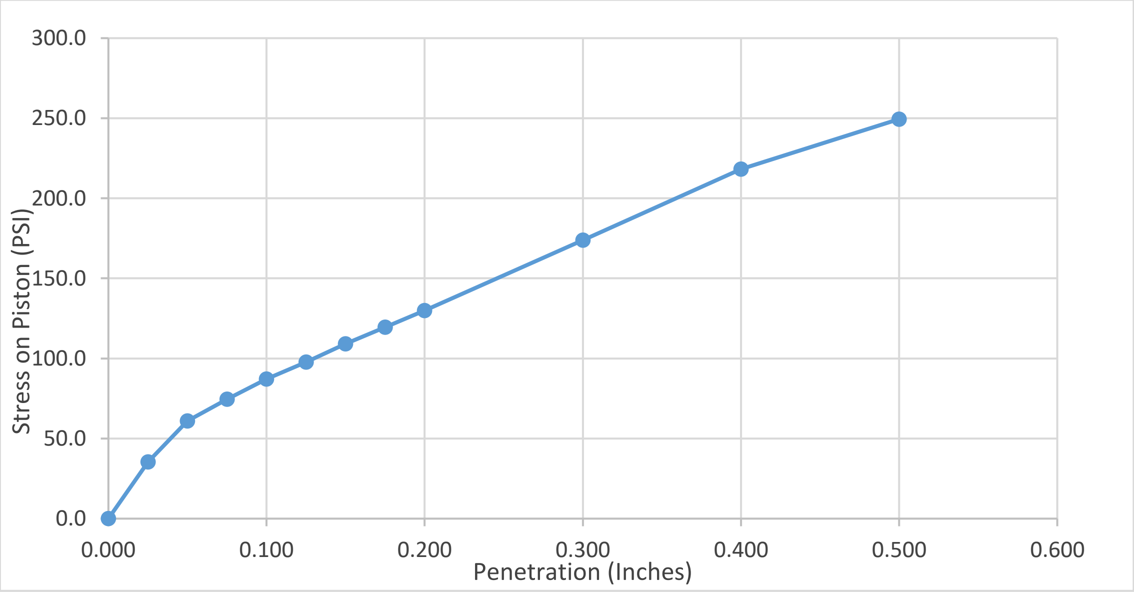
Project:	BL England, Upper Township, NJ Project#101010201	Project No.:	869
		Lab Log #:	22-1943
Client:	Langan Engineering	Date:	10-7-22

Sample: TP-6 BULK-1 2.5'
Recompacted 95% MDD of ASTM D1557

	Moisture Content				
		Dry Density:	121.44	pcf (initial)
		CBR Soaked?	Yes	
Initial:	7.7 %	Soak Period	96	hrs.
Final:	11.9 %	Surcharge Wt:	10	lbs.
inal (Top 1"):	12.5 %	Swell:	0.28	%

Rate of Penetration: 0.05 in./min.

Penetration (inches)	Load lbs.	Corrected Load (lbs)	Stress (psi)	C.B. Ratio
0.000	0	0	0.0	
0.025	106	106	35.5	
0.050	182	182	60.9	
0.075	223	223	74.7	
0.100	260	260	87.1	8.71
0.125	292	292	97.8	
0.150	326	326	109.2	
0.175	357	357	119.5	
0.200	388	388	129.9	8.66
0.300	519	519	173.8	
0.400	652	652	218.3	
0.500	745	745	249.5	



Tested By: MF   Entered By: KH   Checked By: KP

RSA GEOLAB

1017 Greeley Ave N
Union, NJ 07083
908-964-0786
www.RSAGeolab.com

Letter of Transmittal

Date: 9-26-22 Job No.: 869 Lab Log: 22-1916

Attention: Victoria Rhodes
Langan Engineering & Environmental Services
300 Kimball Drive, 4th Floor
Parsippany, NJ 07054

CC:

Re: BL England Substation, Marmora, NJ
Proj. No. 101010201

Sample(s) ID: **TP-1 U-1 thru TP-7 U-1** (7 samples)

Dear Ms. Rhodes,

Please find attached results for the samples referenced above. The following lab testing was performed:

- ASTM D422 Washed Sieve Analysis
- Shelby Tube Permeability

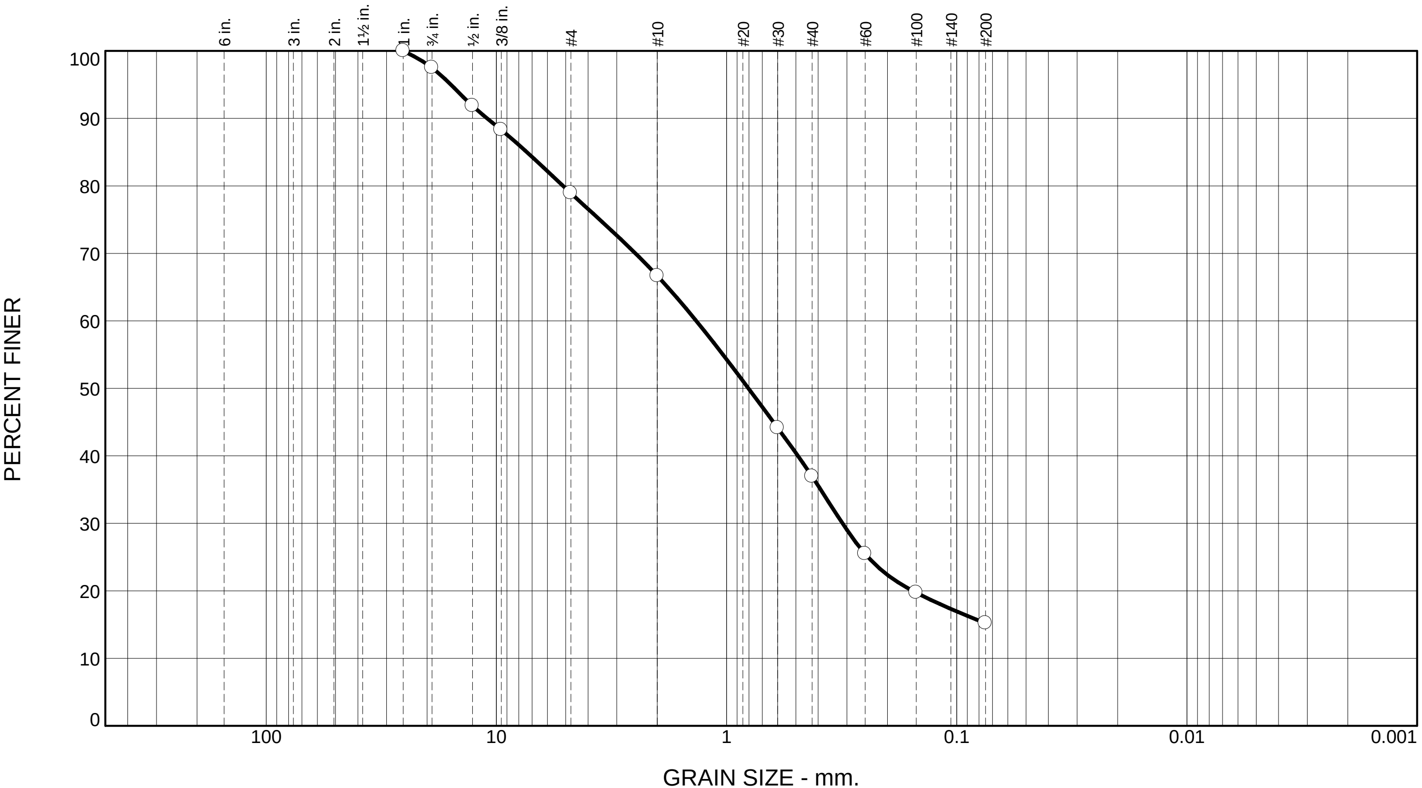
Regards,
RSA Geolab, LLC

Remarks: <u>If you have any questions, please call 908-964-0786.</u>

Signed: ______________________

Dr. Raza S. Ahmed
President RSA Geolab, LLC

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.5	18.6	12.2	29.8	21.7	15.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.5		
.5	91.9		
.375	88.3		
#4	78.9		
#10	66.7		
#30	44.1		
#40	36.9		
#60	25.5		
#100	19.7		
#200	15.2		

* (no specification provided)

Material Description

Black

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 10.9732 D_{85}= 7.3712 D_{60}= 1.3541
D_{50}= 0.8036 D_{30}= 0.3137 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: TP-1 U-1 1-2'

Date: 9-26-22

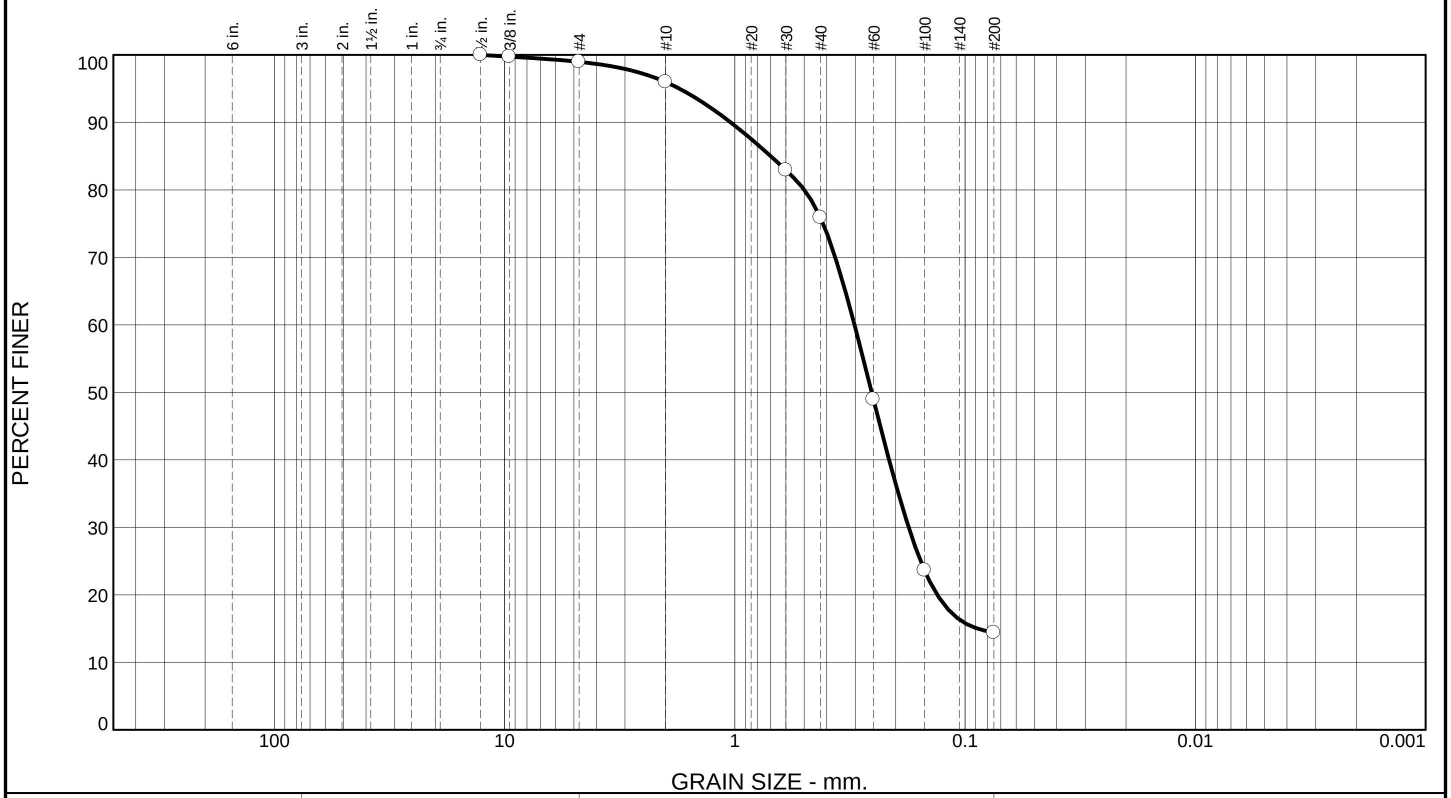
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England Substation, Marmora, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: EE **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.0	3.0	20.1	61.5	14.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.7		
#4	99.0		
#10	96.0		
#30	82.9		
#40	75.9		
#60	49.0		
#100	23.6		
#200	14.4		

* (no specification provided)

Material Description

Yellowish Brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}=	1.0422	D_{85}=	0.6991	D_{60}=	0.3023
D_{50}=	0.2545	D_{30}=	0.1759	D_{15}=	0.0885
D_{10}=		C_u=		C_c=	

Classification

USCS= AASHTO=

Remarks

Sample Number: TP-2 U-1 1-2'

Date: 9-26-22

RSA Geolab

Union, New Jersey

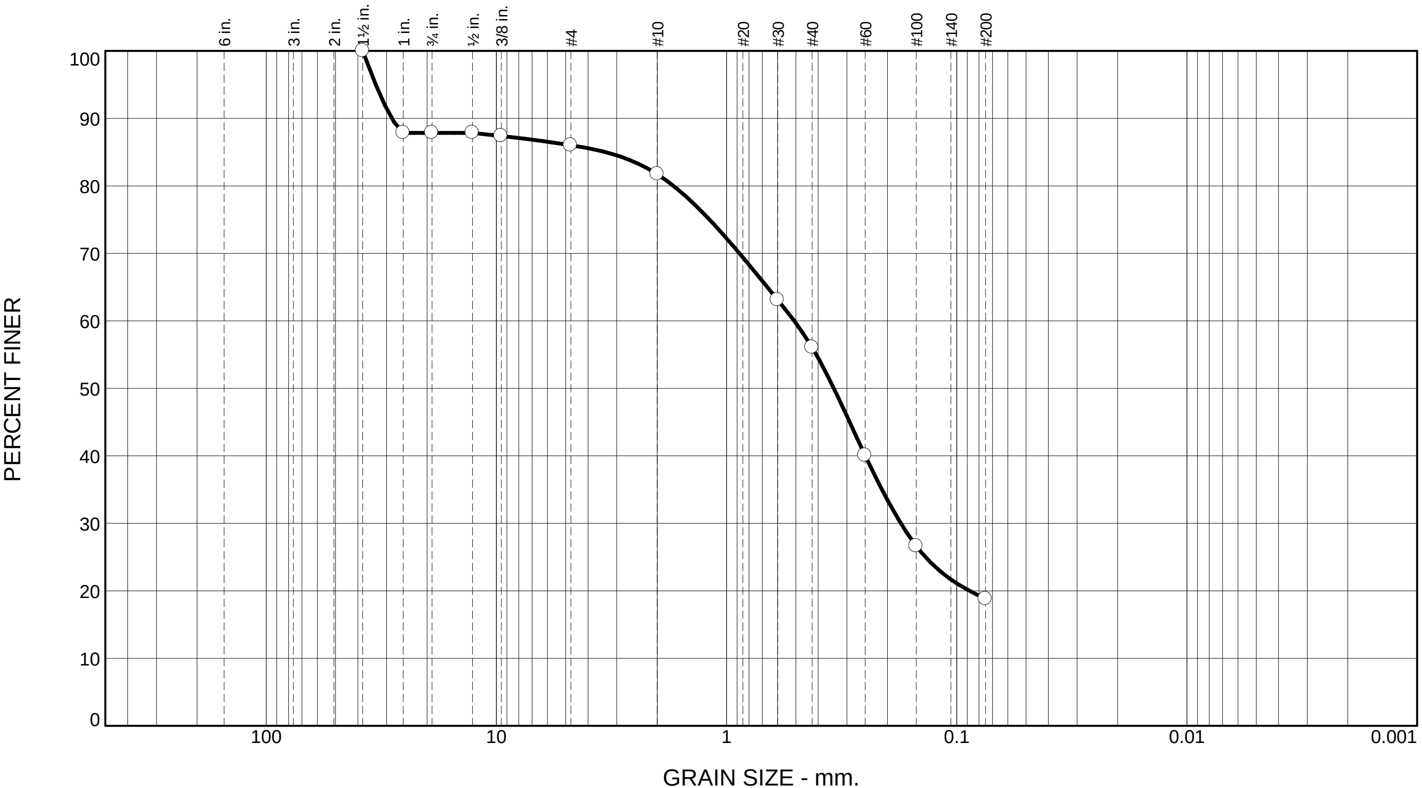
Client: Langan Engineering

Project: BL England Substation, Marmora, NJ
Project#101010201

Project No: 869 **Figure**

Tested By: EE **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.1	1.9	4.3	25.6	37.3	18.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	87.9		
.75	87.9		
.5	87.9		
.375	87.4		
#4	86.0		
#10	81.7		
#30	63.1		
#40	56.1		
#60	40.0		
#100	26.6		
#200	18.8		

* (no specification provided)

Material Description

Yellowish Brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 28.4864 D_{85}= 3.3529 D_{60}= 0.5086
D_{50}= 0.3421 D_{30}= 0.1750 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: TP-3 U-1 0.5-1.5'

Date: 9-26-22

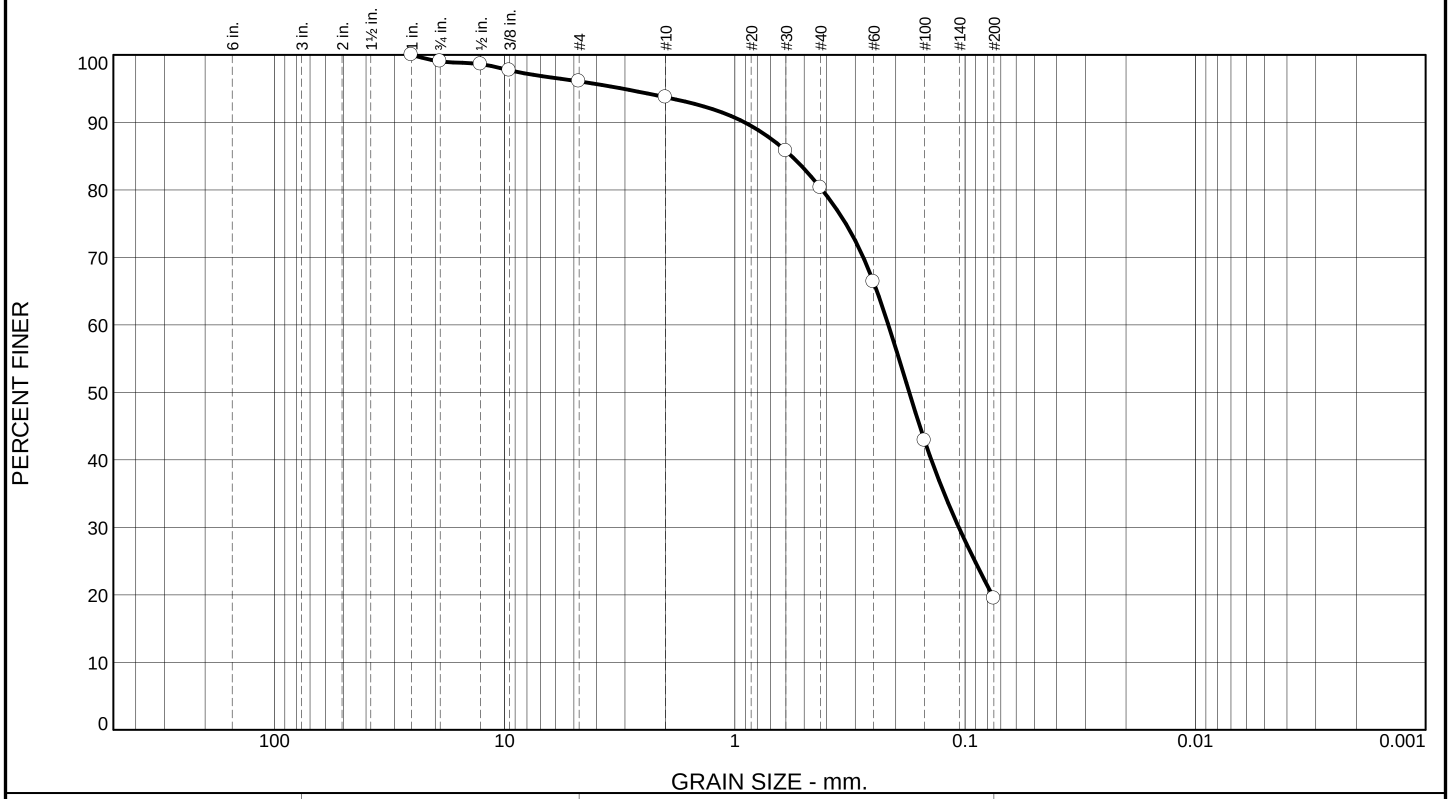
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England Substation, Marmora, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: EE **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.0	2.9	2.4	13.4	60.8	19.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	99.0		
.5	98.6		
.375	97.7		
#4	96.1		
#10	93.7		
#30	85.8		
#40	80.3		
#60	66.4		
#100	42.9		
#200	19.5		

* (no specification provided)

Material Description

Yellow

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.9060 D_{85}= 0.5667 D_{60}= 0.2154
D_{50}= 0.1748 D_{30}= 0.1065 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: TP-4 U-1 1-2'

Date: 9-26-22

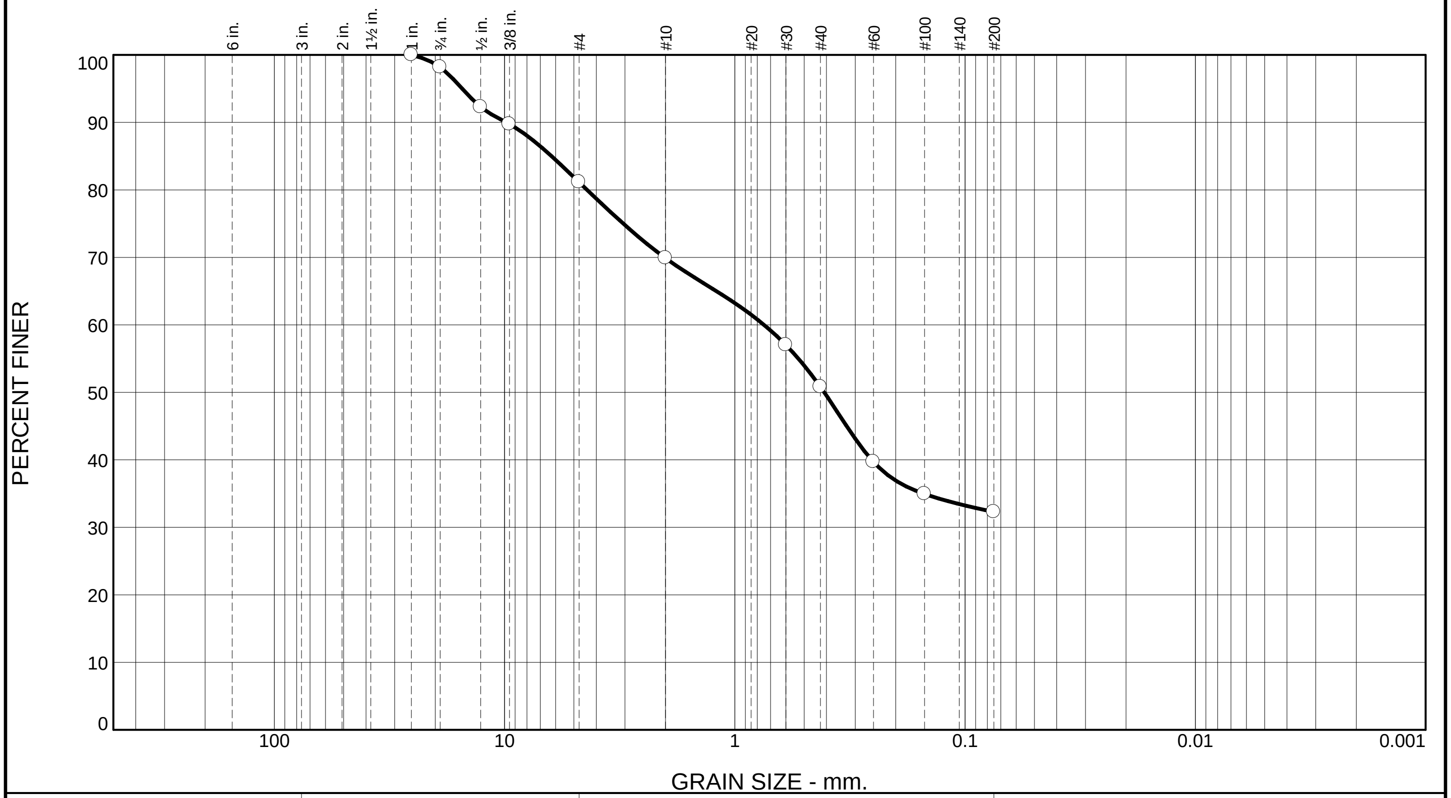
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England Substation, Marmora, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: EE **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.8	17.1	11.2	19.1	18.5	32.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	98.2		
.5	92.3		
.375	89.7		
#4	81.1		
#10	69.9		
#30	57.0		
#40	50.8		
#60	39.7		
#100	34.9		
#200	32.3		

* (no specification provided)

Material Description

Black

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 9.8244 D_{85}= 6.2563 D_{60}= 0.7467
D_{50}= 0.4091 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: TP-5 U-1 1-2'

Date: 9-26-22

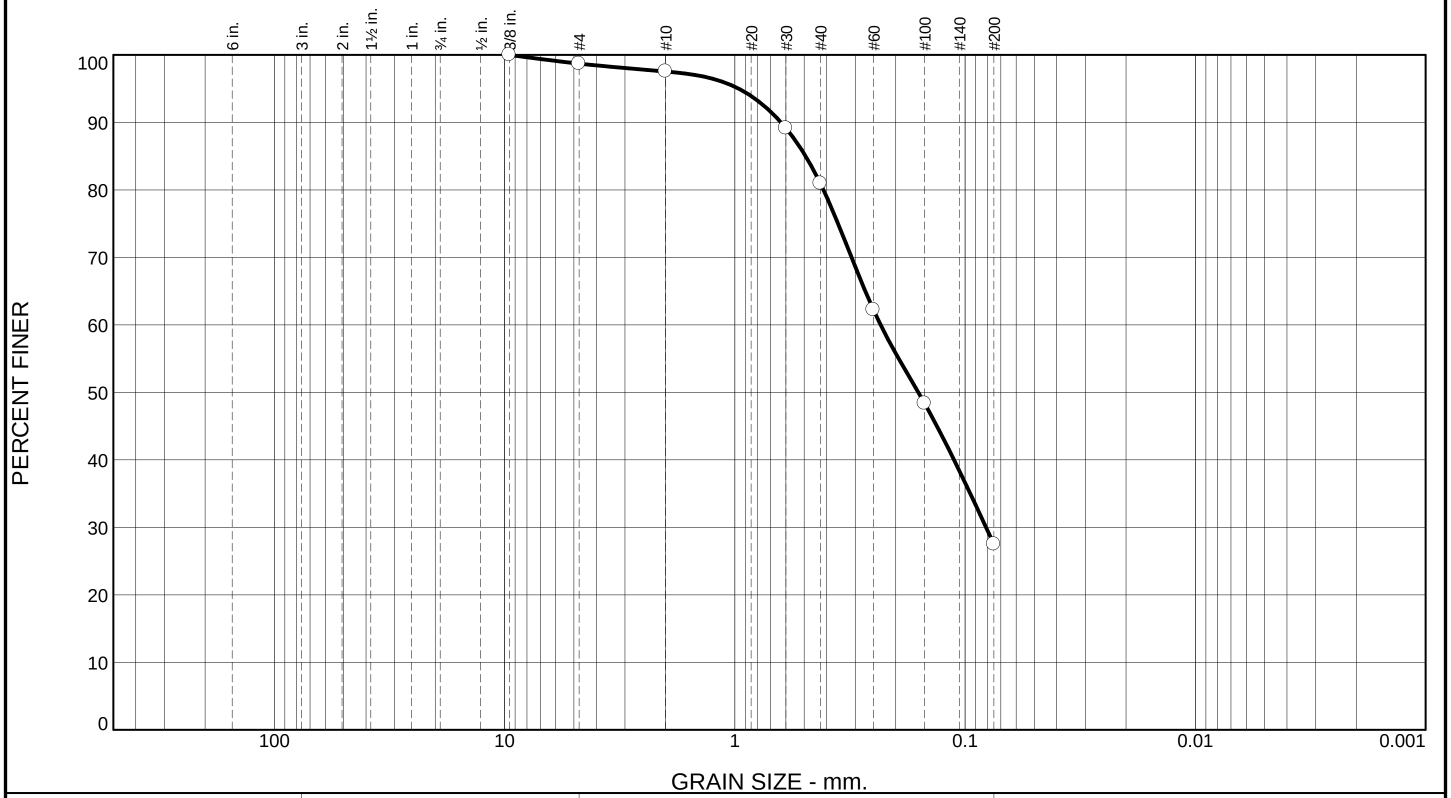
RSA Geolab

Union, New Jersey

Client: Langan Engineering
Project: BL England Substation, Marmora, NJ
Project#101010201
Project No: 869 **Figure**

Tested By: EE **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.3	1.2	16.5	53.5	27.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.7		
#10	97.5		
#30	89.1		
#40	81.0		
#60	62.2		
#100	48.4		
#200	27.5		

* (no specification provided)

Material Description

Dark Brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6302	D_{85}= 0.4926	D_{60}= 0.2327
D_{50}= 0.1596	D_{30}= 0.0811	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: TP-6 U-1 1-2'

Date: 9-26-22

RSA Geolab

Union, New Jersey

Client: Langan Engineering

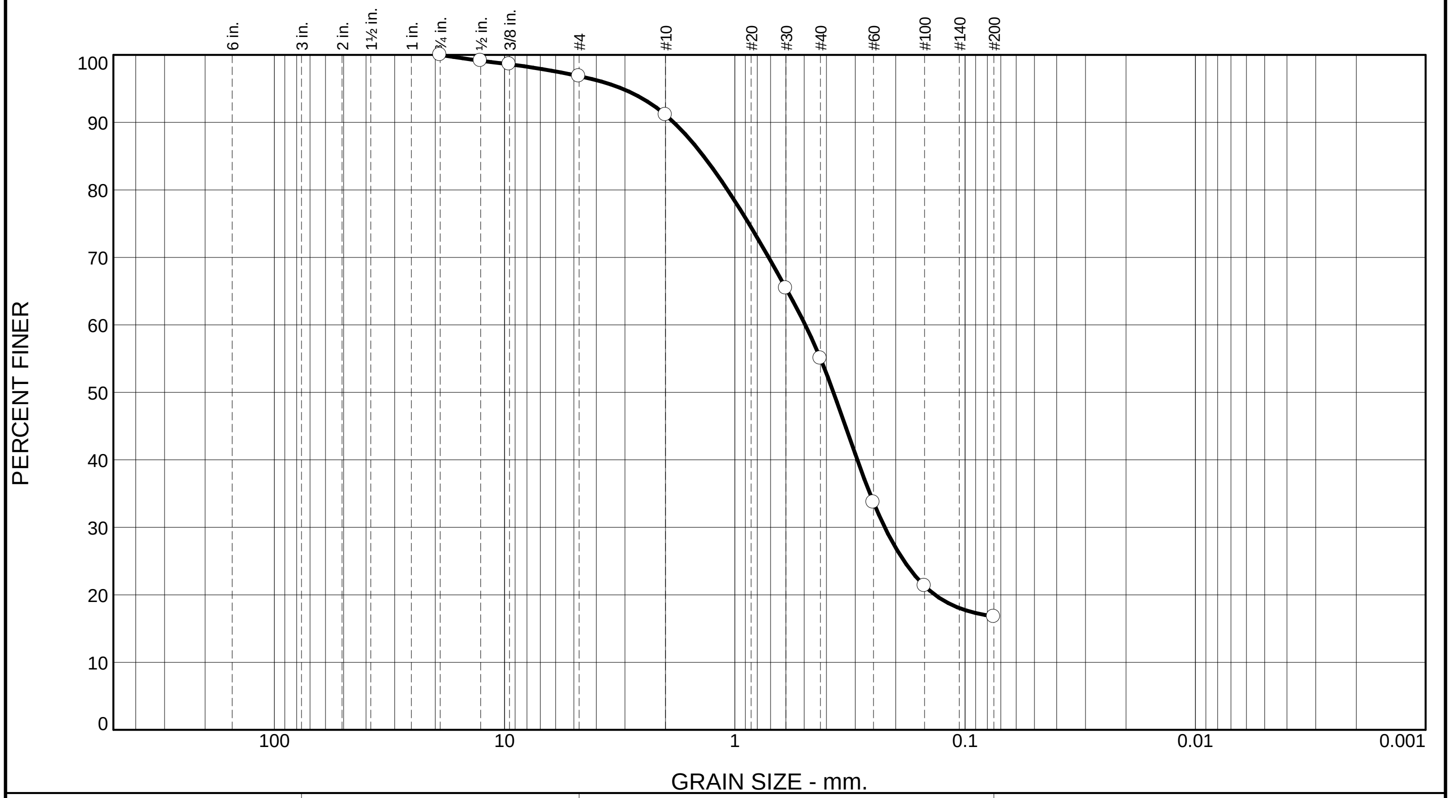
Project: BL England Substation, Marmora, NJ
Project#101010201

Project No: 869

Figure

Tested By: EE **Checked By:** KP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.1	5.8	36.1	38.2	16.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.1		
.375	98.6		
#4	96.9		
#10	91.1		
#30	65.4		
#40	55.0		
#60	33.7		
#100	21.3		
#200	16.8		

* (no specification provided)

Material Description

Yellowish Brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.8404	D_{85}= 1.3668	D_{60}= 0.4946
D_{50}= 0.3731	D_{30}= 0.2233	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: TP-7 U-1 0.5-1.5'

Date: 9-26-22

RSA Geolab

Union, New Jersey

Client: Langan Engineering

Project: BL England Substation, Marmora, NJ
Project#101010201

Project No: 869 **Figure**

Tested By: EE **Checked By:** KP

RSA GEOLAB
1017 Greeley Ave N
Union, NJ 07083
908-964-0786
www.RSAGeolab.com

Shelby Tube Hydraulic Conductivity Test
ASTM D2434 (For Calculations)

Client : Langan Engineering & Environmental Services
Project : BL England Substation
Proj. No. 101010201
Sample TP-1 U-1 1'-2'

Job No. : 869
Lab Log No. : L#22-1916
Date : 9-26-2022

Average Length of Soil Core	6.273	in.
Diameter of Shelby Tube	2.875	in.
Diameter of Standpipe	0.250	in.

Initial Weight of Soil Core	962.8	grams
Final Weight of Soil Core	977.5	grams
Dry Weight of Soil Core	885.0	grams
Initial Moisture Content	8.79%	
Final Moisture Content	10.46%	
Wet Density, Initial	90.06	PCF
Wet Density, Final	91.44	PCF
Dry Density	82.79	PCF

Trial No.	Initial Height (inches)	Final Height (inches)	Change in Water Level (inches)	Time Interval (secs)	Hydraulic Conductivity (cm/sec)
1	38.2	18.2	20.0	1.3	7.15E-02
2	39.5	19.6	19.9	1.3	6.75E-02
3	38.1	19.2	18.9	1.3	6.61E-02

Average Hydraulic Conductivity		
	6.84E-02	**cm/sec**
	9.69E+01	**in/hr**

Remarks:

1. Test Conducted using Deaired Tap Water at Standard Temp. (72 deg F)
2. 100% Saturation Assumed

Tested By : MF/AO
Checked By : KP

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Union, NJ 07083
908-964-0786
www.RSAGeolab.com

Shelby Tube Hydraulic Conductivity Test
ASTM D2434 (For Calculations)

Client : Langan Engineering & Environmental Services
Project : BL England Substation
Proj. No. 101010201
Sample TP-2 ST-1 1'-2'

Job No. : 869
Lab Log No. : L#22-1916
Date : 9-26-2022

Average Length of Soil Core	6.987	in.
Diameter of Shelby Tube	2.875	in.
Diameter of Standpipe	0.250	in.

Initial Weight of Soil Core	1462.1	grams
Final Weight of Soil Core	1480.3	grams
Dry Weight of Soil Core	1333.4	grams
Initial Moisture Content	9.65%	
Final Moisture Content	11.02%	
Wet Density, Initial	122.80	PCF
Wet Density, Final	124.33	PCF
Dry Density	111.99	PCF

Trial No.	Initial Height (inches)	Final Height (inches)	Change in Water Level (inches)	Time Interval (secs)	Hydraulic Conductivity (cm/sec)
1	39.6	19.5	20.1	45.0	2.11E-03
2	38.5	19.4	19.1	45.0	2.04E-03
3	39.1	18.6	20.5	47.5	2.10E-03

Average Hydraulic Conductivity		
	2.09E-03	**cm/sec**
	2.96E+00	**in/hr**

Remarks:

1. Test Conducted using Deaired Tap Water at Standard Temp. (72 deg F)
2. 100% Saturation Assumed

Tested By : MF/AO
Checked By : KP

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Shelby Tube Hydraulic Conductivity Test
ASTM D2434 (For Calculations)

Client : Langan Engineering & Environmental Services
Job No. : 869
Project : BL England Substation
Lab Log No. : L#22-1916
Proj. No. 101010201
Sample TP-3 U-1 .5'-1.5'
Date : 9-26-2022

Average Length of Soil Core	7.432	in.	Initial Weight of Soil Core	1543.7	grams
			Final Weight of Soil Core	1568.2	grams
			Dry Weight of Soil Core	1421.7	grams
Diameter of Shelby Tube	2.875	in.	Initial Moisture Content	8.58%	
Diameter of Standpipe	0.250	in.	Final Moisture Content	10.30%	
			Wet Density, Initial	121.89	PCF
			Wet Density, Final	123.82	PCF
			Dry Density	112.26	PCF

Trial No.	Initial Height (inches)	Final Height (inches)	Change in Water Level (inches)	Time Interval (secs)	Hydraulic Conductivity (cm/sec)
1	38.8	18.6	20.2	75.0	1.40E-03
2	39.2	18.3	20.9	80.0	1.36E-03
3	39.3	19.2	20.1	77.5	1.32E-03

Average Hydraulic Conductivity		
	1.36E-03	**cm/sec**
	1.93E+00	**in/hr**

Remarks:

1. Test Conducted using Deaired Tap Water at Standard Temp. (72 deg F)
2. 100% Saturation Assumed

Tested By : MF/AO
Checked By : KP

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Shelby Tube Hydraulic Conductivity Test

ASTM D2434 (For Calculations)

Client : Langan Engineering & Environmental Services
Project : BL England Substation
Proj. No. 101010201
Sample TP-4 ST-1 1'-2'

Job No. : 869
Lab Log No. : L#22-1916
Date : 9-26-2022

Average Length of Soil Core	7.119	in.
Diameter of Shelby Tube	2.875	in.
Diameter of Standpipe	0.250	in.

Initial Weight of Soil Core	1409.2	grams
Final Weight of Soil Core	1423.6	grams
Dry Weight of Soil Core	1237.3	grams
Initial Moisture Content	13.90%	
Final Moisture Content	15.06%	
Wet Density, Initial	116.17	PCF
Wet Density, Final	117.35	PCF
Dry Density	101.99	PCF

Trial No.	Initial Height (inches)	Final Height (inches)	Change in Water Level (inches)	Time Interval (secs)	Hydraulic Conductivity (cm/sec)
1	39.3	18.4	20.9	85.0	1.22E-03
2	38.6	18.1	20.5	87.5	1.18E-03
3	39.1	18.7	20.4	92.5	1.09E-03

Average Hydraulic Conductivity	**1.16E-03**	**cm/sec**
	1.65E+00	**in/hr**

Remarks:

1. Test Conducted using Deaired Tap Water at Standard Temp. (72 deg F)
2. 100% Saturation Assumed

Tested By : MF/AO
Checked By : KP

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www.RSAGeolab.com

Shelby Tube Hydraulic Conductivity Test
ASTM D2434 (For Calculations)

Client : Langan Engineering & Environmental Services
Job No. : 869
Project : BL England Substation
Proj. No. 101010201
Lab Log No. : L#22-1916
Sample TP-5 U-1 1'-2'
Date : 9-26-2022

Average Length of Soil Core	6.859	in.	Initial Weight of Soil Core	1031.5	grams
			Final Weight of Soil Core	1055.8	grams
			Dry Weight of Soil Core	919.7	grams
Diameter of Shelby Tube	2.875	in.	Initial Moisture Content	12.16%	
Diameter of Standpipe	0.250	in.	Final Moisture Content	14.80%	
			Wet Density, Initial	88.25	PCF
			Wet Density, Final	90.33	PCF
			Dry Density	78.68	PCF

Trial No.	Initial Height (inches)	Final Height (inches)	Change in Water Level (inches)	Time Interval (secs)	Hydraulic Conductivity (cm/sec)
1	38.9	19.6	19.3	3.0	3.01E-02
2	38.7	18.5	20.2	2.8	3.54E-02
3	39.5	19.2	20.3	3.0	3.17E-02

Average Hydraulic Conductivity	**3.24E-02**	**cm/sec**
	4.59E+01	**in/hr**

Remarks:

1. Test Conducted using Deaired Tap Water at Standard Temp. (72 deg F)
2. 100% Saturation Assumed

Tested By : MF/AO
Checked By : KP

RSA GEOLAB
1017 Greeley Ave N
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Shelby Tube Hydraulic Conductivity Test

ASTM D2434 (For Calculations)

Client : Langan Engineering & Environmental Services

Project : BL England Substation

Proj. No. 101010201

Sample TP-6 U-1 1'-2'

Job No. : 869

Lab Log No. : L#22-1916

Date : 9-26-2022

Average Length of Soil Core	3.958	in.	Initial Weight of Soil Core	807.3	grams
			Final Weight of Soil Core	822.3	grams
			Dry Weight of Soil Core	714.5	grams
Diameter of Shelby Tube	2.875	in.	Initial Moisture Content	12.98%	
Diameter of Standpipe	0.250	in.	Final Moisture Content	15.09%	
			Wet Density, Initial	119.69	PCF
			Wet Density, Final	121.92	PCF
			Dry Density	105.93	PCF

Trial No.	Initial Height (inches)	Final Height (inches)	Change in Water Level (inches)	Time Interval (secs)	Hydraulic Conductivity (cm/sec)
1	38.7	18.4	20.3	125.0	4.52E-04
2	38.2	18.9	19.3	120.0	4.46E-04
3	38.6	19.2	19.4	125.0	4.25E-04

Average Hydraulic Conductivity	**4.41E-04**	**cm/sec**
	6.25E-01	**in/hr**

Remarks:

1. Test Conducted using Deaired Tap Water at Standard Temp. (72 deg F)
2. 100% Saturation Assumed

Tested By : MF/AO
Checked By : KP

RSA GEOLAB

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Union, NJ 07083
908-964-0786
www.RSAGeolab.com

Shelby Tube Hydraulic Conductivity Test

ASTM D2434 (For Calculations)

Client : Langan Engineering & Environmental Services
Project : BL England Substation
Proj. No. 101010201
Sample TP-7 U-1 .5'-1.5'

Job No. : 869
Lab Log No. : L#22-1916
Date : 9-26-2022

Average Length of Soil Core	7.611	in.
Diameter of Shelby Tube	2.875	in.
Diameter of Standpipe	0.250	in.

Initial Weight of Soil Core	1409.8	grams
Final Weight of Soil Core	1433.7	grams
Dry Weight of Soil Core	1280.0	grams
Initial Moisture Content	10.15%	
Final Moisture Content	12.01%	
Wet Density, Initial	108.70	PCF
Wet Density, Final	110.54	PCF
Dry Density	98.69	PCF

Trial No.	Initial Height (inches)	Final Height (inches)	Change in Water Level (inches)	Time Interval (secs)	Hydraulic Conductivity (cm/sec)
1	39.6	18.7	20.9	40.0	2.74E-03
2	38.7	19.2	19.5	42.5	2.41E-03
3	39.2	19.4	19.8	42.5	2.42E-03

Average Hydraulic Conductivity		
	2.52E-03	**cm/sec**
	3.58E+00	**in/hr**

Remarks:

1. Test Conducted using Deaired Tap Water at Standard Temp. (72 deg F)
2. 100% Saturation Assumed

Tested By : MF/AO
Checked By : KP

APPENDIX E

Recommended Design Parameters

LPile Input Soil/Rock Layer and Properties

Boring Location: B-24 Depth to Ground water (ft) 5

As-built Information

Elevation:	el 10.030 (NAVD88)
Northing:	165879.926
Easting:	453750.32

Layer Number	Layer Type	Layer Thickness (ft)	Depth to Bottom of Layer (ft)	p-y curve	Total Unit Weight (pcf)	Effective Unit Weight (pcf)	Intact Rock Uniaxial Comp Strength (psi)	Rock Type	Poisson's Ratio	GSI	(option 2) Rock mass Deformation Modulus (ksi)	Friction Angle (deg)	Undrained Cohesion (psf)	Ultimate Skin Friction for Compression (psi)	Ultimate Skin Friction for Tension (psi)	Allowable End-Bearing Resistance (ksf)
1	Sand (FILL)	4	4	Sand(Reese)	140	140	---	---	---	---	---	40	---	2	1	0
2	Sand	1	5	Sand(Reese)	120	120	---	---	---	---	---	32	---	5	1.5	2
3	Sand	10	15	Sand(Reese)	120	58	---	---	---	---	---	32	---	3	1	2
4	Silt	2	17	Sand(Reese)	90	28	---	---	---	---	---	27	---	8	3	0
5	Sand	4	21	Sand(Reese)	120	58	---	---	---	---	---	32	---	9	3	2
6	Silt	4	25	Sand(Reese)	120	58	---	---	---	---	---	32	---	9	3	2
7	Sand	2	27	Sand(Reese)	125	63	---	---	---	---	---	37	---	7	2	2

LPile Input Soil/Rock Layer and Properties

Boring Location: B-28 Depth to Ground water (ft) 4.5

As-built Information

Elevation: el 9.402 (NAVD88)
Northing: 166302.135
Easting: 453793.084

Layer Number	Layer Type	Layer Thickness (ft)	Depth to Bottom of Layer (ft)	p-y curve	Total Unit Weight (pcf)	Effective Unit Weight (pcf)	Intact Rock Uniaxial Comp Strength (psi)	Rock Type	Poisson's Ratio	GSI	(option 2) Rock mass Deformation Modulus (ksi)	Friction Angle (deg)	Undrained Cohesion (psf)	Ultimate Skin Friction for Compression (psi)	Ultimate Skin Friction for Tension (psi)	Allowable End-Bearing Resistance (ksf)
1	Sand (FILL)	4.5	4.5	Sand(Reese)	120	120	---	---	---	---	---	35	---	2	1	0
2	Sand (FILL)	1.5	6	Sand(Reese)	120	58	---	---	---	---	---	35	---	4.5	1.5	0
3	Sand	9	15	Sand(Reese)	120	58	---	---	---	---	---	35	---	2.5	1	2
4	Silty Clay	10	25	Soft Clay(Matlock)	100	38	---	---	---	---	---	---	500	2	0	0
5	Sand	10	35	Sand(Reese)	140	78	---	---	---	---	---	40	---	10	3	3
6	Silty Clay	15	50	Soft Clay(Matlock)	105	43	---	---	---	---	---	---	500	2	0	0
7	Sand	25	75	Sand(Reese)	140	78	---	---	---	---	---	40	---	10	3	3
8	Silty/Clayey Sand	10	85	Sand(Reese)	107	45	---	---	---	---	---	30	---	9	3	3
9	Sand	15	100	Sand(Reese)	125	63	---	---	---	---	---	37	---	9	3	3

FAD Input Soil/Rock Layer and Properties

Boring Location:	B-24	Depth to Ground water (ft)	5

As-built Information

Elevation:	el 10.030 (NAVD88)
Northing:	165879.926
Easting:	453750.32

Layer Number	Layer Type	Layer Thickness (ft)	Depth to Bottom of Layer (ft)	Max. SPTN (blows/ft)/ RQD (%)	Min. SPTN (blows/ft)/ RQD (%)	Ave. SPTN (blows/ft)/ RQD (%)	Total Unit Weight (pcf)	Deformation Modulus (ksi)	Friction Angle (deg)	Undrained Shear Strength or Rock Cohesion (tsf)	Rock / Concrete Bond Strength (ksf)
1	Sand (FILL)	4	4	58	58	58	140	8.7	40	---	
2	Sand	1	5	12	12	12	120	1.8	32	---	
3	Sand	10	15	20	12	16	120	1.6	32	---	
4	Silt	2	17	2	2	2	90	0.1	27	---	
5	Sand	4	21	17	17	17	120	1.7	32	---	
6	Silt	4	25	17	17	17	120	1.0	32	---	
7	Sand	2	27	32	32	32	125	3.2	37	---	

FAD Input Soil/Rock Layer and Properties

Boring Location: B-28 Depth to Ground water (ft) 4.5

As-built Information

Elevation:	el 9.402 (NAVD88)
Northing:	166302.135
Easting:	453793.084

Layer Number	Layer Type	Layer Thickness (ft)	Depth to Bottom of Layer (ft)	Max. SPTN (blows/ft)/ RQD (%)	Min. SPTN (blows/ft)/ RQD (%)	Ave. SPTN (blows/ft)/ RQD (%)	Total Unit Weight (pcf)	Deformation Modulus (ksi)	Friction Angle (deg)	Undrained Shear Strength or Rock Cohesion (tsf)	Rock / Concrete Bond Strength (ksf)
1	Sand (FILL)	4.5	4.5	28	28	28	120	2.8	35	---	
2	Sand (FILL)	1.5	6	28	28	28	120	2.8	35	---	
3	Sand	9	15	25	24	25	120	2.5	35	---	
4	Silty Clay	10	25	1	1	1	100	0.1	---	0.25	
5	Sand	10	35	82	31	57	140	5.7	40	---	
6	Silty Clay	15	50	5	1	2	105	0.2	---	0.25	
7	Sand	25	75	99	33	64	140	6.4	40	---	
8	Silty/Clayey Sand	10	85	14	2	8	107	0.5	30	---	
9	Sand	15	100	74	26	49	125	4.9	37	---	

APPENDIX F

Pavement Design Calculations

Standard Duty
ASPHALT PAVEMENT DESIGN

Design Criteria :

Design Life =	*20*	Years
Terminal Serviceability =	*2.5*	
Reliability =	*90*	percent
Initial Serviceability =	*4.2*	
Standard Deviation =	*0.45*	
CBR =	*8*	
Equivalent Single Axle Loads =	*60,000*	

Estimate Resilient Modulus (M_R)

M_R = (2,555) x ($CBR^{0.64}$) = **9,669**

From the AASHTO Design Chart, $SN_{Required}$ = **2.2** (See Sheet 2)

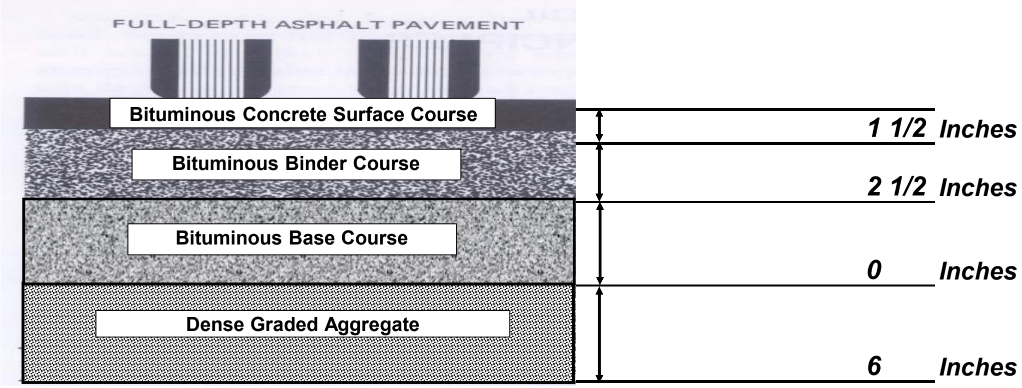
Langan Minimum Recommended Pavement Section:

Thickness		Material		AASHTO Coefficient		
1 1/2	*inches*	Bituminous Concrete Surface Course	x	0.44	=	0.66
2 1/2	*inches*	Bituminous Binder Course	x	0.44	=	1.10
0	*inches*	Bituminous Base Course	x	0.4	=	0.00
6	*inches*	Dense Graded Aggregate	x	0.11	=	0.66

Recommended SN= **2.42**

Check whether the Recommended SN is greater than or equal to the Required SN

Recommended SN		Required SN	CHECK
2.42	>/=	2.2	OK



LANGAN

PROJECT:

Ocean Wind - BL England Substation

Pavement Design Requirements
Car Parking Lots

Upper Township New Jersey

Job # 101010201
Date: 10/5/2022

Sheet 1/2

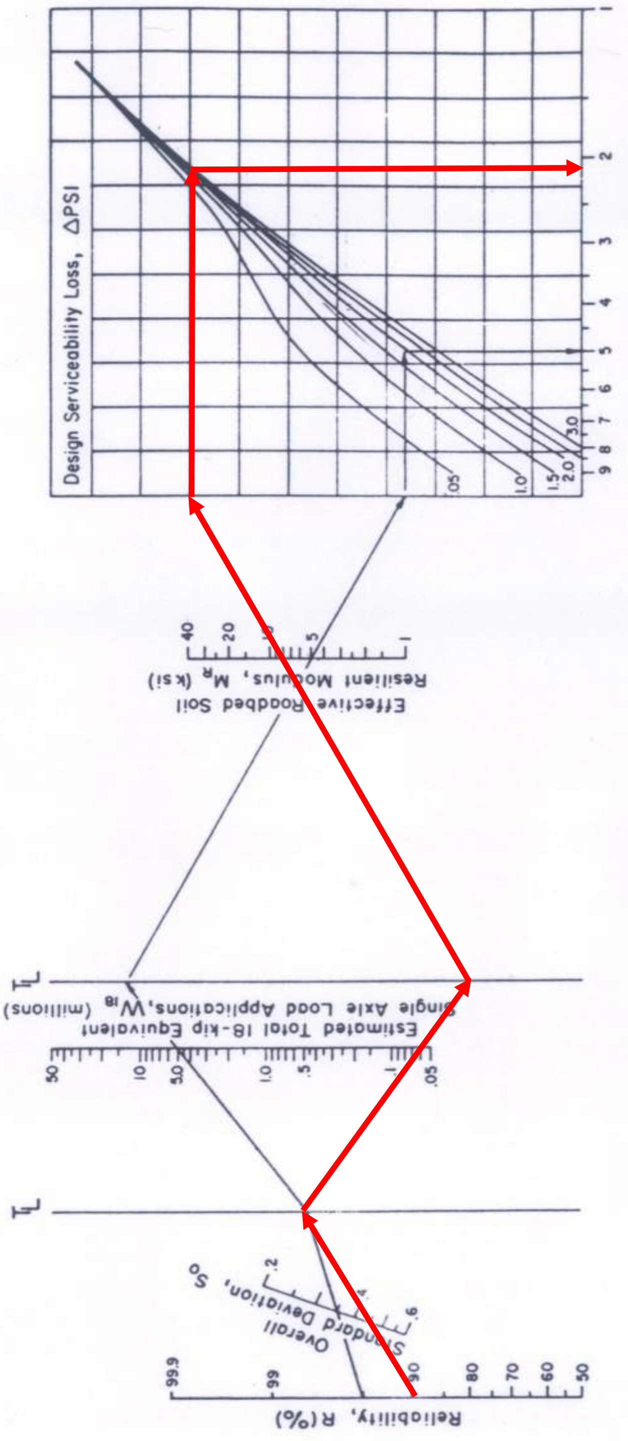


Figure 11.25 Design chart for flexible pavements based on mean values for each input (1 ksi = 6.9 MPa). (From the *AASHTO Guide for Design of Pavement Structures*. Copyright 1986. American Association of State Highway and Transportation Officials, Washington, DC. Used by permission.)

LANGAN

PROJECT:

Ocean Wind - BL England Substation

Pavement Design Requirements
Car Parking Lots

Upper Township **New Jersey**

Job # 101010201

Date: 10/5/2022

Sheet 2/2

Heavy Duty
ASPHALT PAVEMENT DESIGN

Design Criteria :

Design Life = *20* Years

Terminal Serviceability = *2.5*

Reliability = *90* percent

Initial Serviceability = *4.2*

Standard Deviation = *0.45*

CBR = *8*

Equivalent Single Axle Loads = *1,000,000*

Estimate Resilient Modulus (M_R)

M_R = (2,555) x (CBR$^{0.64}$) = **9,669**

From the AASHTO Design Chart, SN $_{Required}$ = **3.3** **(See Sheet 2)**

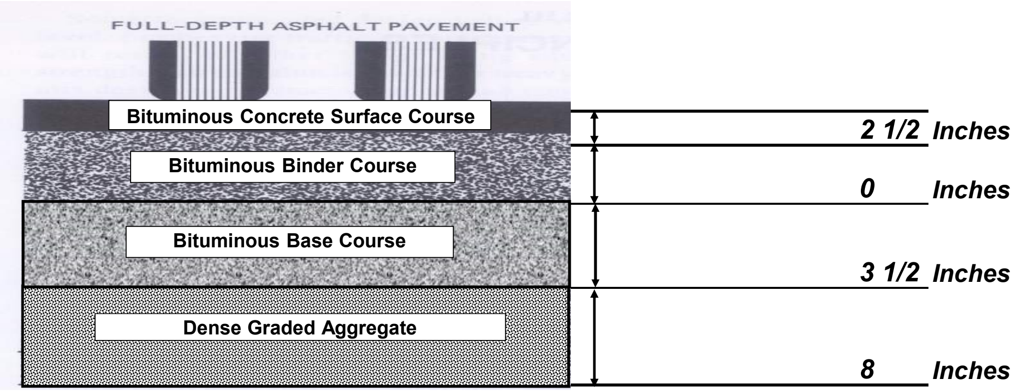
Langan Minimum Recommended Pavement Section:

Thickness		Material		AASHTO Coefficient		
2 1/2	*inches*	Bituminous Concrete Surface Course	x	0.44	=	1.10
0	*inches*	Bituminous Binder Course	x	0.44	=	0.00
3 1/2	*inches*	Bituminous Base Course	x	0.4	=	1.40
8	*inches*	Dense Graded Aggregate	x	0.11	=	0.88

Recommended SN= **3.38**

Check whether the Recommended SN is greater than or equal to the Required SN

Recommended SN		Required SN	CHECK
3.38	>/=	3.3	OK



LANGAN

PROJECT:

Ocean Wind - BL England Substation

Pavement Design Requirements
Heavy Duty

Upper Township New Jersey

Job # 101010201

Date: 10/5/2022

Sheet 1/2

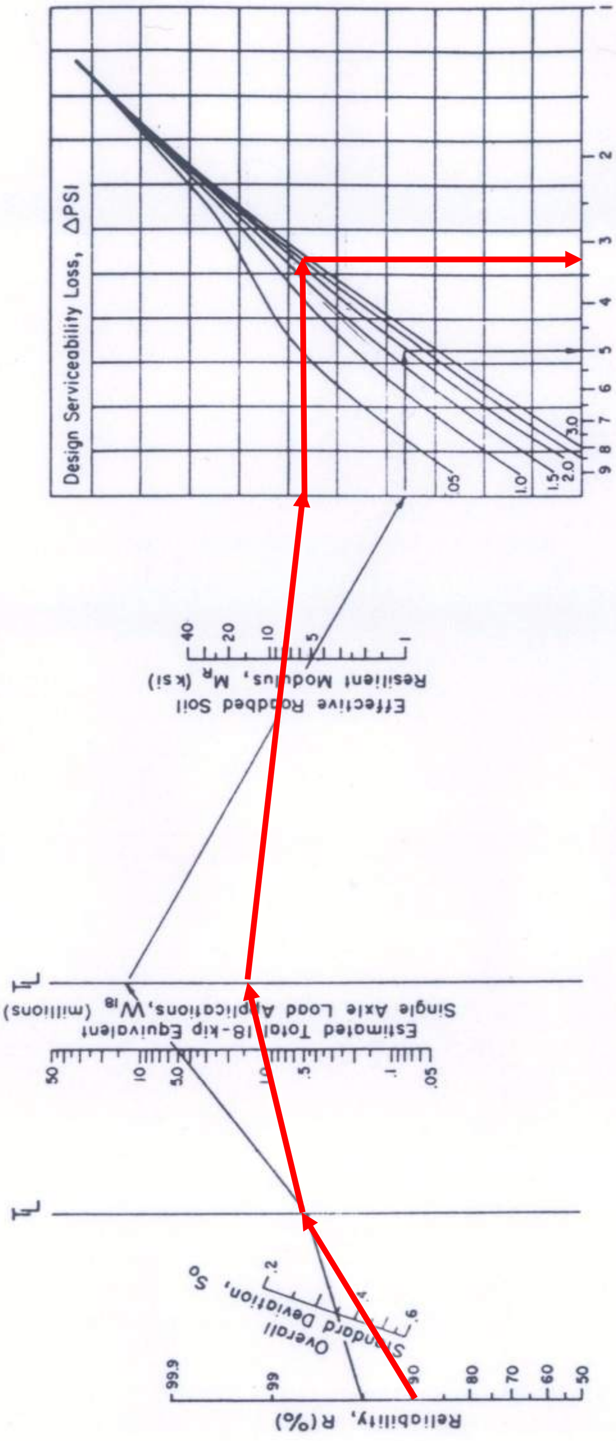


Figure 11.25 Design chart for flexible pavements based on mean values for each input (1 ksi = 6.9 MPa). (From the *AASHTO Guide for Design of Pavement Structures.* Copyright 1986. American Association of State Highway and Transportation Officials, Washington, DC. Used by permission.)

LANGAN

PROJECT:

Ocean Wind - BL England Substation

Pavement Design Requirements
Heavy Duty

Upper Township **New Jersey**

Job #	101010201
Date:	10/5/2022

Sheet 2/2

APPENDIX G

Corrosion Potential Evaluation

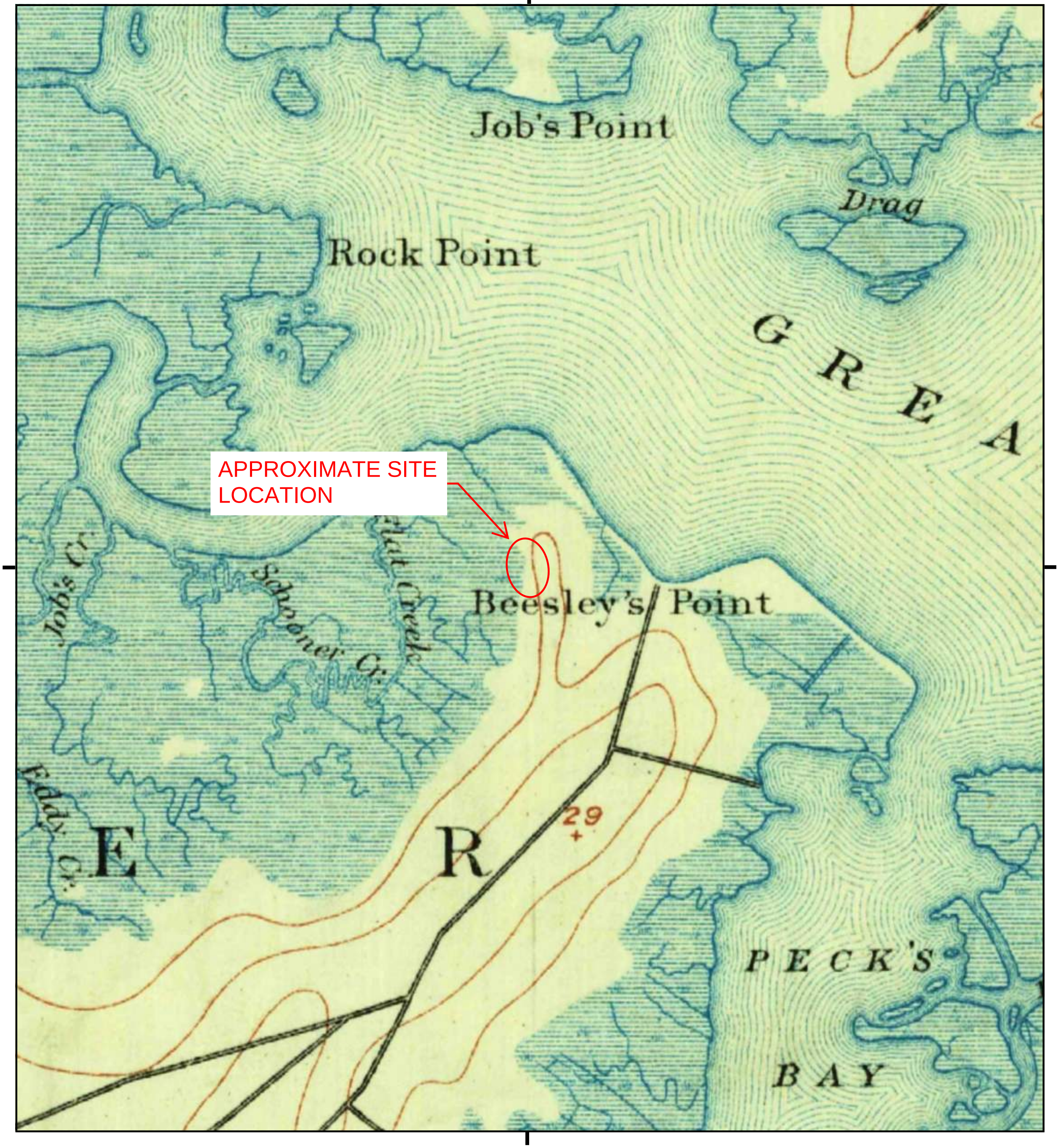
(PENDING)

ATTACHMENT A

Historic Topographic Maps

Historical Topo Map

1890



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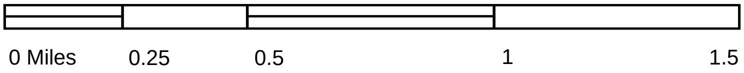
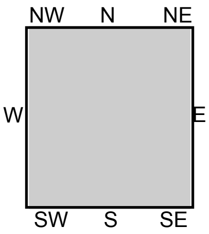


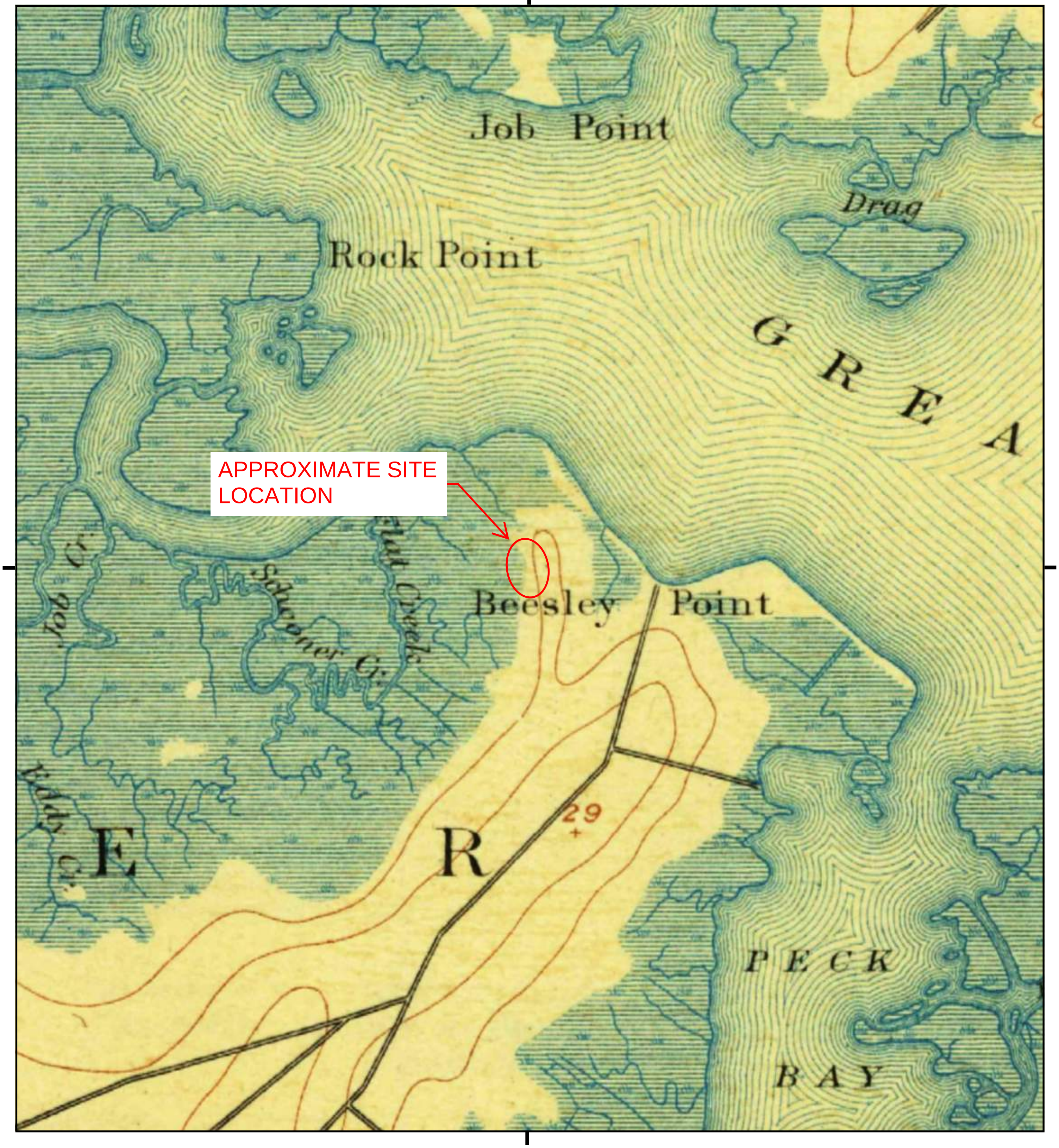


TP, Great Egg Harbor, 1890, 15-minute

SITE NAME: BL England
ADDRESS: 900 N Shore Rd
Marmora, NJ 08223
CLIENT: Langan Engineering

Historical Topo Map

1893



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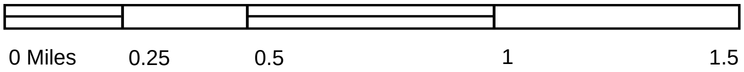
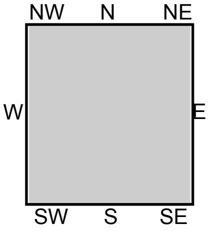


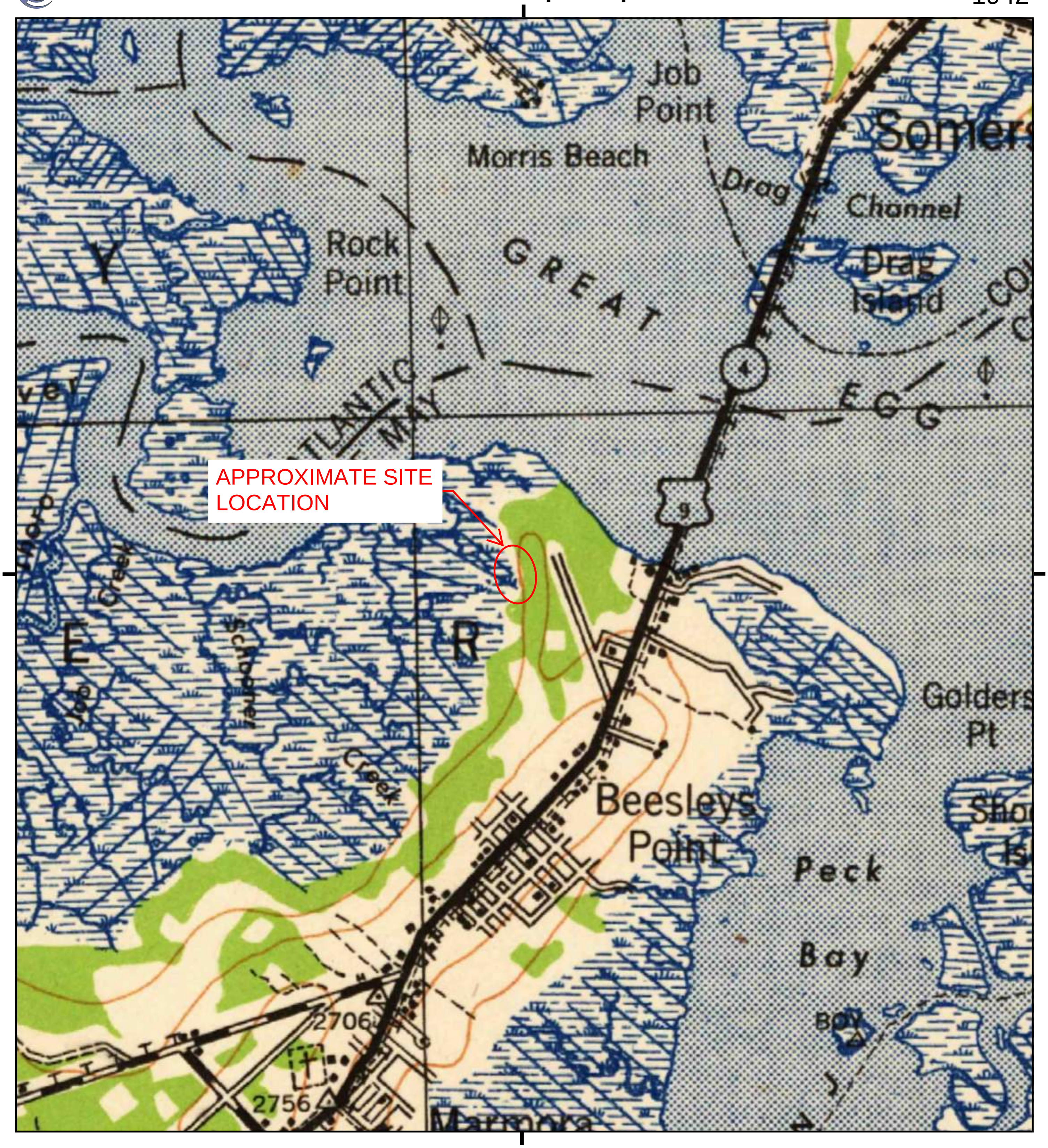


TP, Great Egg Harbor, 1893, 15-minute

SITE NAME: BL England
ADDRESS: 900 N Shore Rd
Marmora, NJ 08223
CLIENT: Langan Engineering

Historical Topo Map

1942



This report includes information from the following map sheet(s).

NW	N	NE
W		E
SW	S	SE

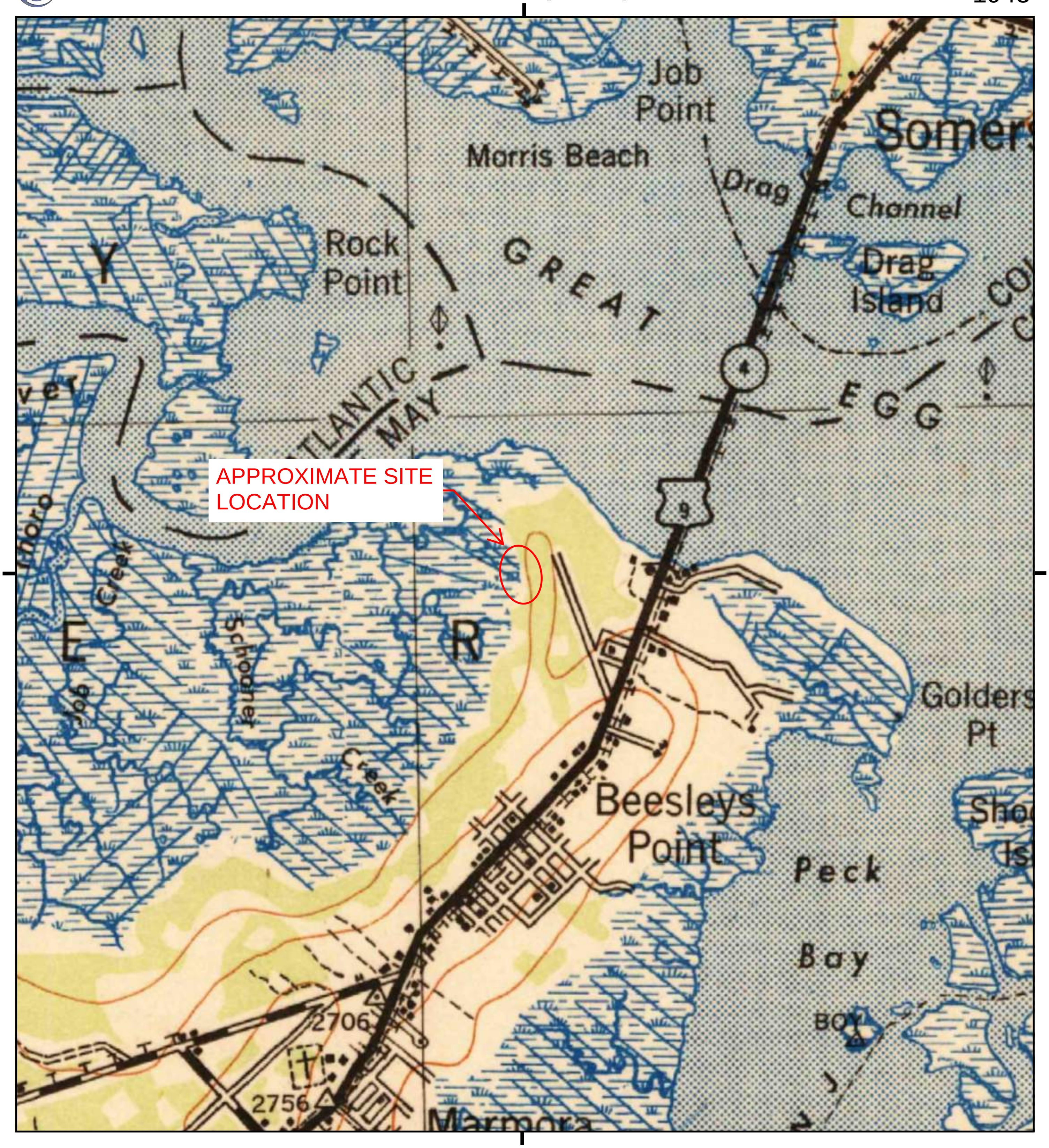
TP, Pleasantville, 1942, 15-minute

SITE NAME: BL England
ADDRESS: 900 N Shore Rd
Marmora, NJ 08223
CLIENT: Langan Engineering

N

Historical Topo Map

1943



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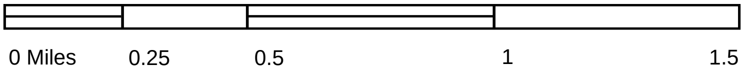
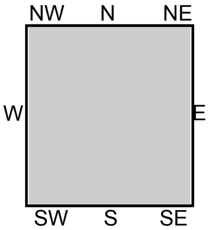


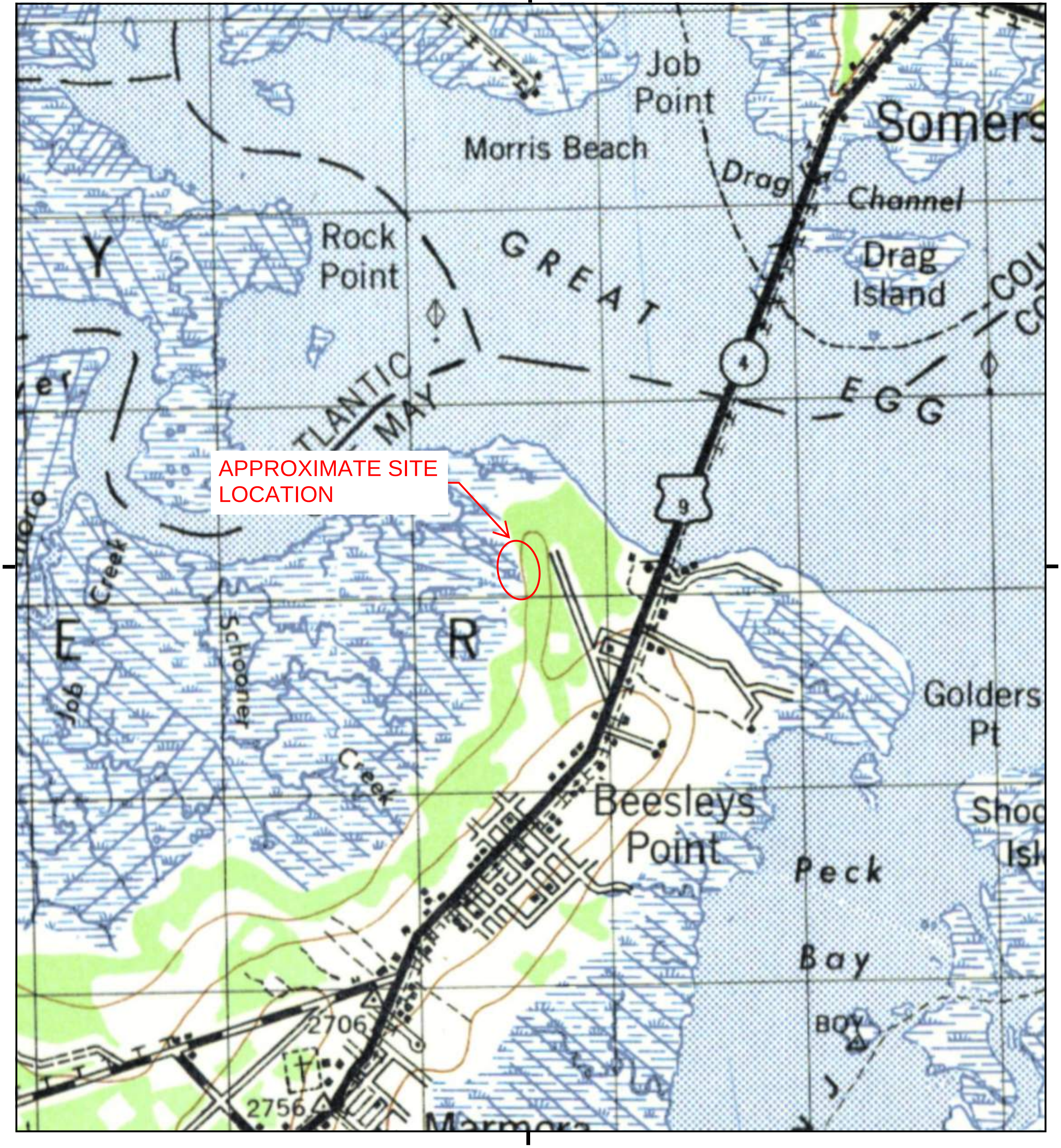


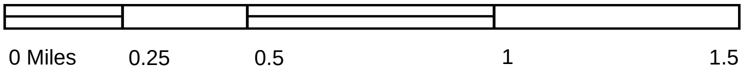
TP, Pleasantville, 1943, 15-minute

SITE NAME: BL England
ADDRESS: 900 N Shore Rd
Marmora, NJ 08223
CLIENT: Langan Engineering

Historical Topo Map

1946





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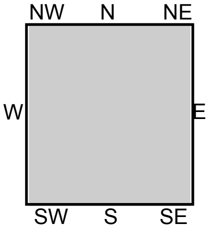
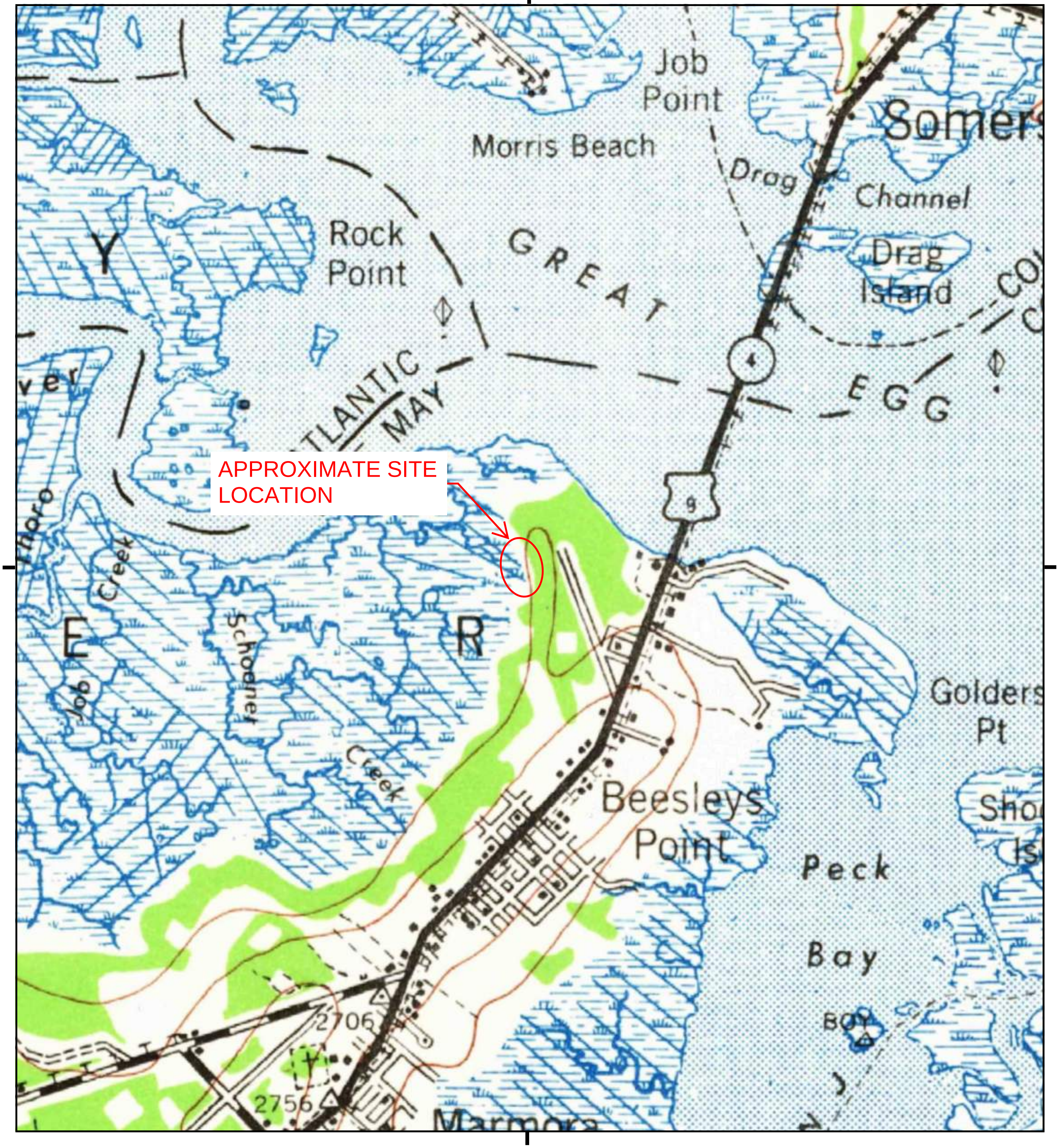


TP, PLEASANTVILLE, 1946, 15-minute

SITE NAME: BL England
ADDRESS: 900 N Shore Rd
Marmora, NJ 08223
CLIENT: Langan Engineering

Historical Topo Map

1948



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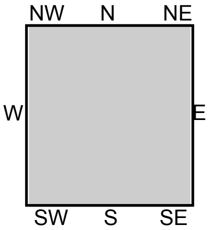
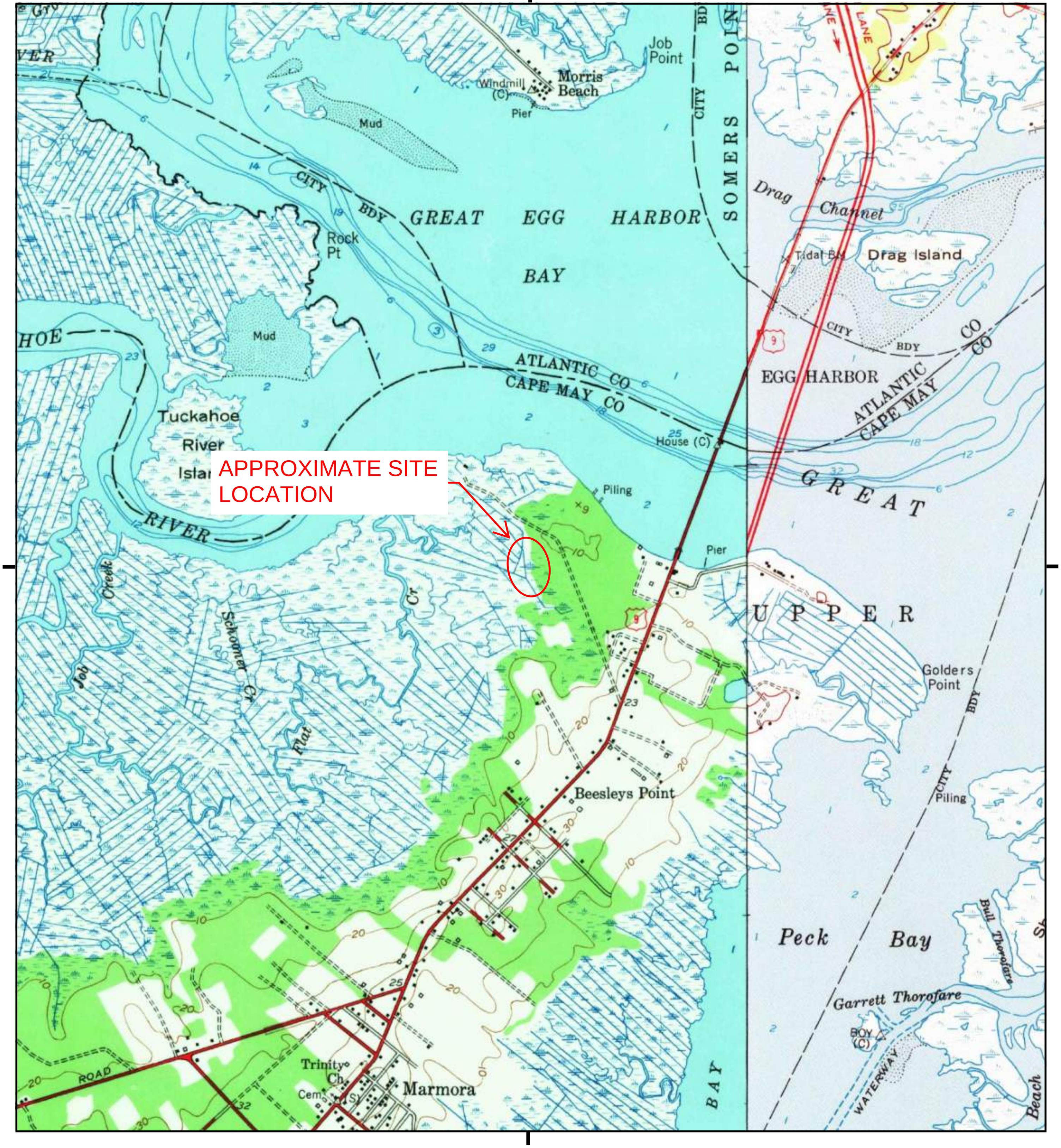


TP, Pleasantville, 1948, 15-minute

SITE NAME:	BL England
ADDRESS:	900 N Shore Rd Marmora, NJ 08223
CLIENT:	Langan Engineering

Historical Topo Map

1952



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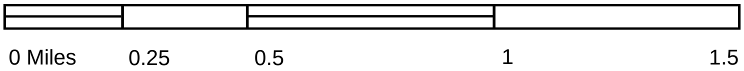
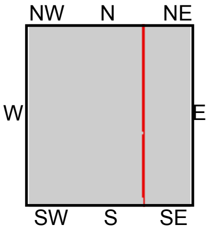


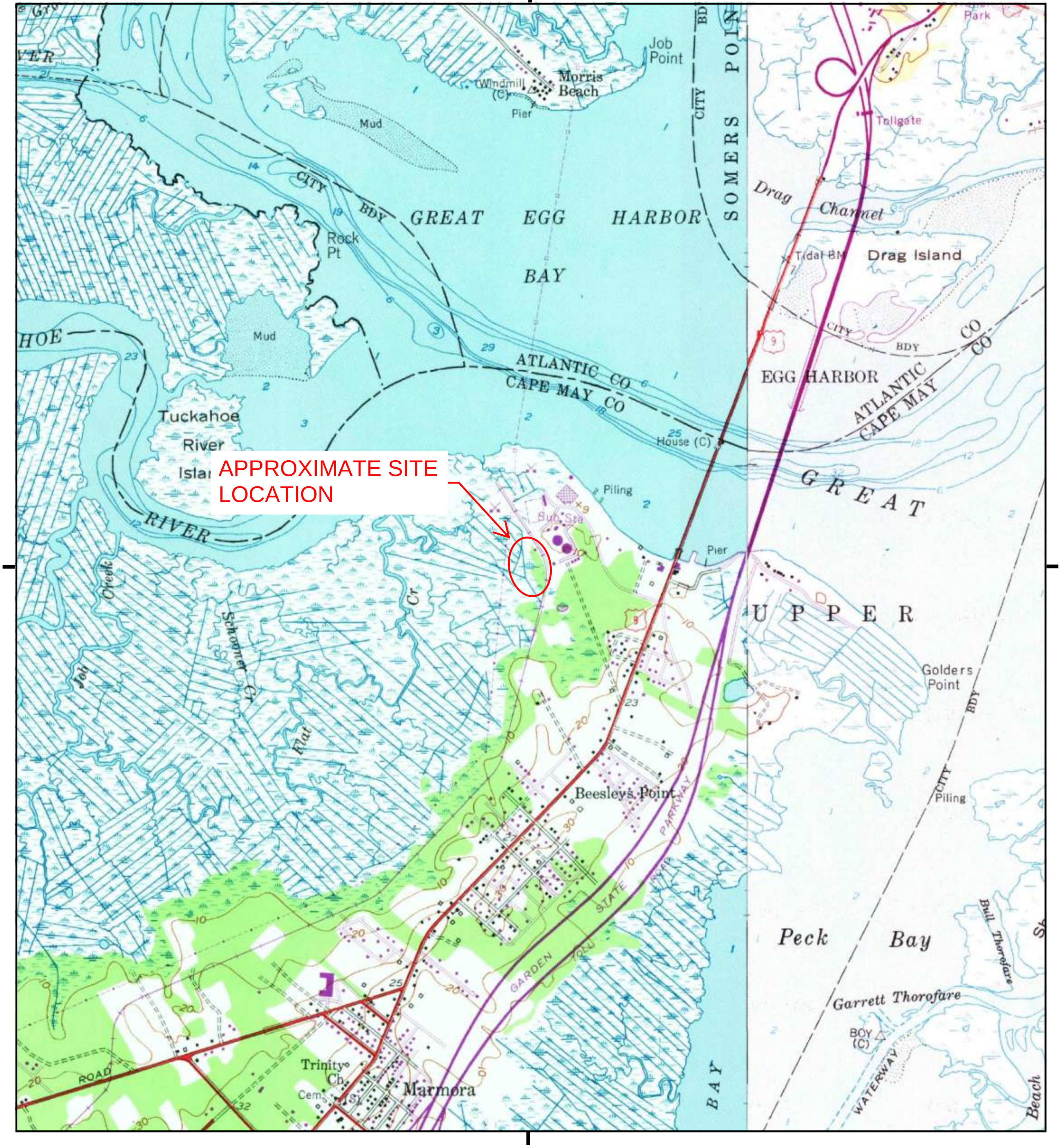


TP, Marmora, 1952, 7.5-minute
NE, Ocean City, 1952, 7.5-minute

SITE NAME: BL England
ADDRESS: 900 N Shore Rd
Marmora, NJ 08223
CLIENT: Langan Engineering

Historical Topo Map

1972



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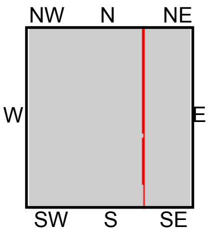
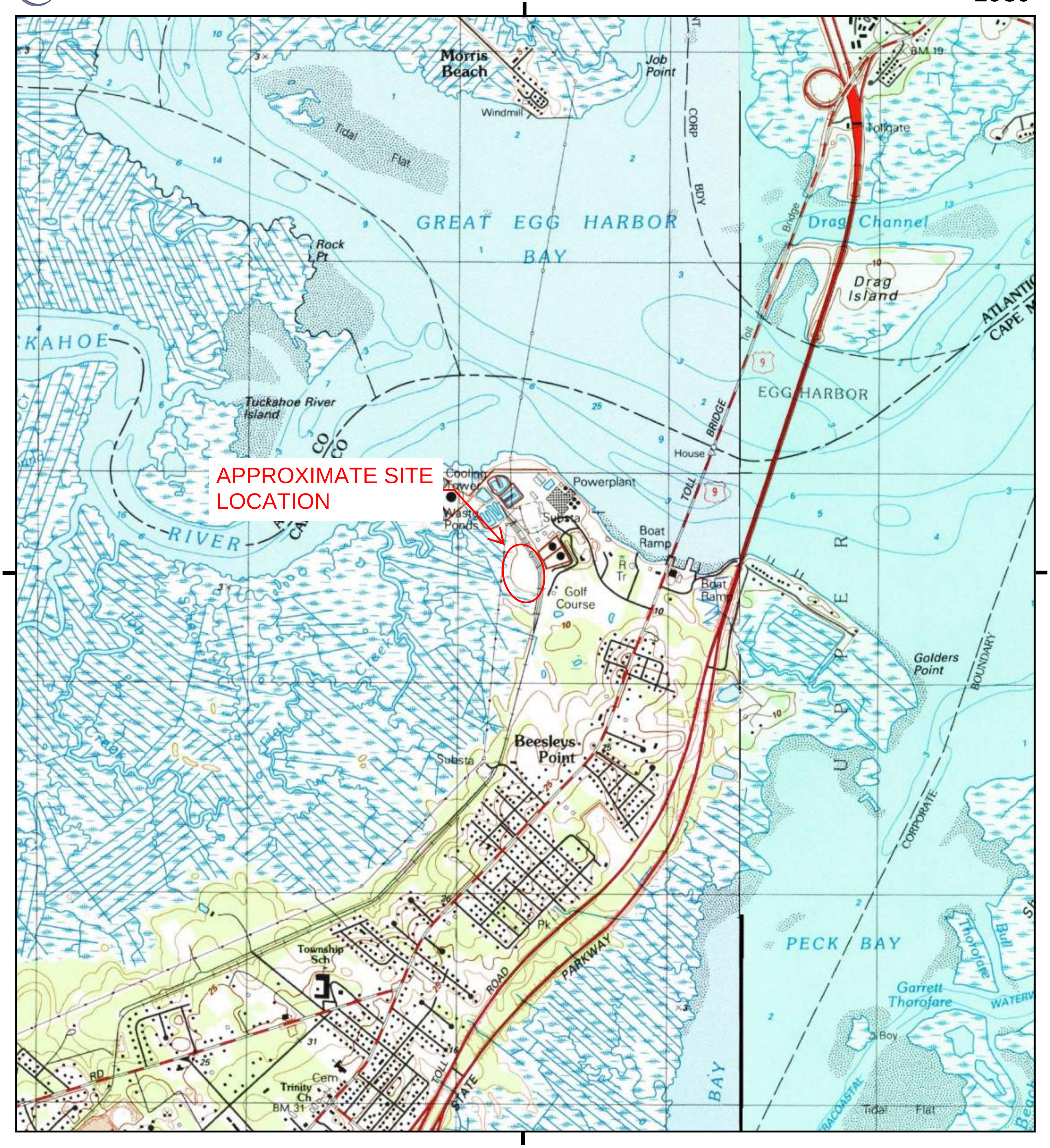


TP, Marmora, 1972, 7.5-minute
NE, Ocean City, 1972, 7.5-minute

SITE NAME: BL England
ADDRESS: 900 N Shore Rd
Marmora, NJ 08223
CLIENT: Langan Engineering

Historical Topo Map

1989



This report includes information from the following map sheet(s).

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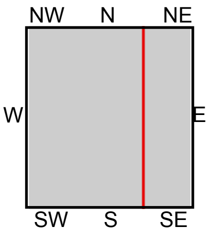
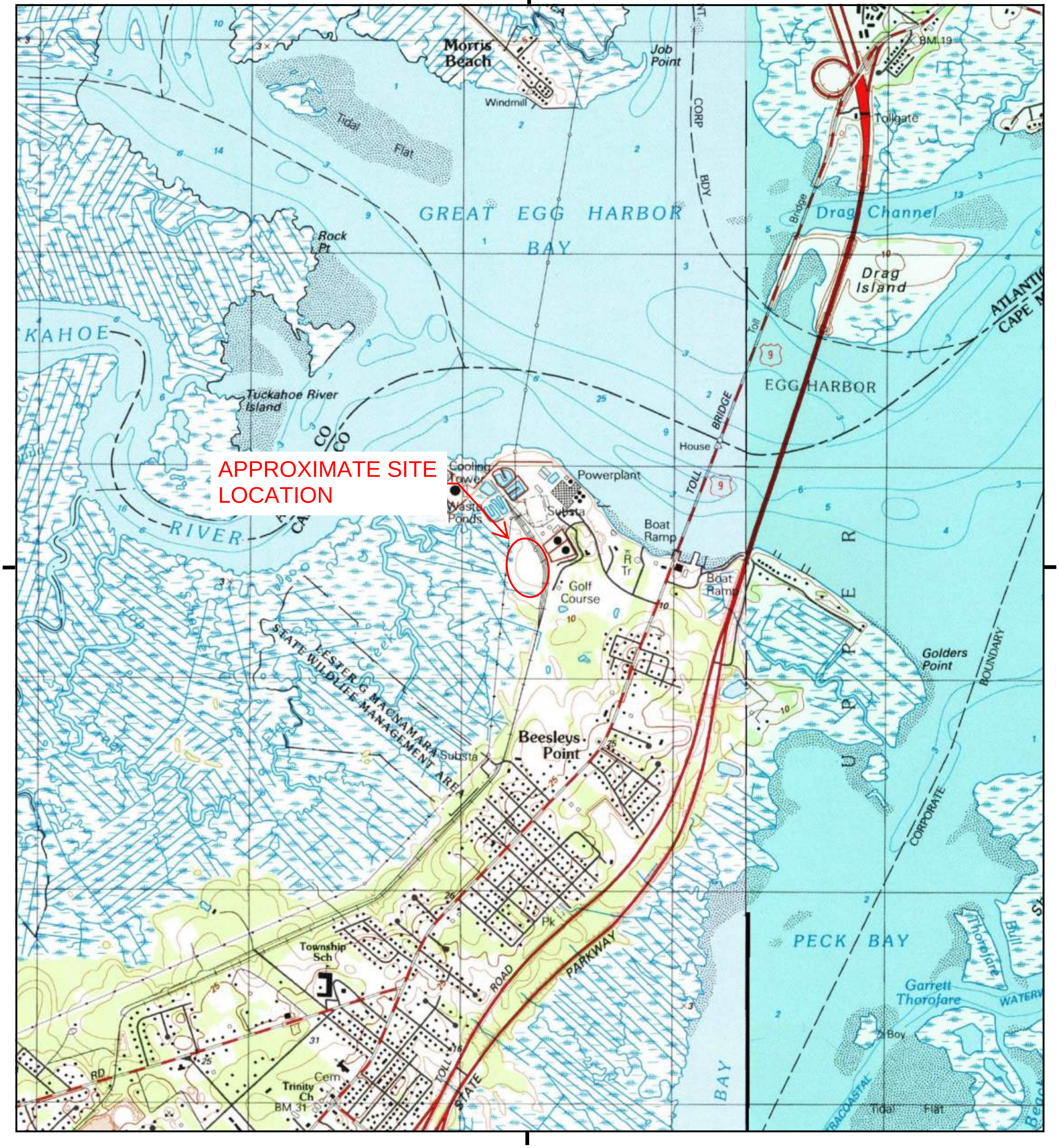


TP, Marmora, 1989, 7.5-minute
NE, Ocean City, 1989, 7.5-minute

SITE NAME: BL England
ADDRESS: 900 N Shore Rd
Marmora, NJ 08223
CLIENT: Langan Engineering

Historical Topo Map

1994



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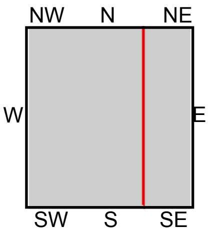
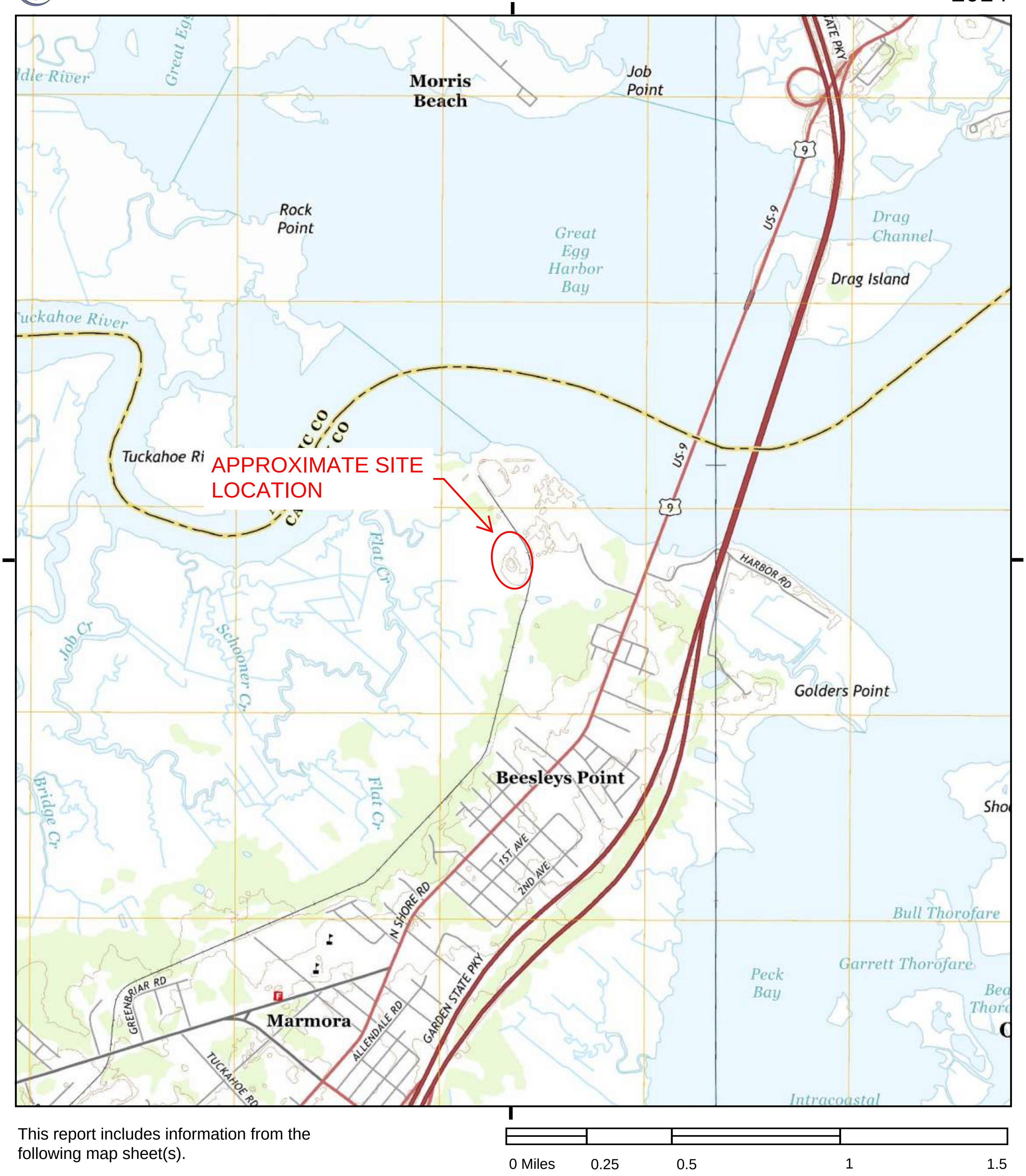


TP, Marmora, 1994, 7.5-minute
NE, Ocean City, 1994, 7.5-minute

SITE NAME: BL England
ADDRESS: 900 N Shore Rd
Marmora, NJ 08223
CLIENT: Langan Engineering

Historical Topo Map

2014



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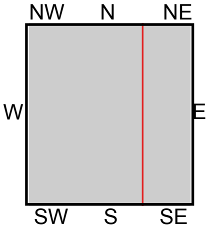
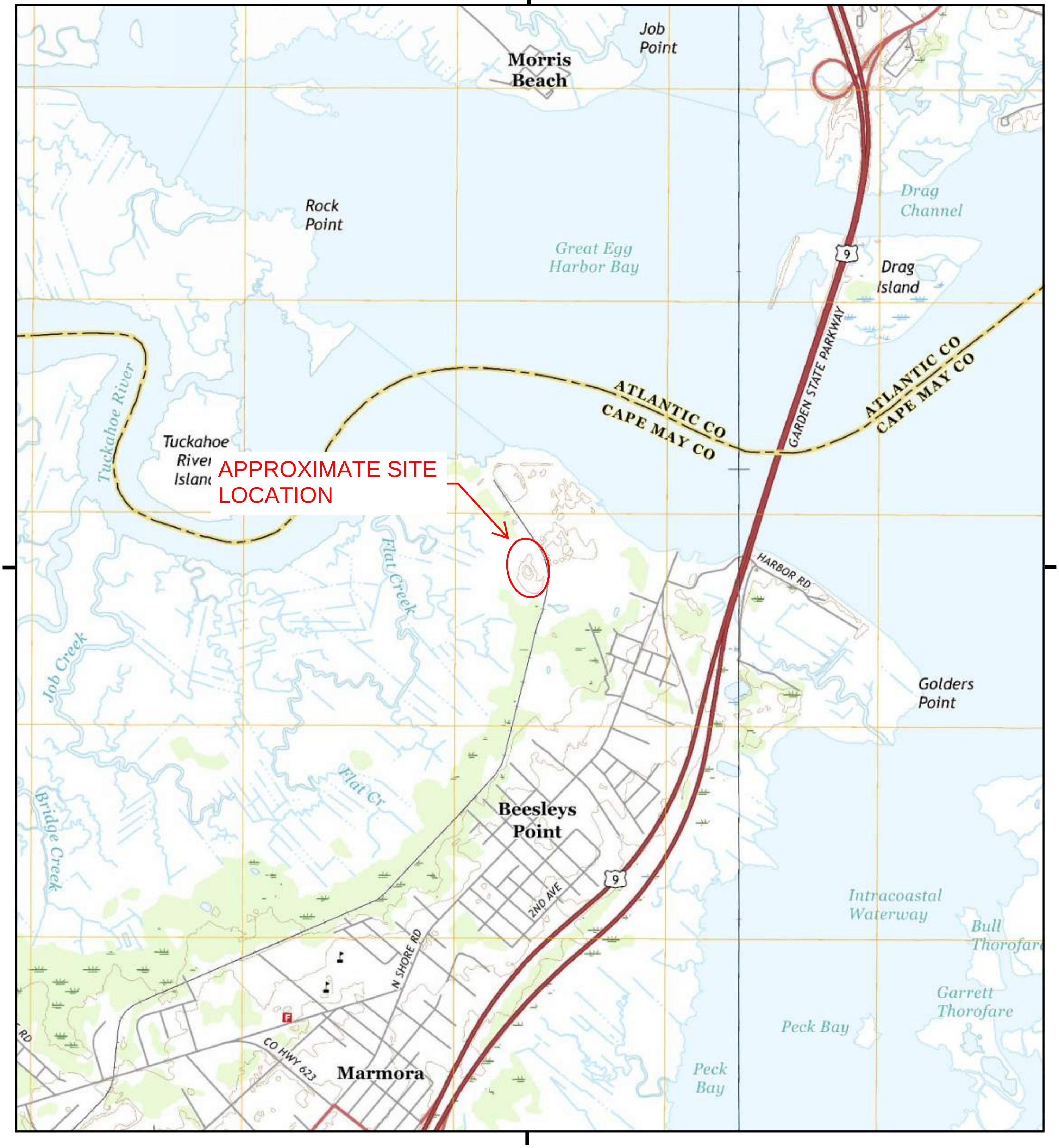


TP, Marmora, 2014, 7.5-minute
NE, Ocean City, 2014, 7.5-minute

SITE NAME: BL England
ADDRESS: 900 N Shore Rd
Marmora, NJ 08223
CLIENT: Langan Engineering

Historical Topo Map

2016



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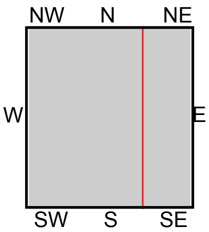
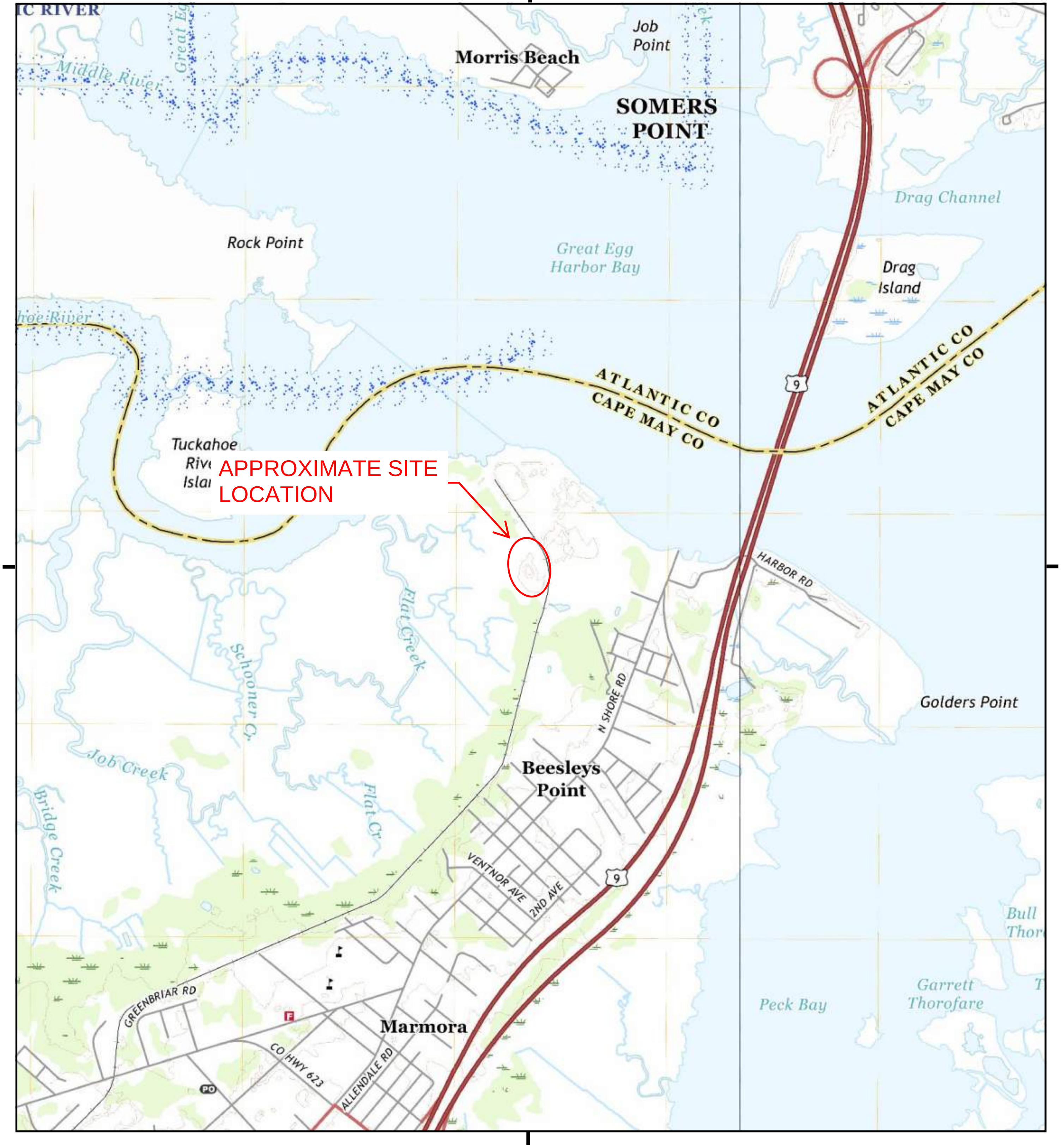


TP, Marmora, 2016, 7.5-minute
NE, Ocean City, 2016, 7.5-minute

SITE NAME:	BL England
ADDRESS:	900 N Shore Rd Marmora, NJ 08223
CLIENT:	Langan Engineering

Historical Topo Map

2019



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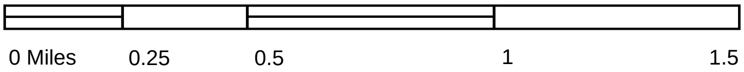
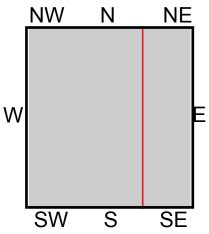


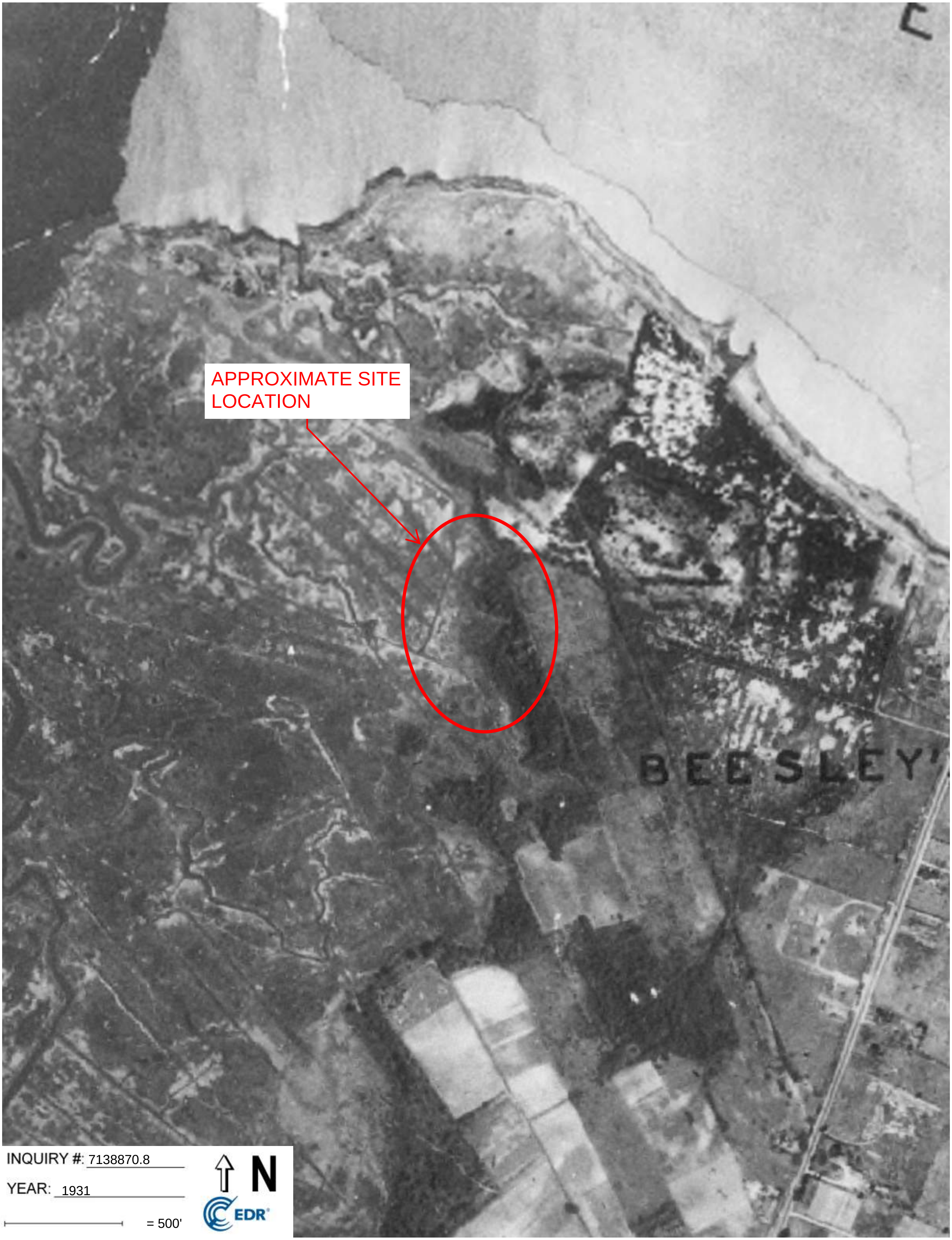


TP, Marmora, 2019, 7.5-minute
NE, Ocean City, 2019, 7.5-minute

SITE NAME:	BL England
ADDRESS:	900 N Shore Rd Marmora, NJ 08223
CLIENT:	Langan Engineering

ATTACHMENT B

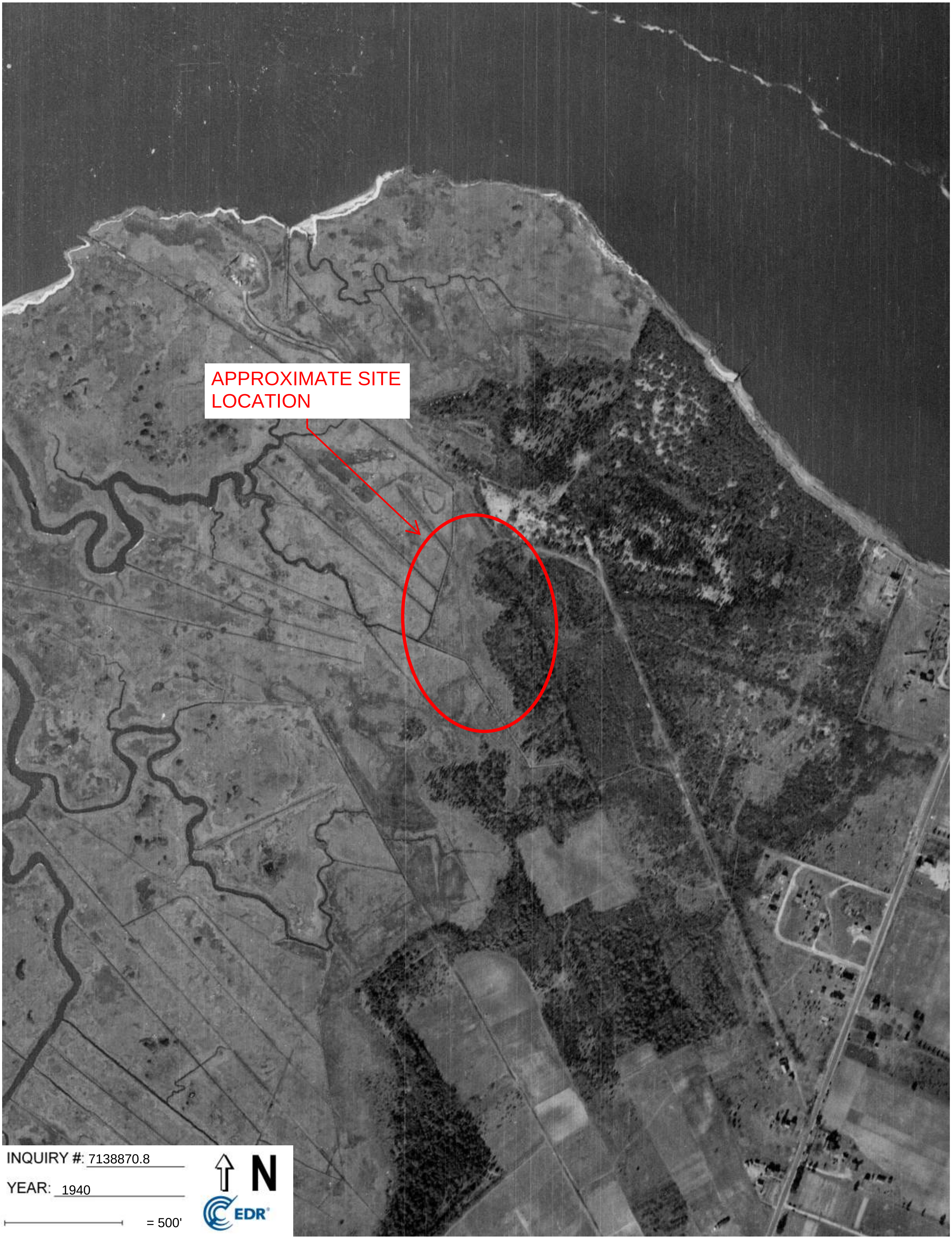
Historic Aerial Photographs



INQUIRY #: 7138870.8

YEAR: 1931

= 500'



INQUIRY #: 7138870.8

YEAR: 1940

INQUIRY #: 7138870.8

YEAR: 1951

= 500'

INQUIRY #: 7138870.8

YEAR: 1957

= 500'

EDR

INQUIRY #: 7138870.8

YEAR: 1961

= 500'

INQUIRY #: 7138870.8

YEAR: 1974

INQUIRY #: 7138870.8

YEAR: 1977

INQUIRY #: 7138870.8

YEAR: 1984

= 500'

INQUIRY #: 7138870.8

YEAR: 1986

INQUIRY #: 7138870.8

YEAR: 1991

= 500'

INQUIRY #: 7138870.8

YEAR: 1995

= 500'

N

APPROXIMATE SITE LOCATION

INQUIRY #: 7138870.8

YEAR: 2006

= 500'

INQUIRY #: 7138870.8

YEAR: 2010


APPROXIMATE SITE LOCATION
INQUIRY #: 7138870.8
YEAR: 2013
= 500'
N
EDR

INQUIRY #: 7138870.8

YEAR: 2017

= 500'

ATTACHMENT C

Cone Penetration Test Report

PRESENTATION OF SITE INVESTIGATION RESULTS

BL England Substation – Marmora NJ

Prepared for:
Langan Engineering

Prepared by:

Craig Geotechnical Drilling Co., Inc.
PO Box 427
Mays Landing NJ 08330

Tel: 609-625-4862
Fax: 609-625-4306

Email: Kcraig@craigtest.com
www.craigtest.com

CRAIG

Introduction

The enclosed report presents the results of piezocone penetration testing (CPTu or CPT) program carried out at BL England Substation – Marmora NJ. The site investigation was conducted by Craig Geotechnical Drilling Co., Inc. under contract to Langan.

A total of 17 cone penetration tests were completed. The CPT program was performed to evaluate the subsurface soil conditions. CPT sounding locations were selected and numbered under the supervision of Langan personnel.

Project Information

Project	
Client:	Langan Engineering
Project:	BL England Substation – Marmora NJ
Job Number:	220288
Date:	9/1/22 – 9/6/22

Rig Description	Deployment System	Test Type
CPT Truck Rig	20 Ton Truck (Twin Cylinders)	CPT & SCPT

Cone Penetration Test (CPT)	
Depth Reference	Ground Surface at the time of the investigation.
Seismic Shear Wave Velocity	

Limitations

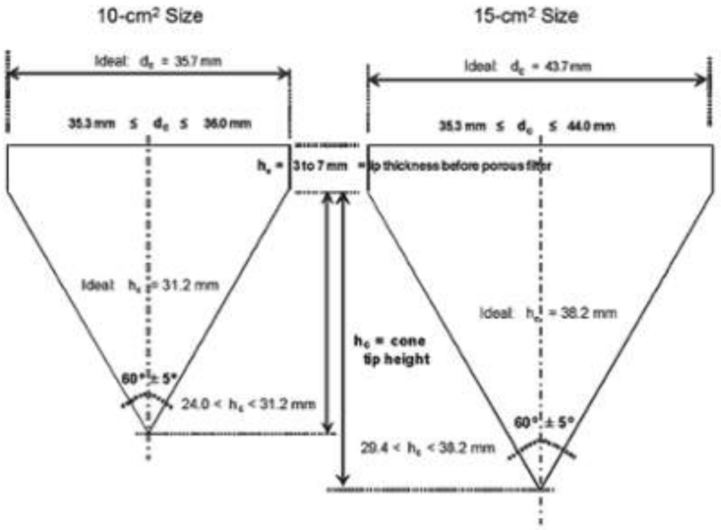
This report has been prepared for the exclusive use of Langan for the project titles “BL England Substation – Marmora NJ”. The report’s contents may not be relied upon by any other party without the express written permission of Craig Geotechnical Drilling Co., Inc. CGD has provided site investigation services, prepared the factual data reporting, and provided geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

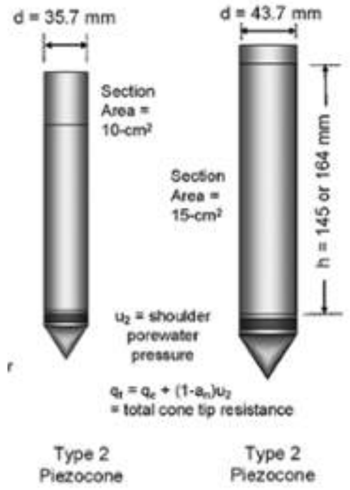
The information presented in the report document and the accompanying data set pertain to the specific project, site conditions and objectives described to Craig Geotechnical Drilling by the client. In order to properly understand the factual data, assumptions and calculations, reference must be made to the documents provided and their accompanying data sets, in their entirety.

CPT Cones

Cone Penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Vertek of Randolph, VT 05060.

CPT cones are available in multiple sizes, but the10 cm^2 cone and 10 cm^2 cone are the industry standard. Penetrometers are made of high strength steel and designed to resist abrasion by soil. The 10 cm^2 cone & 15 cm^2 cone were used on this project.





Minimum and Maximum Cone Measurements

Cone Size (Cross-Sectional Area)	**10 cm^2**			**15 cm^2**		
Measurement	***Min***	***Ideal***	***Max***	***Min***	***Ideal***	***Max***
Cone Diameter (d_c)	35.3 mm	35.7 mm	36.0 mm	35.3 mm	43.7 mm	44.0 mm
Cone Tip Height (h_c)	24.0 mm	31.2 mm	31.2 mm	29.4 mm	38.2 mm	38.2 mm
Cone Tip Angle	55°	60°	65°	55°	60°	65°
Lip Thickness Before Porous Filter (h_e)	3 mm	N/A	7 mm	3 mm	N/A	7 mm
Friction Sleeve Diameter	35.7 mm	35.7 mm	36.05 mm	43.7 mm	43.7 mm	44.05 mm
Friction Sleeve Surface Area	147 cm^2	150 cm^2	153 cm^2	220.5 cm^2	225 cm^2	229.5 cm^2

Cone Penetration Tests

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position. The CPTu is conducted at a steady rate of 2 cm/s, within acceptable tolerances. Typically, one-meter length rods with an outer diameter of 15cm are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Dissipation Tests

As a CPT cone is pushed into saturated subsurface soil, it creates a localized increase in pore pressure (denoted excess pore pressure, u_i) as groundwater is pushed out of the way of the cone. In a pore pressure dissipation test, the downward movement of the cone is paused and the time it takes for the pore pressure to stabilize is measured. This stable pore pressure is called equilibrium pore pressure, u_o. This information allows the user to identify important hydrogeologic features:

The water table (or phreatic surface) depth is defined as the distance below the soil surface at which pore pressure is equal to atmospheric pressure. This can be roughly visualized as the level below which subsurface materials are fully saturated with groundwater.

Especially in fine-grained soils, estimating the water table can be more complex than simply detecting moisture, since surface tension draws groundwater upwards, creating negative pore pressures. This is effect is called capillary rise.

Very low or negative pressures can be difficult to measure precisely with the piezocone, which is primarily designed to measure high pressures below the water table. In this case, the water table depth can be calculated by the following formula:

$$d_{water} = d_{cone} - h_w$$

d_{water} = *water table depth*
d_{cone} = *depth of piezocone*
h_w = *water head*

The **water head**, h_w, is the height of the water above the cone, which can be calculated based on the pore pressure and the unit weight of water:

$$h_w = u/\gamma_w + z$$

h_w = *water head*
u_o = *equilibrium pore pressure*
γ_w = *unit weight of water*
z = *distance, if any, between pressure sensor location and depth reference point on the piezocone*

The rate of dissipation indicates the permeability or hydraulic conductivity of the soil – that is, the tendency of the soil to allow or resist the flow of groundwater.

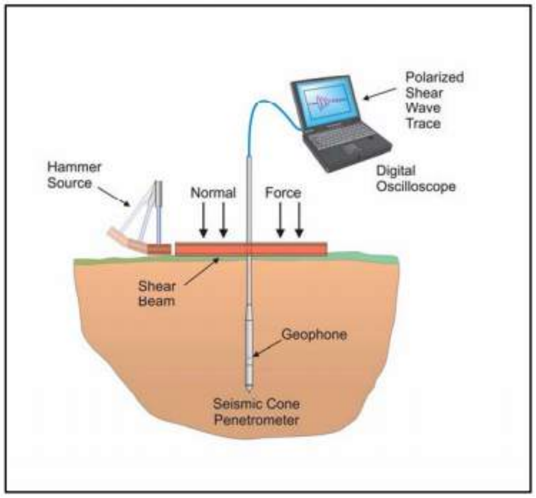
A rapidly dissipating pore pressure indicates the presence of an aquifer (a porous region where groundwater tends to flow), while a slowly dissipating pore pressure indicates an aquitard (a compacted region that resists the flow of groundwater).

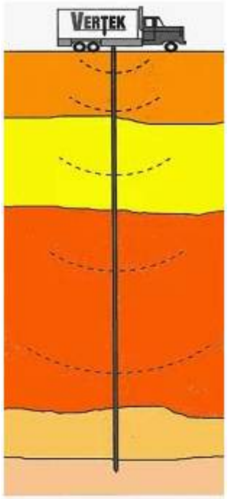
Seismic CPTs

Seismic CPT or SCPT is a method of calculating the *small strain shear modulus* of the soil by measuring shear wave velocity through the soil. The small strain modulus is an important quantity for determining the *dynamic response* of soil during earthquakes, explosive detonations, vibrations from machinery, and during wave loading for offshore structures. The wave speeds and moduli derived from seismic CPT measurements aid in the determination of *soil liquefaction potential* and improve the interpretation of surface seismic surveys by *providing wave speed profiles as a function of depth*.

SCPT Cone: The SCPT cone is a CPT or CPTU cone that is equipped with one or more geophone sensors. These sensors measure the magnitude and arrival time of seismic shear and compression waves.
Wave Generator: Seismic shear waves are generated at the soil surface.
This method uses an electronic wave generator attached to the CPT rig and increases repeatability and reduces physical strain and testing time for the field team.
The CPT test must be paused briefly at the desired intervals to perform the wave generation and data collection.
Data Acquisition System: As seismic waves are registered by the geophone sensors, data is transferred from the cone to the soil surface by wires that run though the push rods. The SCPT data acquisition system logs this data and analyzes it to determine the speed of the waves based on their arrival time and the distance between the wave generator and the sensors.

Calculation of the interval velocities are performed by visually picking a common feature (e.g. the first characteristic peak, trough, or crossover) on all of the recorded wave sets and taking the difference in ray path divided by the time difference between subsequent features. Ray path is defined as the straight-line distance from the seismic source to the geophone, accounting for beam offset, source depth and geophone offset from the cone tip.





Boring and CPT Location Plan

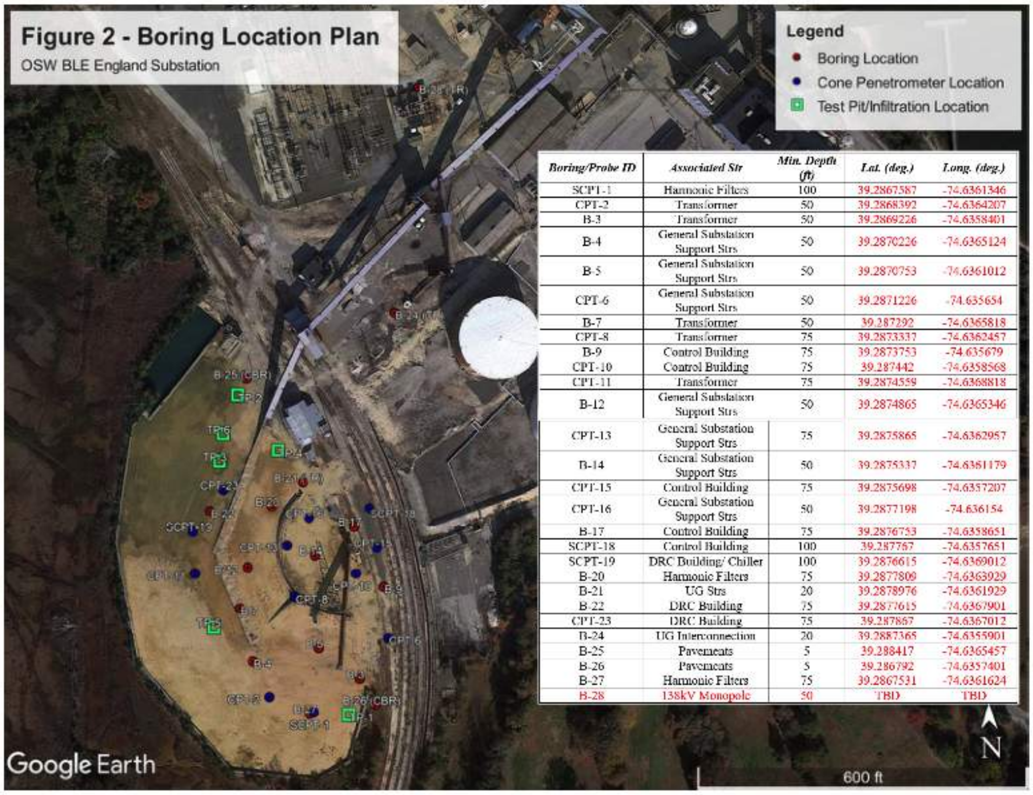


Figure 2 - Boring Location Plan

OSW BLE England Substation

Boring/Probe ID	*Associated Str*	*Min. Depth (ft)*	*Lat. (deg.)*	*Long. (deg.)*
SCPT-1	Harmonic Filters	100	39.2867587	-74.6361346
CPT-2	Transformer	50	39.2868392	-74.6364207
B-3	Transformer	50	39.2869226	-74.6358401
B-4	General Substation Support Strs	50	39.2870226	-74.6365124
B-5	General Substation Support Strs	50	39.2870753	-74.6361012
CPT-6	General Substation Support Strs	50	39.2871226	-74.635654
B-7	Transformer	50	39.287292	-74.6365818
CPT-8	Transformer	75	39.2873337	-74.6362457
B-9	Control Building	75	39.2873753	-74.635679
CPT-10	Control Building	75	39.287442	-74.6358568
CPT-11	Transformer	75	39.2874559	-74.6368818
B-12	General Substation Support Strs	50	39.2874865	-74.6365346
CPT-13	General Substation Support Strs	75	39.2875865	-74.6362957
B-14	General Substation Support Strs	50	39.2875337	-74.6361179
CPT-15	Control Building	75	39.2875698	-74.6357207
CPT-16	General Substation Support Strs	50	39.2877198	-74.636154
B-17	Control Building	75	39.2876753	-74.6358651
SCPT-18	Control Building	100	39.287767	-74.6357651
SCPT-19	DRC Building/ Chiller	100	39.2876615	-74.6369012
B-20	Harmonic Filters	75	39.2877809	-74.6363929
B-21	UG Strs	20	39.2878976	-74.6361929
B-22	DRC Building	75	39.2877615	-74.6367901
CPT-23	DRC Building	75	39.287867	-74.6367012
B-24	UG Interconnection	20	39.2887365	-74.6355901
B-25	Pavements	5	39.288417	-74.6365457
B-26	Pavements	5	39.286792	-74.6357401
B-27	Harmonic Filters	75	39.2867531	-74.6361624
B-28	138kV Monopole	50	TBD	TBD

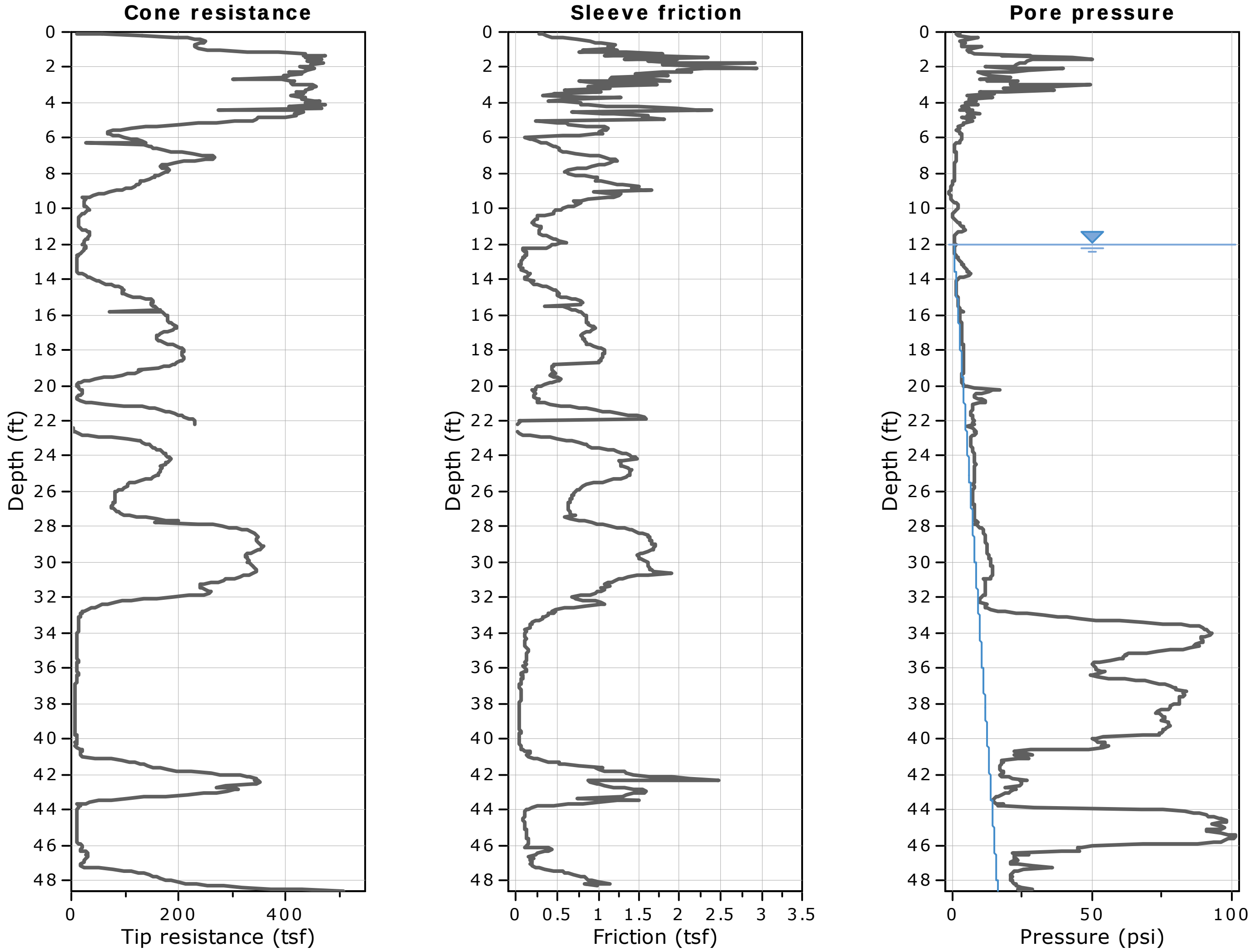
Cone Penetration Test Summary and Cone Penetration Test Plots

CRAIG

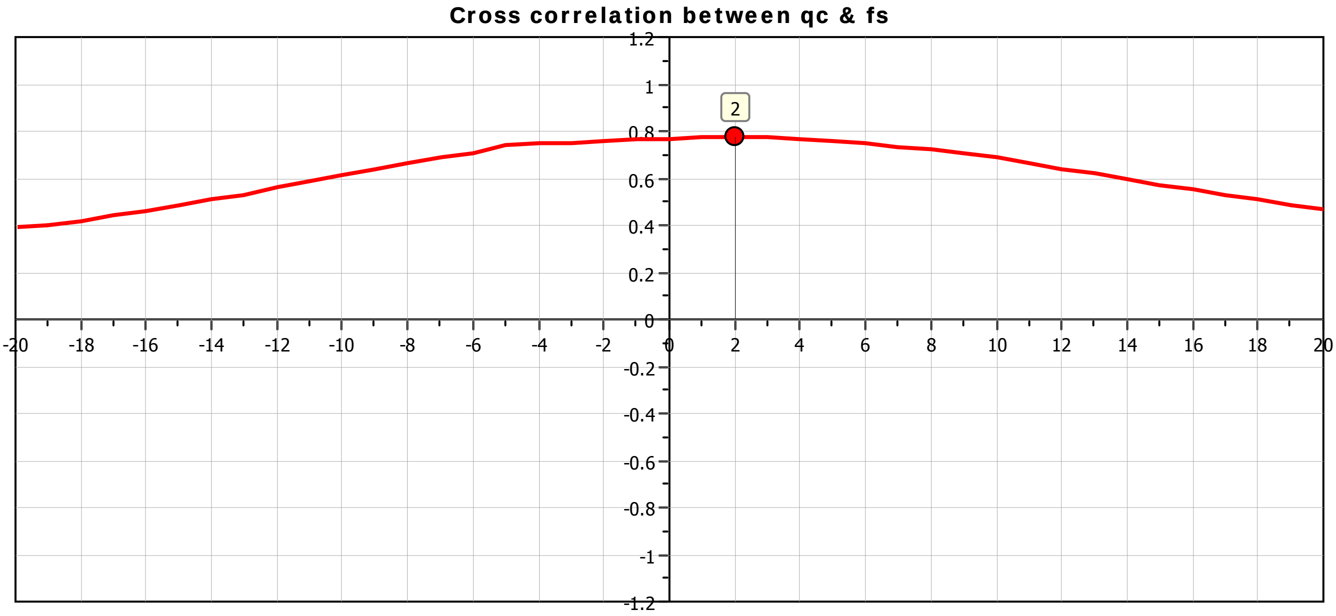
Sounding ID	Depth (ft)	Seismic Tests	Pre-Drill Depth (ft)
CPT-10	48.62		
CPT-11	47.44		
CPT-13	3.02		
CPT-13a	51.05		
CPT-15	47.70		
CPT-16	49.67		
CPT-2	10.76		
CPT-23	48.36		
CPT-2a	48.36		
CPT-6	49.74		
CPT-8	4.46		
CPT-8a	49.54		
SCPT-1	48.36	10	
SCPT-18	47.97	10	
SCPT-19	0.79		
SCPT-19a	0.79		
SCPT-19b	48.10	10	

Project: Langan
Location: BL England Substation - Marmora NJ

CPT: CPT-10
Total depth: 48.62 ft

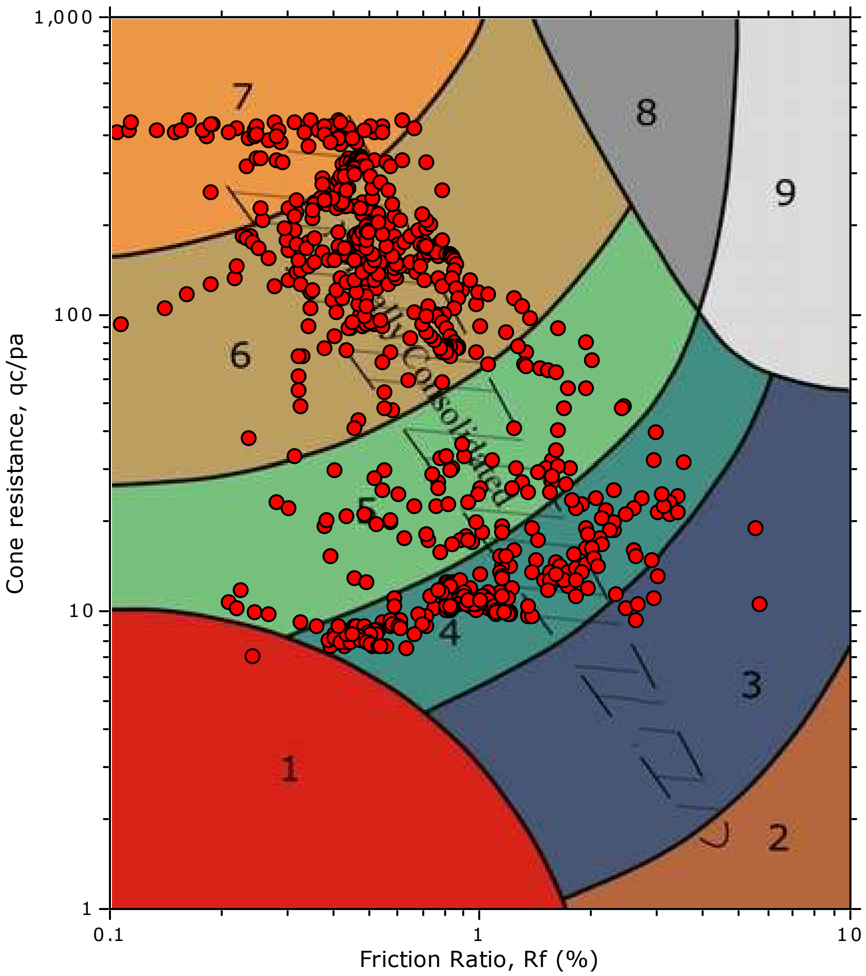


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

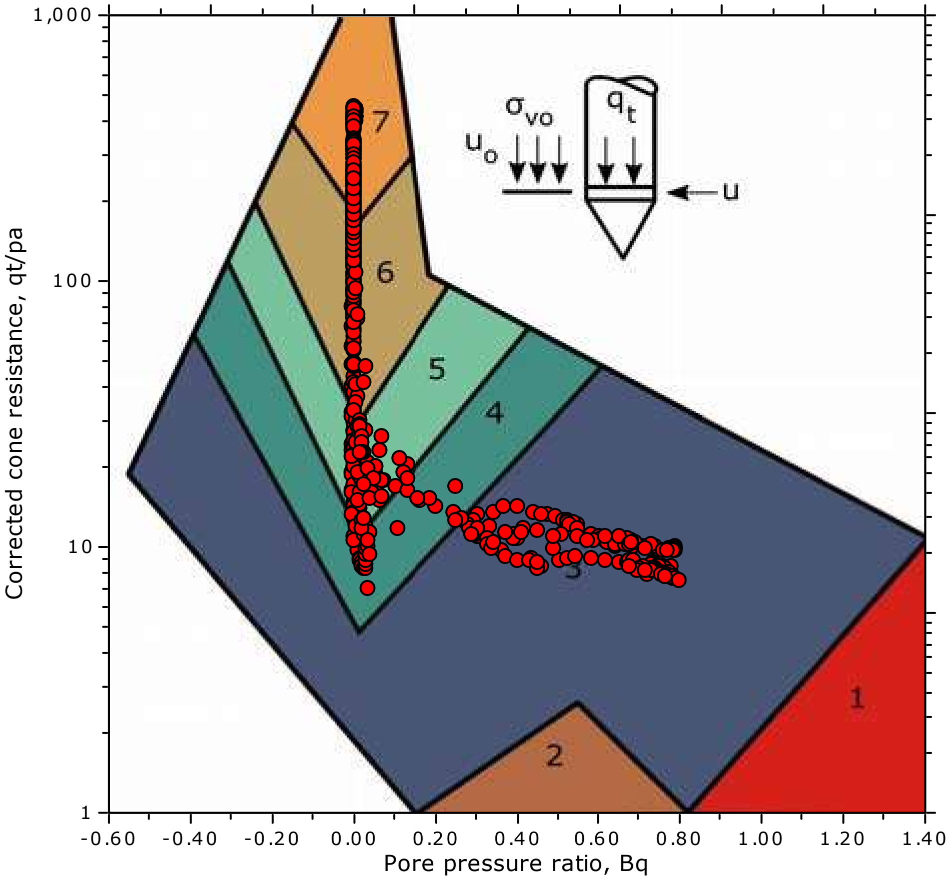


SBT - Bq plots

SBT plot



Bq plot

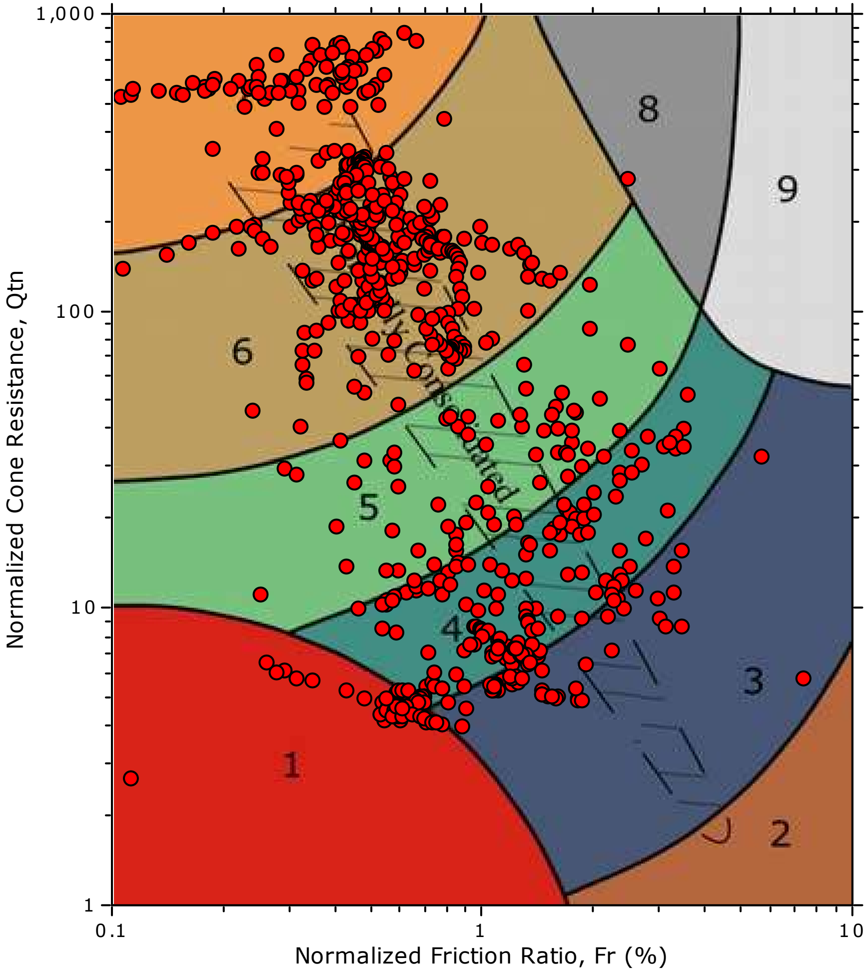


SBT legend

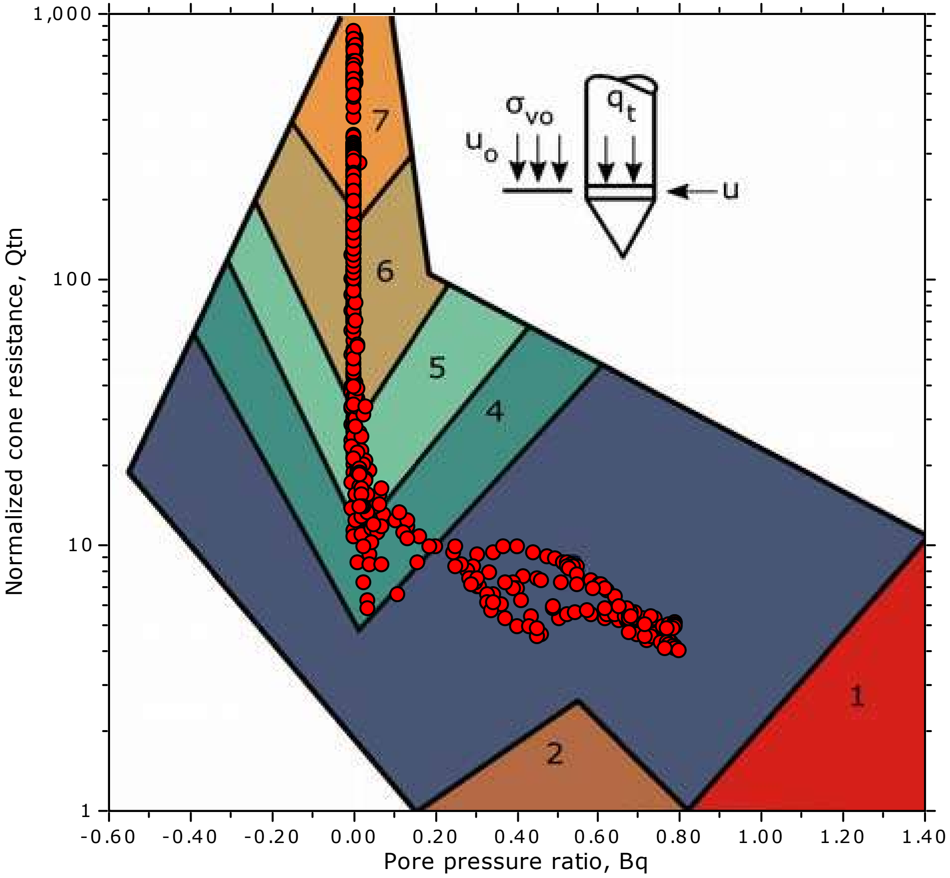
■ 1. Sensitive fine grained
■ 2. Organic material
■ 3. Clay to silty clay
■ 4. Clayey silt to silty clay
■ 5. Silty sand to sandy silt
■ 6. Clean sand to silty sand
■ 7. Gravelly sand to sand
■ 8. Very stiff sand to clayey sand
■ 9. Very stiff fine grained

SBT - Bq plots (normalized)

SBTn plot



Normalized Bq plot



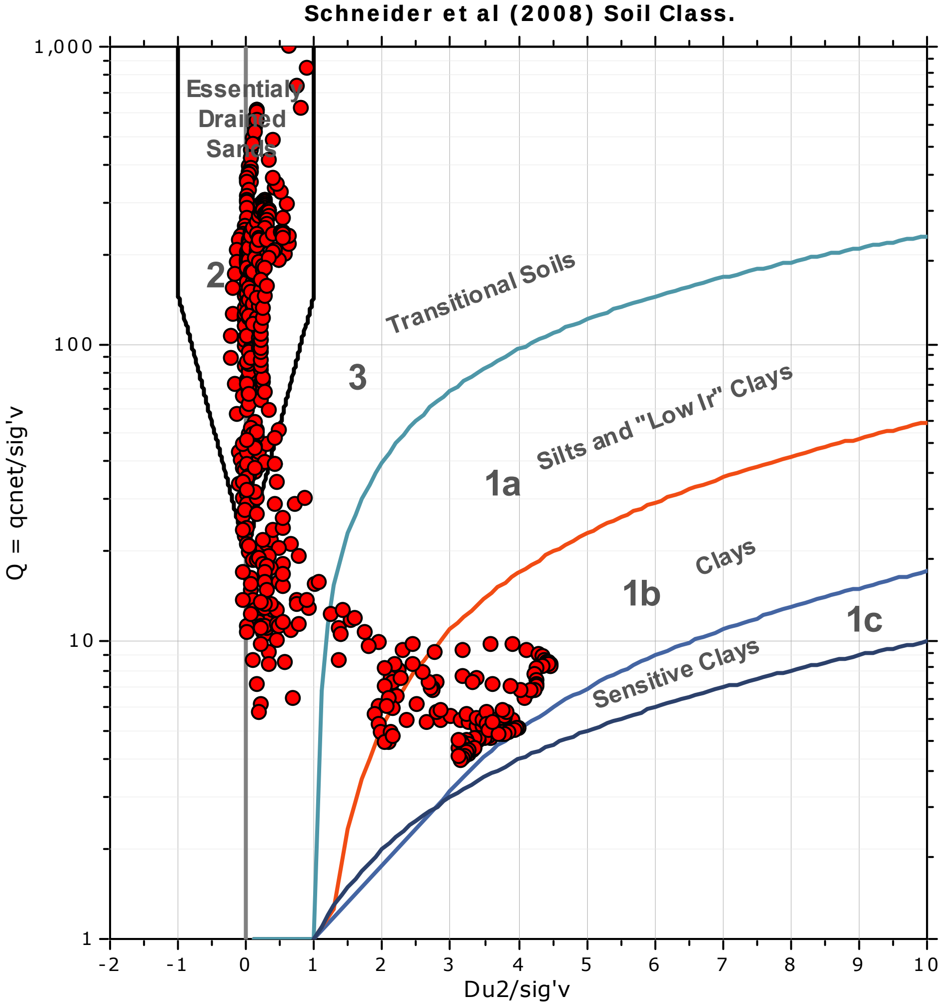
SBTn legend

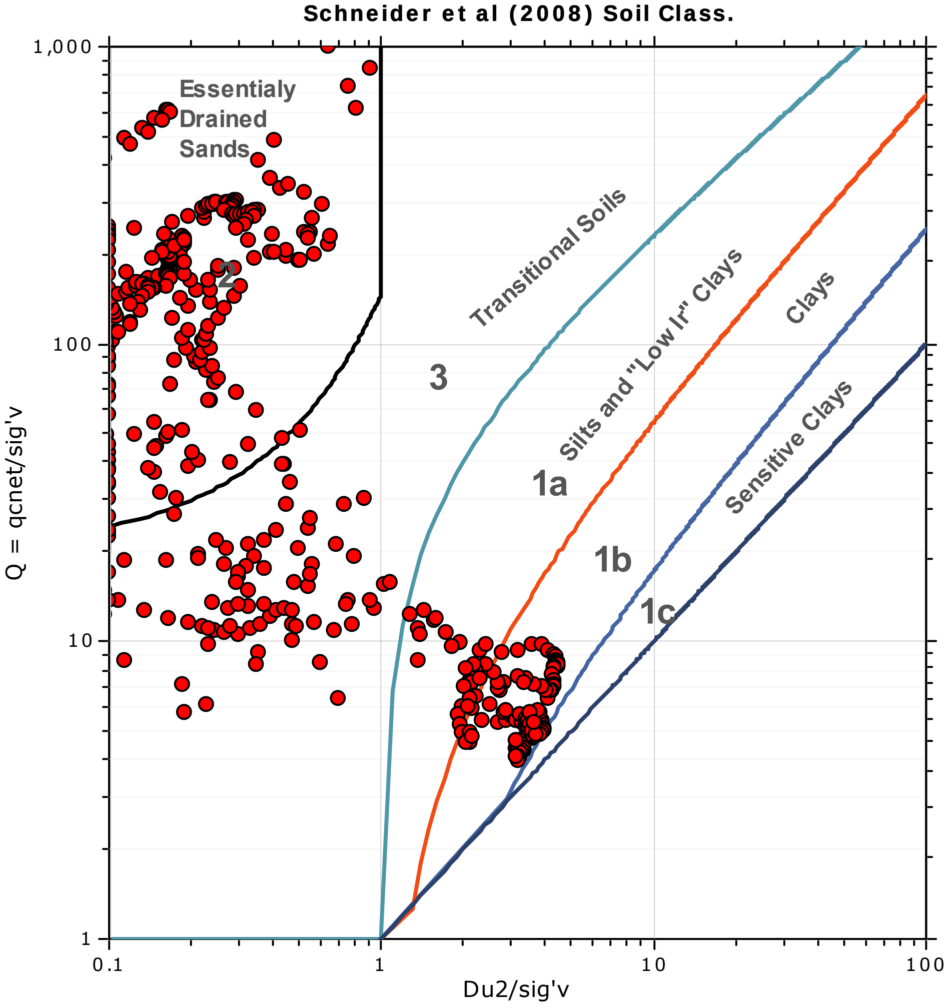
- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-10
Total depth: 48.62 ft

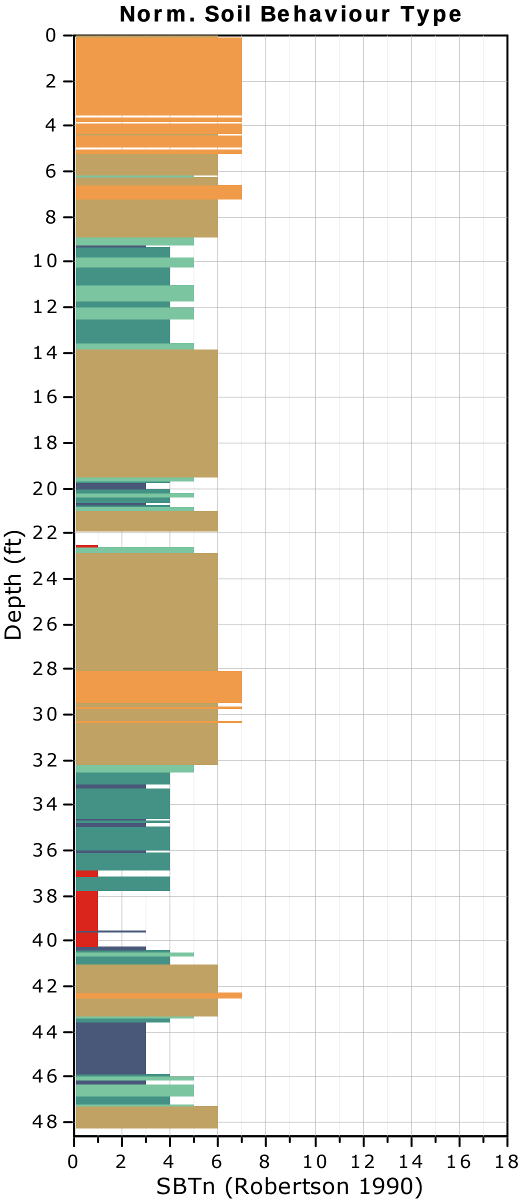
Bq plots (Schneider)

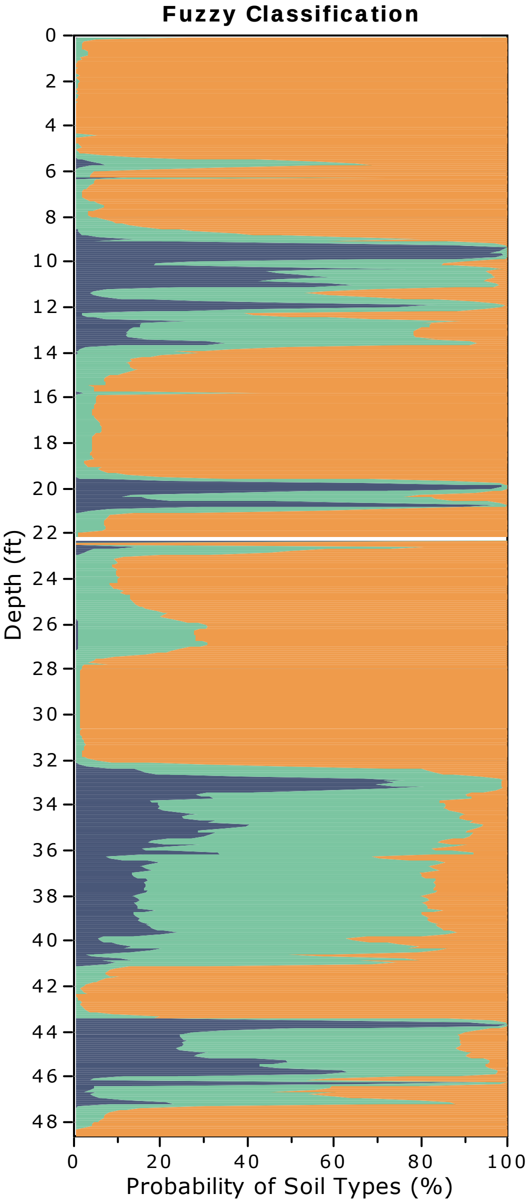




Project: **Langan**
Location: **BL England Substation - Marmora NJ**

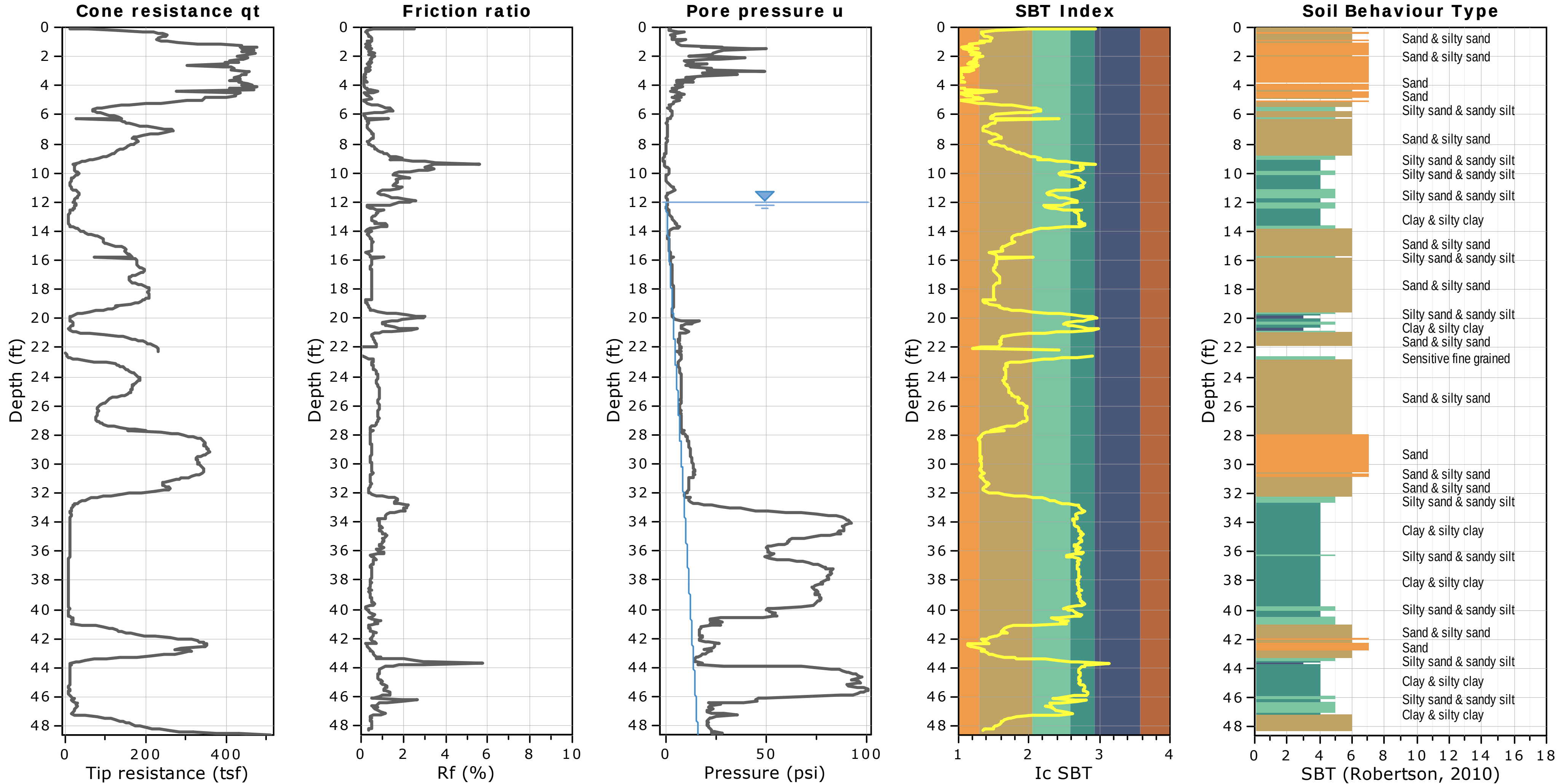
CPT: CPT-10
Total depth: 48.62 ft





Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-10
Total depth: 48.62 ft

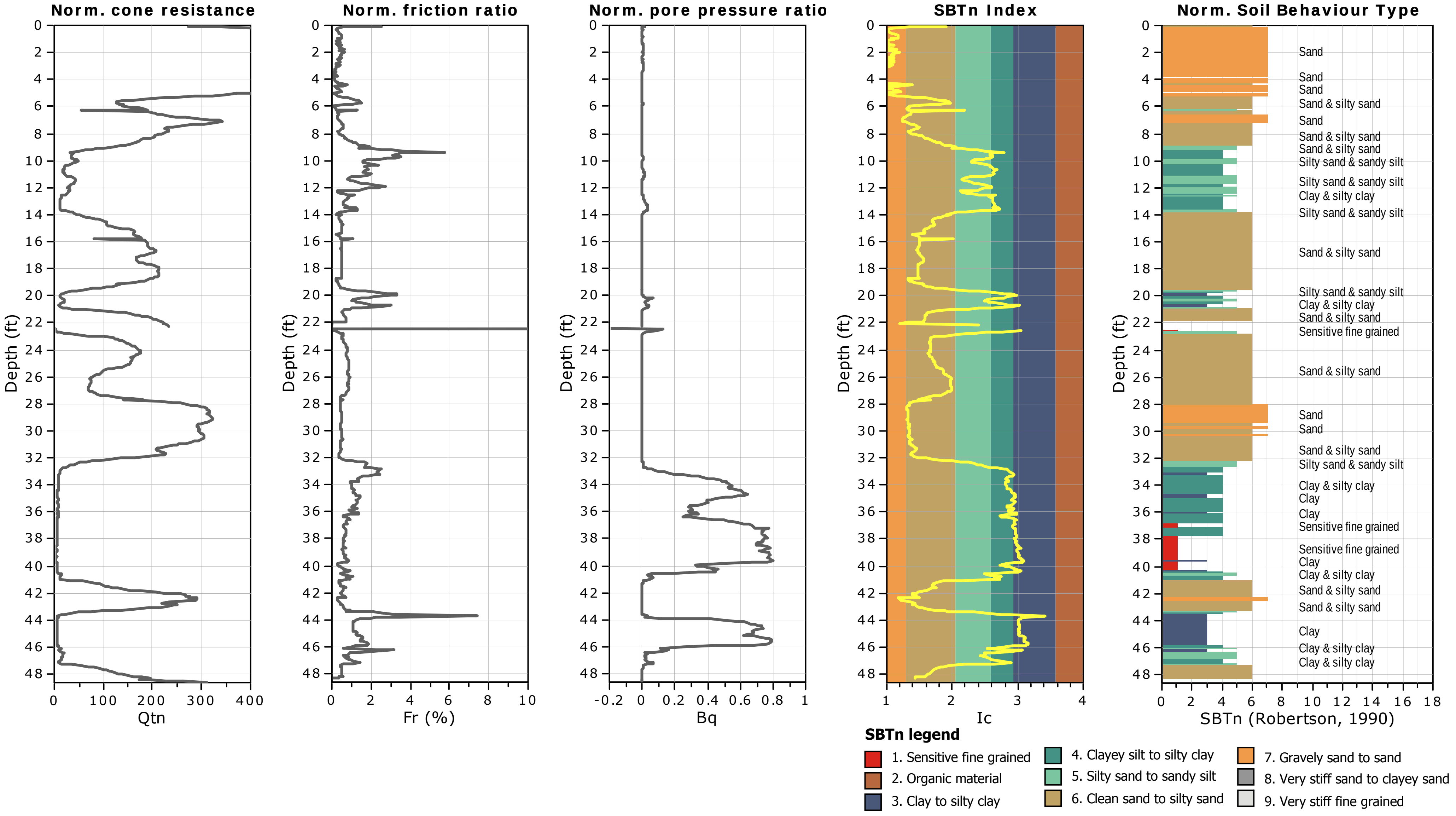


SBT legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟫 6. Clean sand to silty sand
🟧 7. Gravely sand to sand
⬜ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-10
Total depth: 48.62 ft

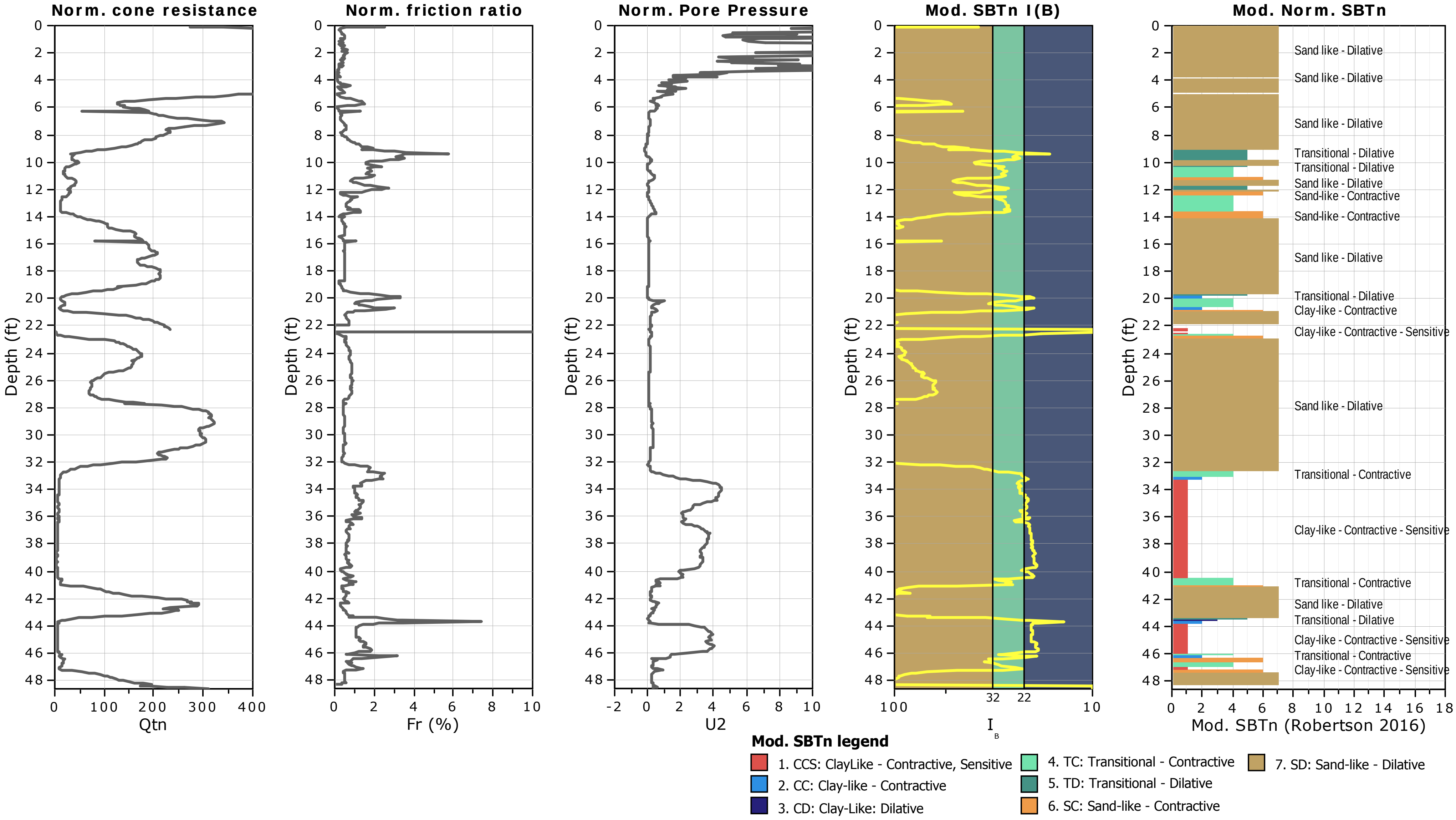


Project: **Langan**

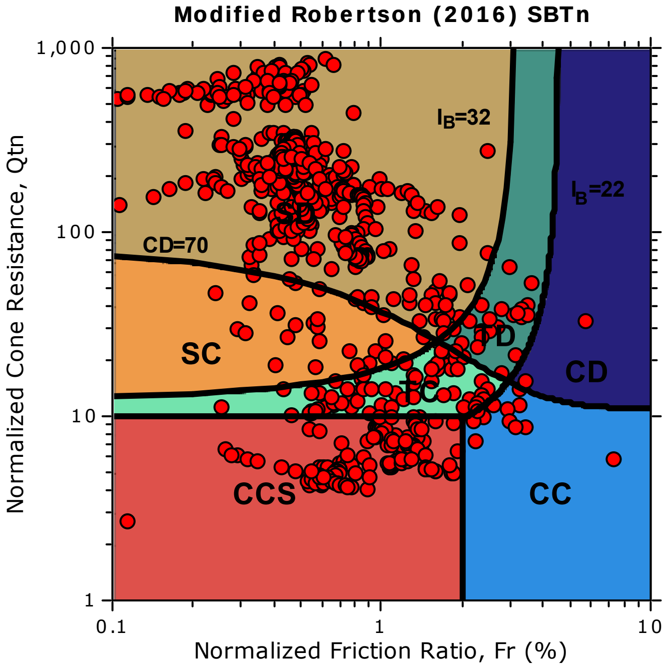
Location: **BL England Substation - Marmora NJ**

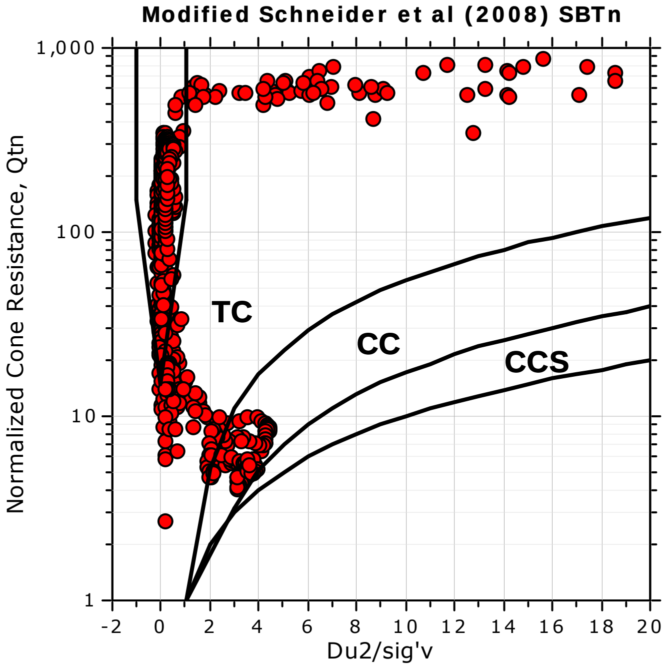
CPT: CPT-10

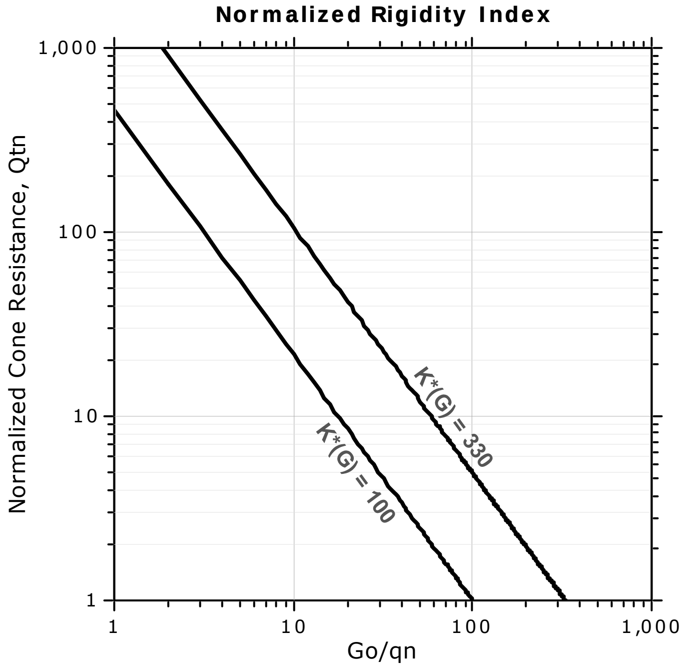
Total depth: 48.62 ft



Updated SBTn plots


Modified Robertson (2016) SBTn


Modified Schneider et al (2008) SBTn


Normalized Rigidity Index

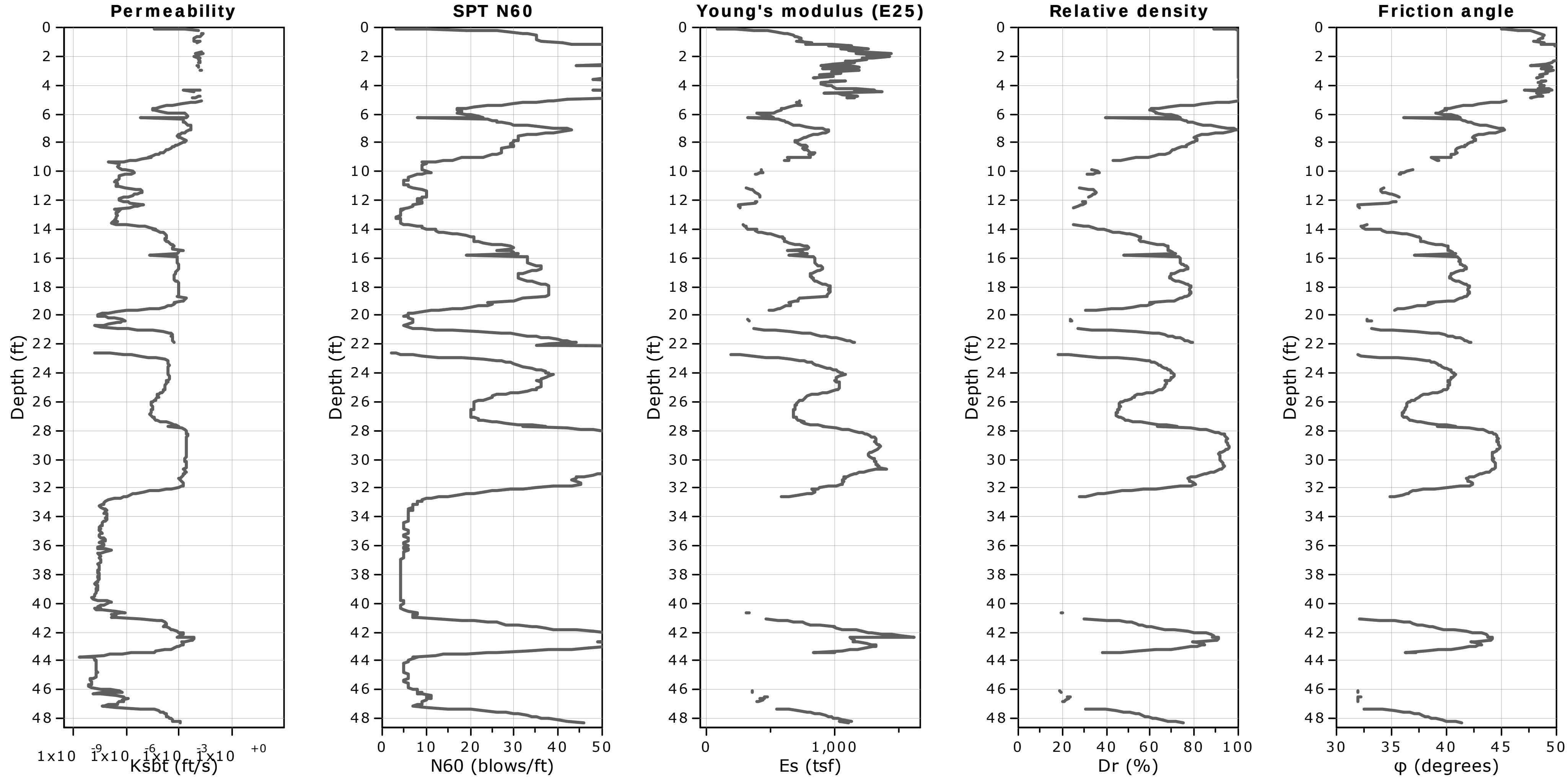
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure
(e.g. age/cementation)

Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-10
Total depth: 48.62 ft



Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
● User defined estimation data

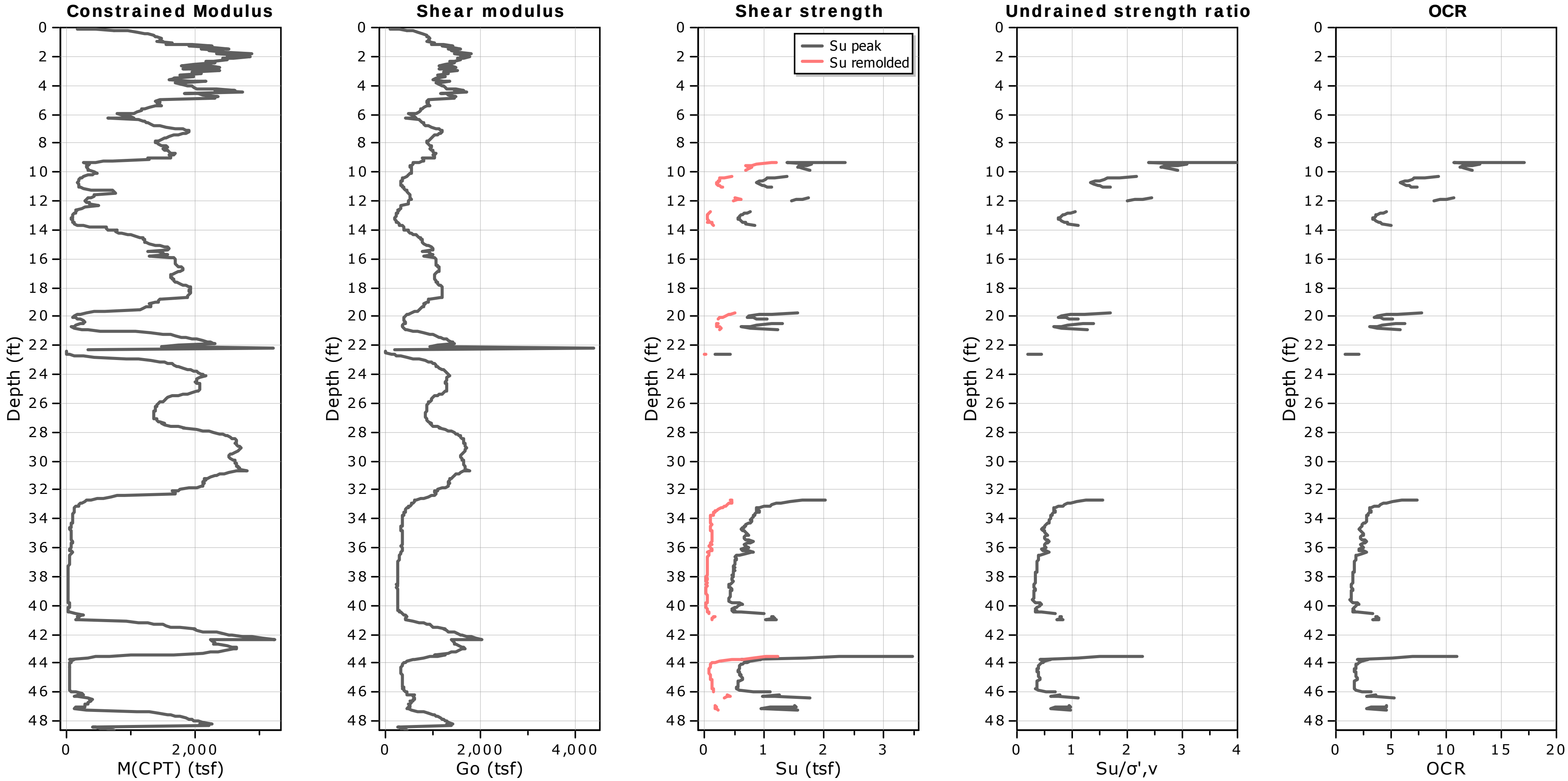
Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-10

Total depth: 48.62 ft



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)

Go: Based on variable *alpha* using I_c (Robertson, 2009)

Undrained shear strength cone factor for clays, N_{kt}: 14

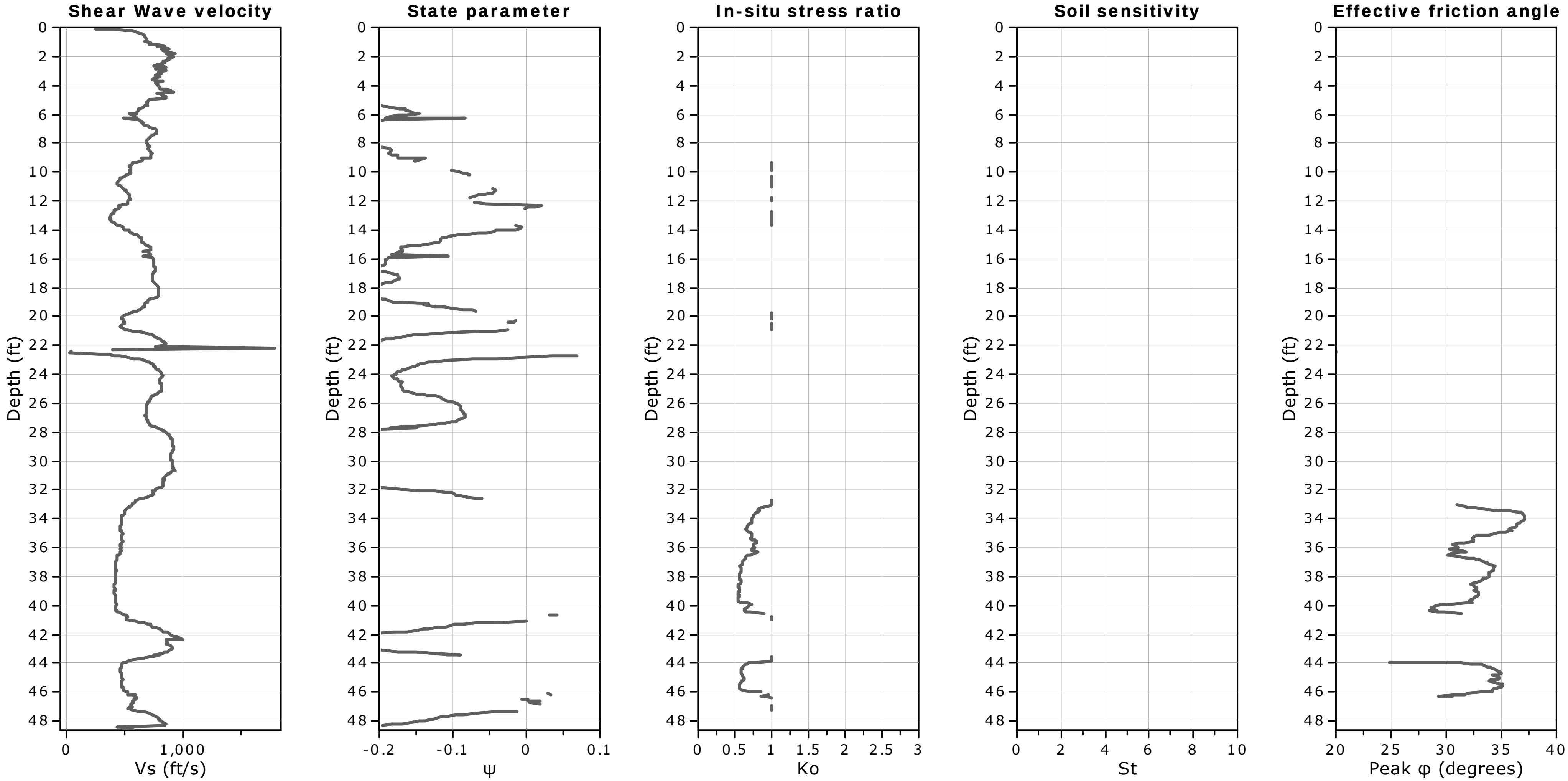
OCR factor for clays, N_{kt}: 0.33

● User defined estimation data

● Flat Dilatometer Test data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-10
Total depth: 48.62 ft



Calculation parameters

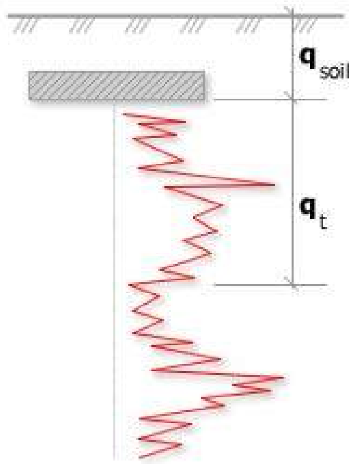
Soil Sensitivity factor, N_S: 350.00
● User defined estimation data

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-10

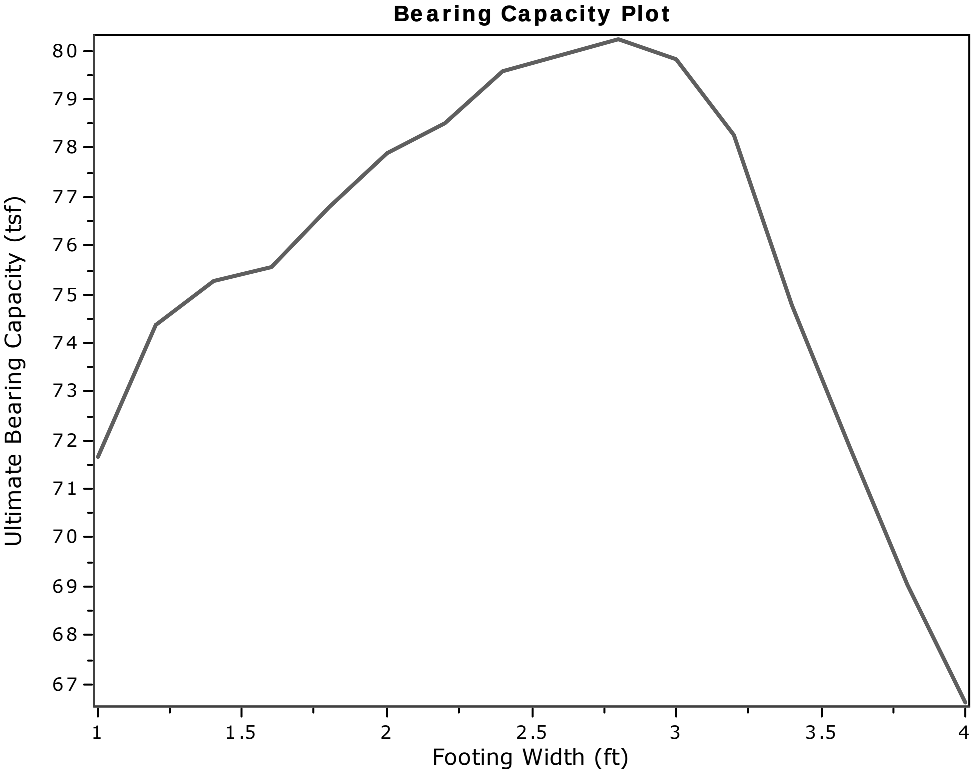
Total depth: 48.62 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

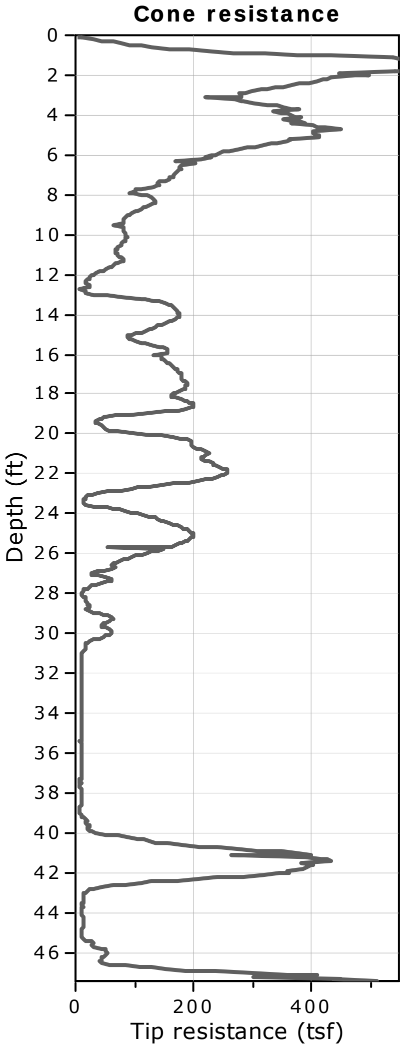
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	358.11	0.20	0.03	71.65
2	1.20	0.50	2.30	371.67	0.20	0.03	74.36
3	1.40	0.50	2.60	376.12	0.20	0.03	75.25
4	1.60	0.50	2.90	377.63	0.20	0.03	75.56
5	1.80	0.50	3.20	383.83	0.20	0.03	76.80
6	2.00	0.50	3.50	389.30	0.20	0.03	77.89
7	2.20	0.50	3.80	392.39	0.20	0.03	78.51
8	2.40	0.50	4.10	397.84	0.20	0.03	79.60
9	2.60	0.50	4.40	399.31	0.20	0.03	79.89
10	2.80	0.50	4.70	401.03	0.20	0.03	80.24
11	3.00	0.50	5.00	398.93	0.20	0.03	79.82
12	3.20	0.50	5.30	391.09	0.20	0.03	78.25
13	3.40	0.50	5.60	373.72	0.20	0.03	74.77
14	3.60	0.50	5.90	359.19	0.20	0.03	71.87
15	3.80	0.50	6.20	345.04	0.20	0.03	69.04
16	4.00	0.50	6.50	332.92	0.20	0.03	66.61

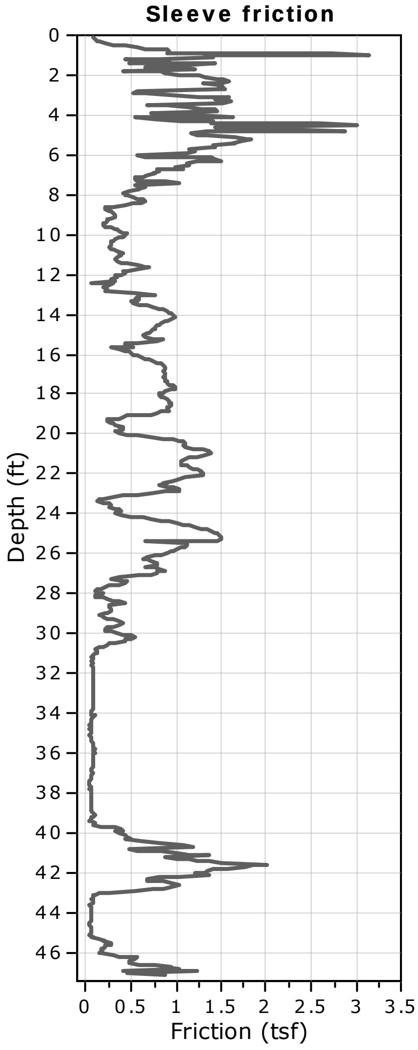
Project: Langan

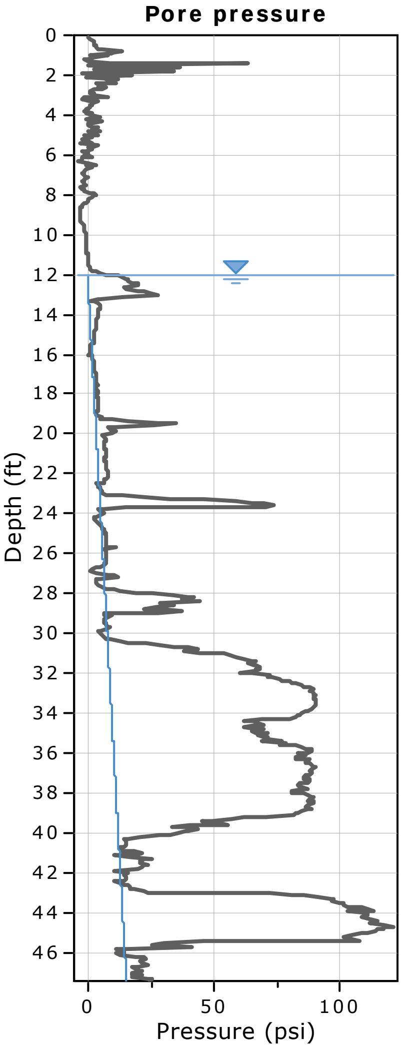
Location: BL England Substation - Marmora NJ

CPT: CPT-11

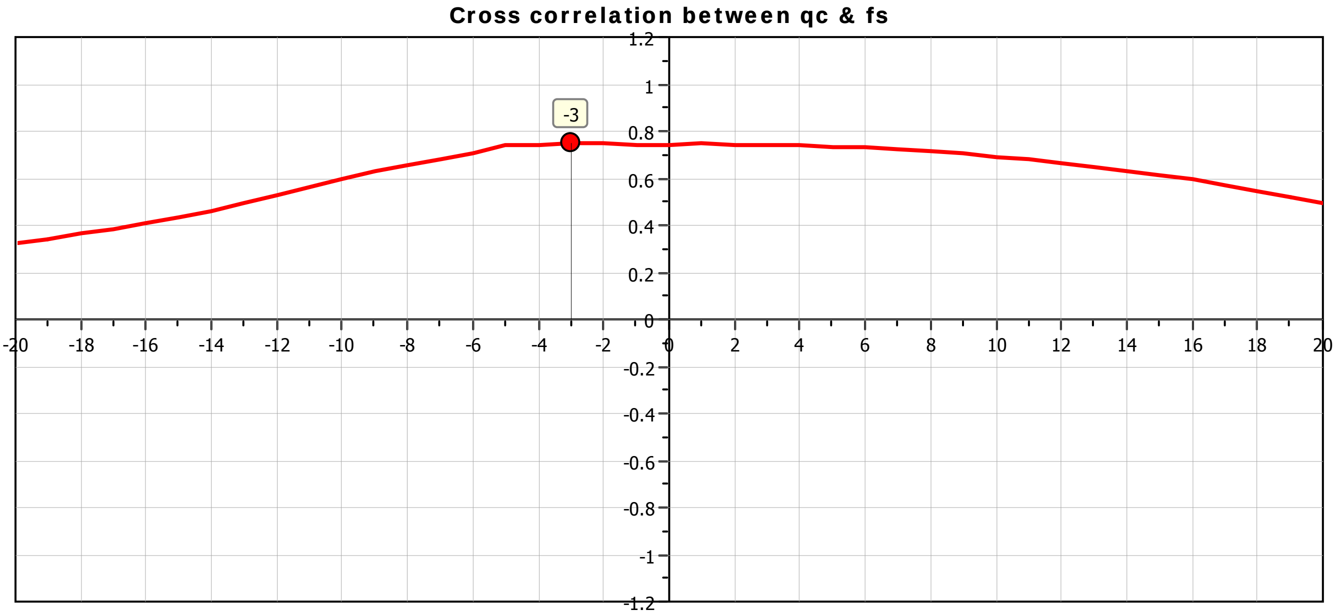
Total depth: 47.44 ft



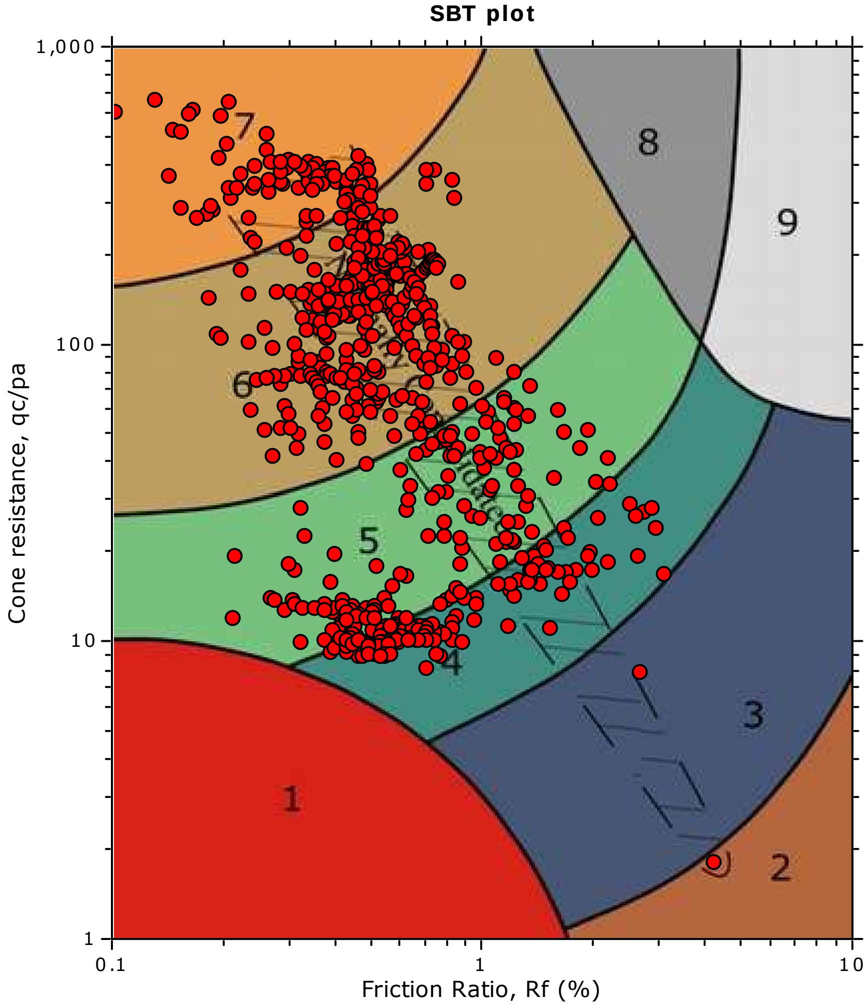


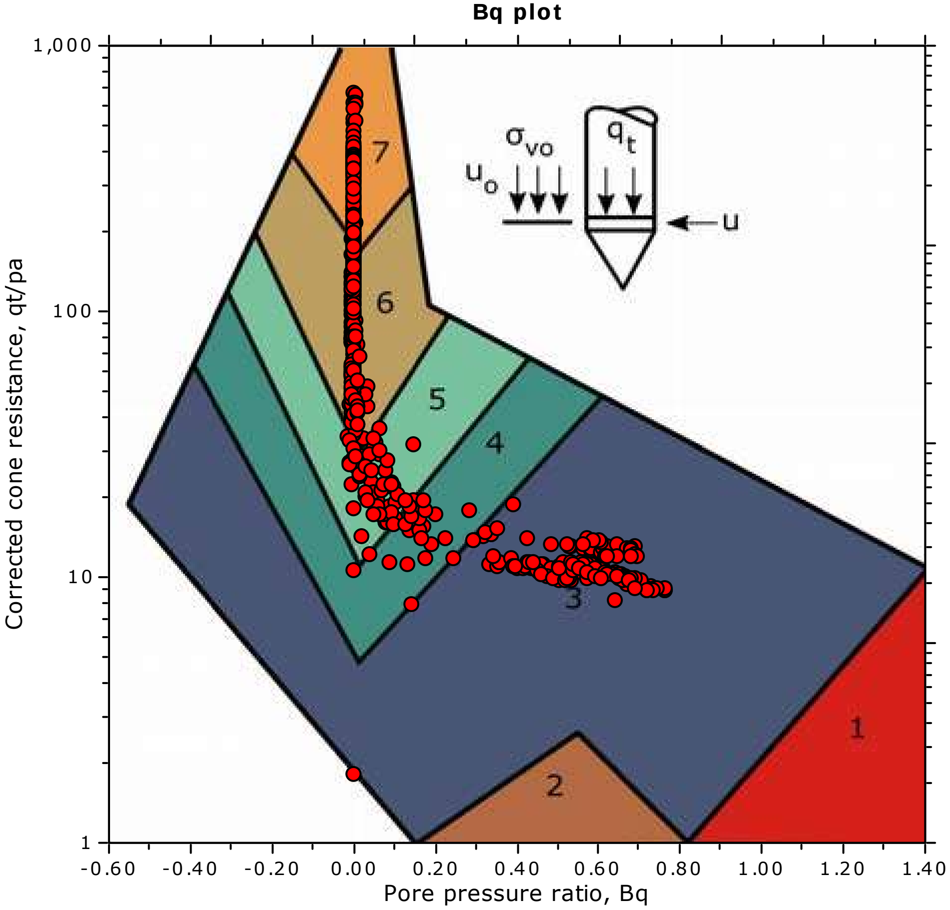


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

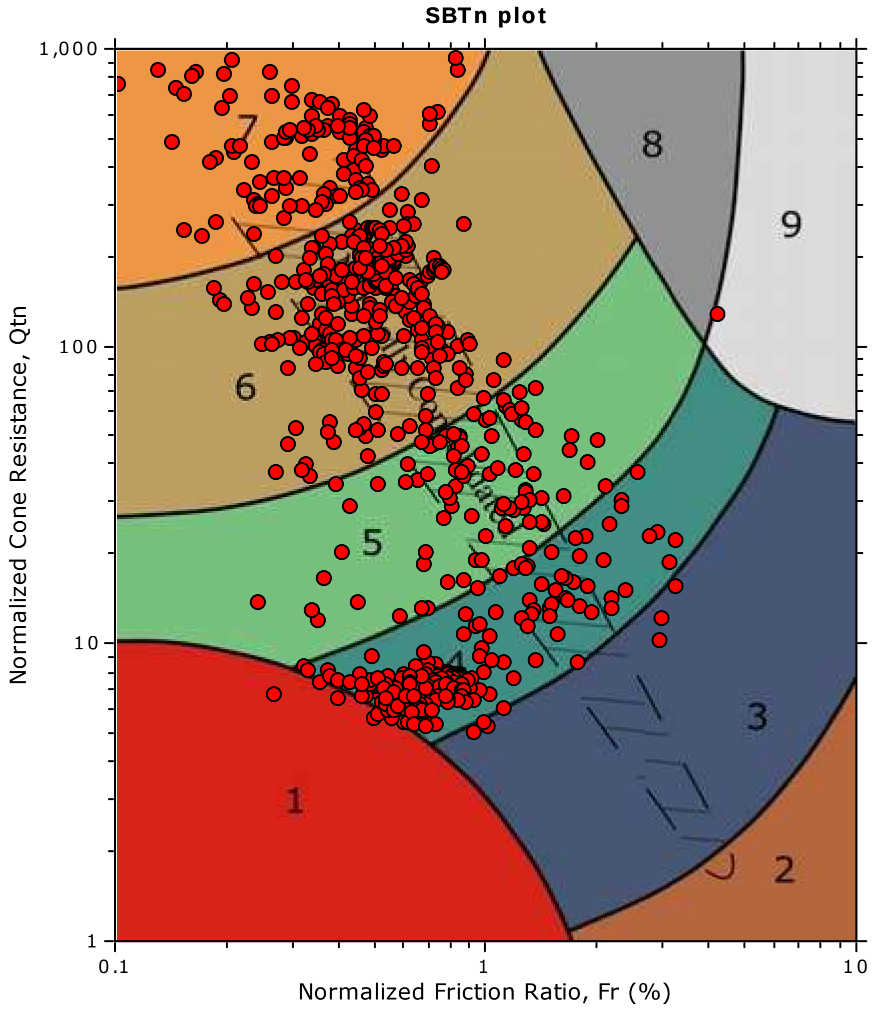


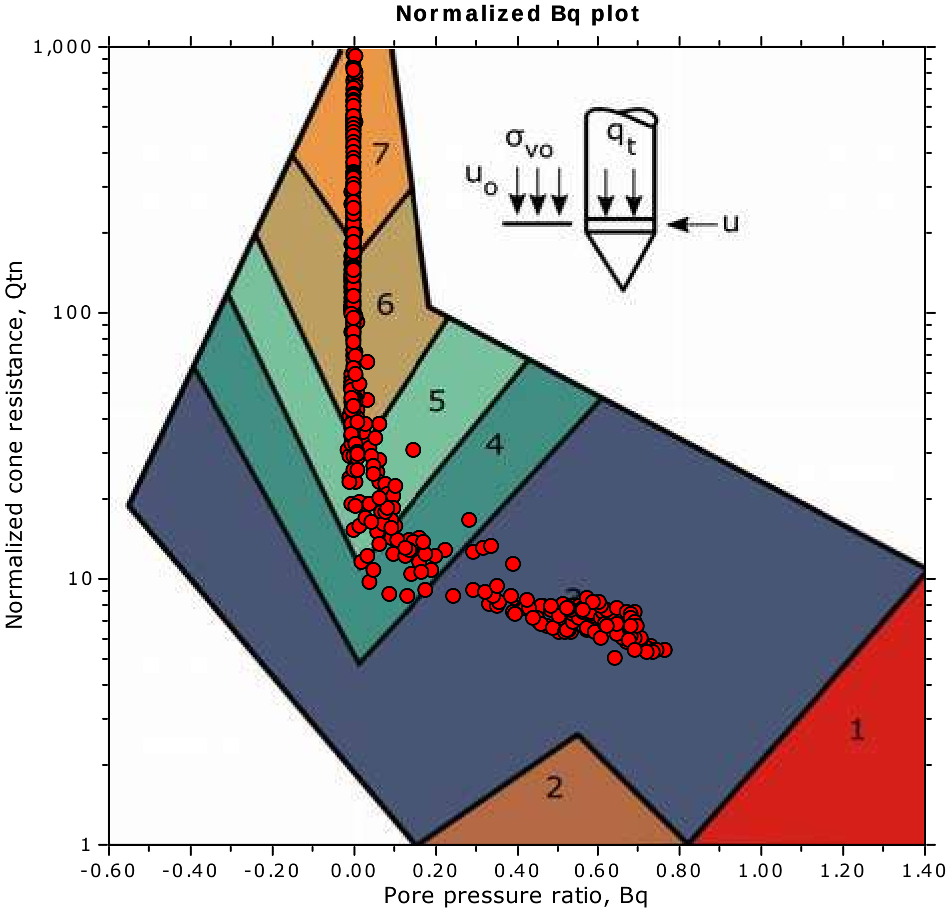


SBT legend

🟥 1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

SBT - Bq plots (normalized)

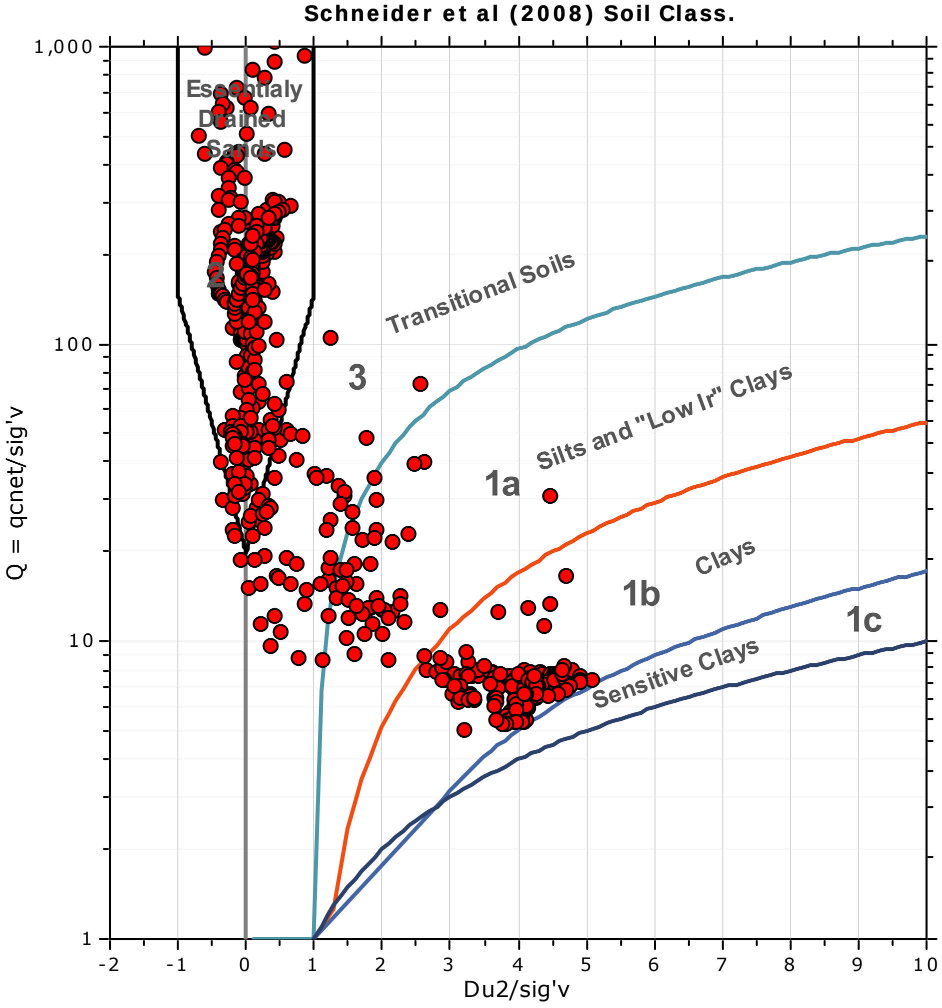


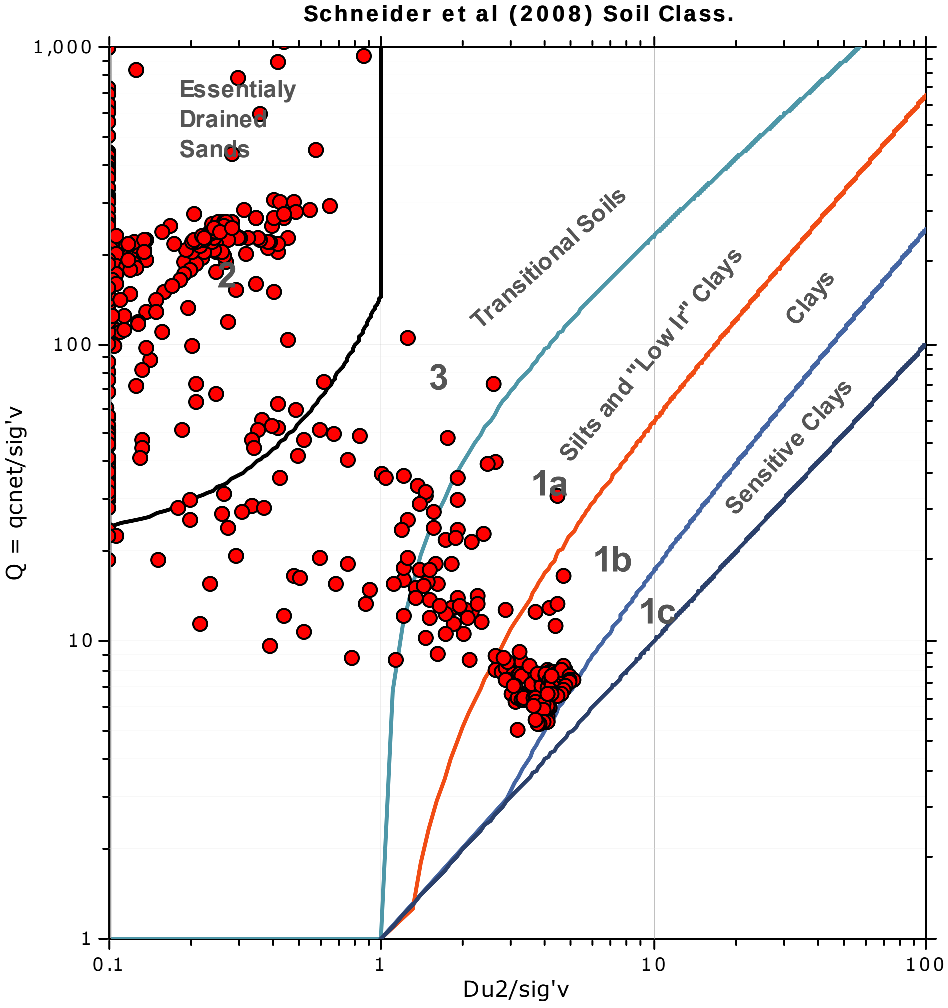


SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬜ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

Bq plots (Schneider)



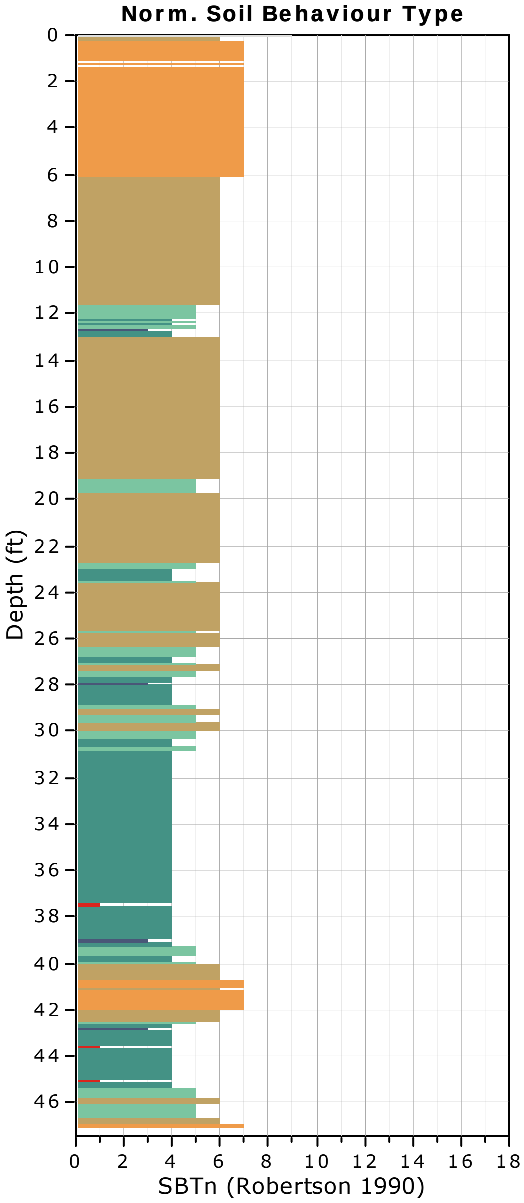


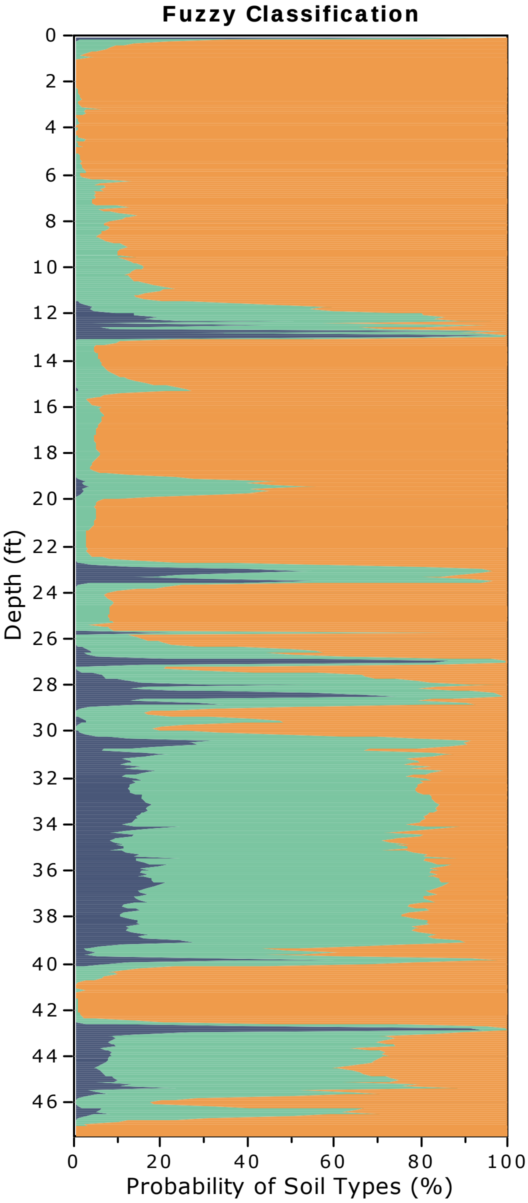
Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-11

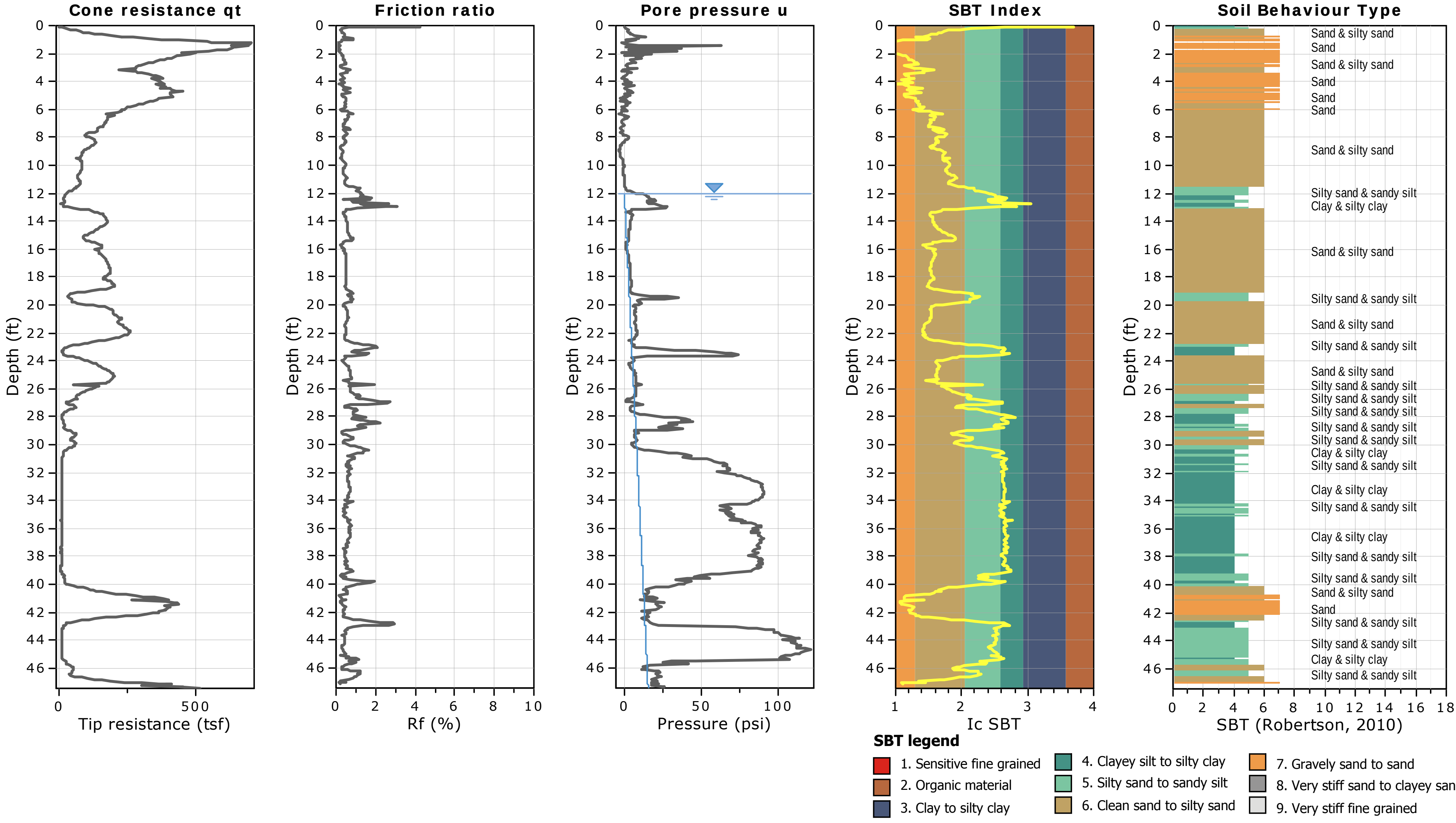
Total depth: 47.44 ft





Project: **Langan**
Location: **BL England Substation - Marmora NJ**

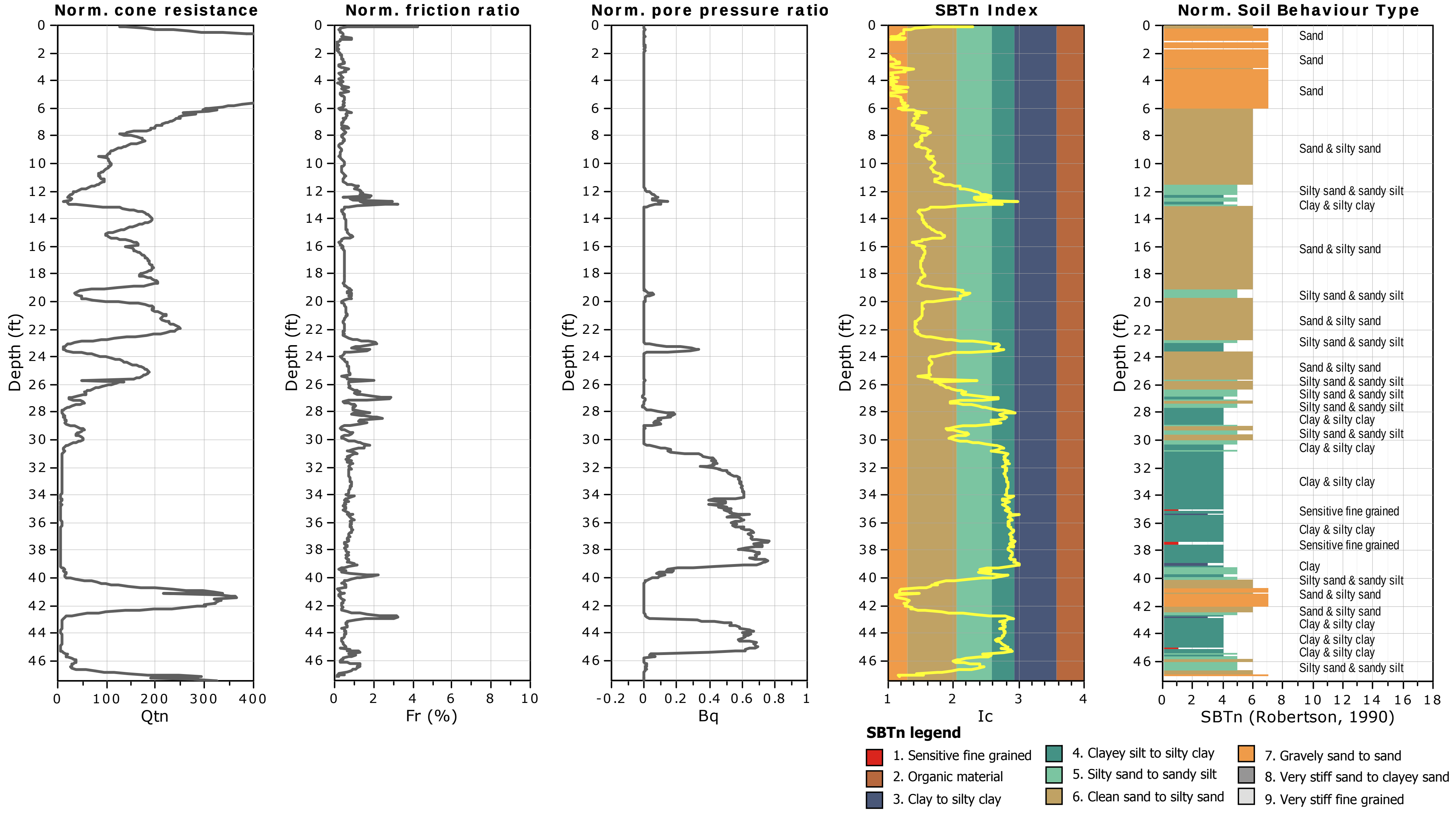
CPT: CPT-11
Total depth: 47.44 ft



Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

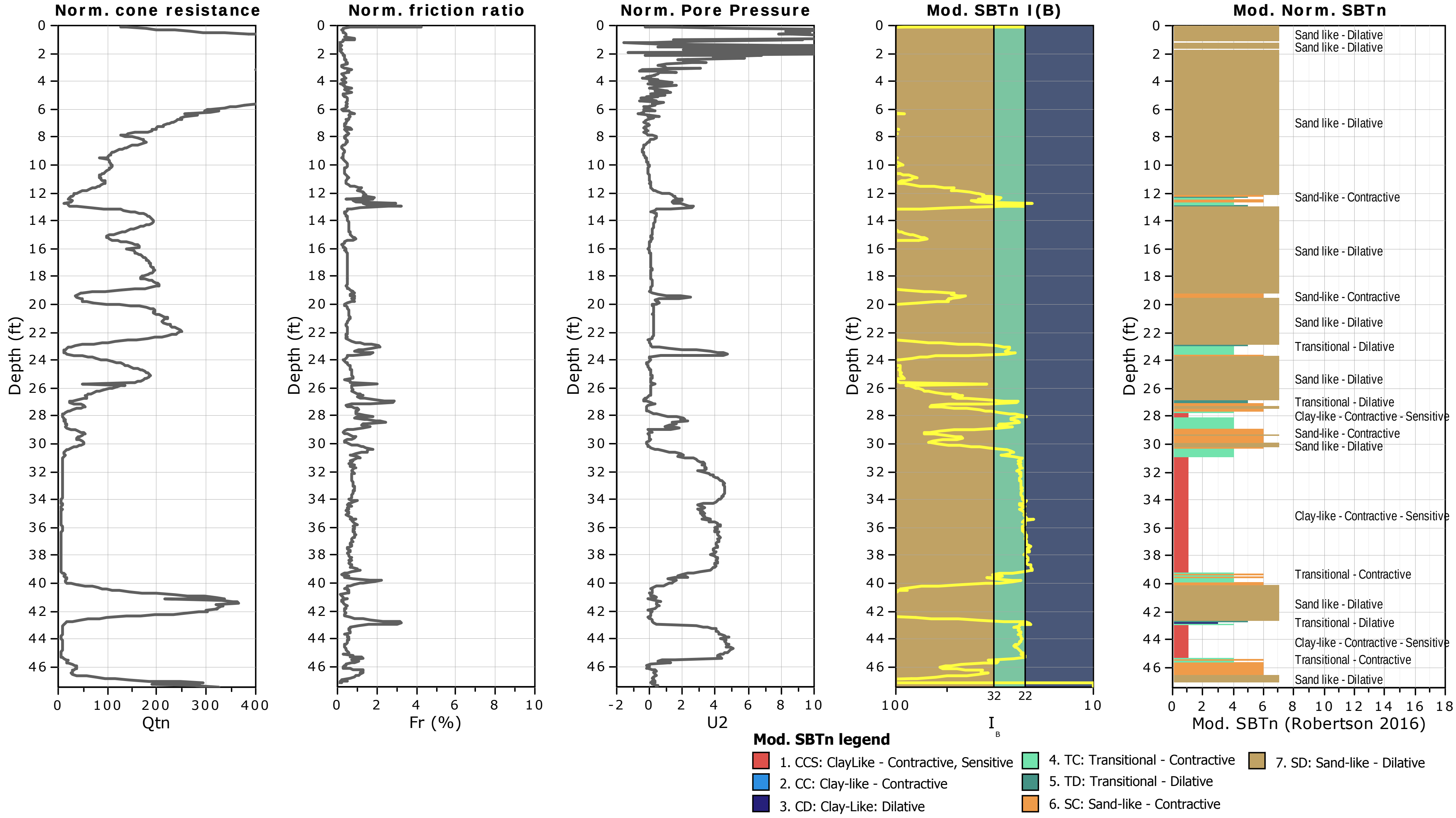
CPT: CPT-11
Total depth: 47.44 ft



Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-11
Total depth: 47.44 ft

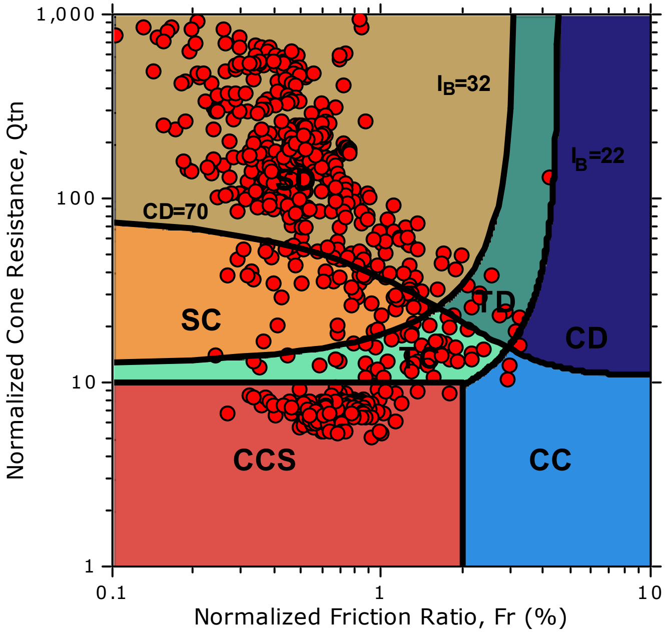


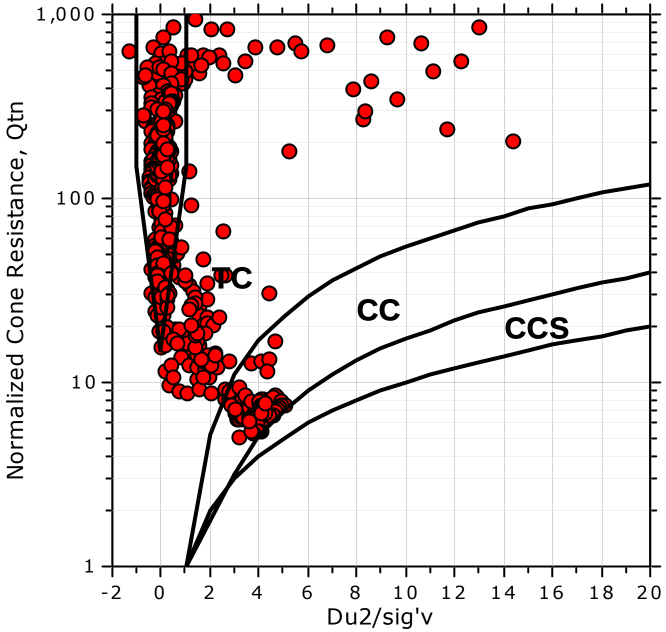
Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

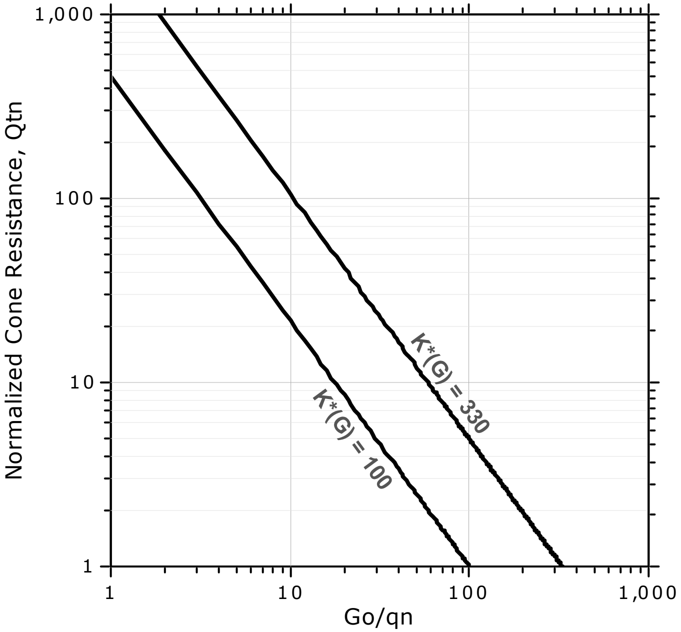
Project: Langan
Location: BL England Substation - Marmora NJ

CPT: CPT-11
Total depth: 47.44 ft

Updated SBTn plots


Modified Robertson (2016) SBTn


Modified Schneider et al (2008) SBTn


Normalized Rigidity Index

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

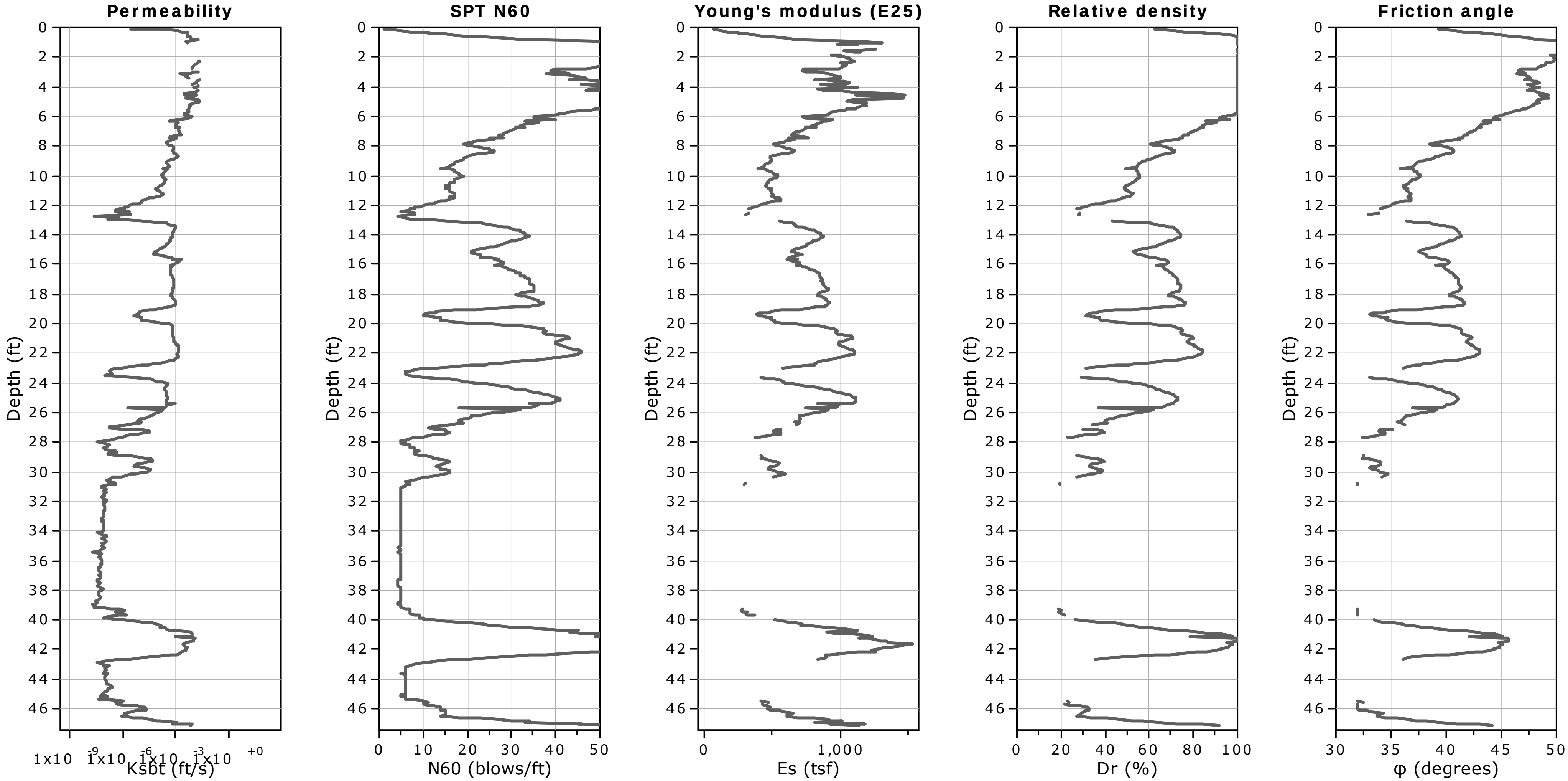
K(G) > 330: Soils with significant microstructure
(e.g. age/cementation)

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-11

Total depth: 47.44 ft



Calculation parameters

Permeability: Based on SBT_n

SPT N_{60}: Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

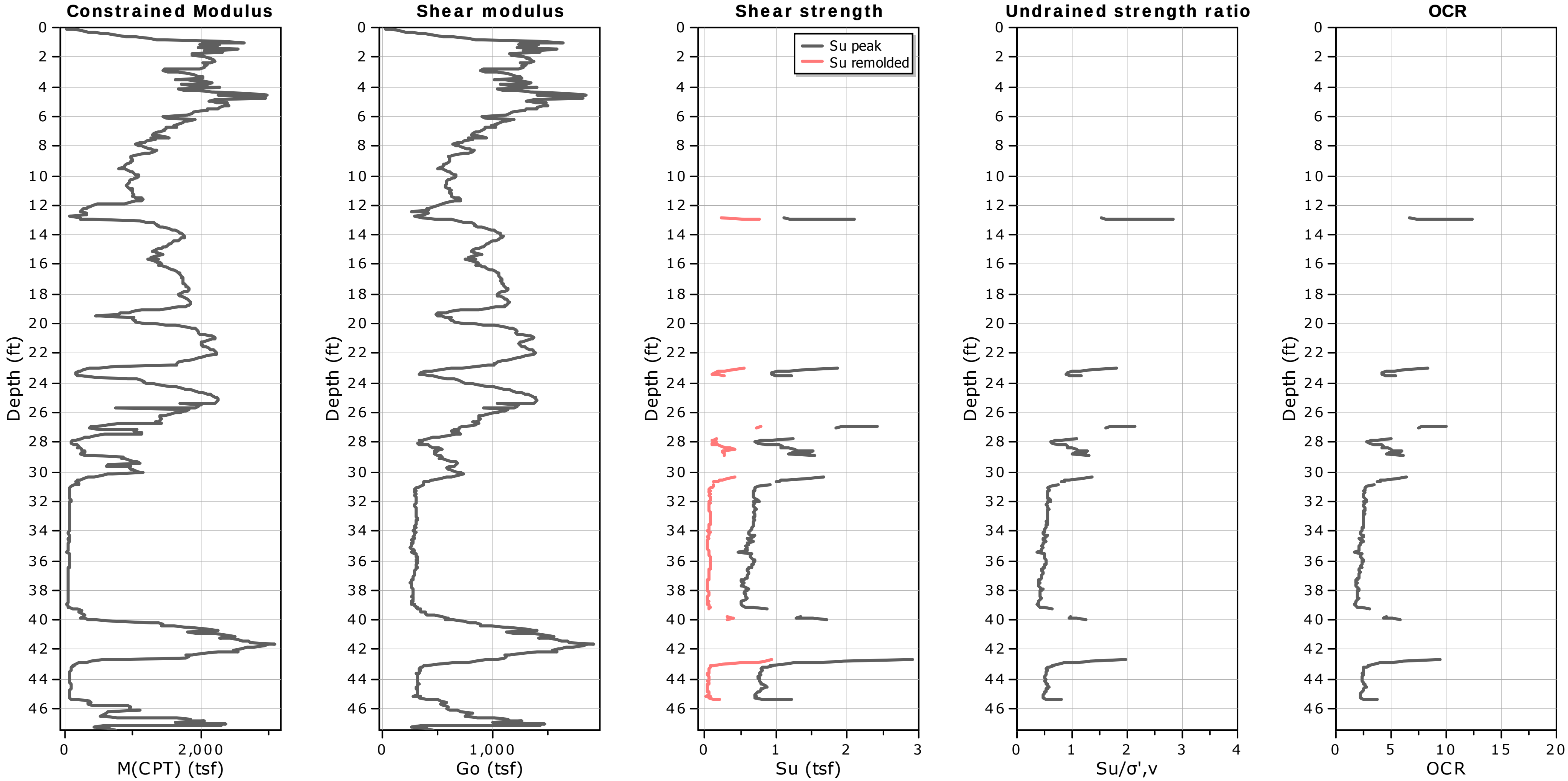
Relative density constant, C_{Dr}: 350.0

Phi: Based on Kulhawy & Mayne (1990)

—●— User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-11
Total depth: 47.44 ft



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

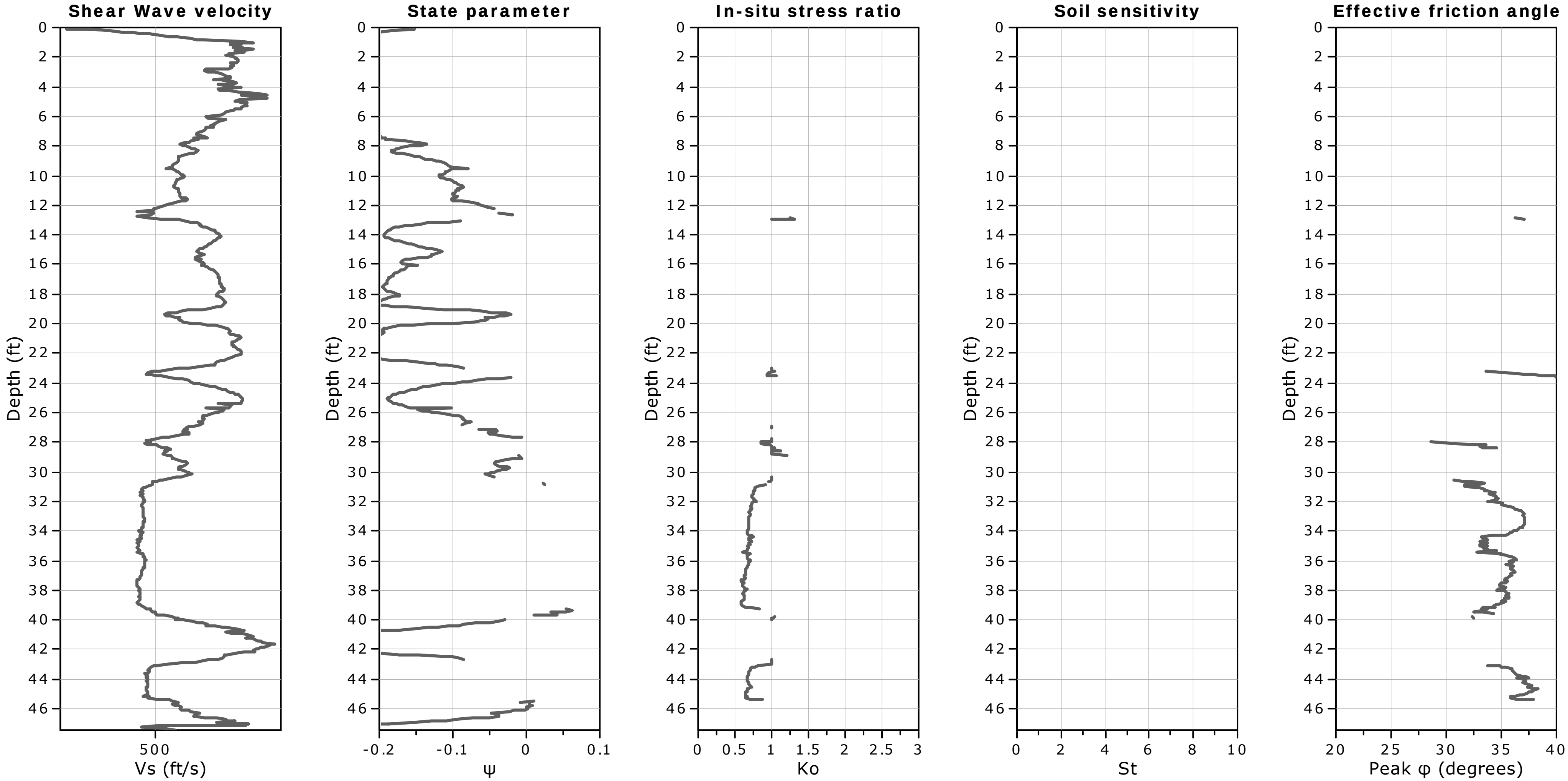
OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-11

Total depth: 47.44 ft



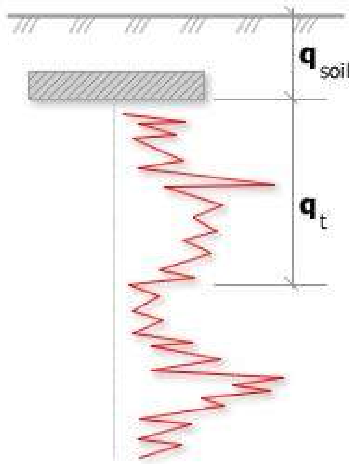
Calculation parameters

Soil Sensitivity factor, N_S: 350.00

● User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

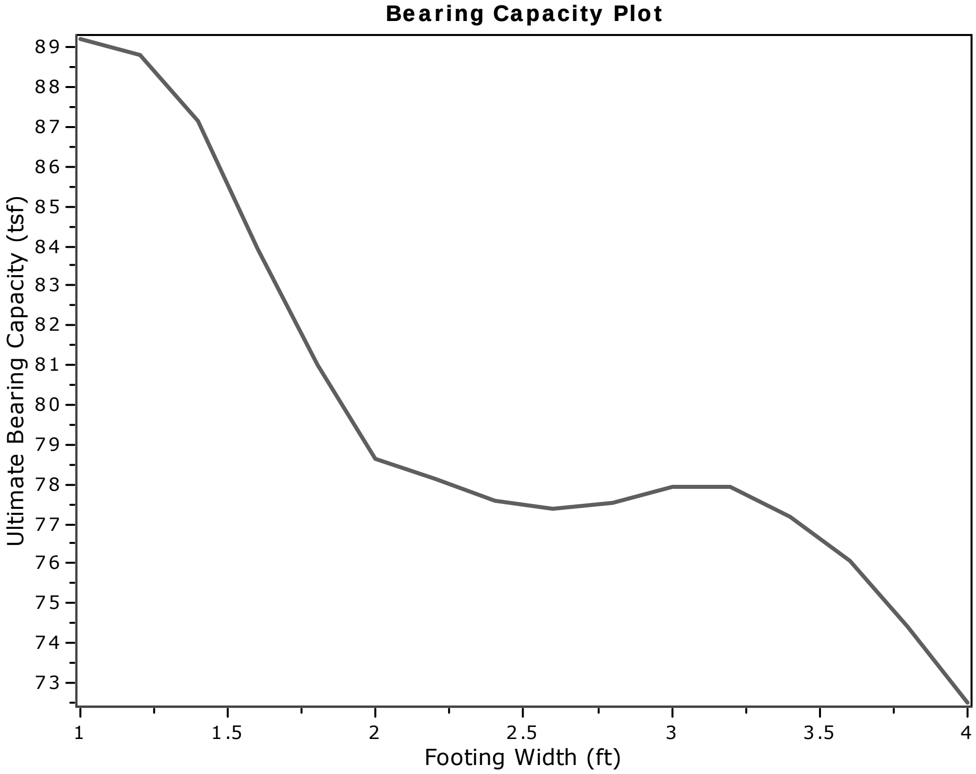
CPT: CPT-11
Total depth: 47.44 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

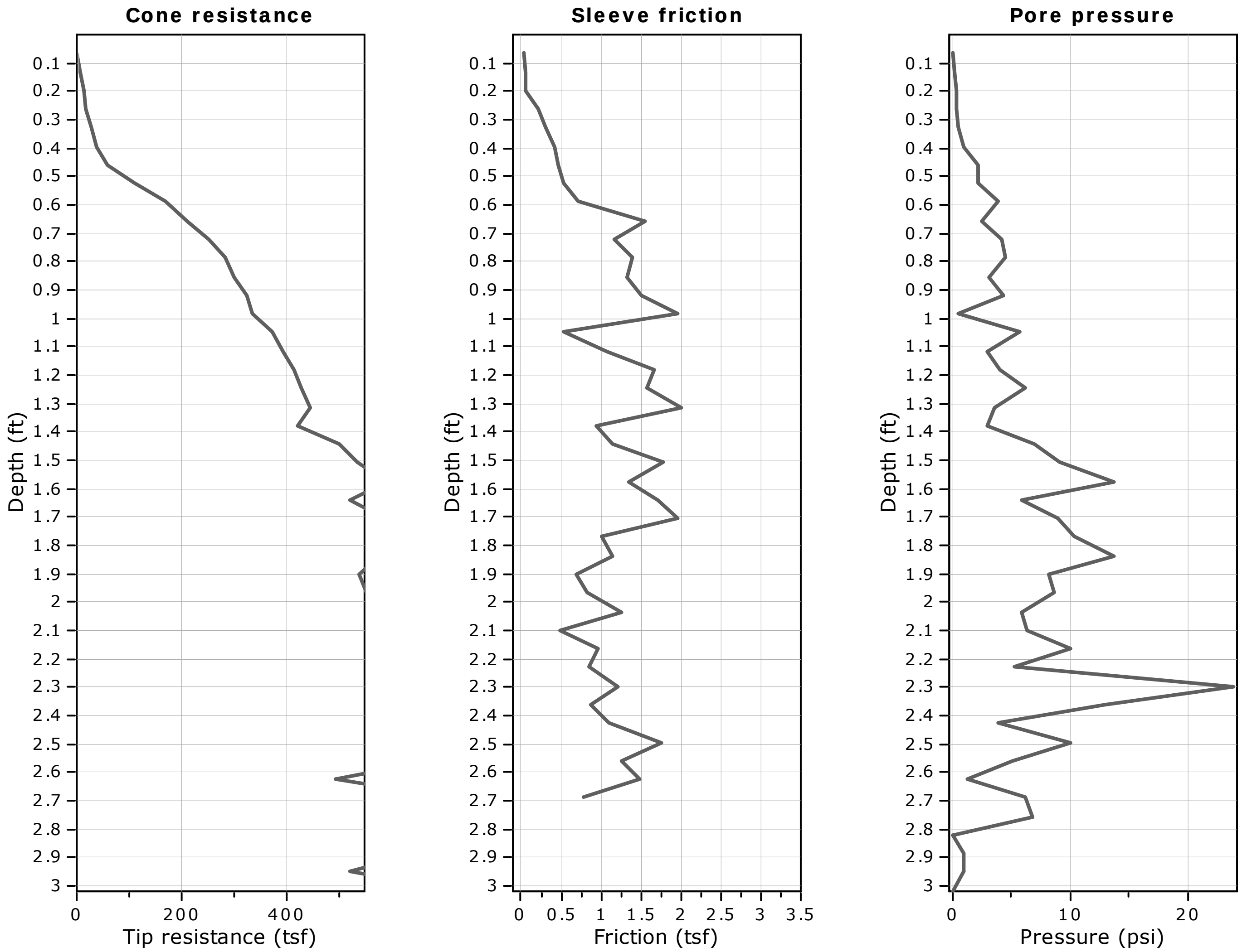


:: Tabular results ::

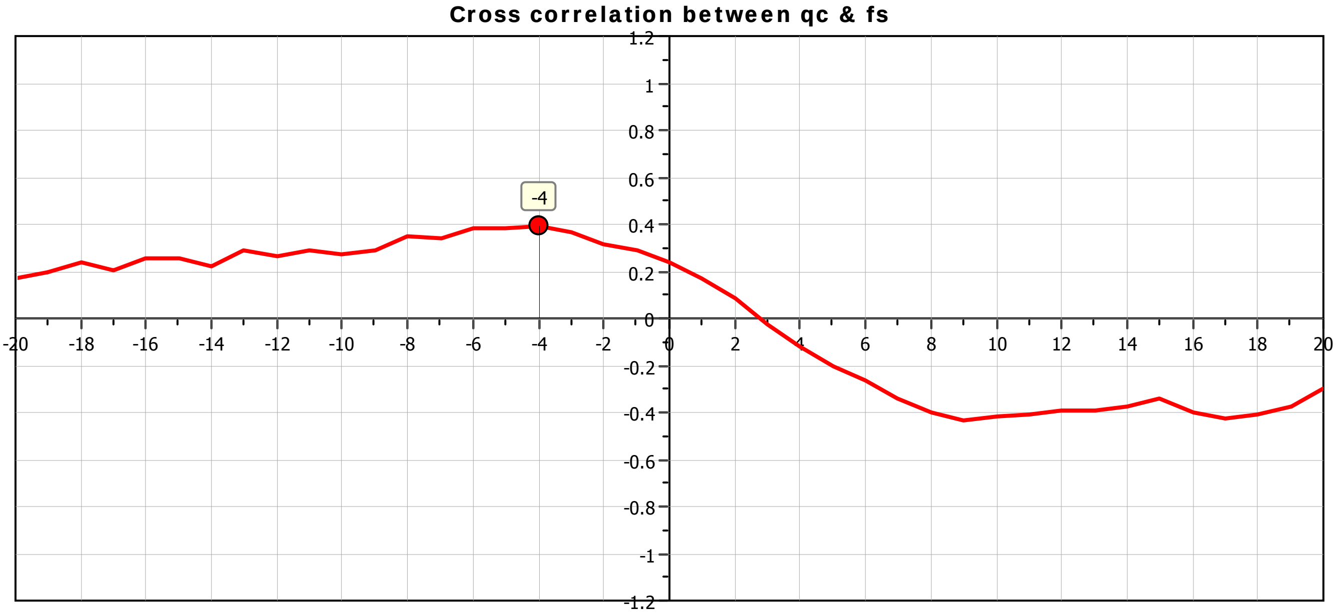
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	445.94	0.20	0.03	89.22
2	1.20	0.50	2.30	444.00	0.20	0.03	88.83
3	1.40	0.50	2.60	435.58	0.20	0.03	87.15
4	1.60	0.50	2.90	419.49	0.20	0.03	83.93
5	1.80	0.50	3.20	404.83	0.20	0.03	81.00
6	2.00	0.50	3.50	393.02	0.20	0.03	78.63
7	2.20	0.50	3.80	390.56	0.20	0.03	78.14
8	2.40	0.50	4.10	387.70	0.20	0.03	77.57
9	2.60	0.50	4.40	386.76	0.20	0.03	77.38
10	2.80	0.50	4.70	387.61	0.20	0.03	77.55
11	3.00	0.50	5.00	389.55	0.20	0.03	77.94
12	3.20	0.50	5.30	389.55	0.20	0.03	77.94
13	3.40	0.50	5.60	385.88	0.20	0.03	77.21
14	3.60	0.50	5.90	380.30	0.20	0.03	76.09
15	3.80	0.50	6.20	371.94	0.20	0.03	74.42
16	4.00	0.50	6.50	362.35	0.20	0.03	72.50

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

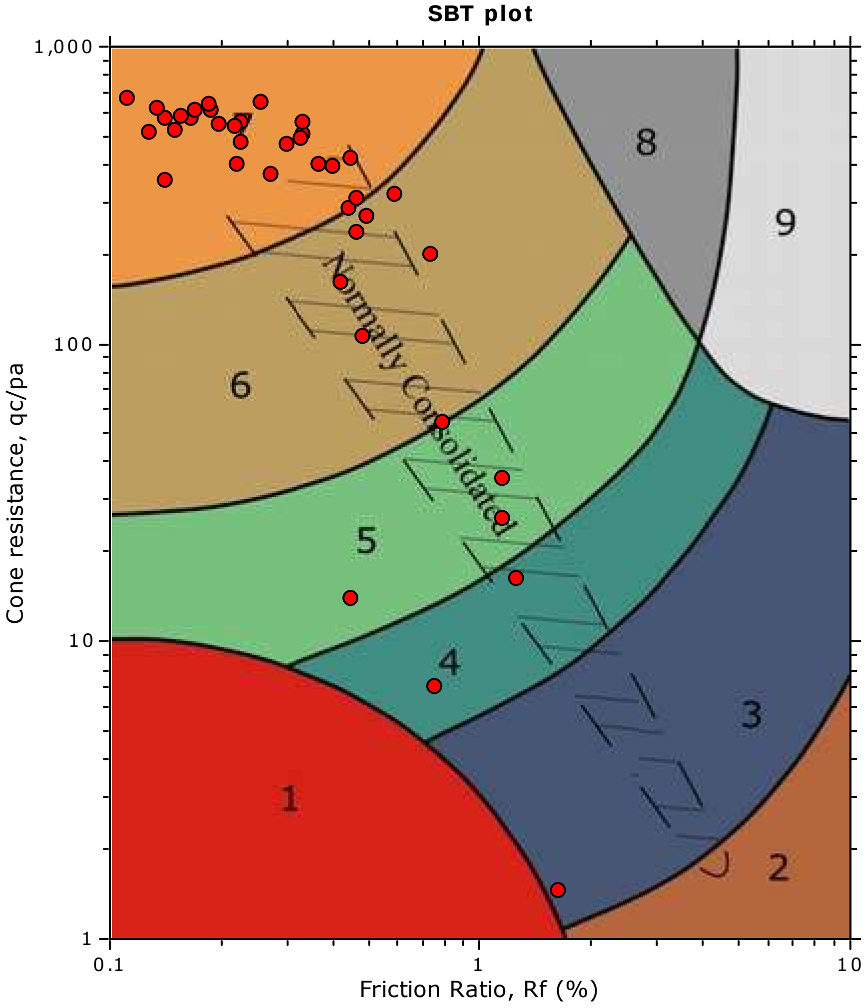
CPT: CPT-13
Total depth: 3.02 ft

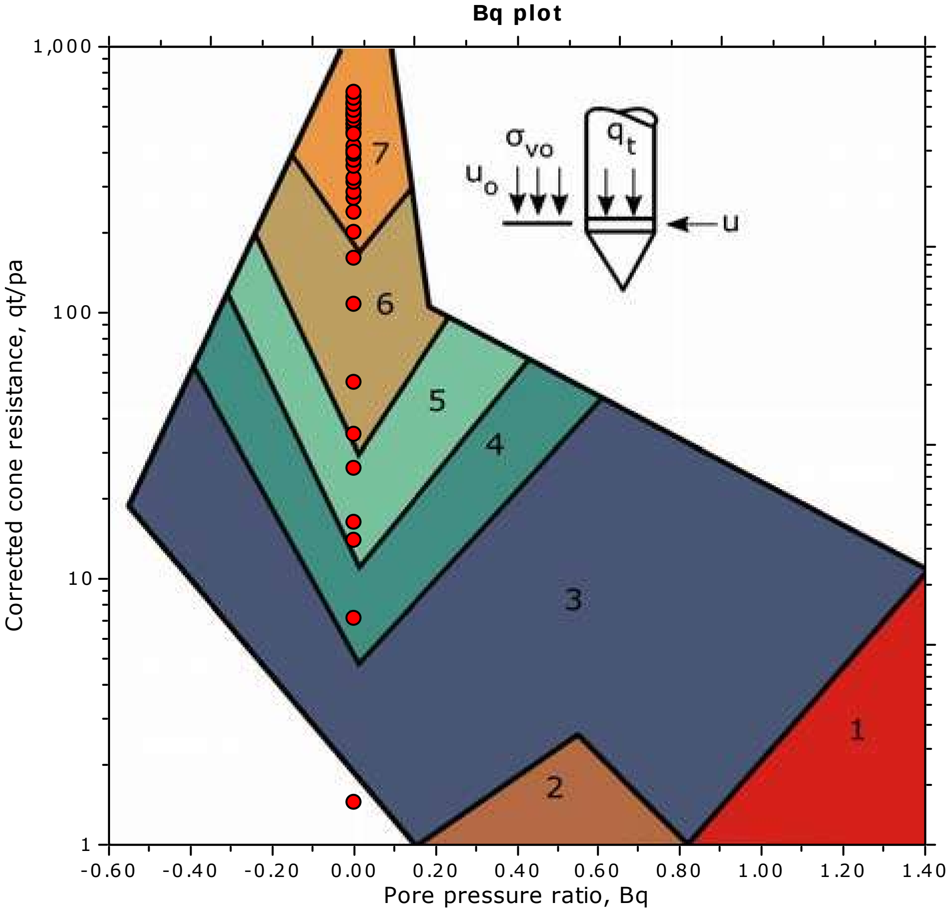


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

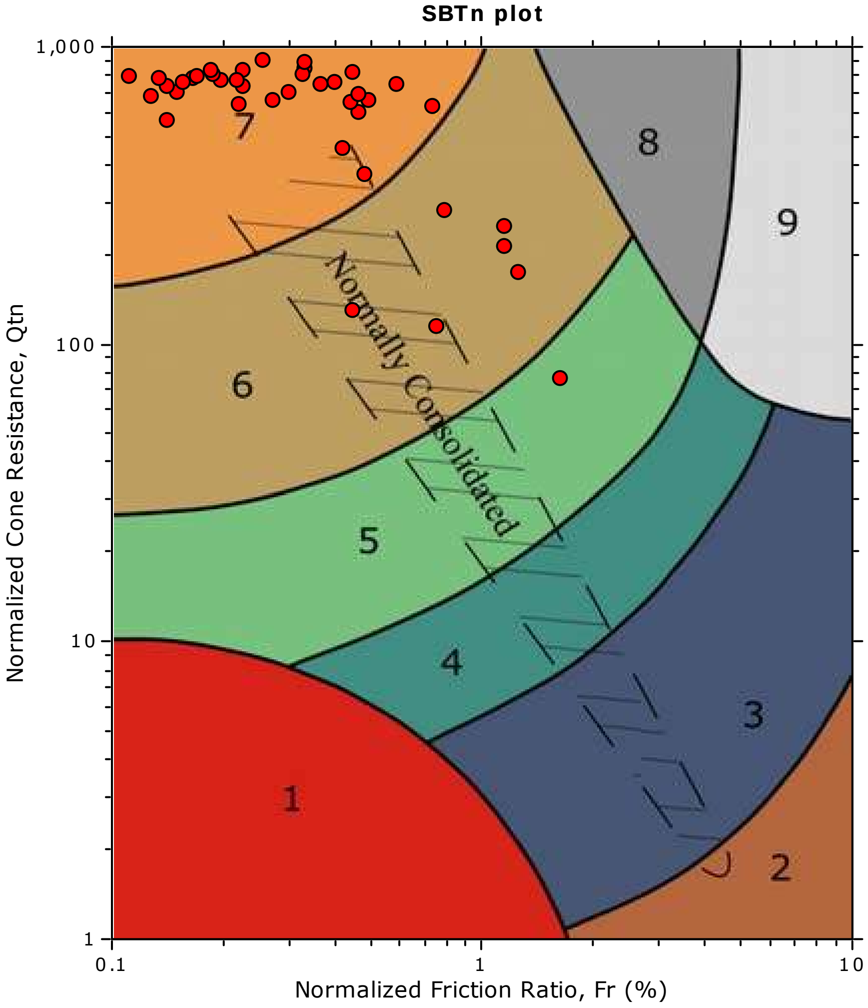


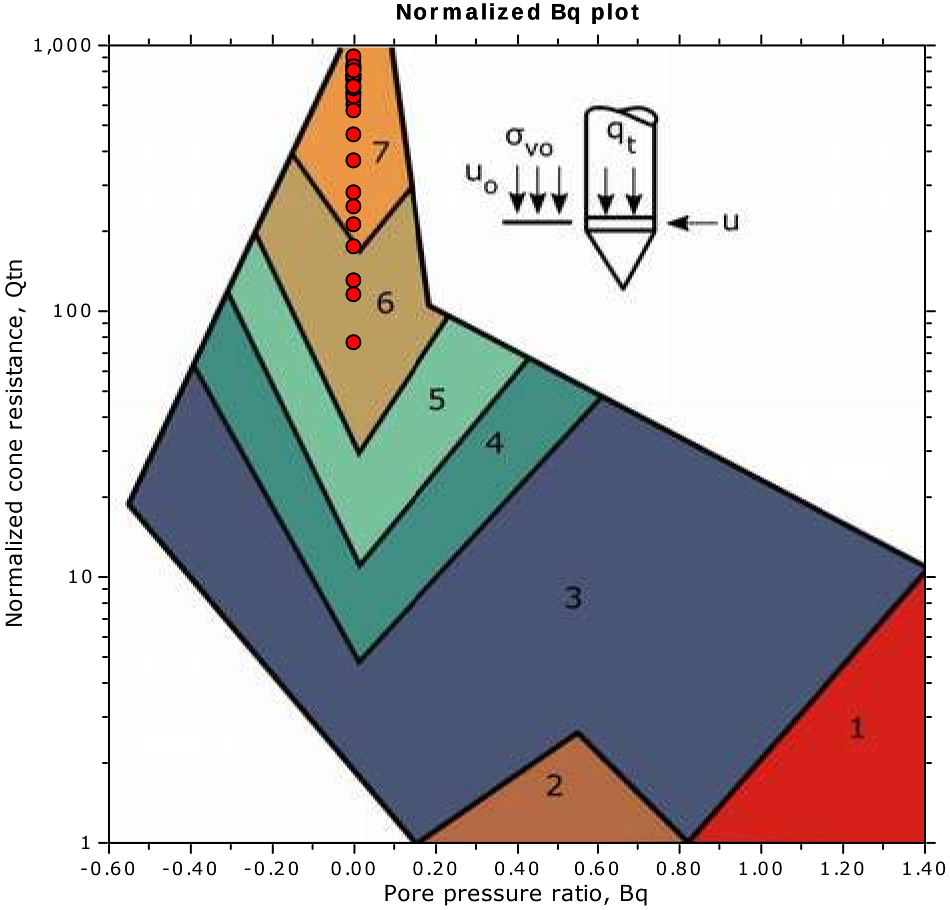


SBT legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty clay	🟧 7. Gravelly sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬛ 8. Very stiff sand to clayey sand
🟦 3. Clay to silty clay	🟫 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

SBT - Bq plots (normalized)

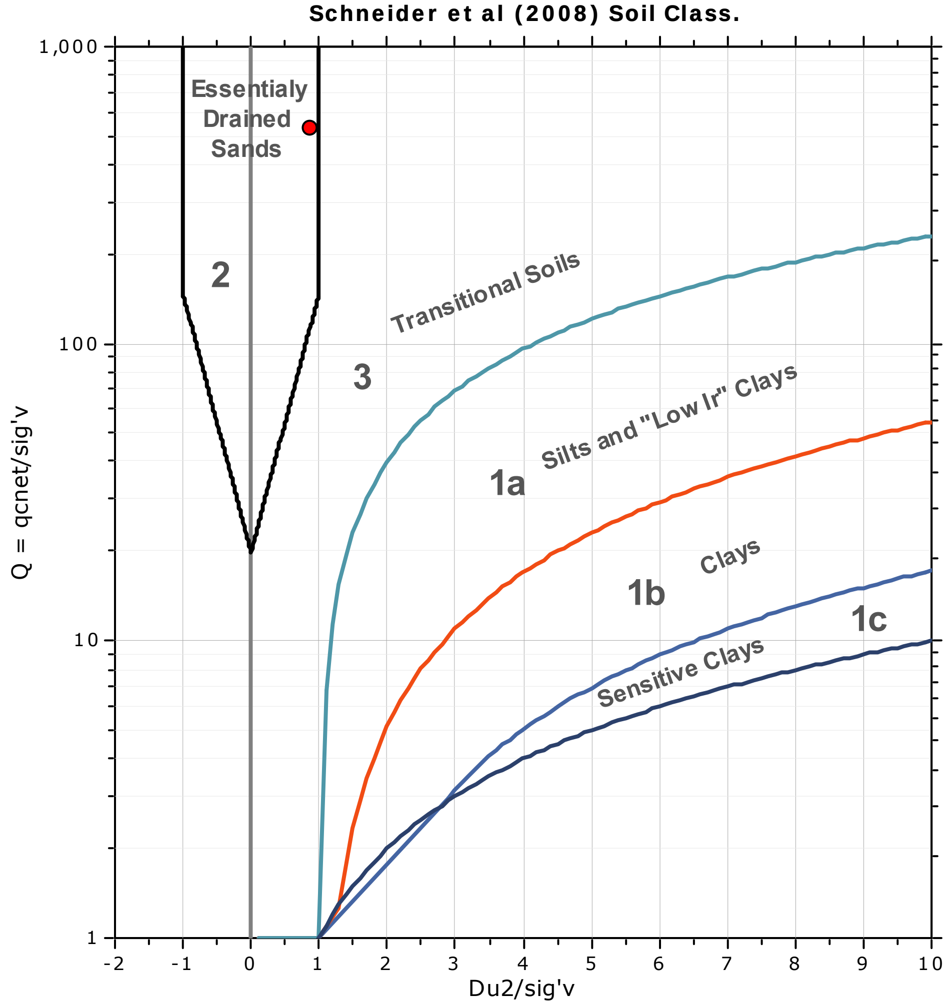


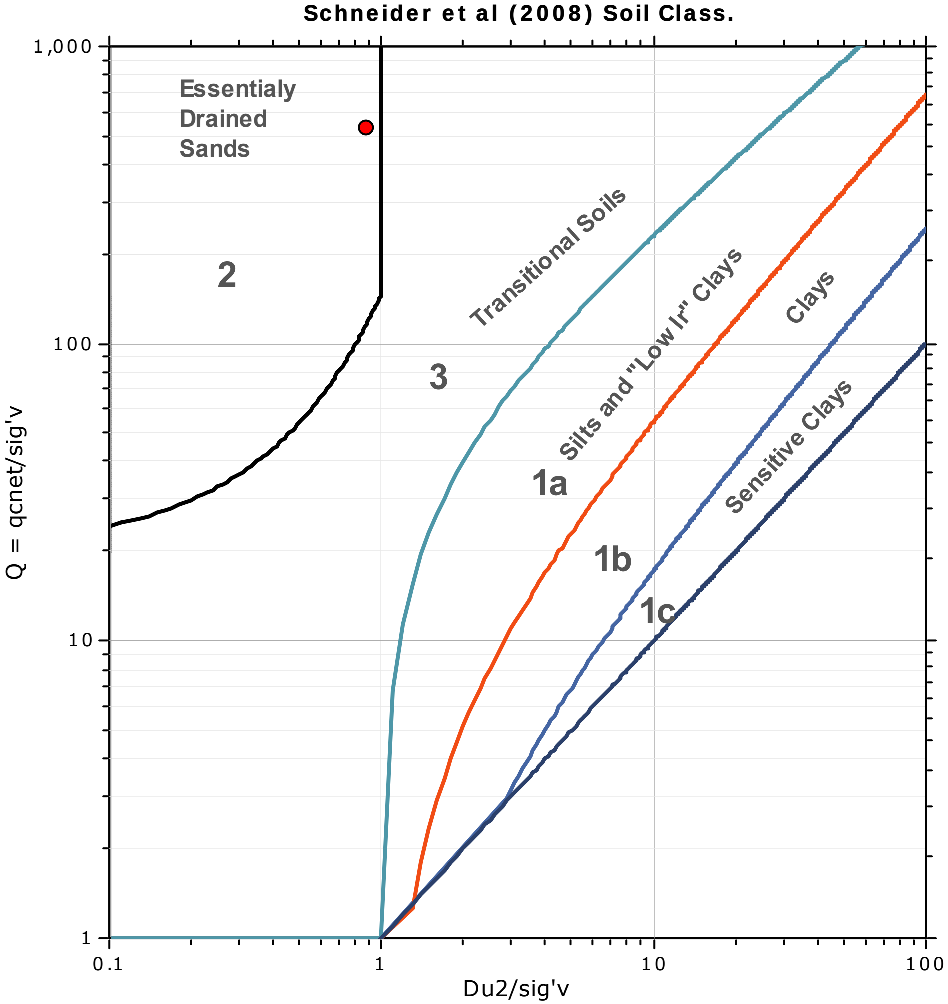


SBTn legend

🟥 1. Sensitive fine grained	▨ 4. Clayey silt to silty clay	▨ 7. Gravelly sand to sand
▨ 2. Organic material	🟩 5. Silty sand to sandy silt	▨ 8. Very stiff sand to clayey sand
🟦 3. Clay to silty clay	▨ 6. Clean sand to silty sand	☐ 9. Very stiff fine grained

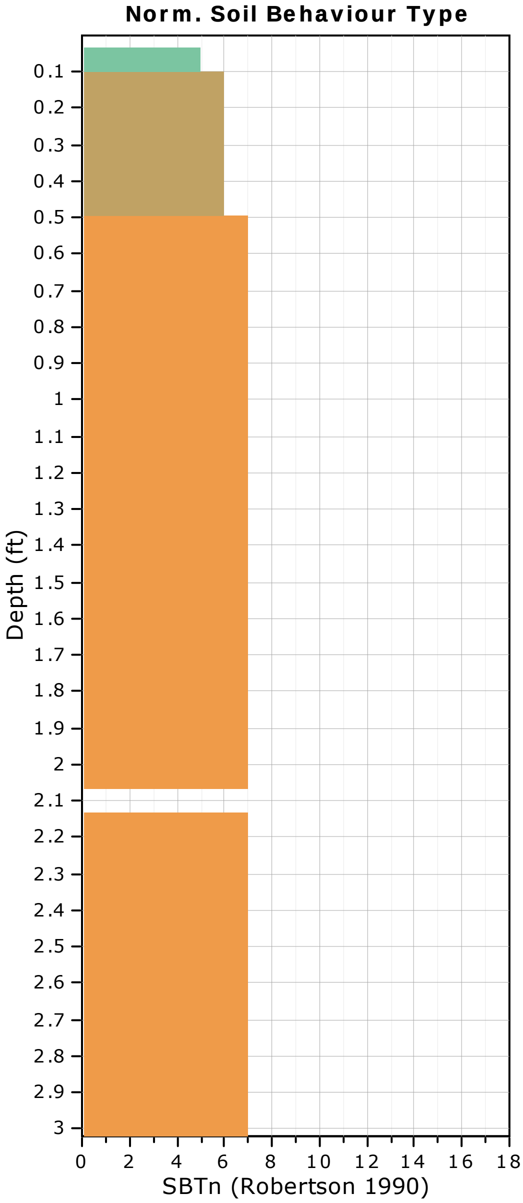
Bq plots (Schneider)

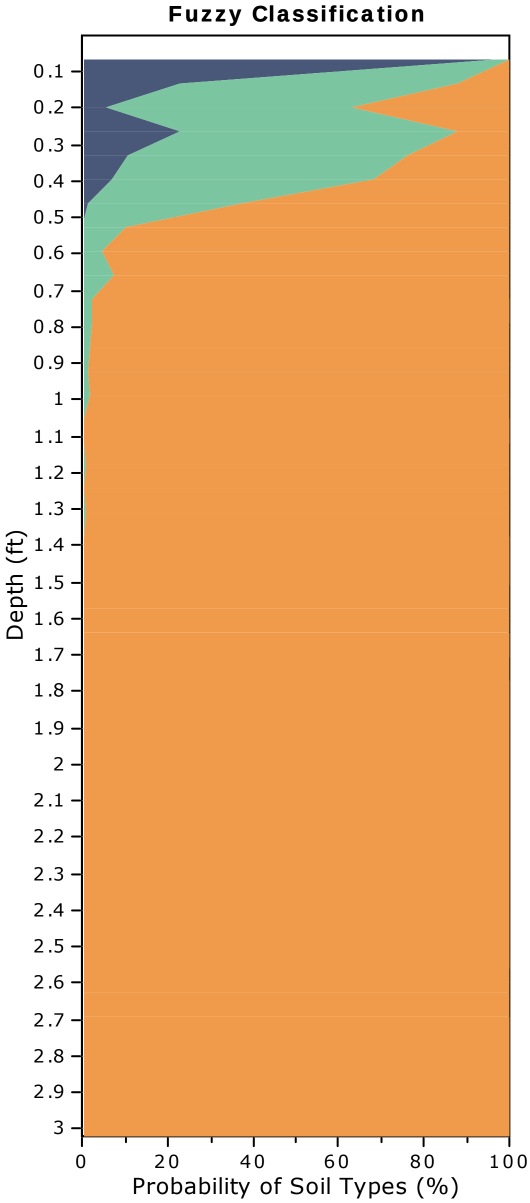




Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-13
Total depth: 3.02 ft





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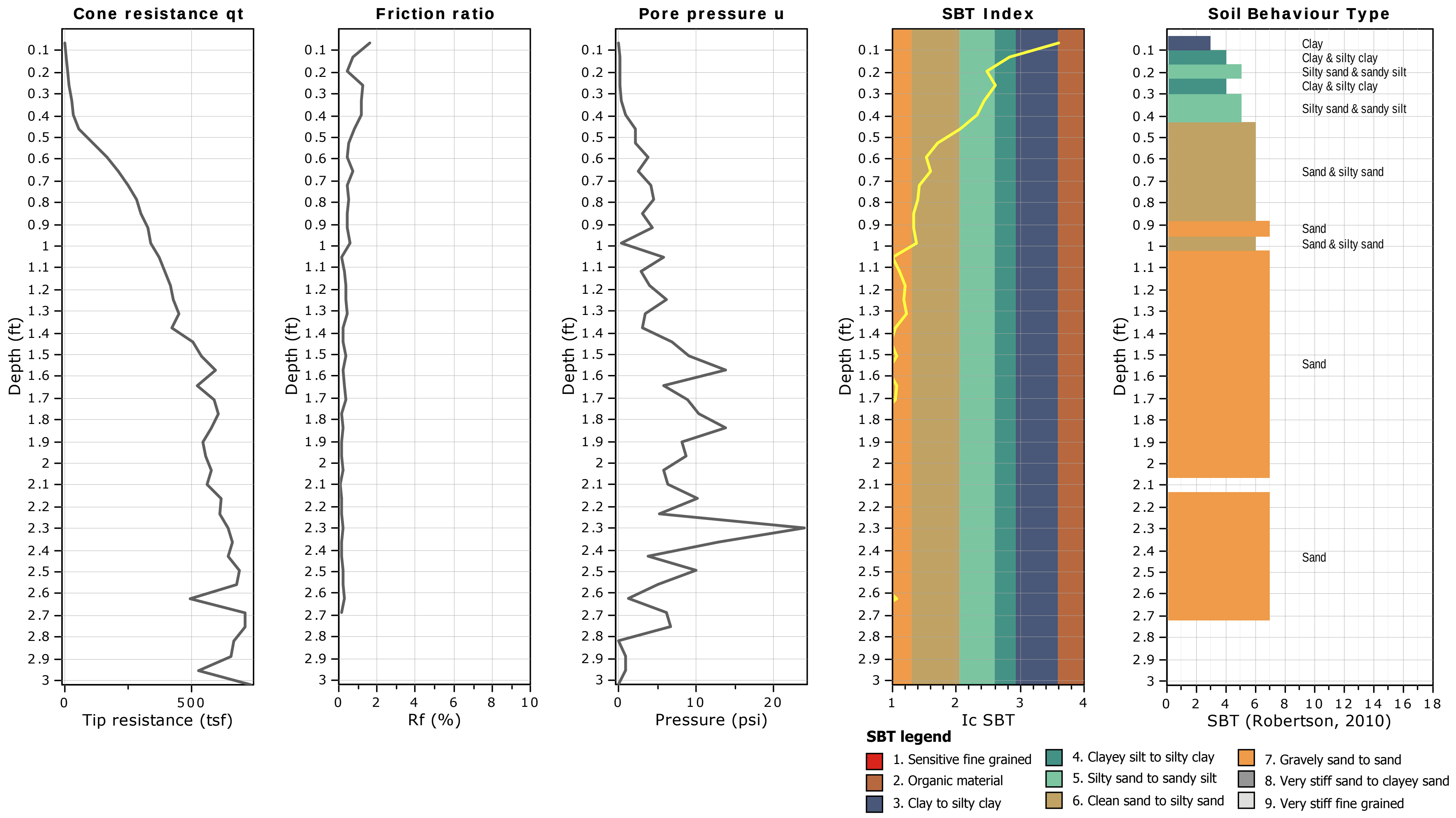
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-13
Total depth: 3.02 ft



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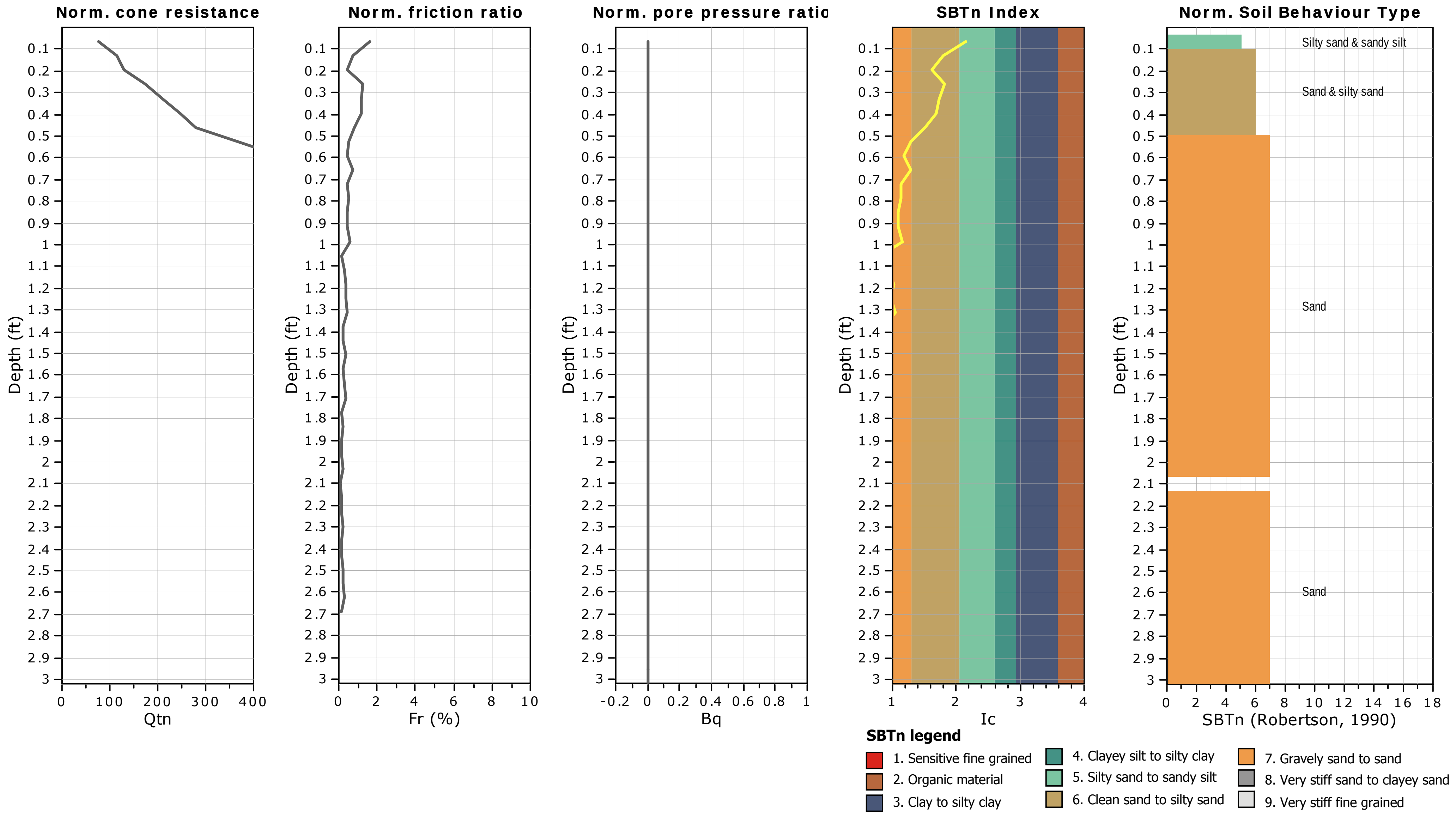
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

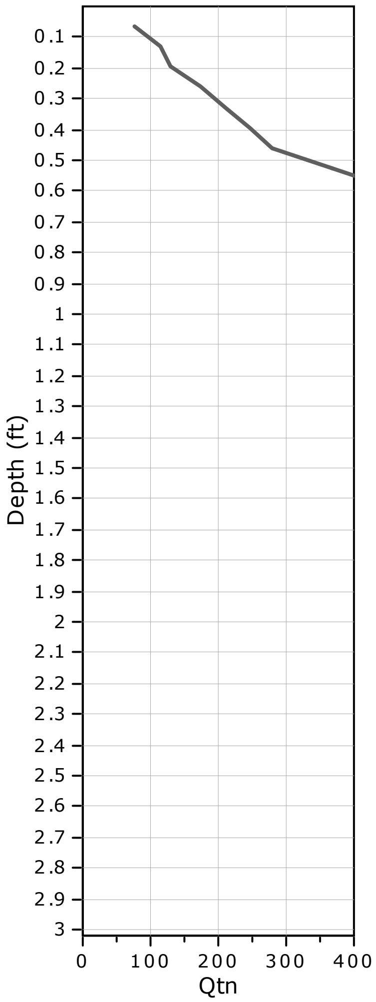
CPT: CPT-13
Total depth: 3.02 ft



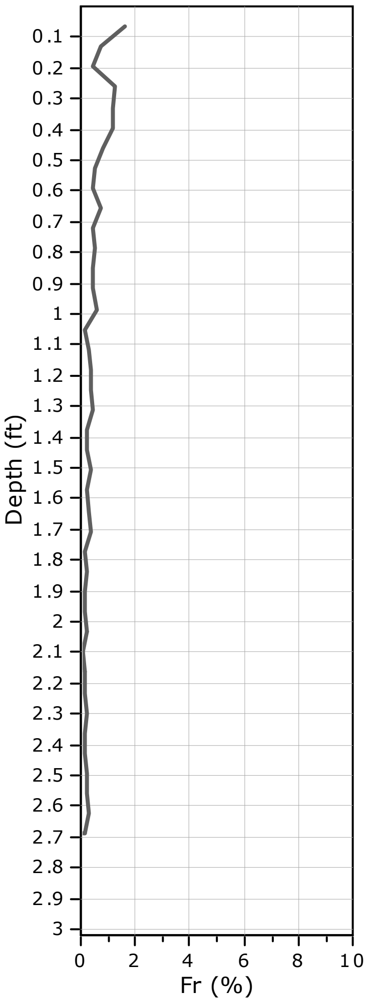
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-13
Total depth: 3.02 ft

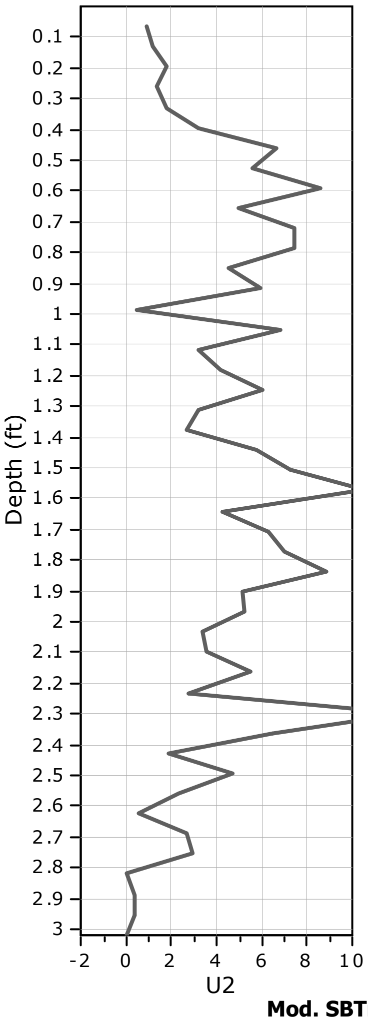
Norm. cone resistance



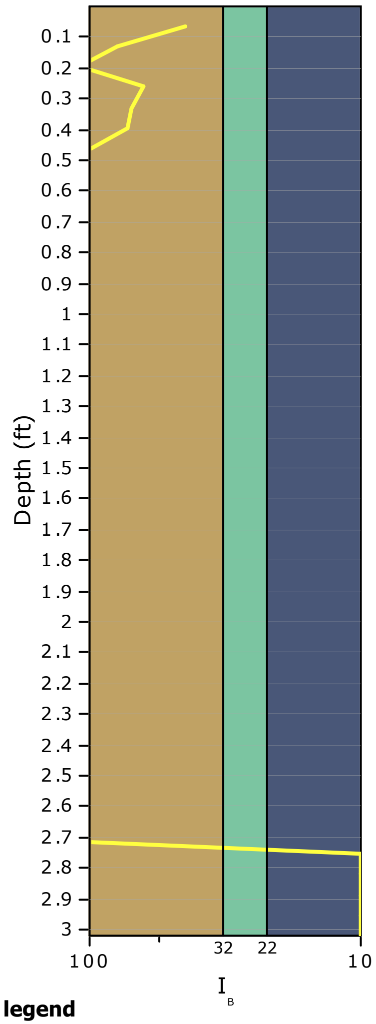
Norm. friction ratio



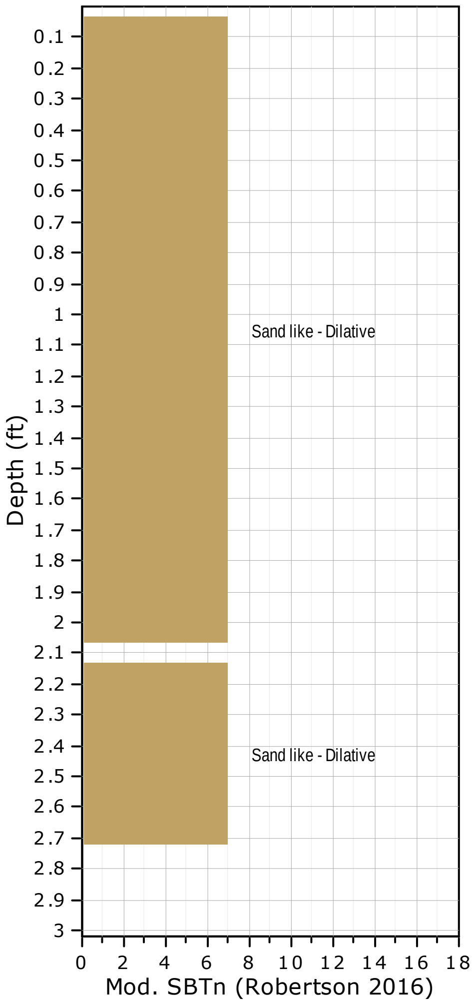
Norm. Pore Pressure



Mod. SBTn I(B)



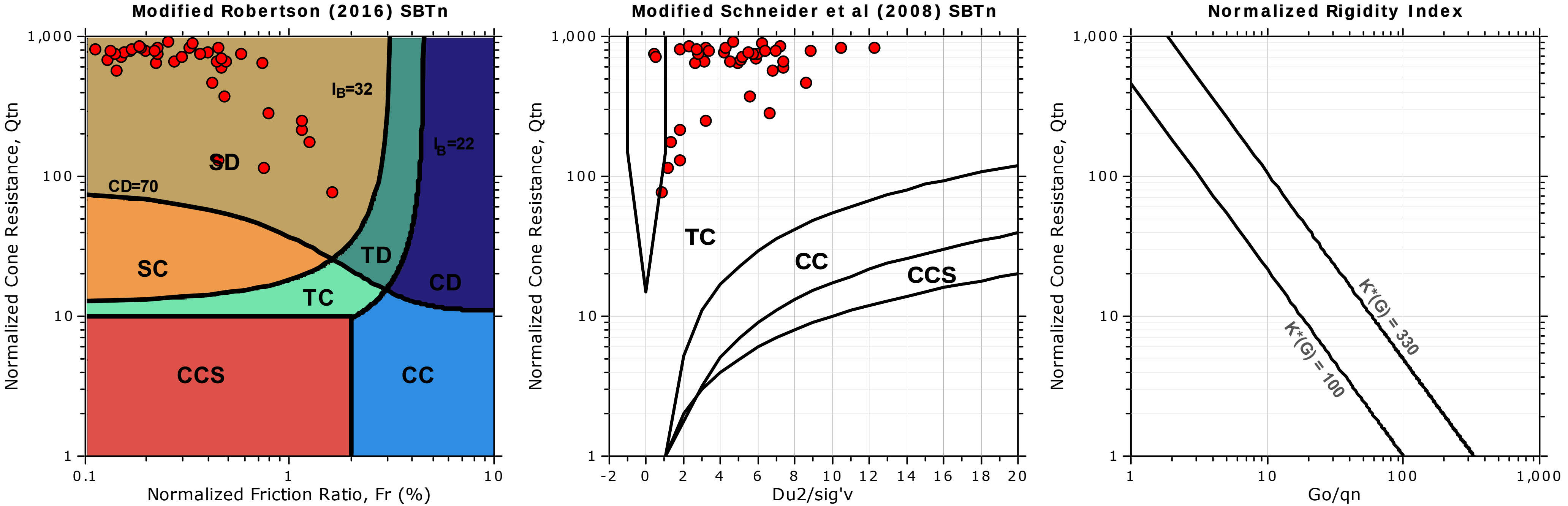
Mod. Norm. SBTn



Mod. SBTn legend

- 🟥 1. CCS: ClayLike - Contractive, Sensitive
- 🟦 2. CC: Clay-like - Contractive
- 🟦 3. CD: Clay-Like: Dilative
- 🟩 4. TC: Transitional - Contractive
- 🟩 5. TD: Transitional - Dilative
- 🟧 6. SC: Sand-like - Contractive
- 🟫 7. SD: Sand-like - Dilative

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

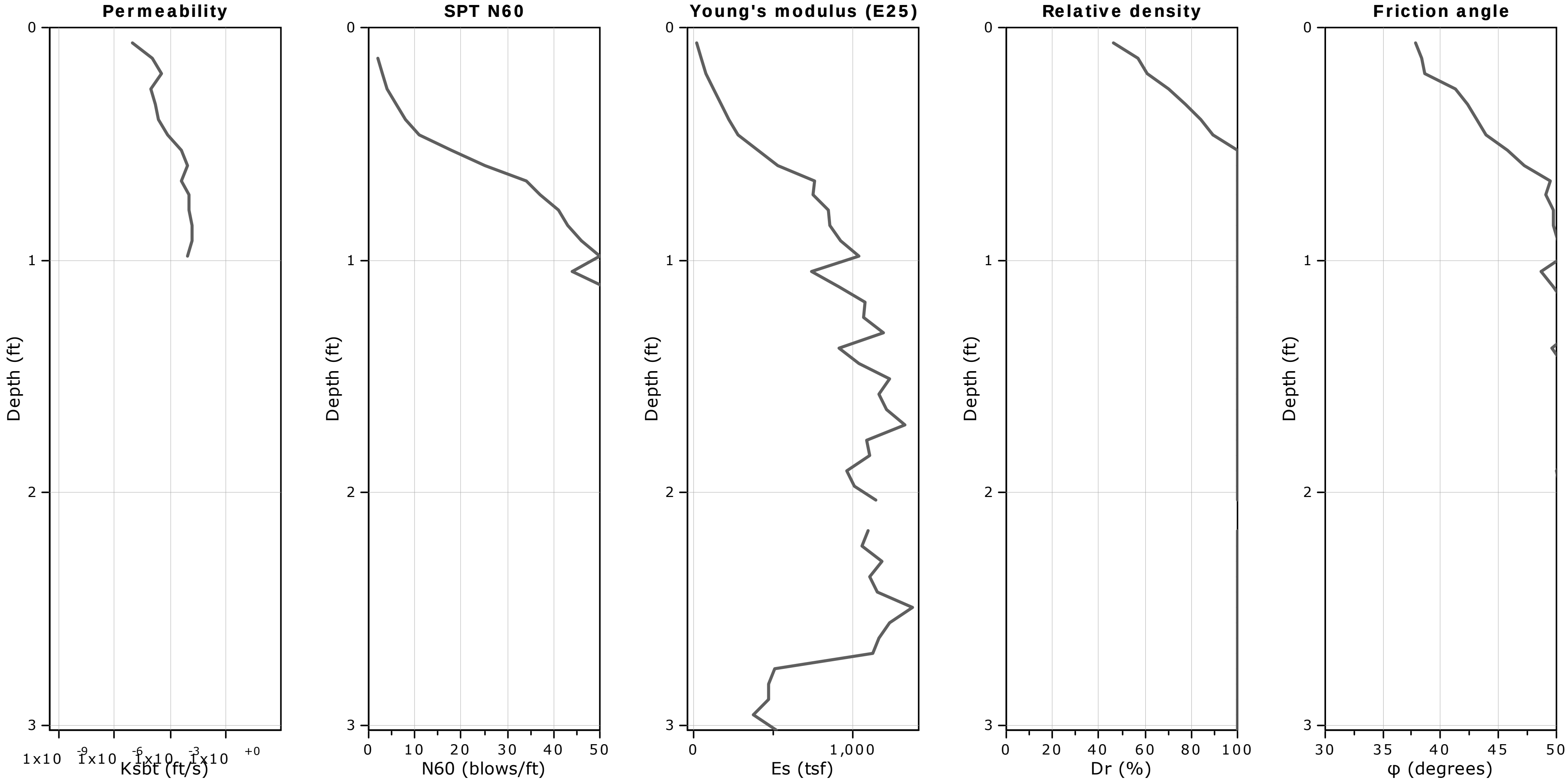
K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-13

Total depth: 3.02 ft



Calculation parameters

Permeability: Based on SBT_n

SPT N_{60}: Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

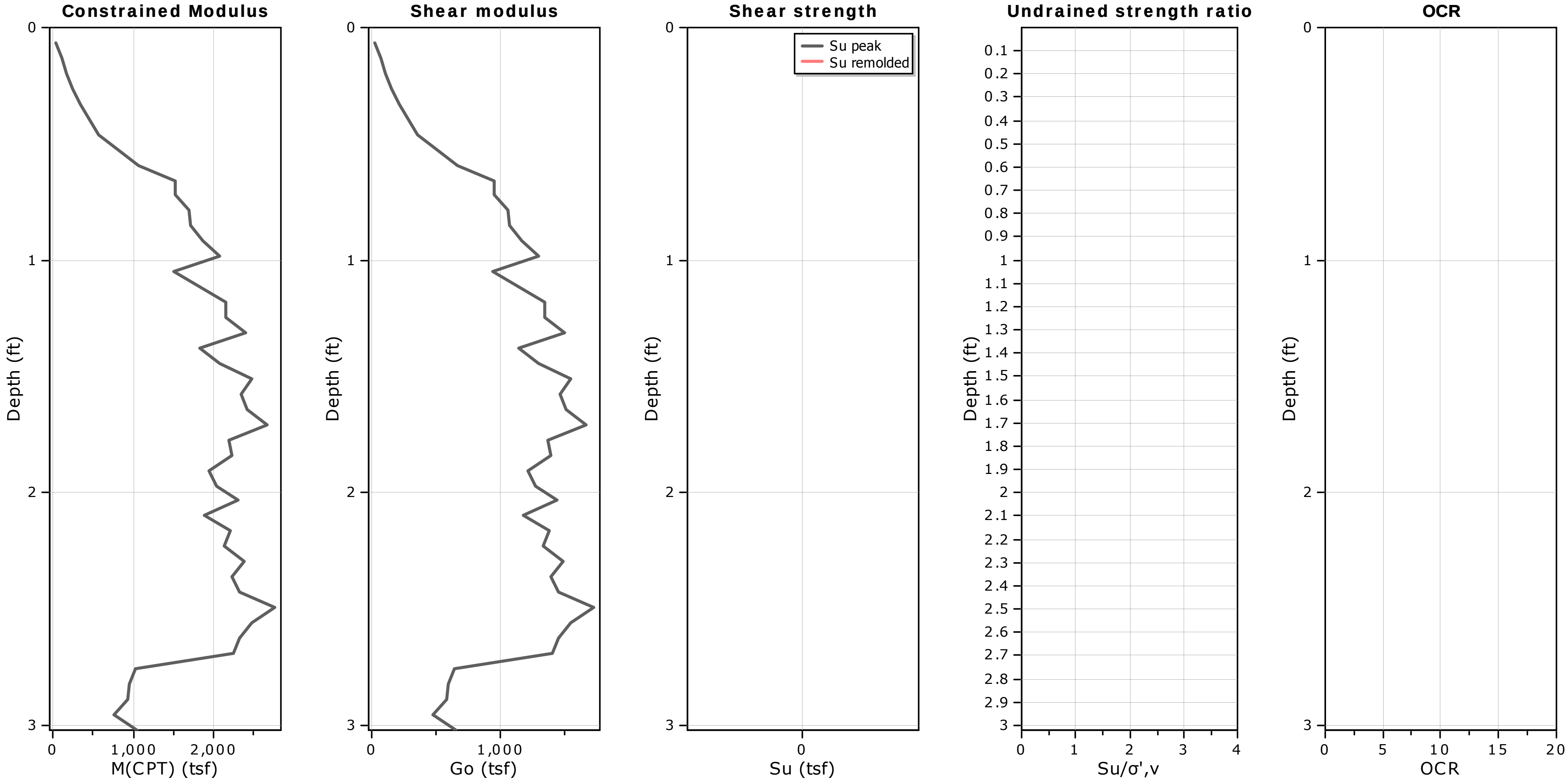
Relative density constant, C_{Dr}: 350.0

Phi: Based on Kulhawy & Mayne (1990)

—●— User defined estimation data

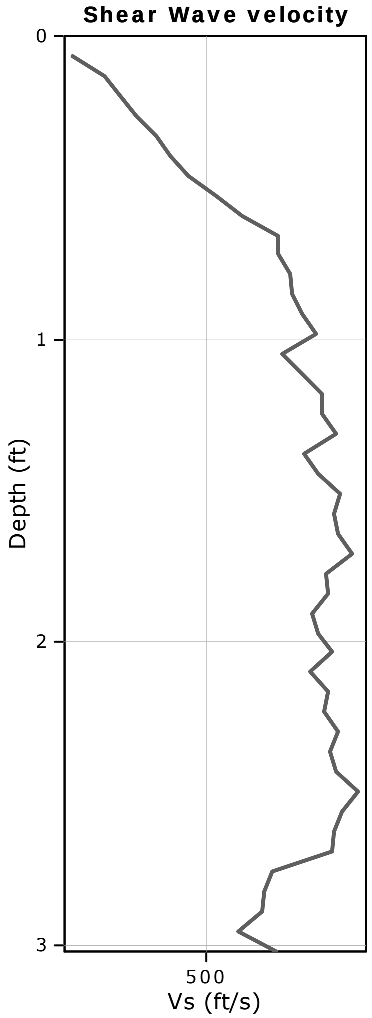
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

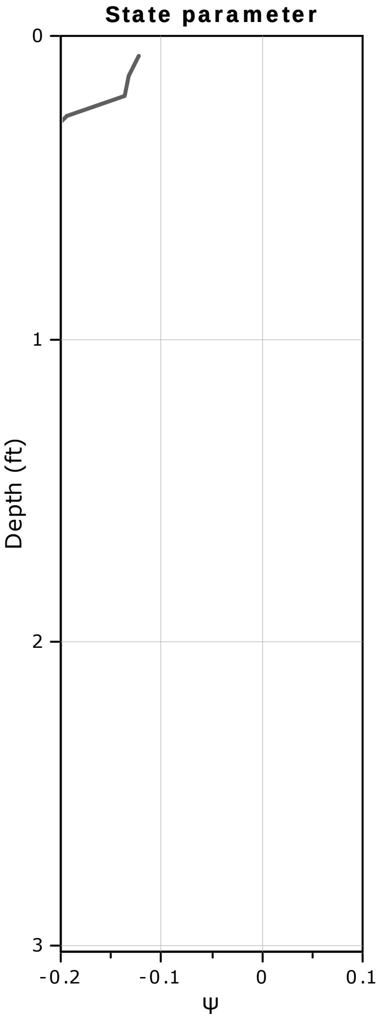
CPT: CPT-13
Total depth: 3.02 ft

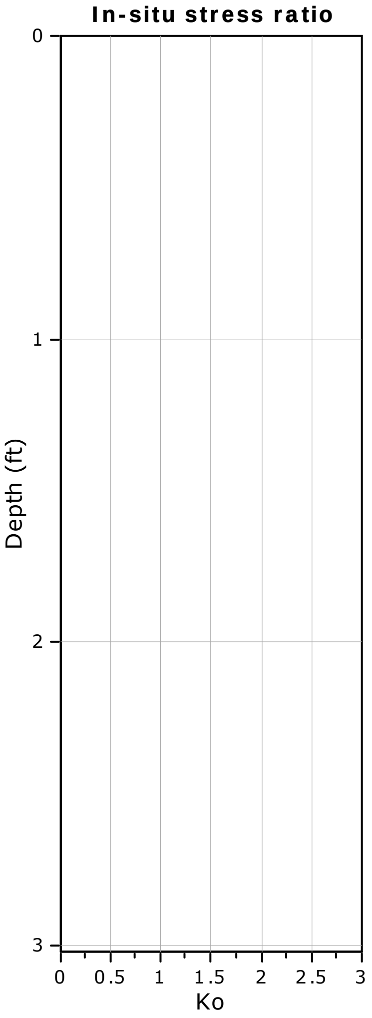


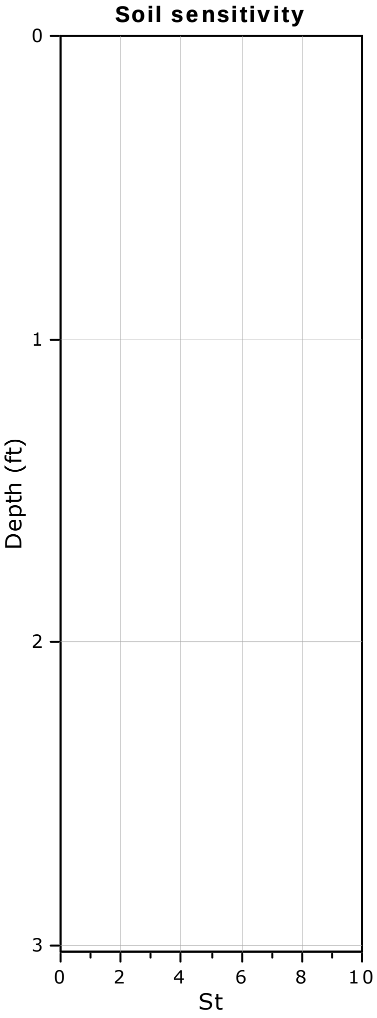
Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

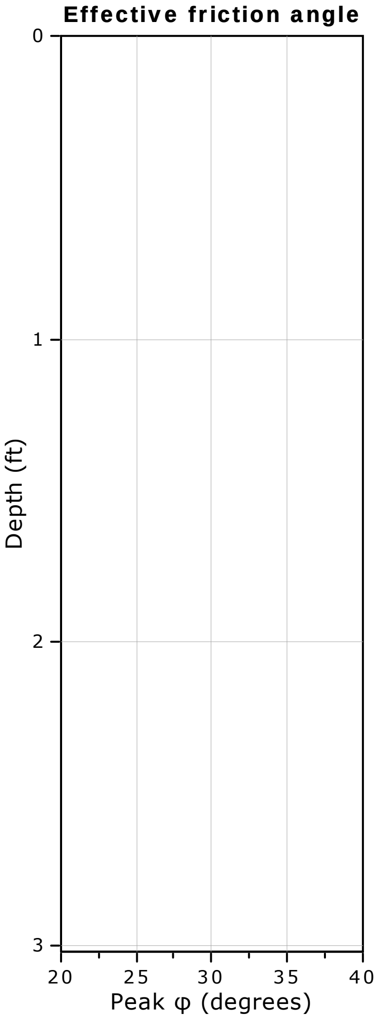
OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data









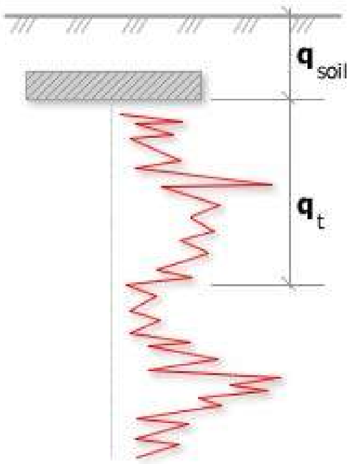


Calculation parameters

Soil Sensitivity factor, N_S: 350.00

—●— User defined estimation data

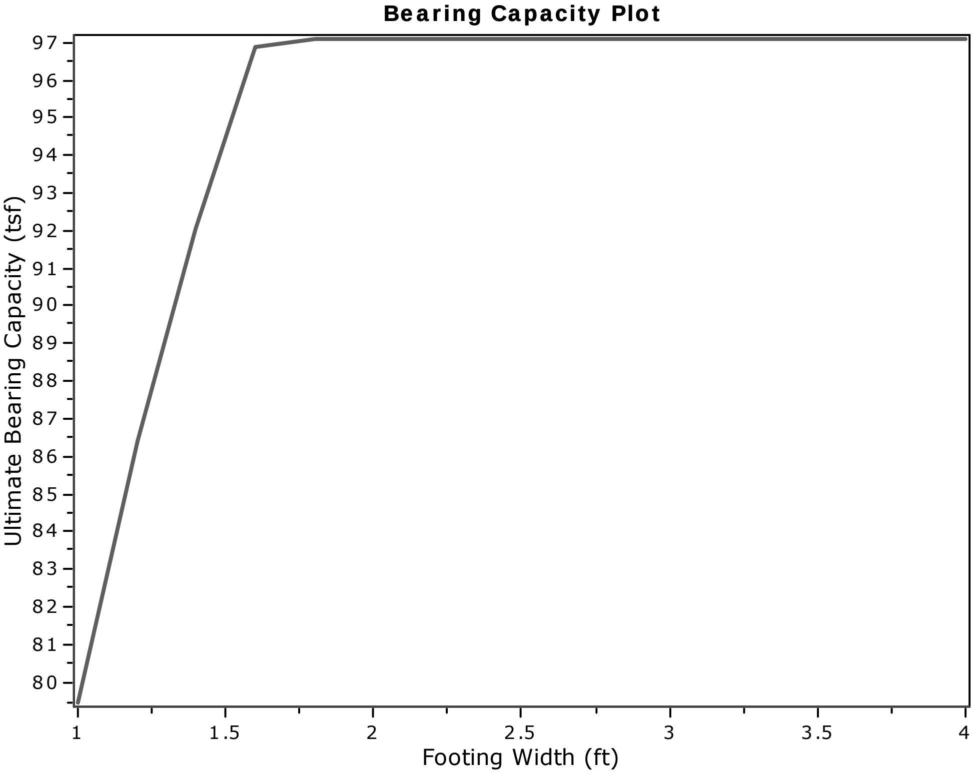
Project: **Langan** **CPT: CPT-13**
Location: **BL England Substation - Marmora NJ** Total depth: 3.02 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

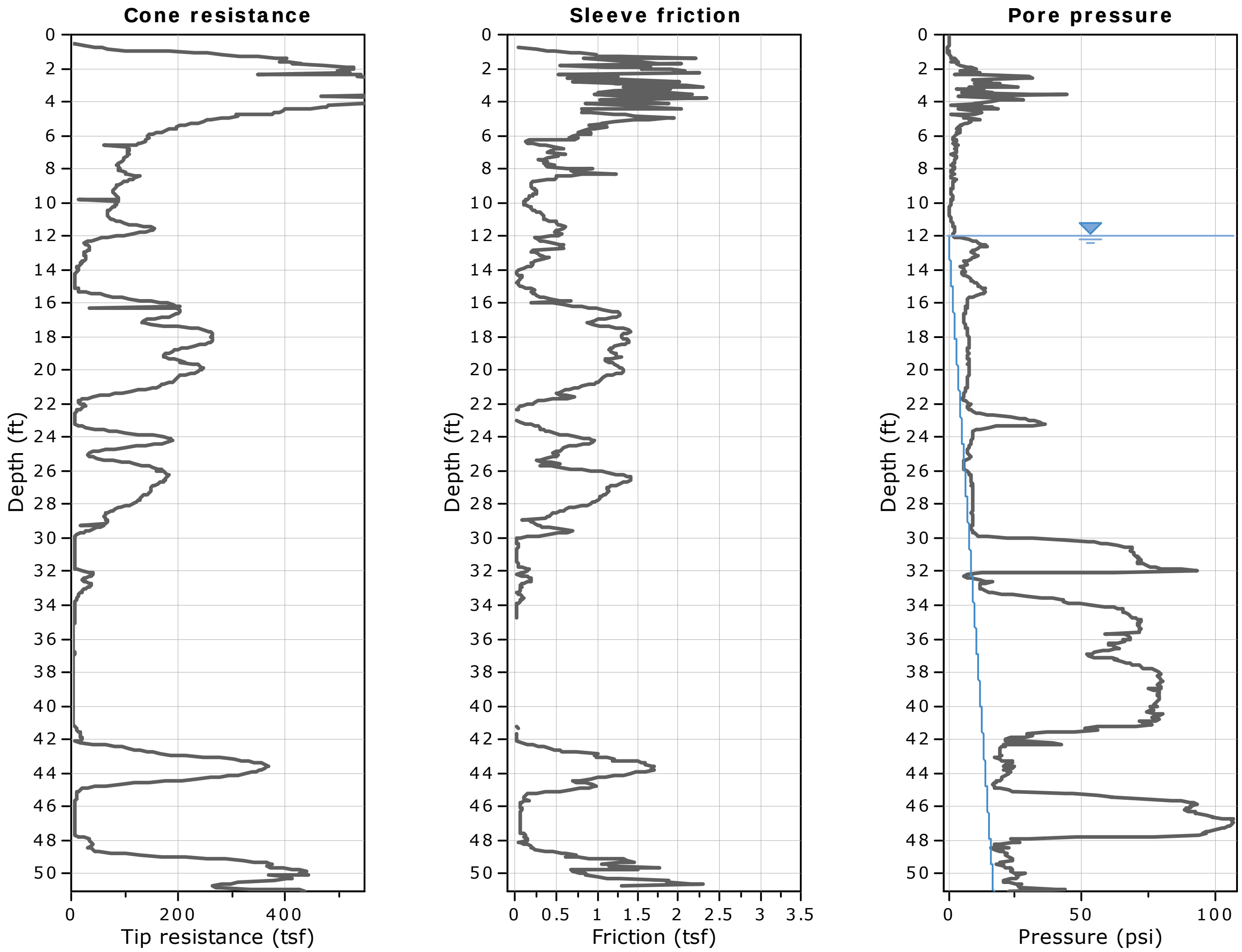


:: Tabular results ::

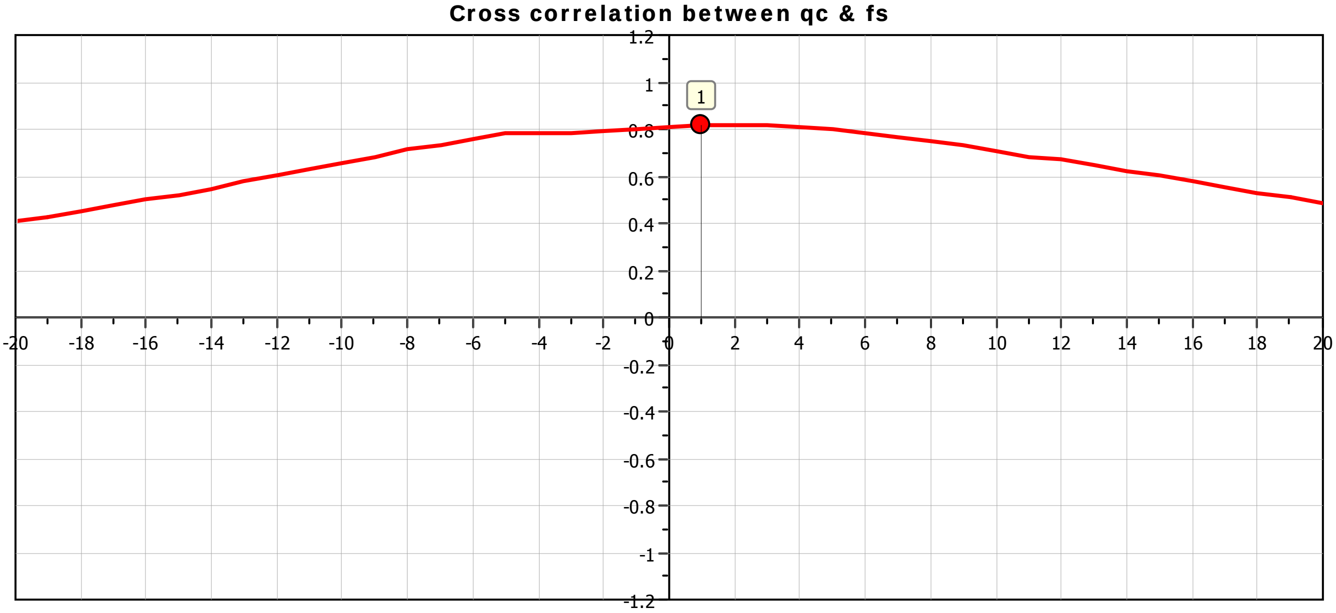
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	397.07	0.20	0.03	79.44
2	1.20	0.50	2.30	431.86	0.20	0.03	86.40
3	1.40	0.50	2.60	460.02	0.20	0.03	92.03
4	1.60	0.50	2.90	484.31	0.20	0.03	96.89
5	1.80	0.50	3.20	485.32	0.20	0.03	97.09
6	2.00	0.50	3.50	485.32	0.20	0.03	97.09
7	2.20	0.50	3.80	485.32	0.20	0.03	97.09
8	2.40	0.50	4.10	485.32	0.20	0.03	97.09
9	2.60	0.50	4.40	485.32	0.20	0.03	97.09
10	2.80	0.50	4.70	485.32	0.20	0.03	97.09
11	3.00	0.50	5.00	485.32	0.20	0.03	97.09
12	3.20	0.50	5.30	485.32	0.20	0.03	97.09
13	3.40	0.50	5.60	485.32	0.20	0.03	97.09
14	3.60	0.50	5.90	485.32	0.20	0.03	97.09
15	3.80	0.50	6.20	485.32	0.20	0.03	97.09
16	4.00	0.50	6.50	485.32	0.20	0.03	97.09

Project: **Langan** **CPT: CPT-13a**

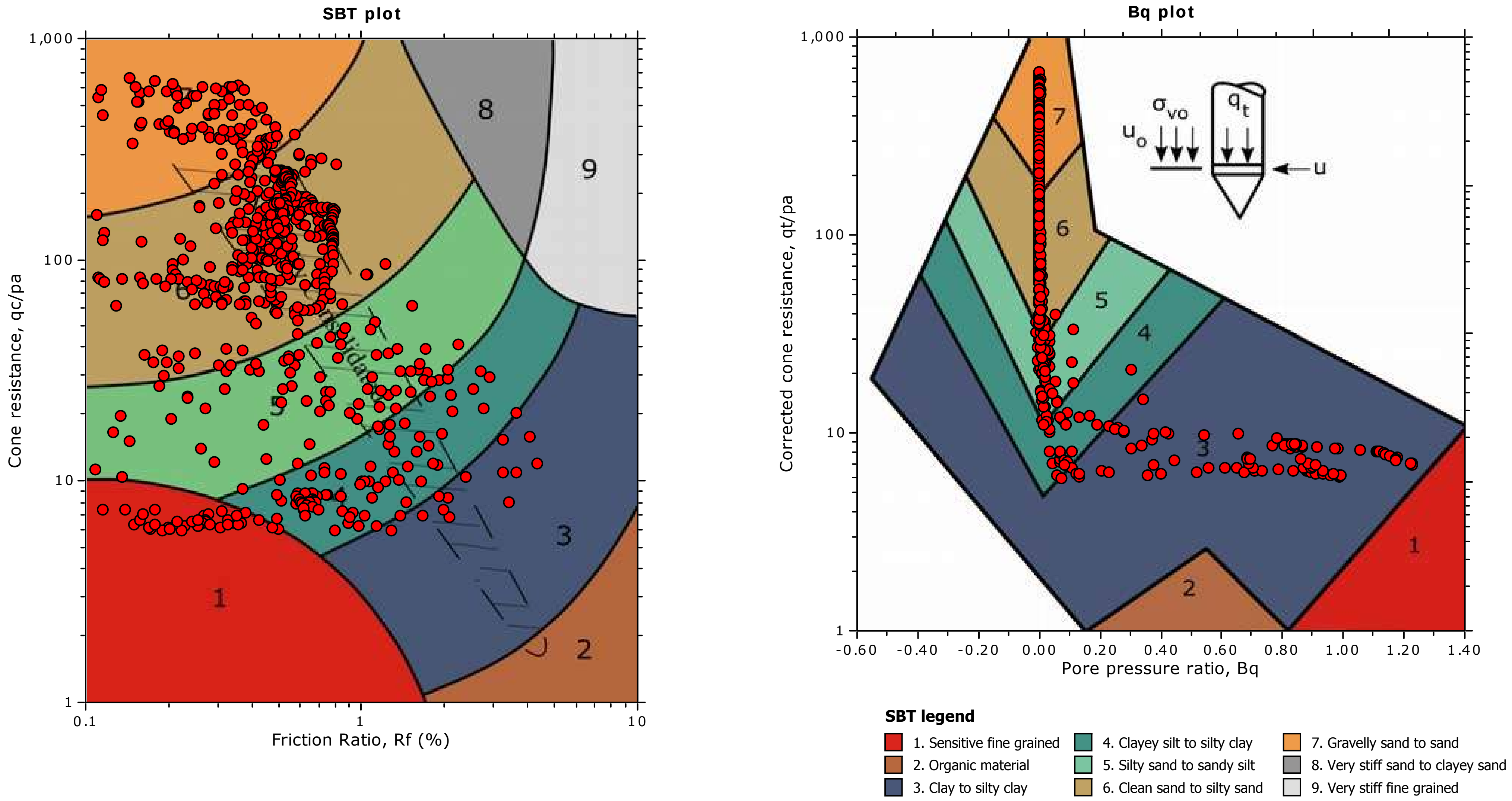
Location: **BL England Substation - Marmora NJ** Total depth: 51.05 ft



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



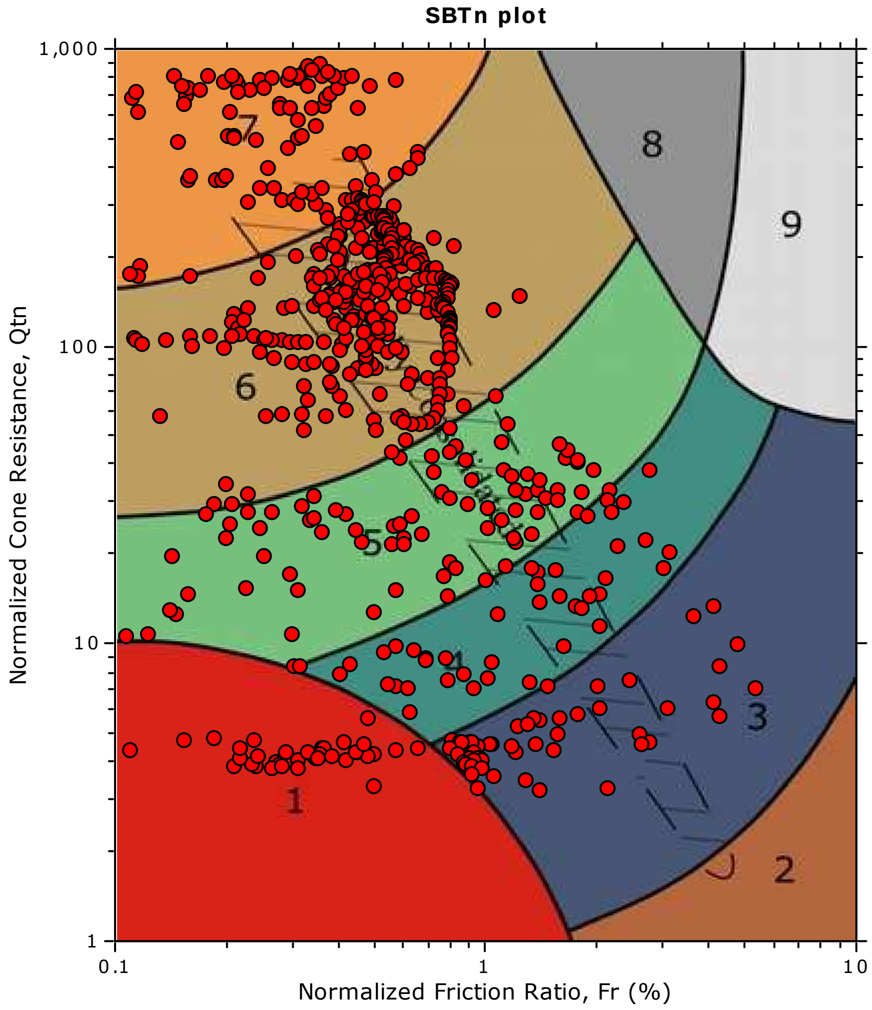
SBT - Bq plots

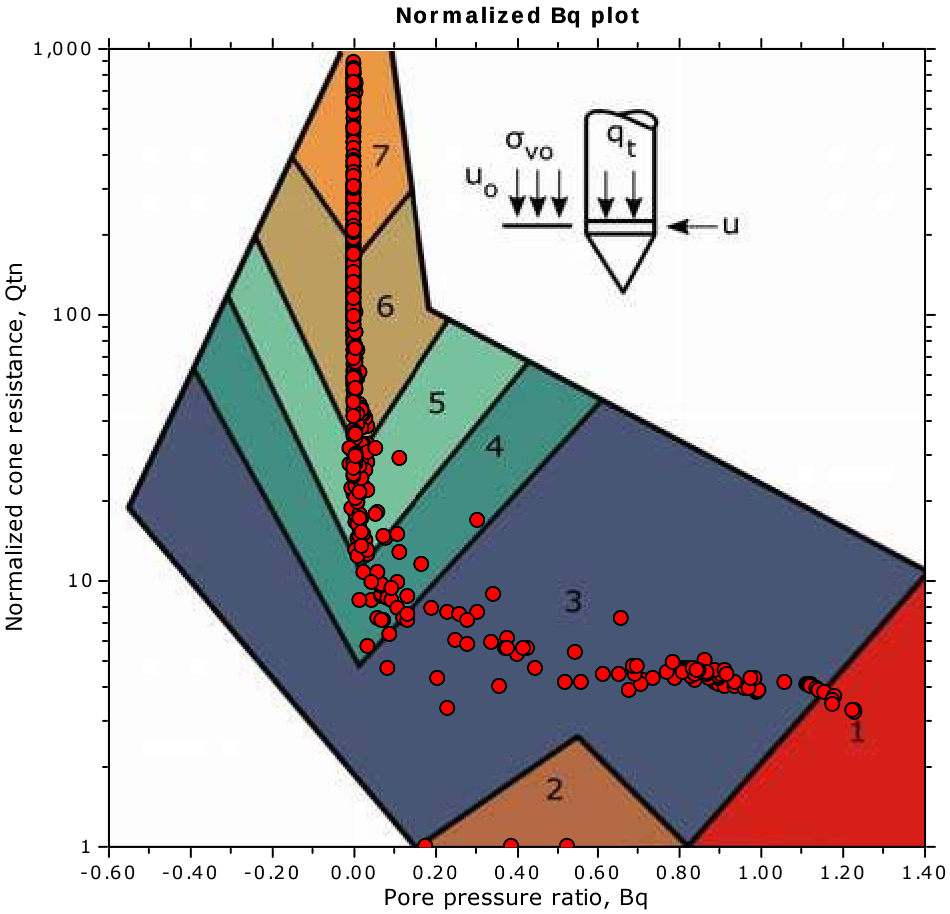

SBT plot
1,000
100
10
1
0.1
1
10
Cone resistance, qc/pa
Friction Ratio, Rf (%)
1
2
3
5
6
7
8
9
Bq plot
1,000
100
10
1
-0.60
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Corrected cone resistance, qt/pa
Pore pressure ratio, Bq
1
2
3
4
5
6
7
σvo
uo
qt
u
SBT legend
🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟫 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬜ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-13a
Total depth: 51.05 ft

SBT - Bq plots (normalized)

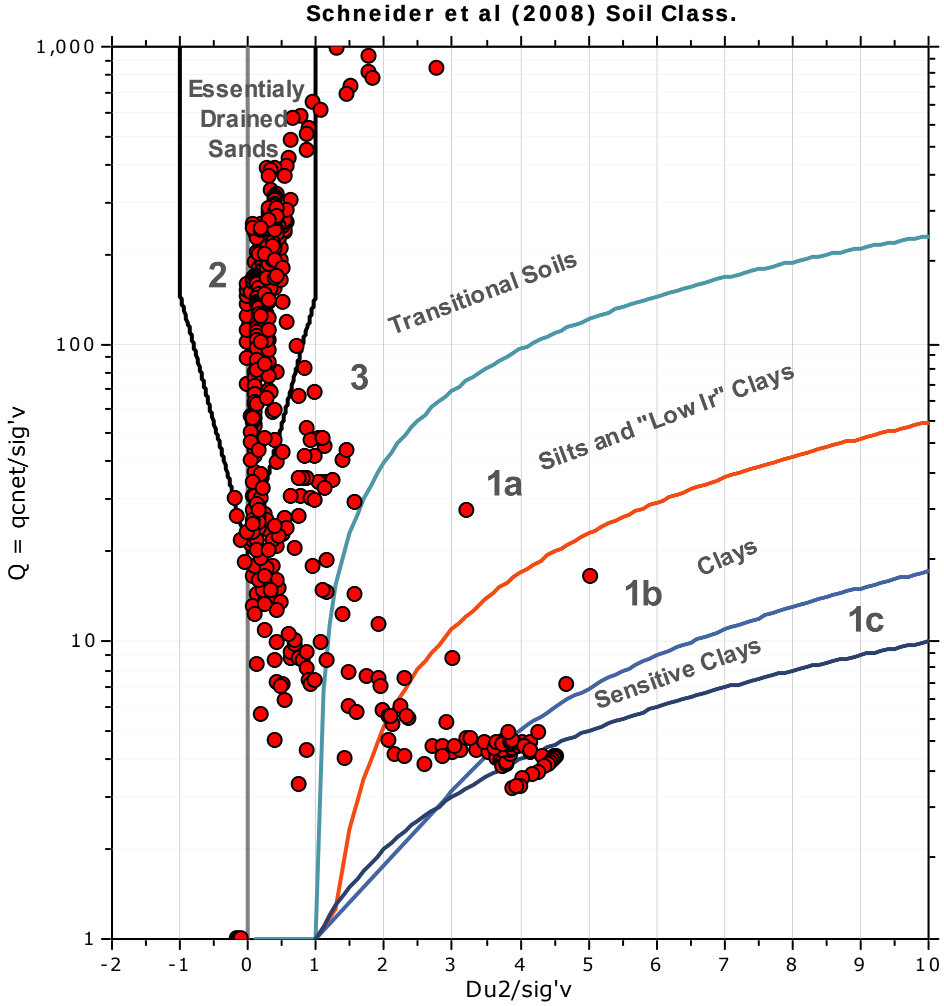


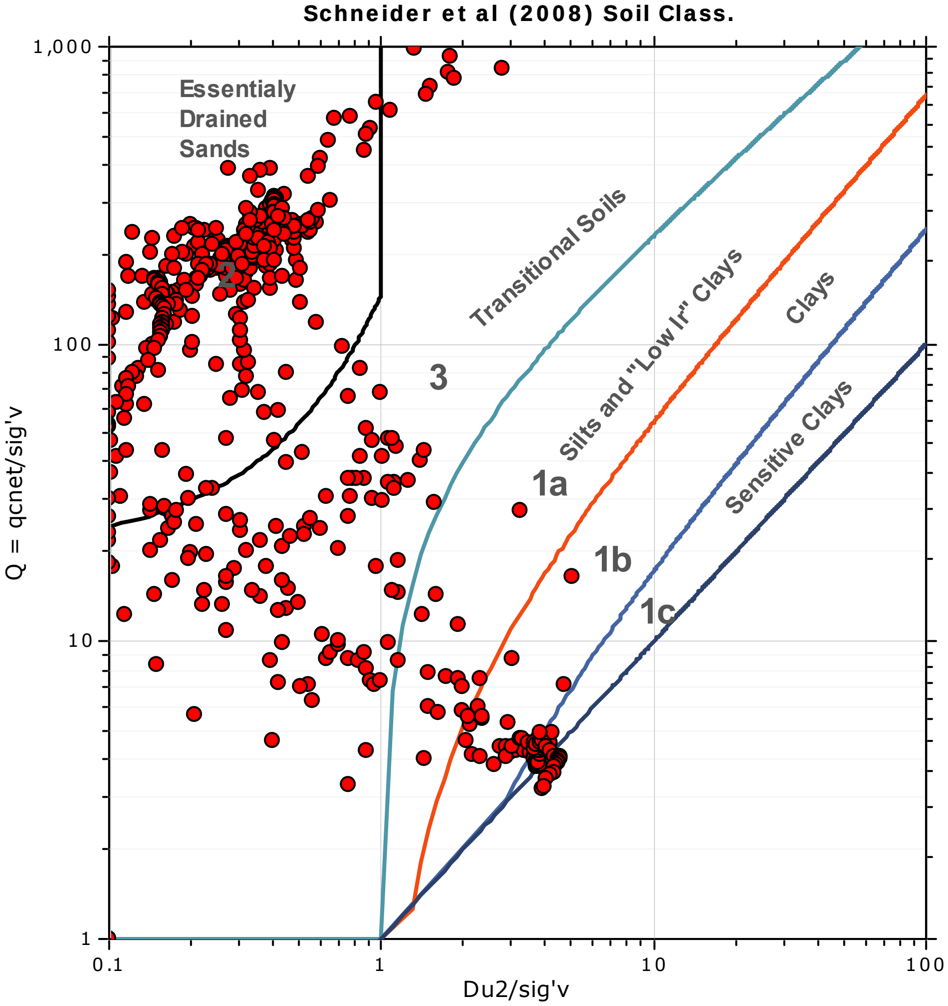


SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬜ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

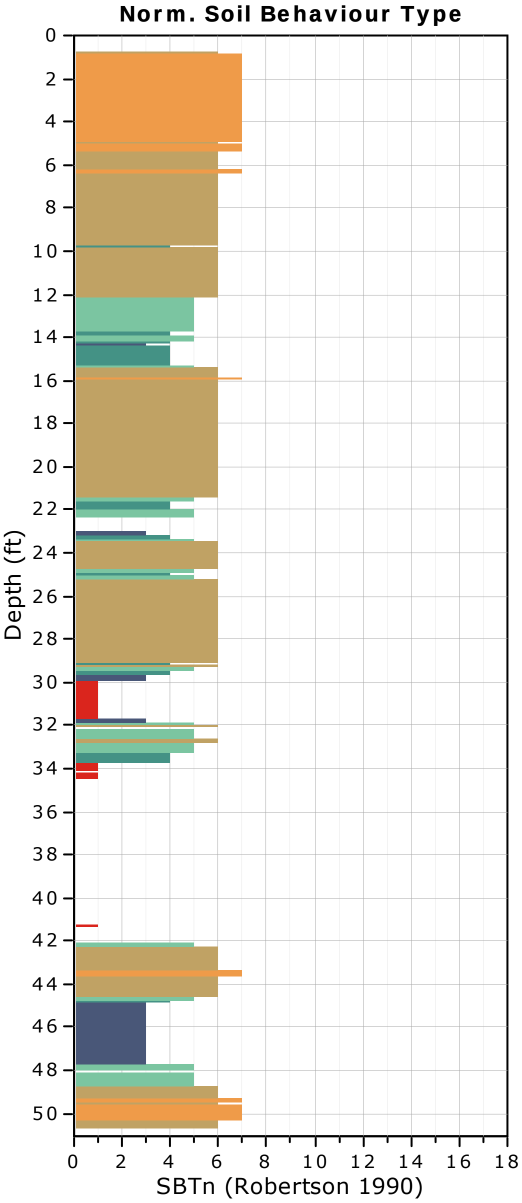
Bq plots (Schneider)

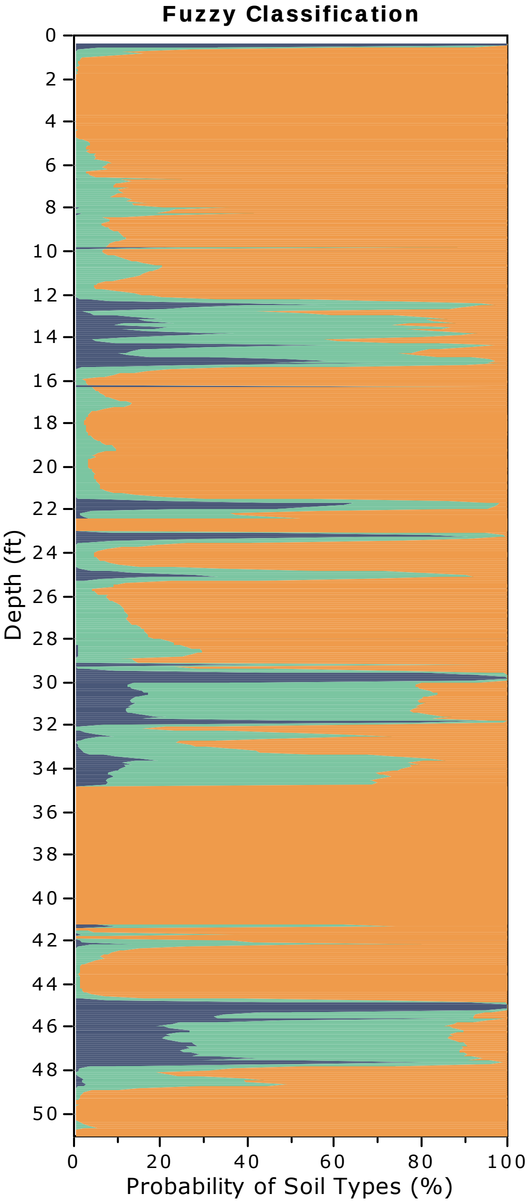




Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-13a
Total depth: 51.05 ft





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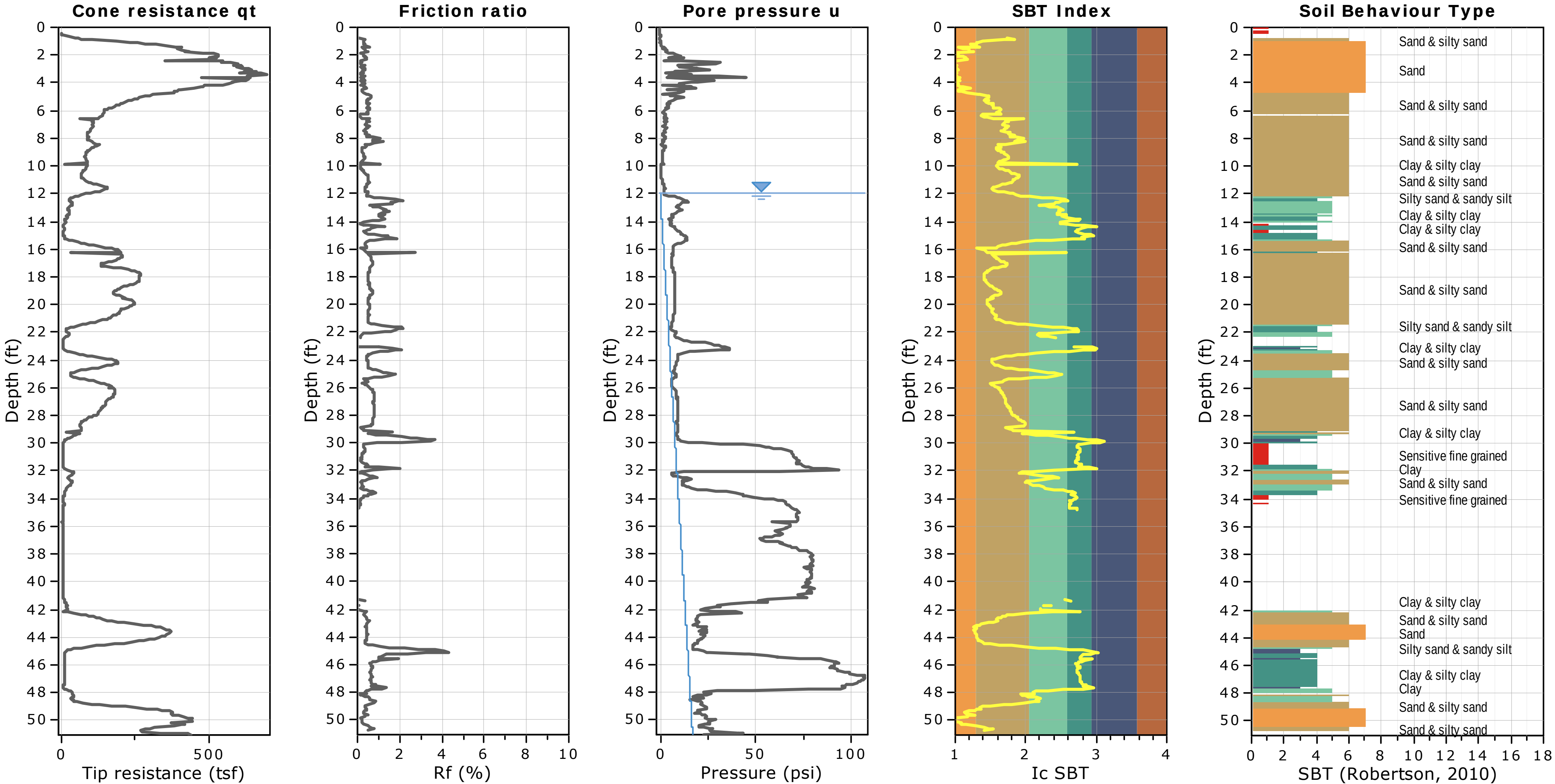
Mays Landing, NJ

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-13a

Total depth: 51.05 ft



SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
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- 🟧 7. Gravely sand to sand
- ⬜ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

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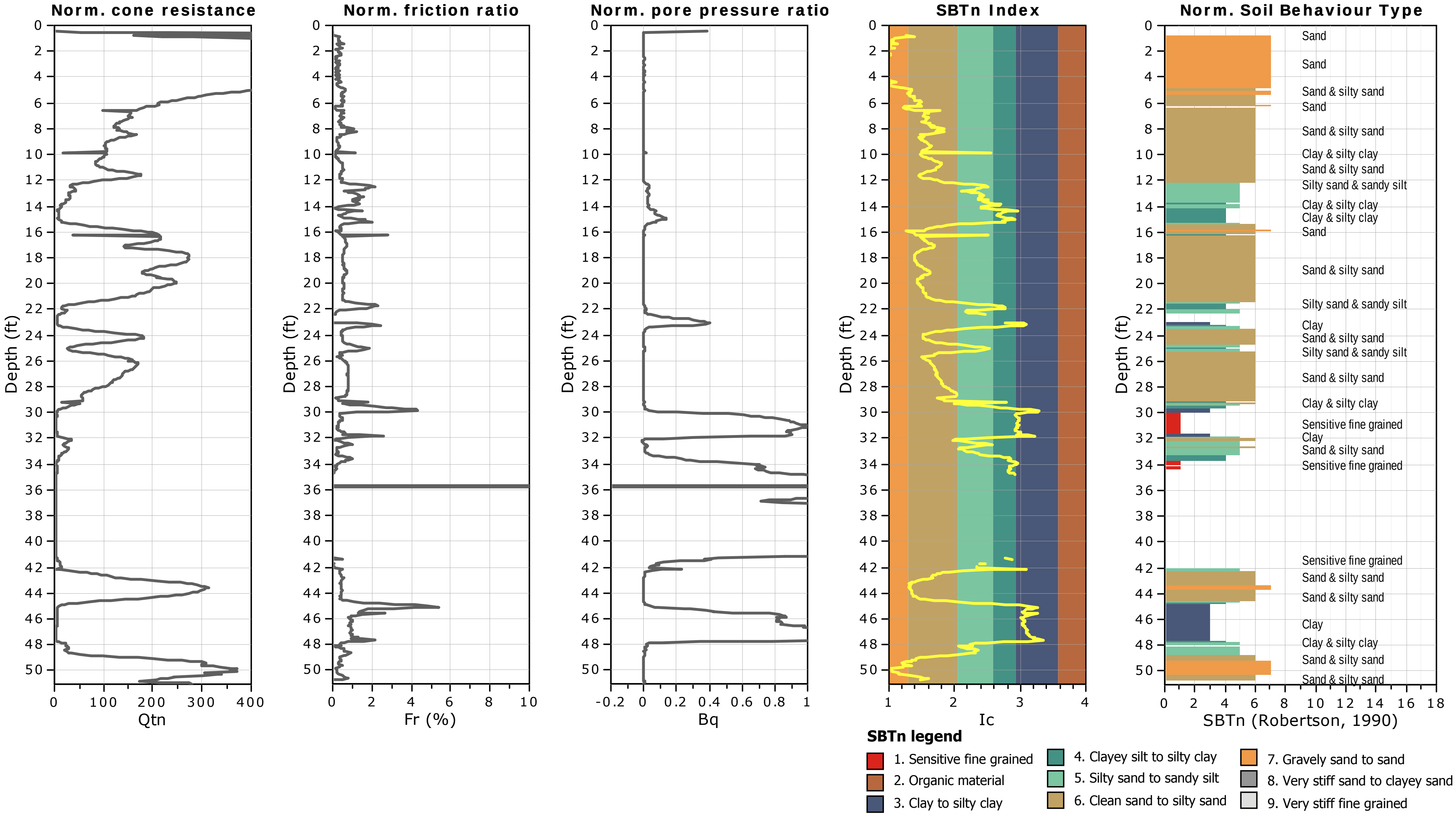
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-13a
Total depth: 51.05 ft



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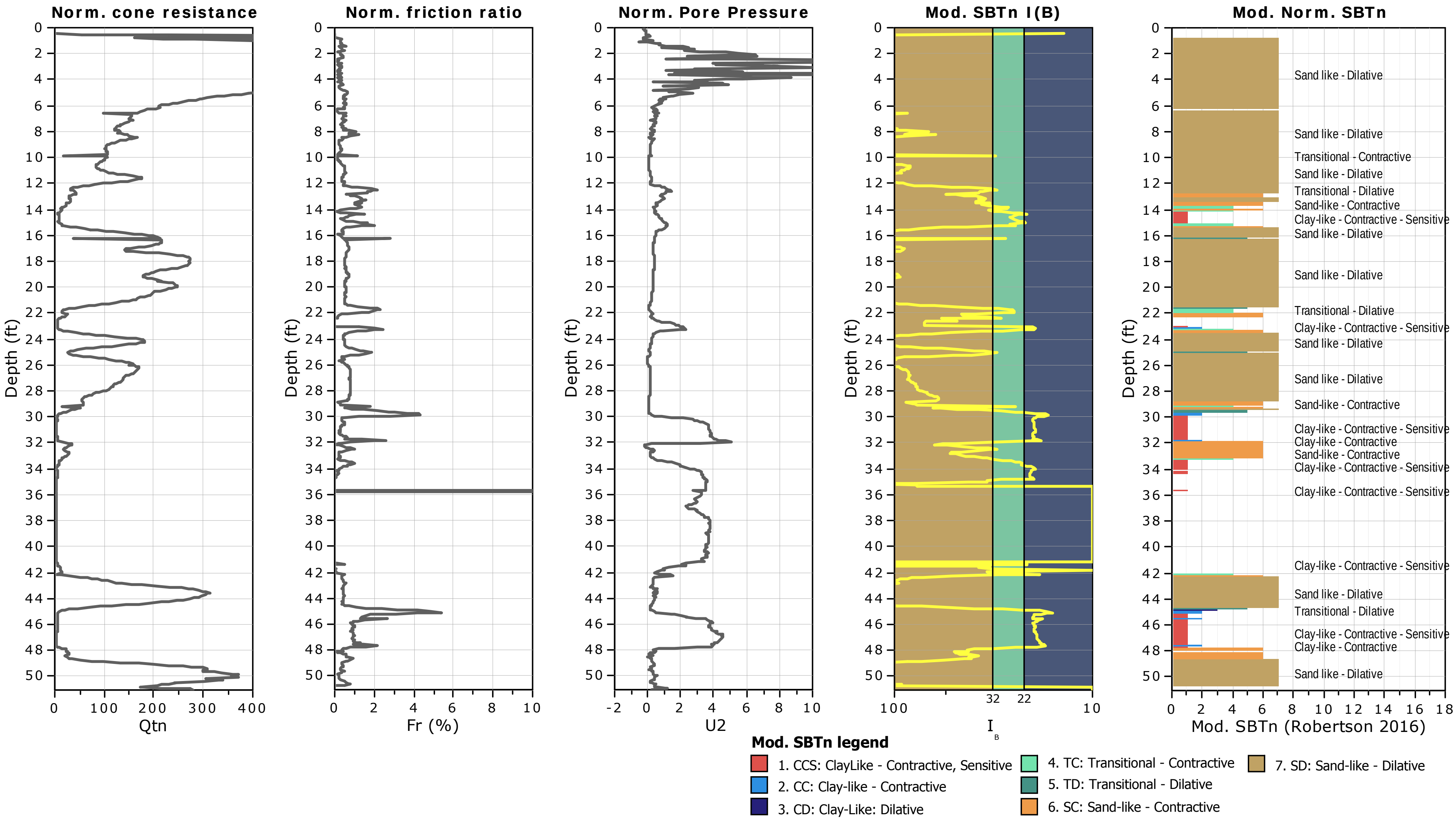
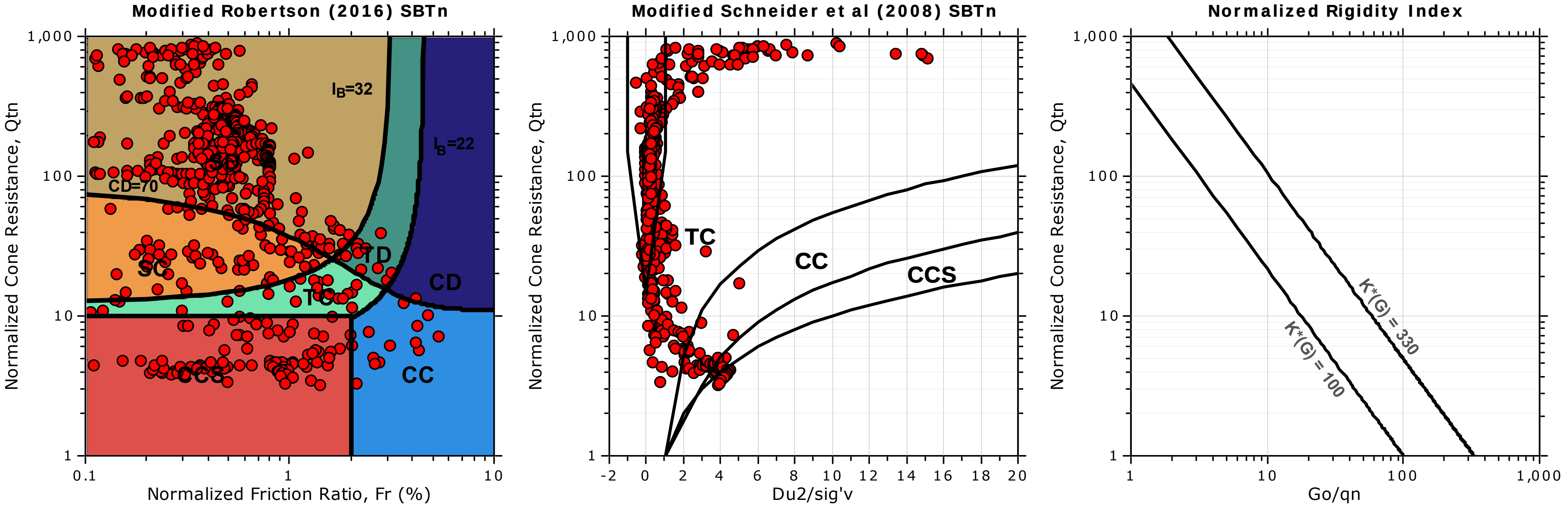
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-13a
Total depth: 51.05 ft



Updated SBTn plots

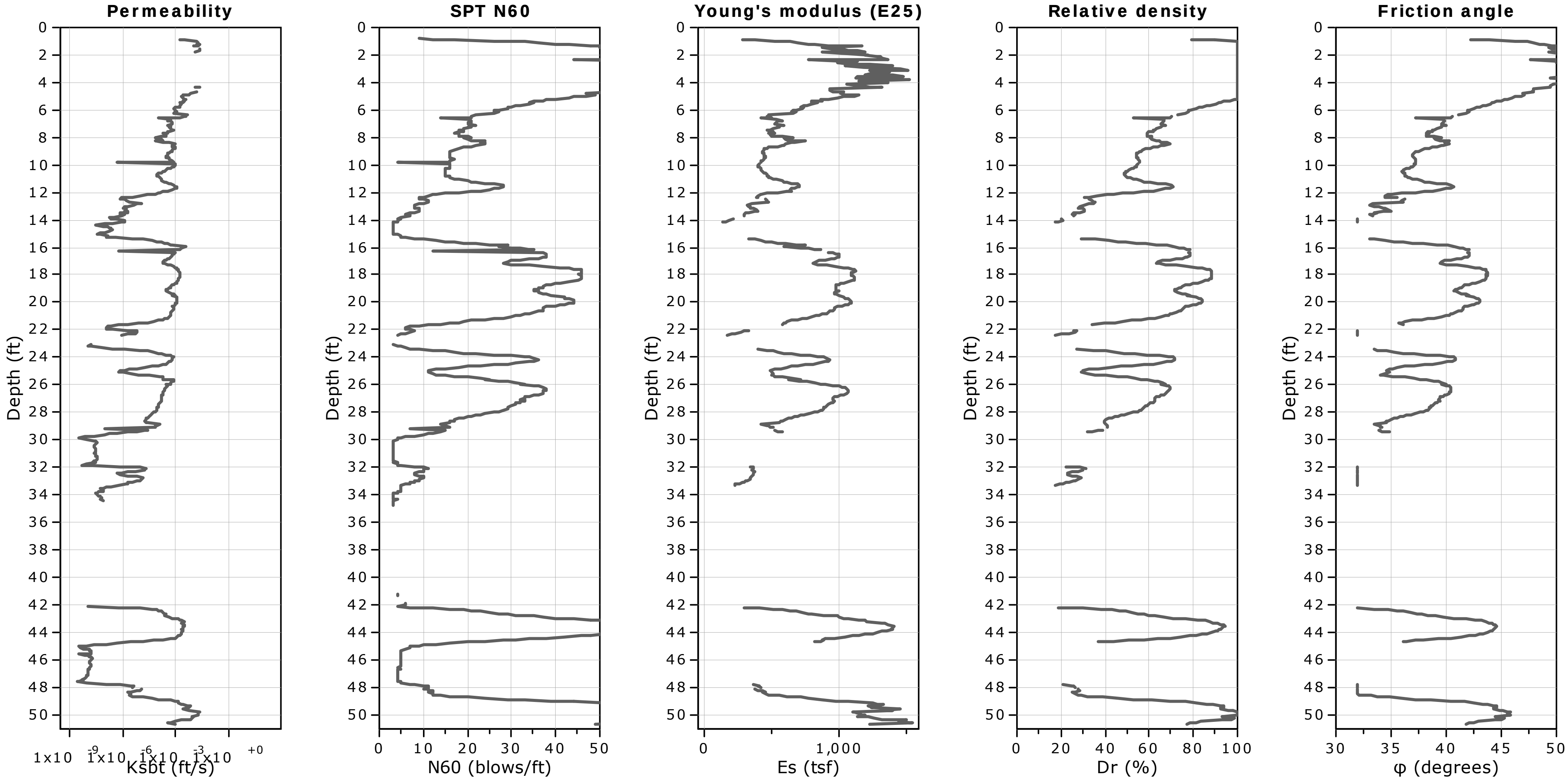


CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure
(e.g. age/cementation)

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-13a
Total depth: 51.05 ft

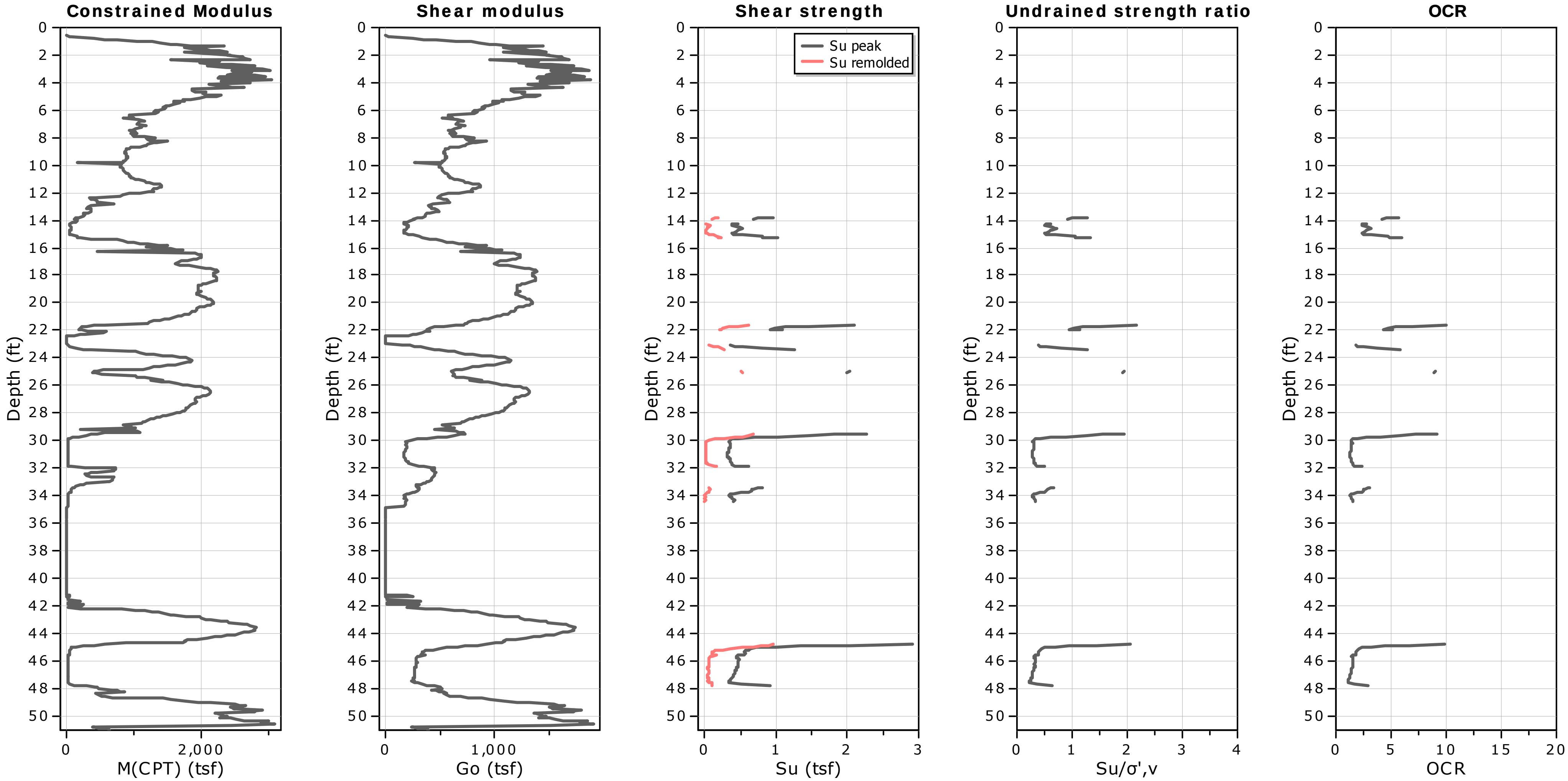


Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
—●— User defined estimation data

Project: Langan
Location: BL England Substation - Marmora NJ

CPT: CPT-13a
Total depth: 51.05 ft



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

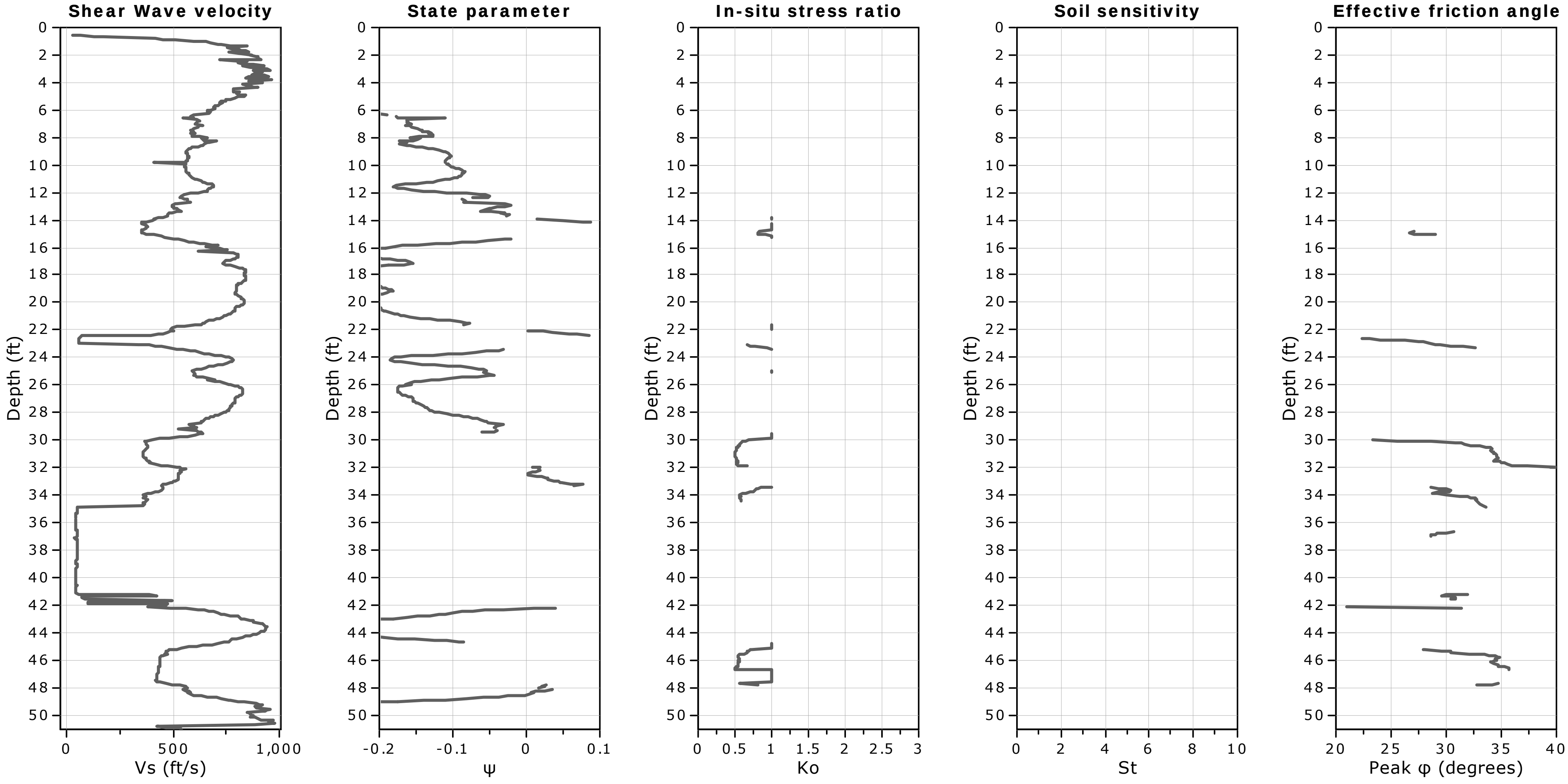
OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-13a

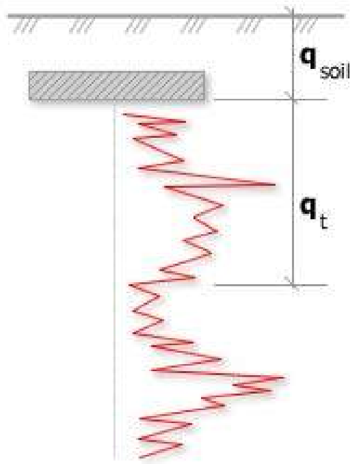
Total depth: 51.05 ft



Calculation parameters

Soil Sensitivity factor, N_S: 350.00

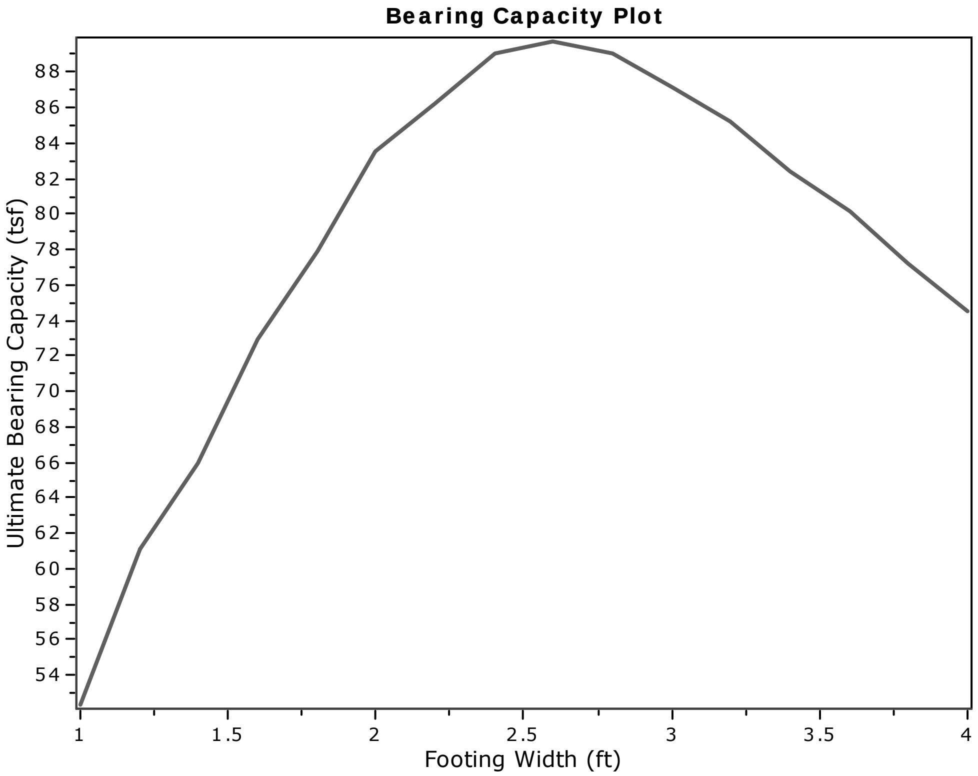
● User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

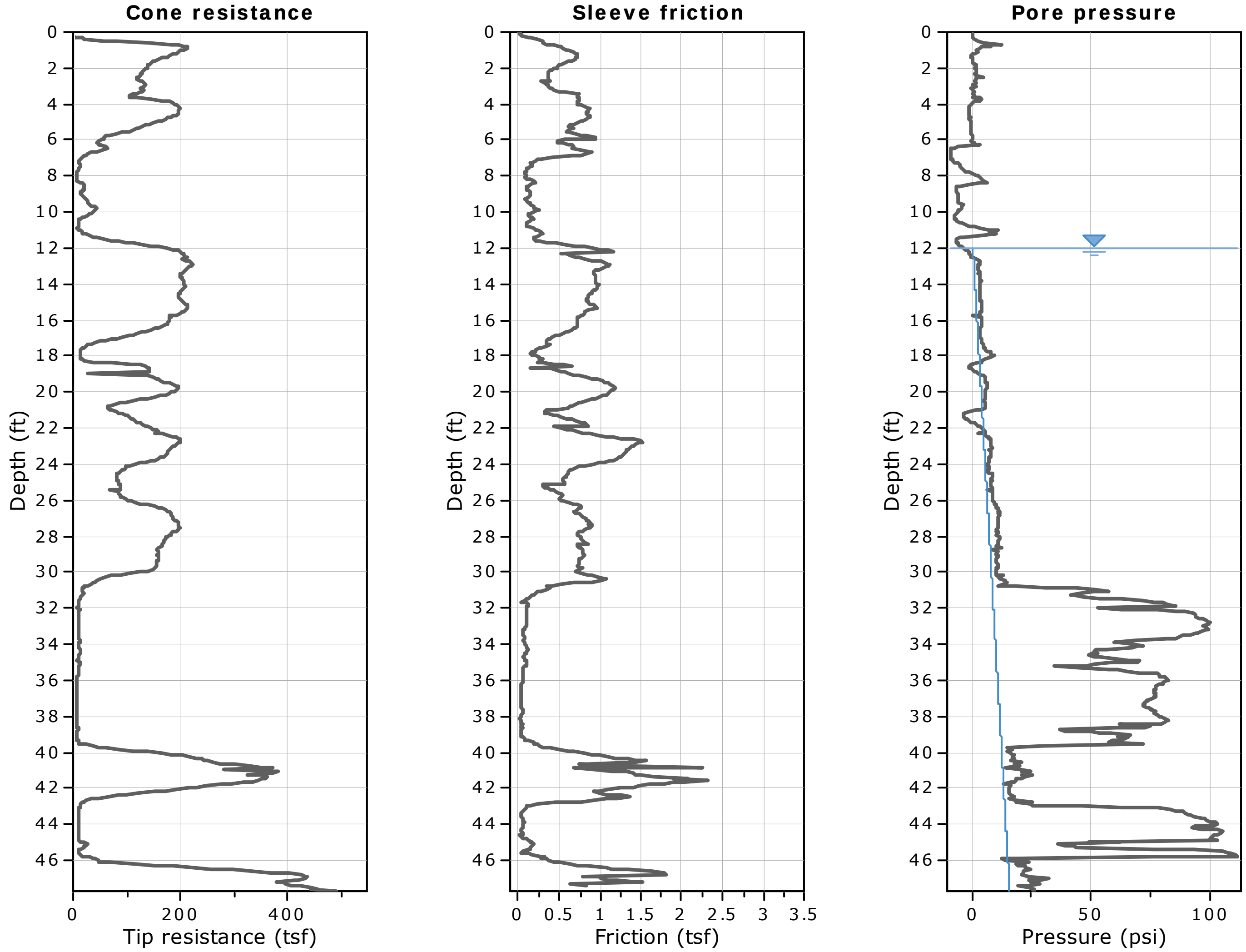


:: Tabular results ::

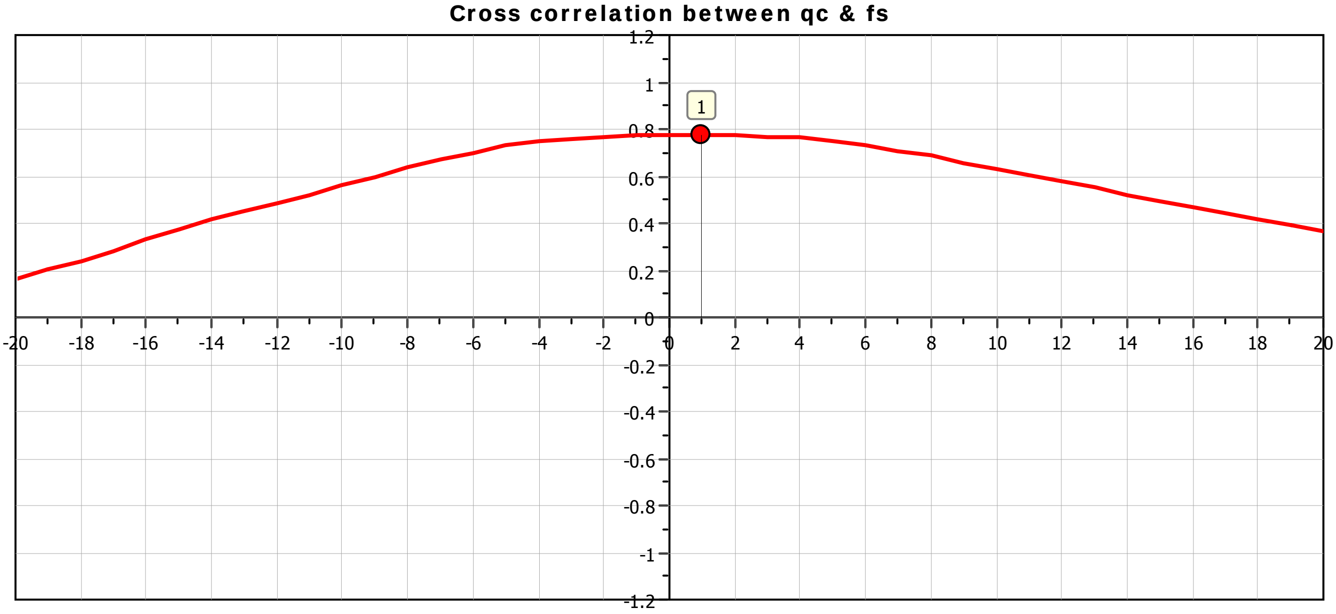
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	261.52	0.20	0.03	52.33
2	1.20	0.50	2.30	305.68	0.20	0.03	61.17
3	1.40	0.50	2.60	329.38	0.20	0.03	65.91
4	1.60	0.50	2.90	364.75	0.20	0.03	72.98
5	1.80	0.50	3.20	389.56	0.20	0.03	77.94
6	2.00	0.50	3.50	417.33	0.20	0.03	83.50
7	2.20	0.50	3.80	431.04	0.20	0.03	86.24
8	2.40	0.50	4.10	445.13	0.20	0.03	89.06
9	2.60	0.50	4.40	448.47	0.20	0.03	89.72
10	2.80	0.50	4.70	445.02	0.20	0.03	89.03
11	3.00	0.50	5.00	435.75	0.20	0.03	87.18
12	3.20	0.50	5.30	425.74	0.20	0.03	85.18
13	3.40	0.50	5.60	411.94	0.20	0.03	82.42
14	3.60	0.50	5.90	400.44	0.20	0.03	80.12
15	3.80	0.50	6.20	386.01	0.20	0.03	77.23
16	4.00	0.50	6.50	372.51	0.20	0.03	74.53

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-15
Total depth: 47.70 ft



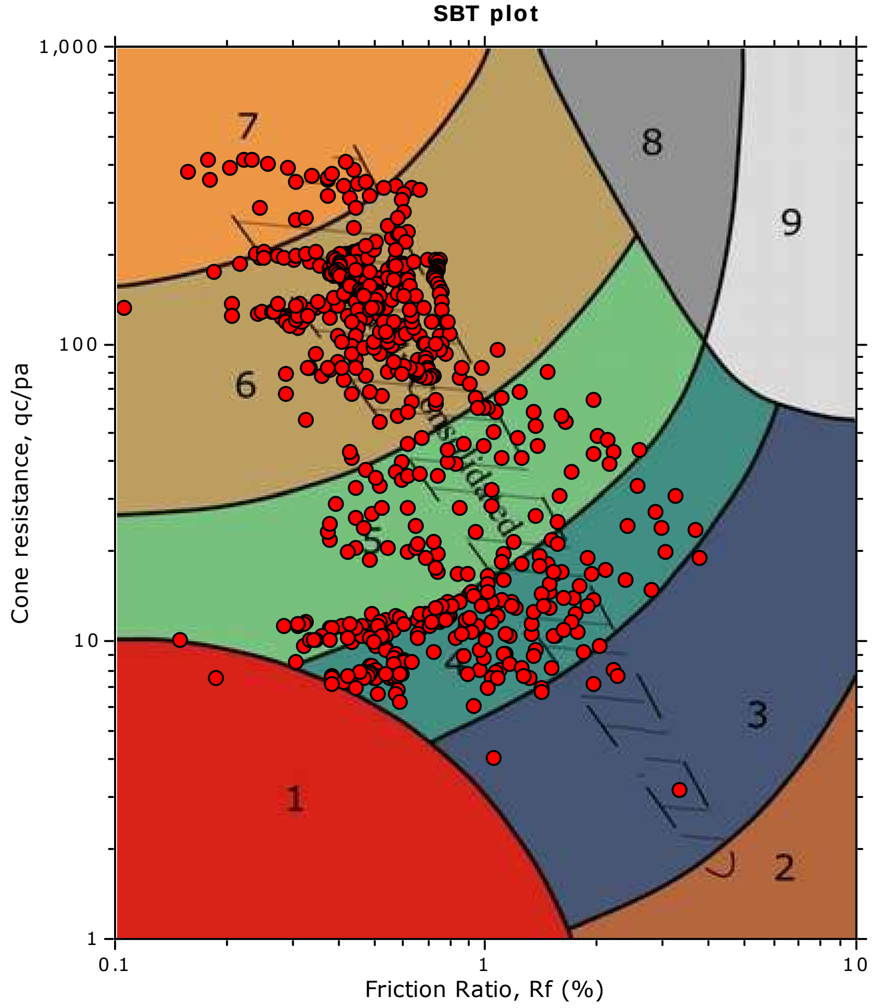
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

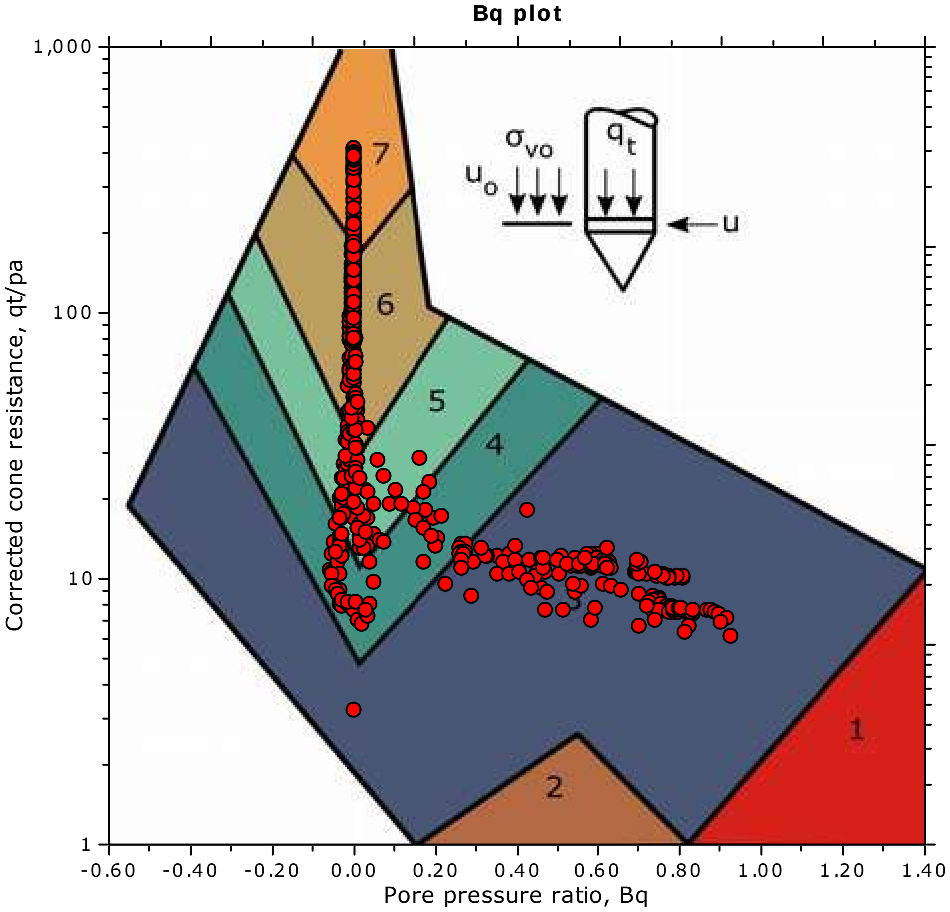


Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-15
Total depth: 47.70 ft

SBT - Bq plots


SBT plot

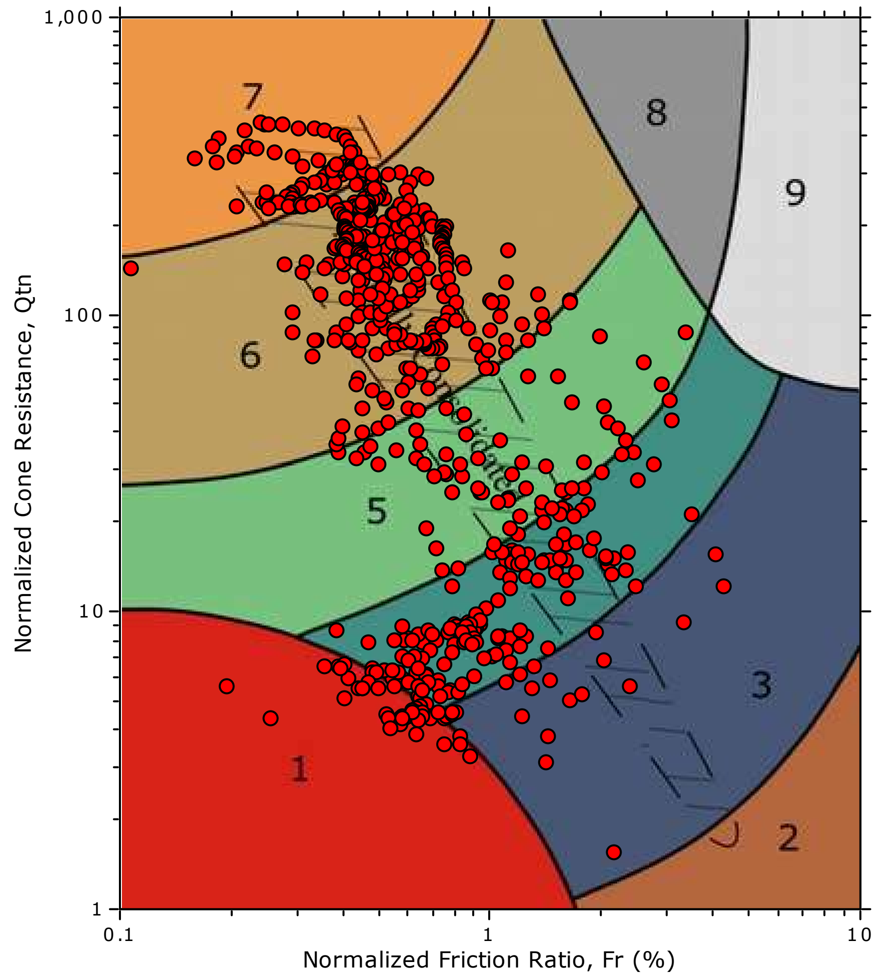

Bq plot

SBT legend

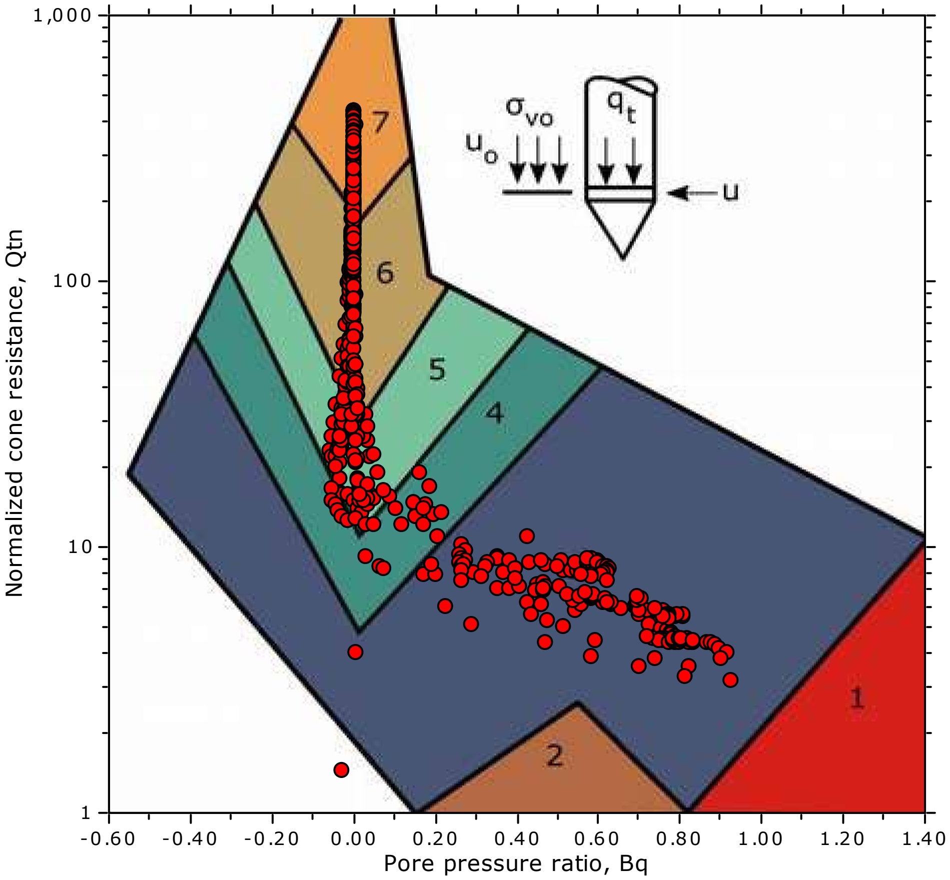
🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬛ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

SBT - Bq plots (normalized)

SBTn plot



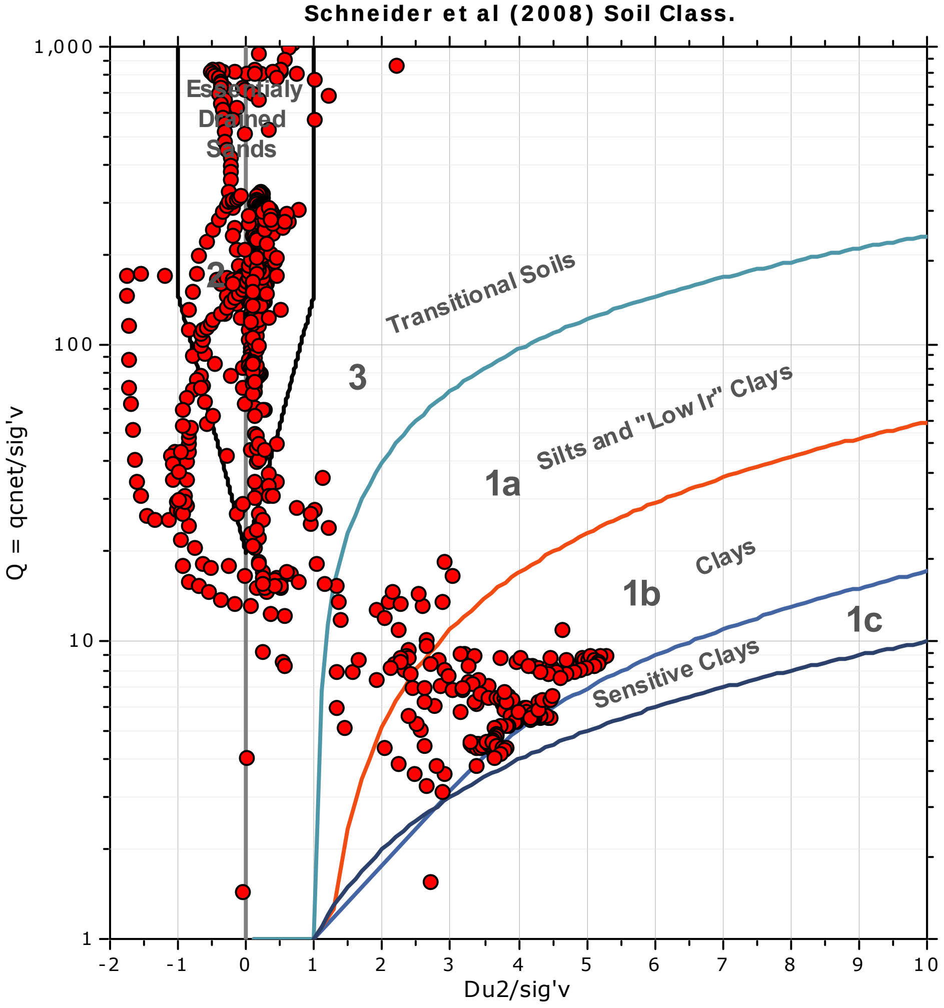
Normalized Bq plot

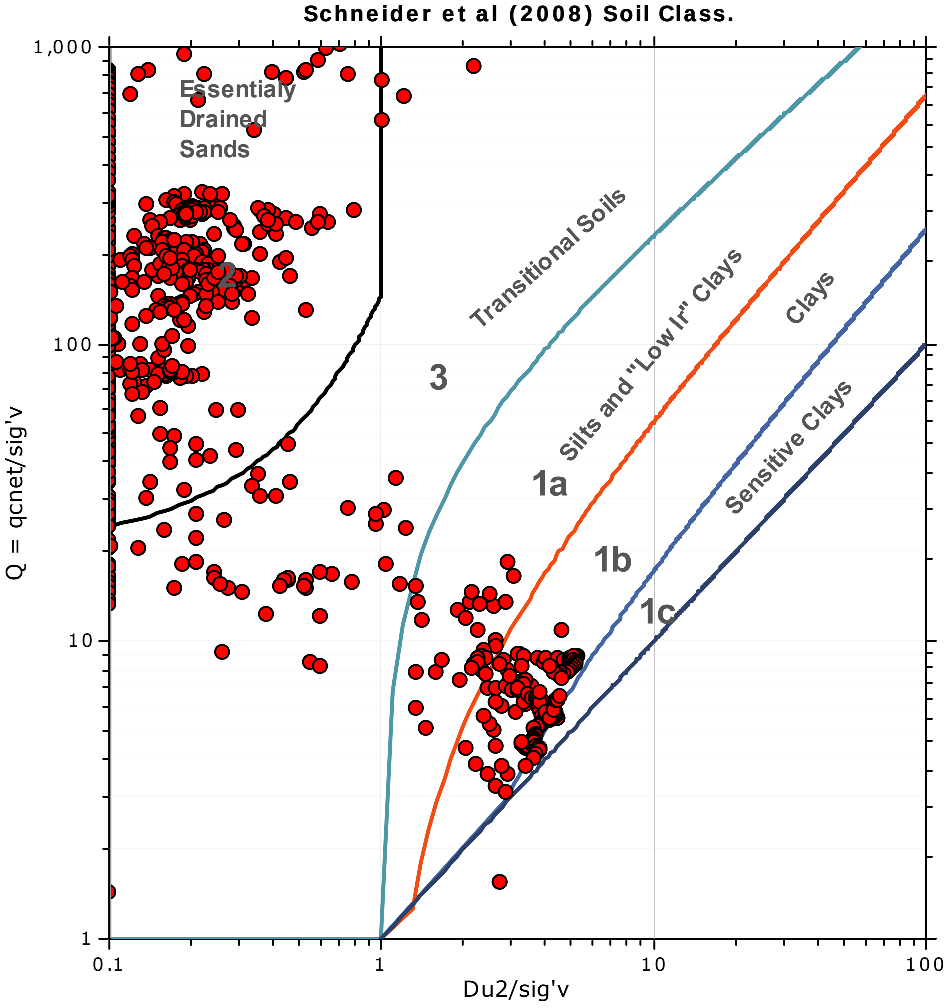


SBTn legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟫 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬜ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

Bq plots (Schneider)

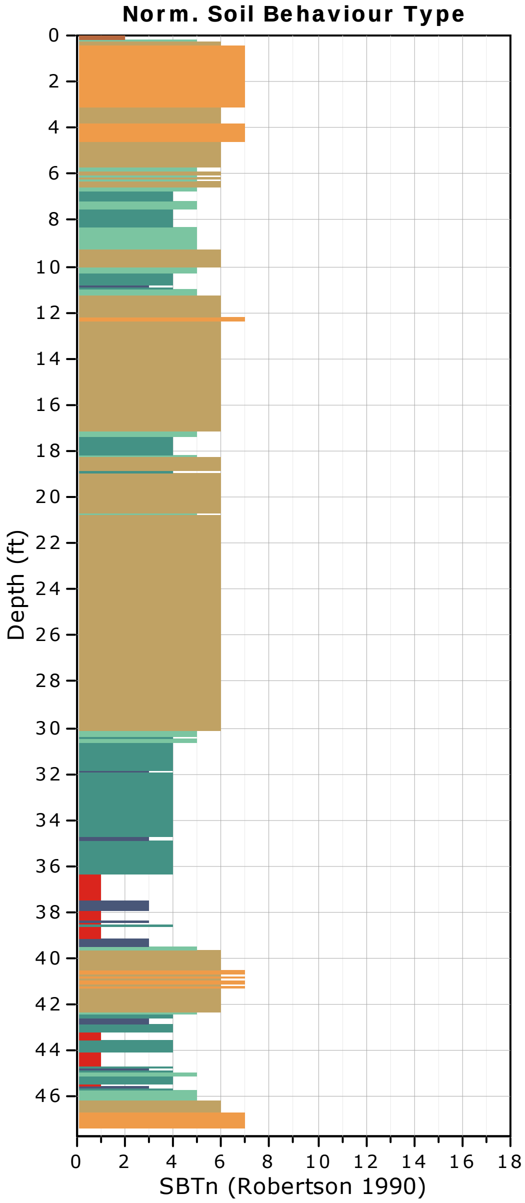


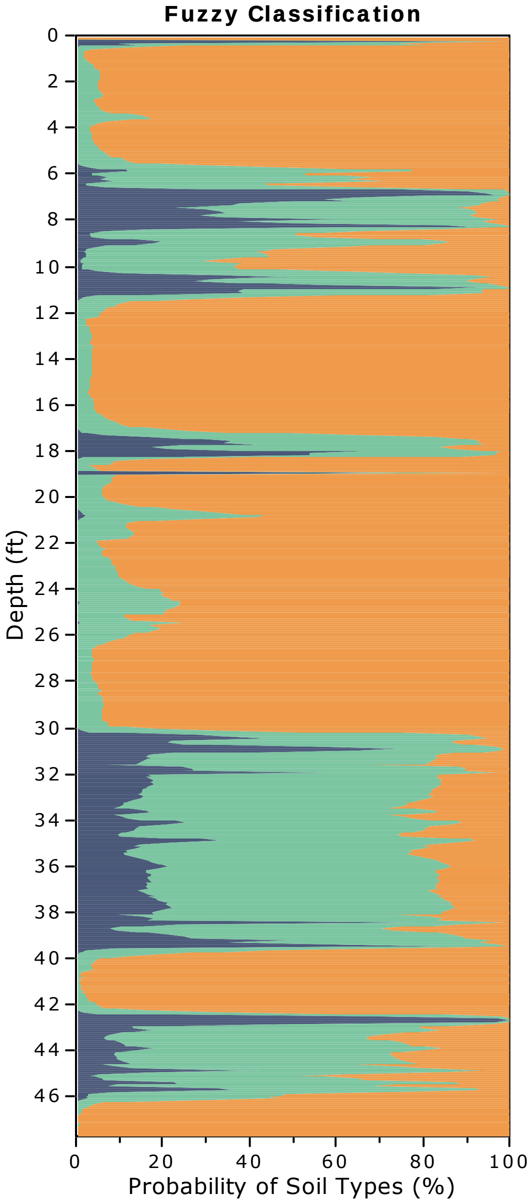


Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-15
Total depth: 47.70 ft





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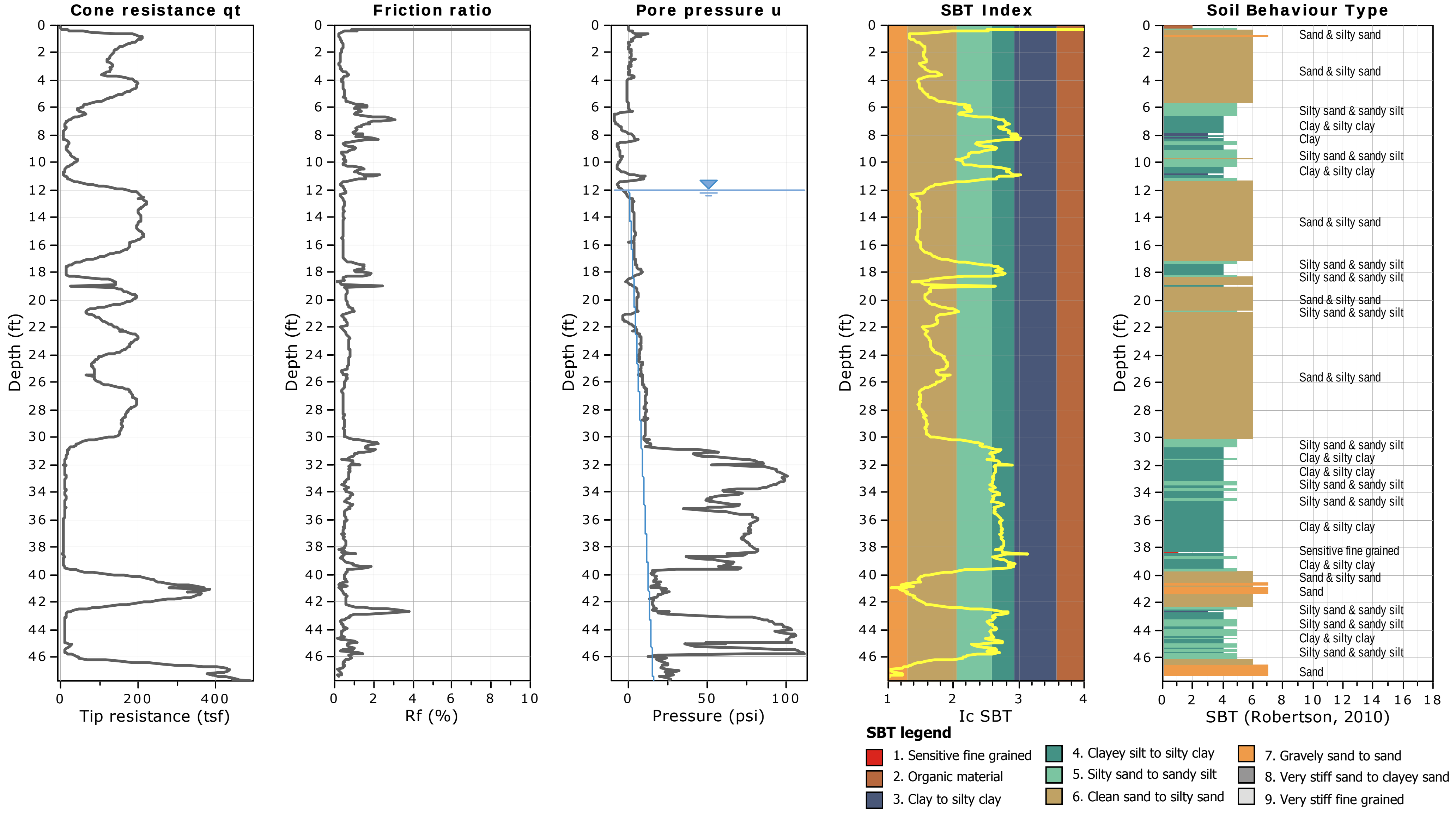
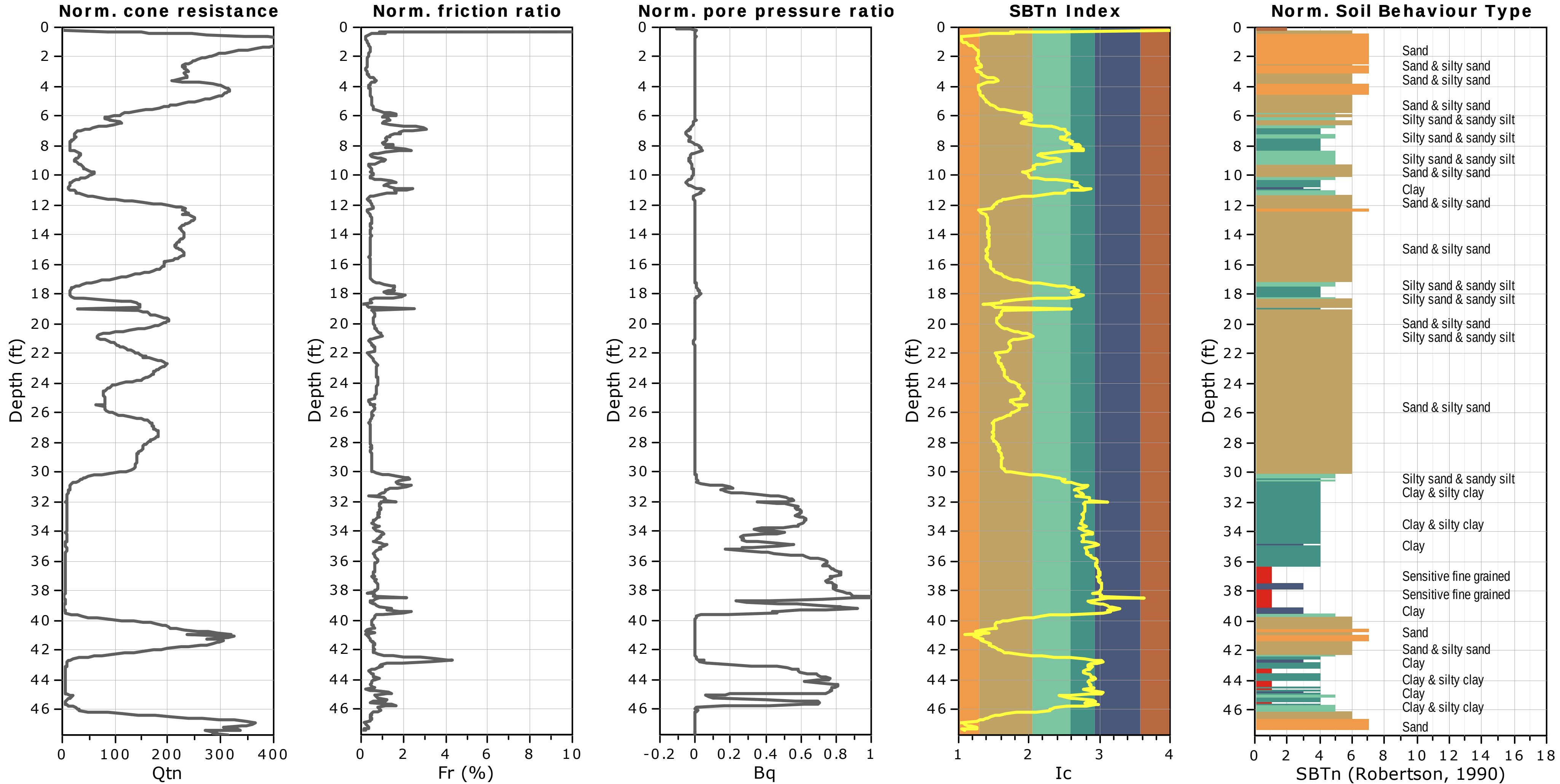


Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-15
Total depth: 47.70 ft



SBTn legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
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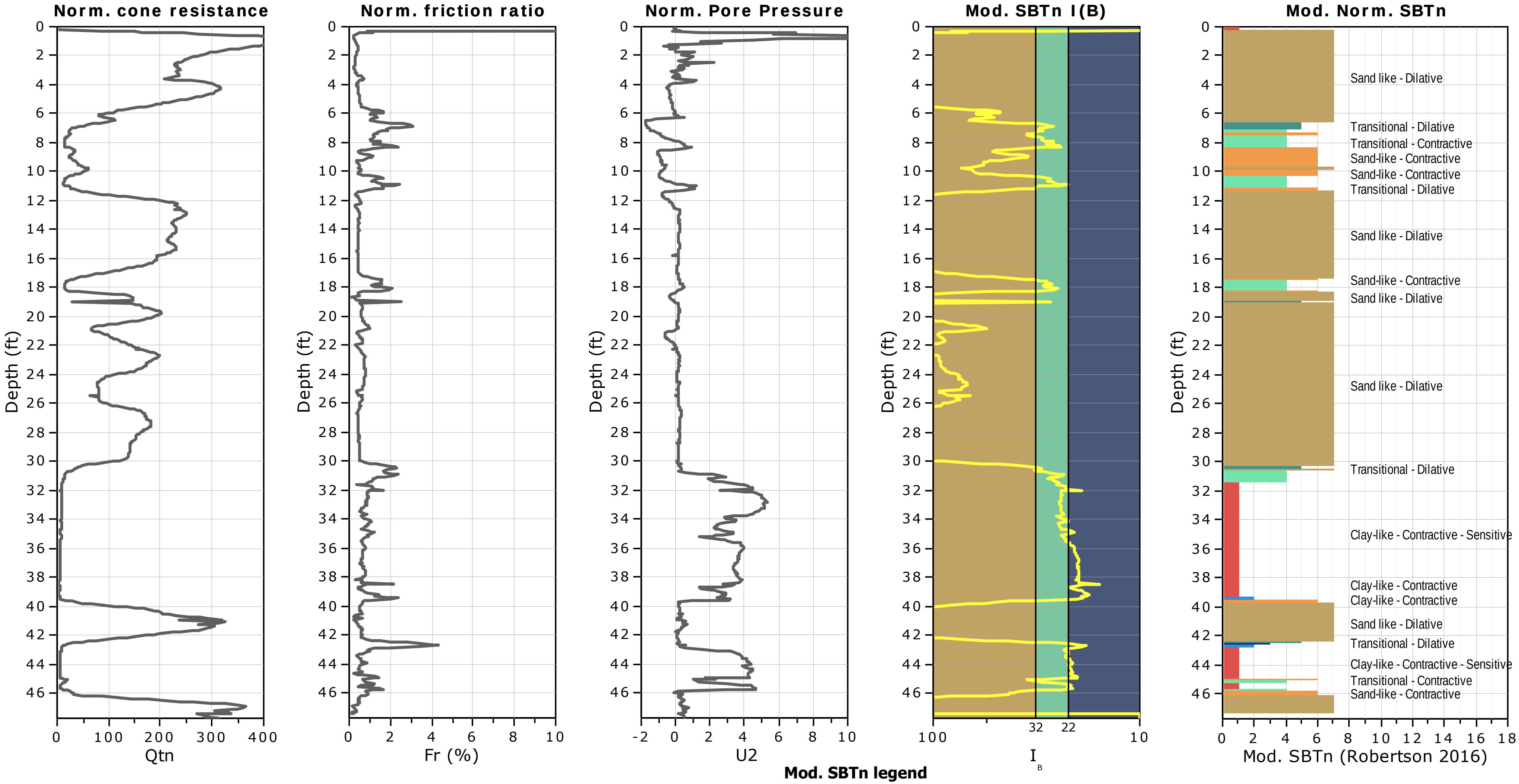
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

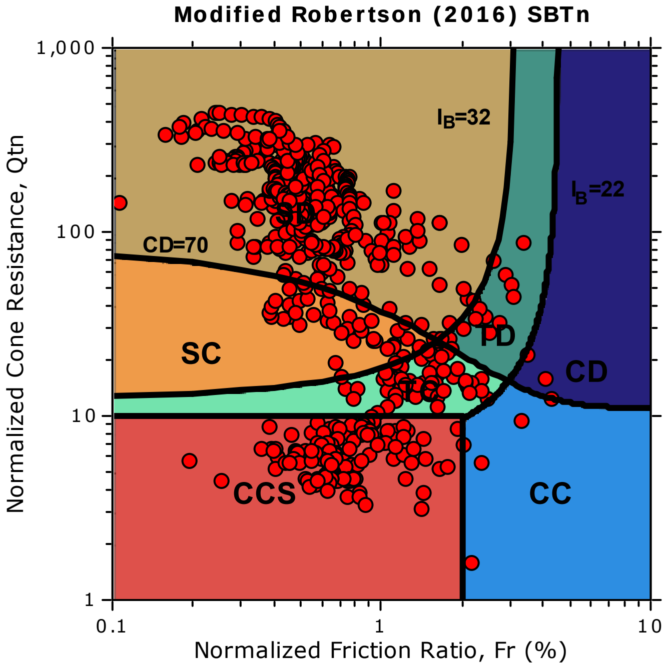
CPT: CPT-15
Total depth: 47.70 ft

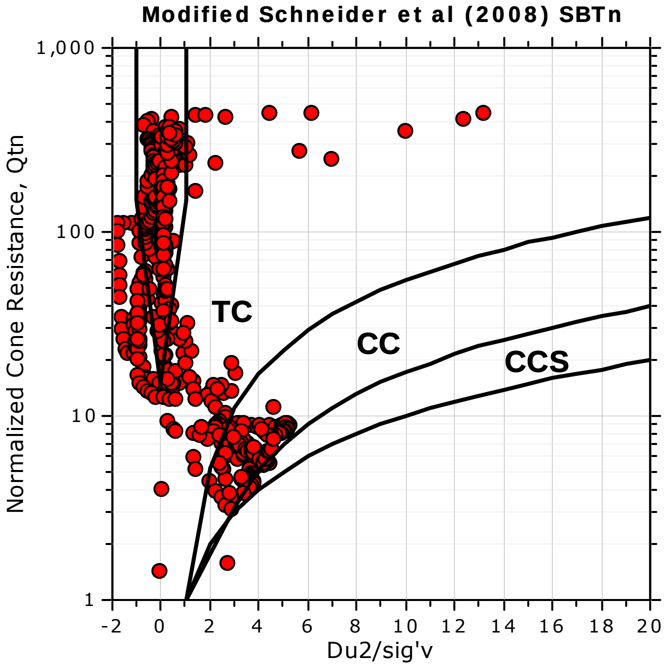


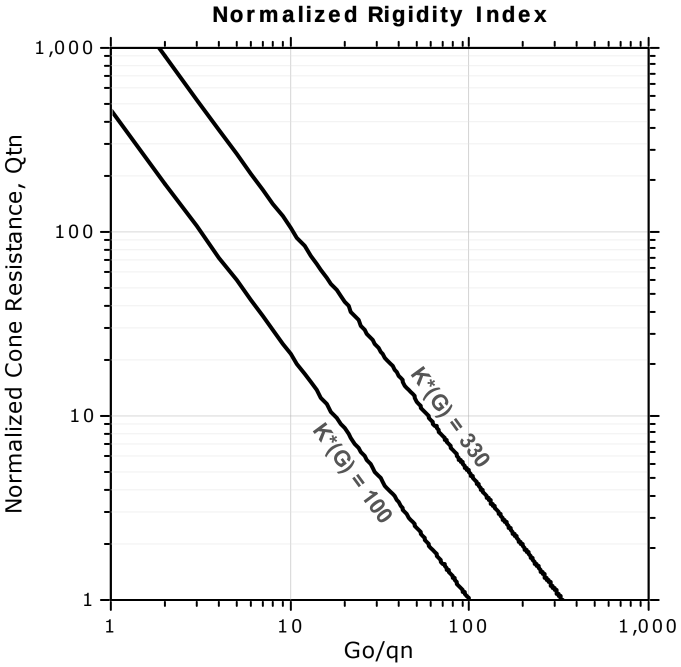
Mod. SBTn legend

- 🟥 1. CCS: ClayLike - Contractive, Sensitive
- 🟦 2. CC: Clay-like - Contractive
- 🟦 3. CD: Clay-Like: Dilative
- 🟩 4. TC: Transitional - Contractive
- 🟩 5. TD: Transitional - Dilative
- 🟧 6. SC: Sand-like - Contractive
- 🟫 7. SD: Sand-like - Dilative

Updated SBTn plots





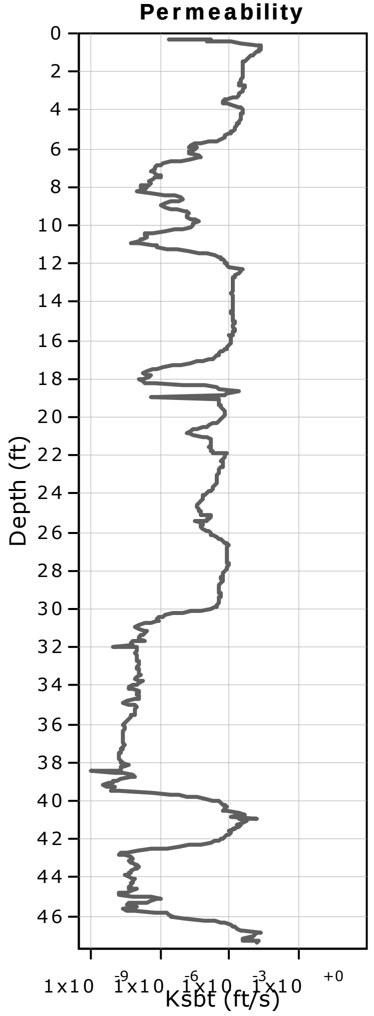


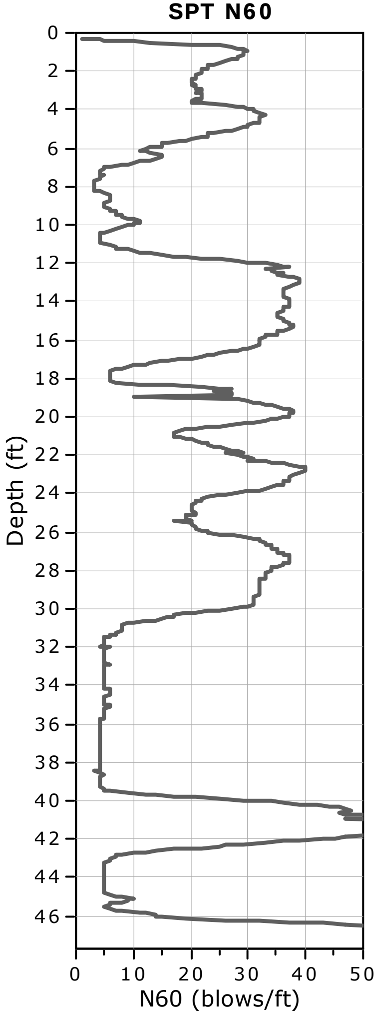
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

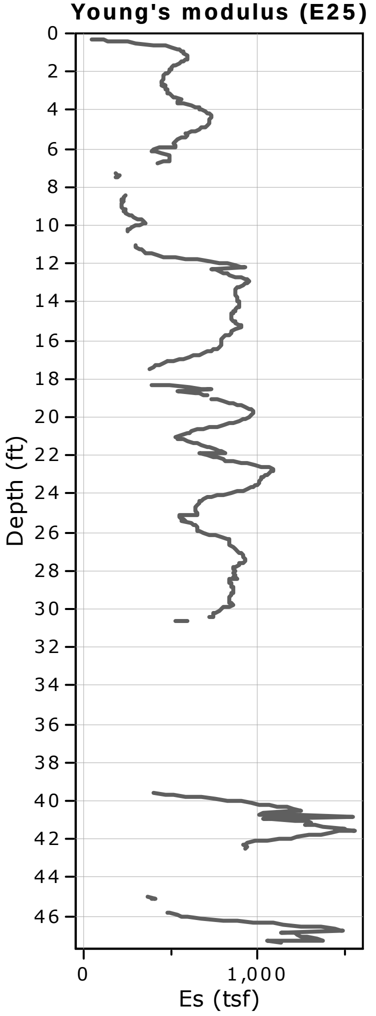
K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

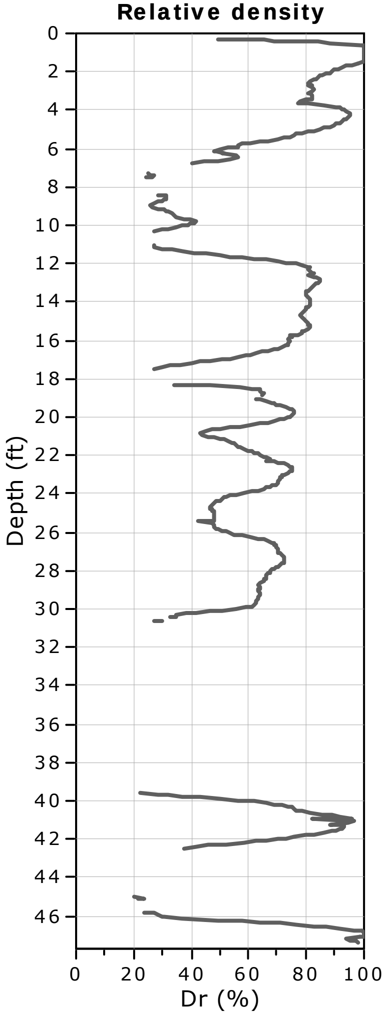
Project: Langan
Location: BL England Substation - Marmora NJ

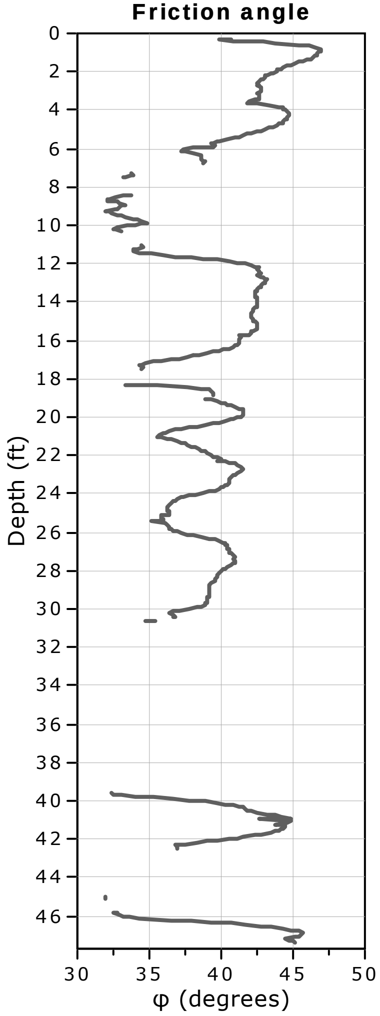
CPT: CPT-15
Total depth: 47.70 ft











Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

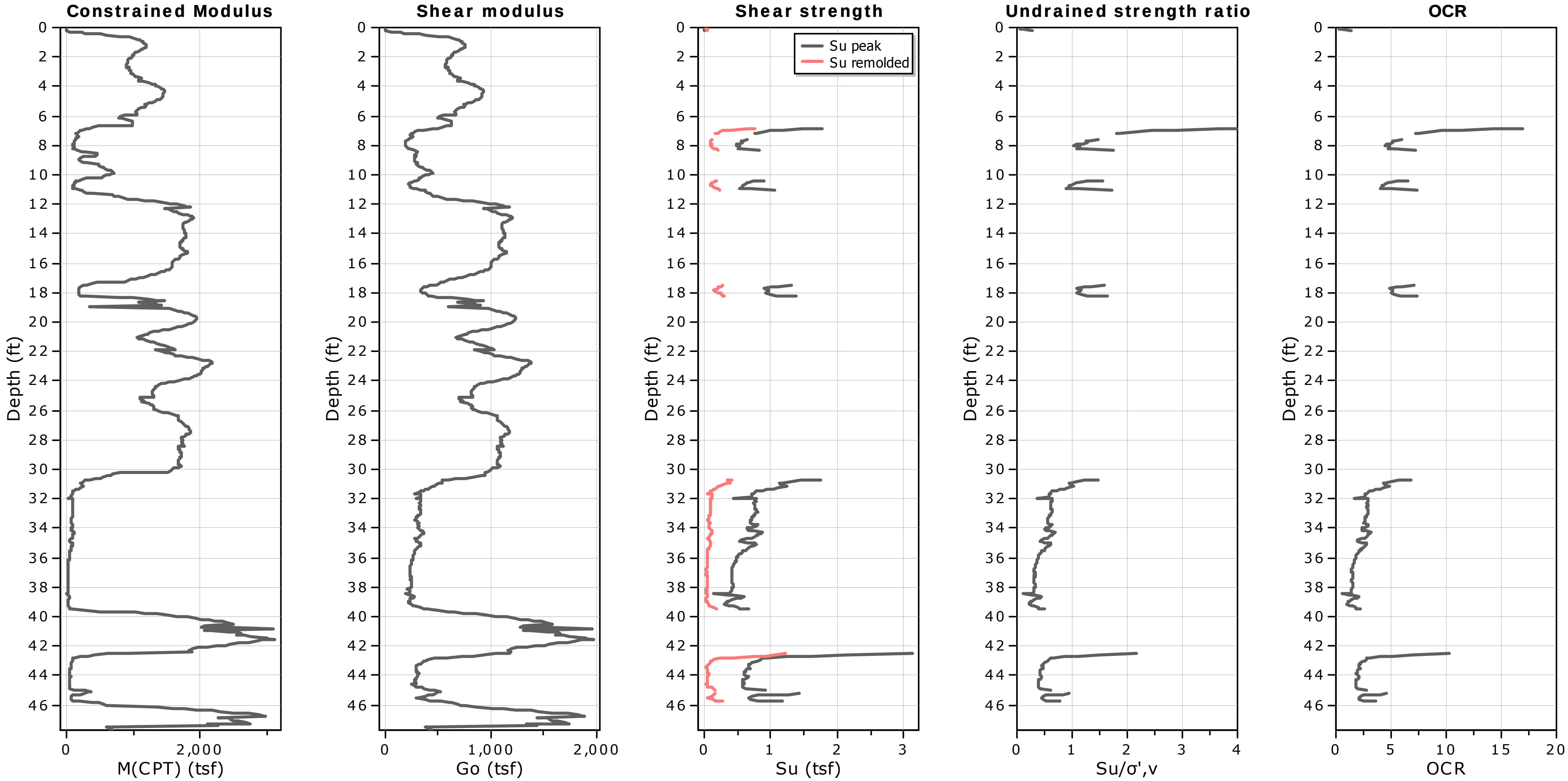
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
●— User defined estimation data

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-15

Total depth: 47.70 ft



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)

Go: Based on variable *alpha* using I_c (Robertson, 2009)

Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33

🔴 User defined estimation data

🔵 Flat Dilatometer Test data

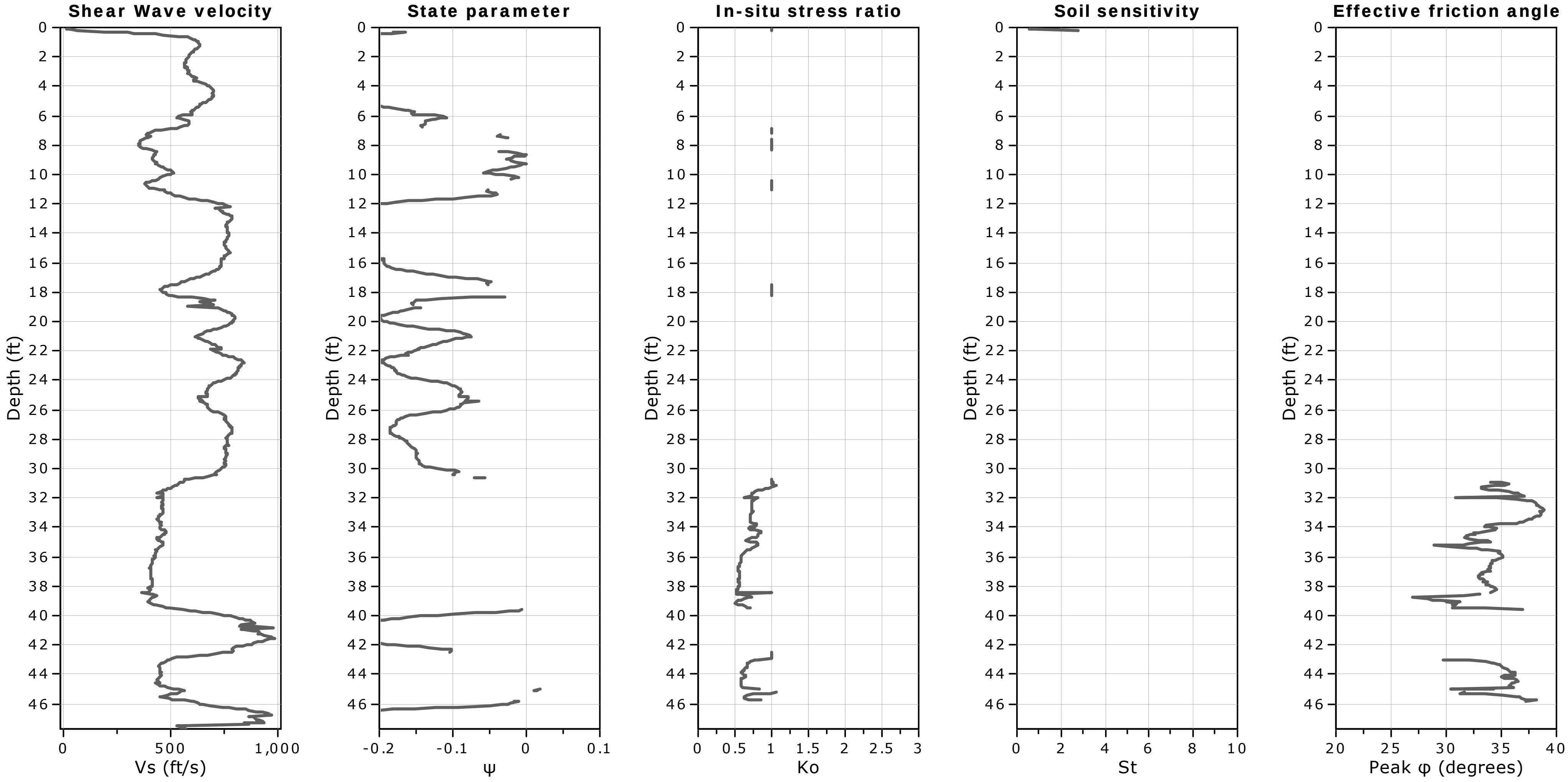
Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-15

Total depth: 47.70 ft



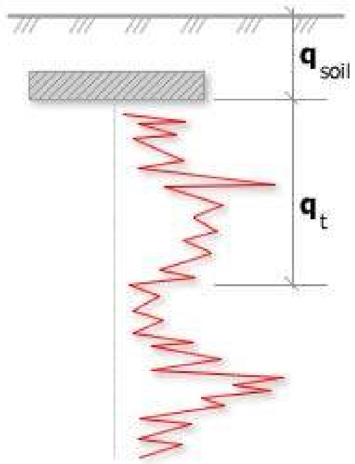
Calculation parameters

Soil Sensitivity factor, N_S: 350.00

●— User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

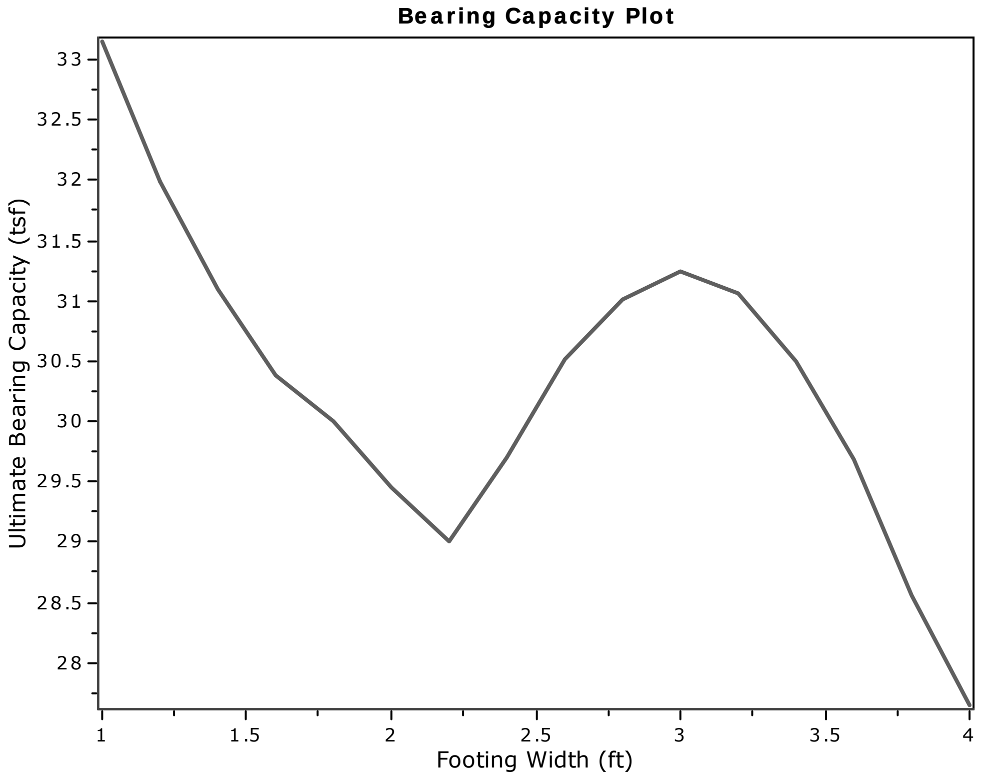
CPT: CPT-15
Total depth: 47.70 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

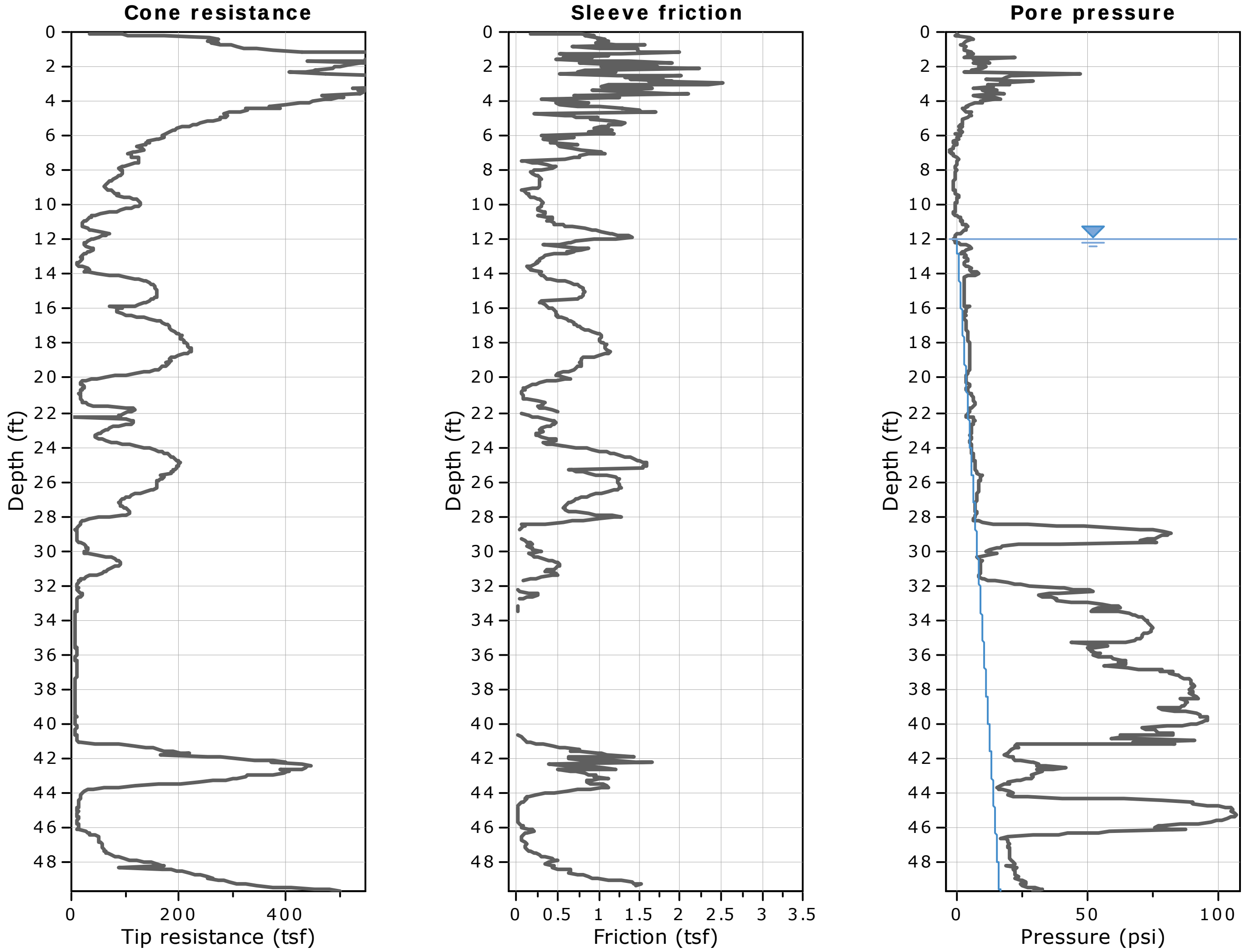
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	165.60	0.20	0.03	33.15
2	1.20	0.50	2.30	159.79	0.20	0.03	31.99
3	1.40	0.50	2.60	155.30	0.20	0.03	31.09
4	1.60	0.50	2.90	151.79	0.20	0.03	30.39
5	1.80	0.50	3.20	149.87	0.20	0.03	30.00
6	2.00	0.50	3.50	147.10	0.20	0.03	29.45
7	2.20	0.50	3.80	144.89	0.20	0.03	29.01
8	2.40	0.50	4.10	148.33	0.20	0.03	29.70
9	2.60	0.50	4.40	152.41	0.20	0.03	30.51
10	2.80	0.50	4.70	154.92	0.20	0.03	31.01
11	3.00	0.50	5.00	156.09	0.20	0.03	31.25
12	3.20	0.50	5.30	155.19	0.20	0.03	31.07
13	3.40	0.50	5.60	152.37	0.20	0.03	30.50
14	3.60	0.50	5.90	148.28	0.20	0.03	29.69
15	3.80	0.50	6.20	142.64	0.20	0.03	28.56
16	4.00	0.50	6.50	138.09	0.20	0.03	27.65

Project: **Langan**

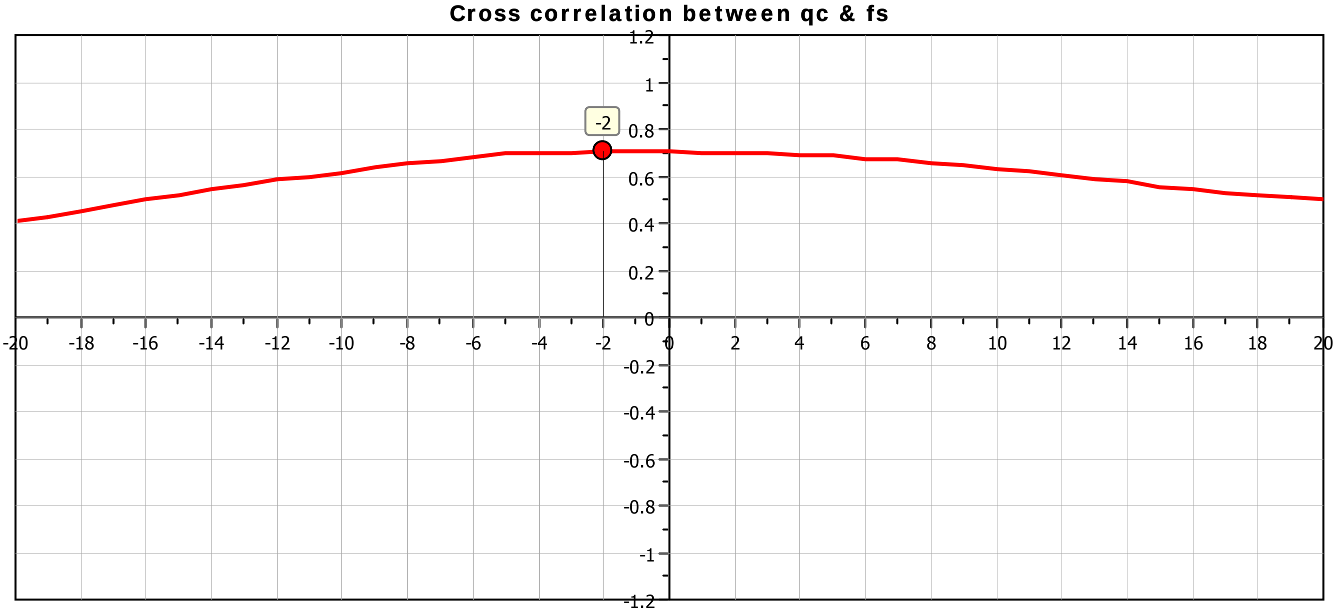
Location: **BL England Substation - Marmora NJ**

CPT: CPT-16

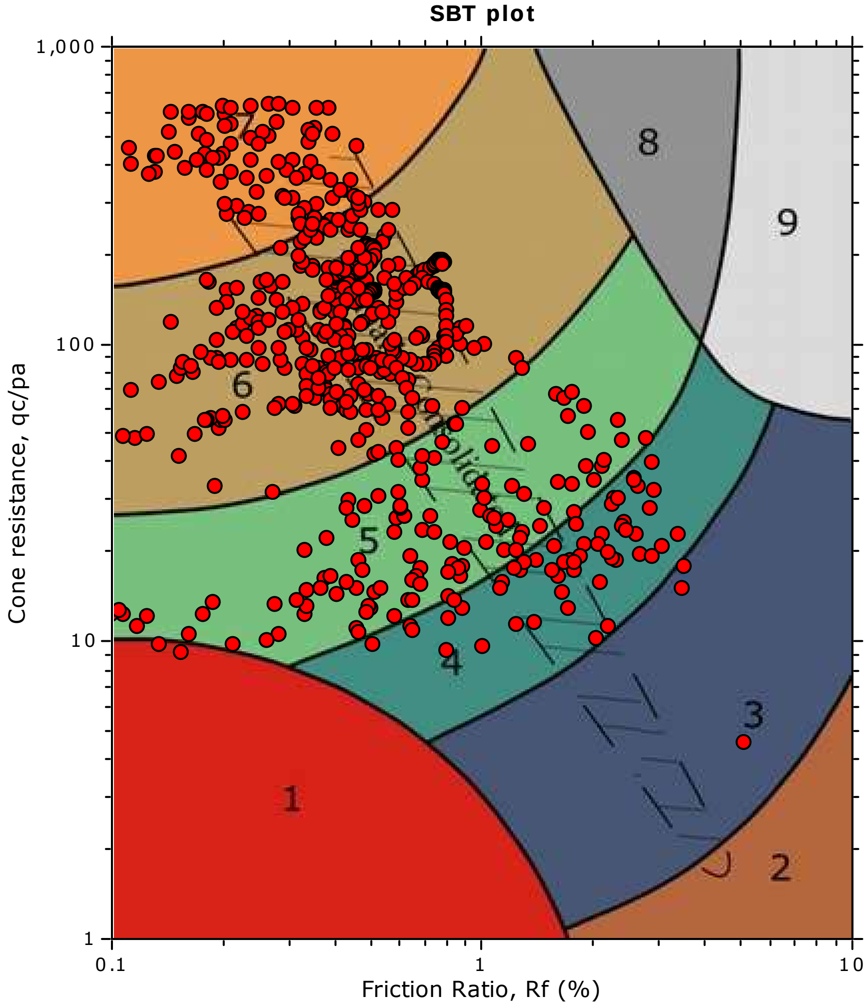
Total depth: 49.67 ft

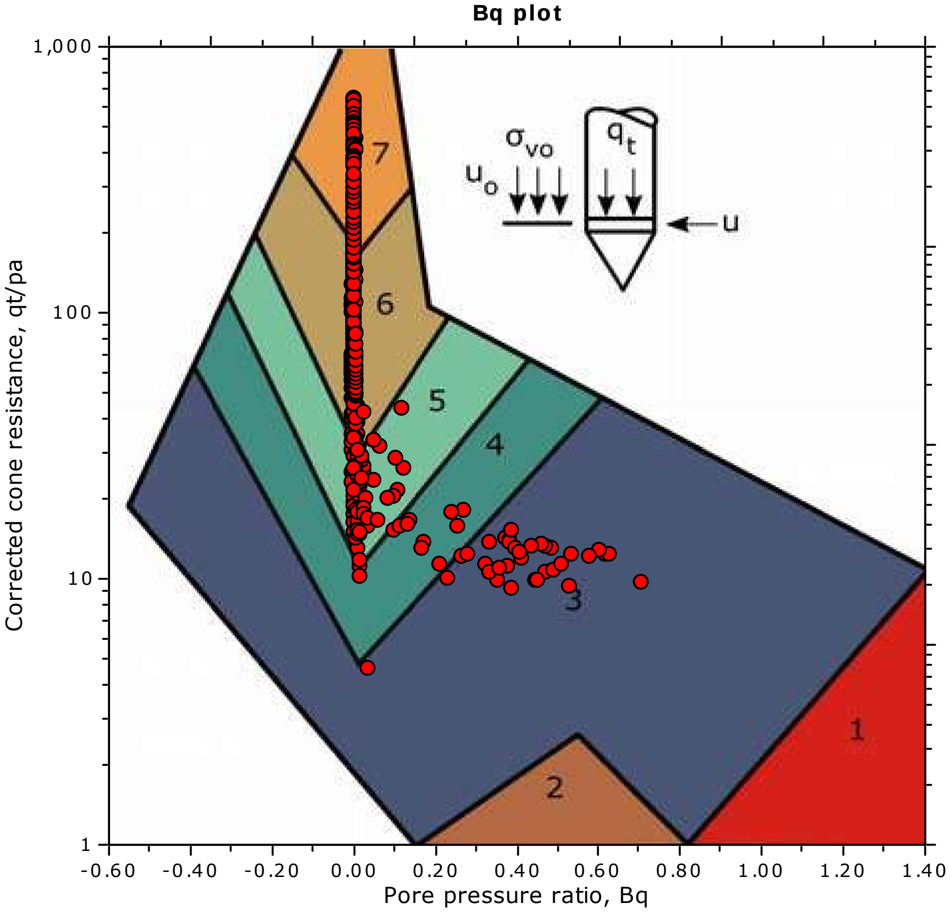


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots


SBT plot


Bq plot

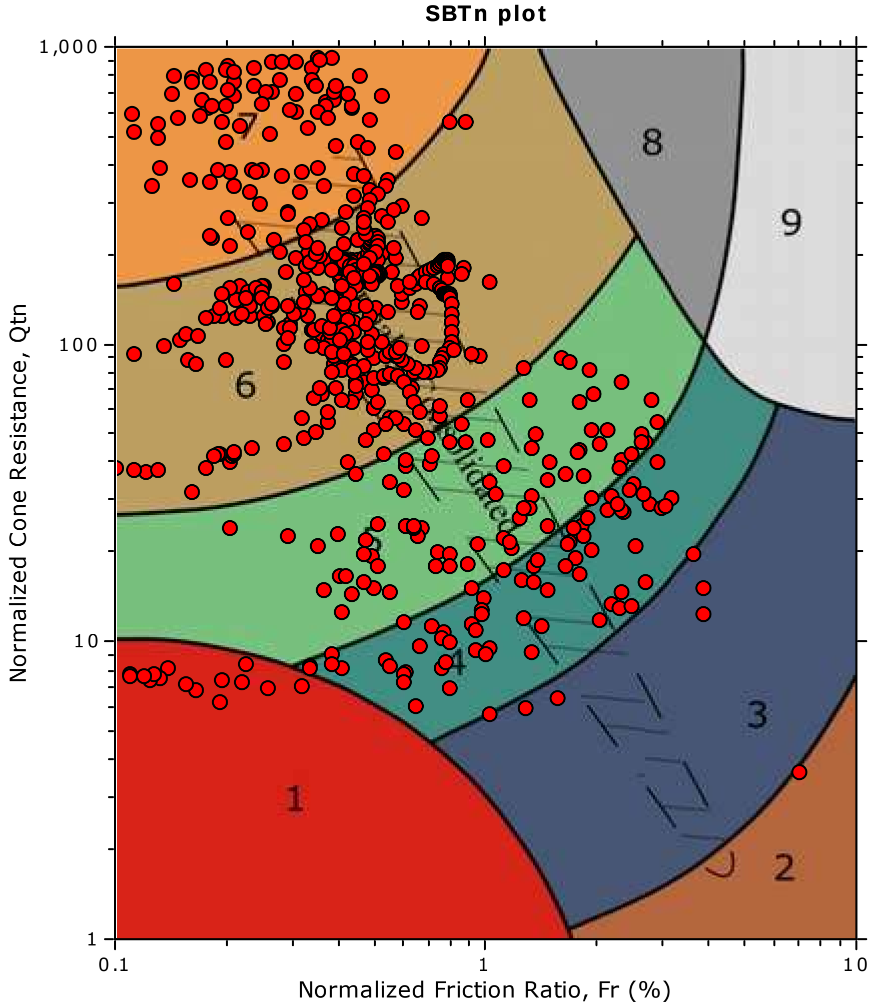
SBT legend

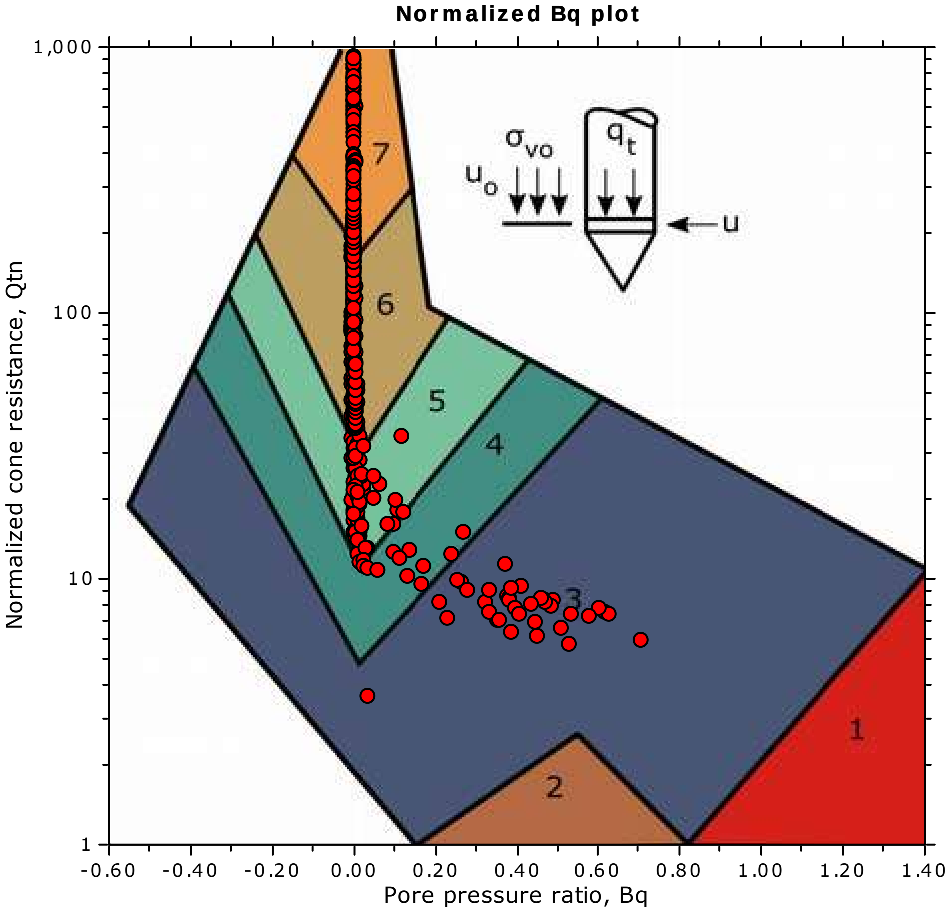
- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-16
Total depth: 49.67 ft

SBT - Bq plots (normalized)

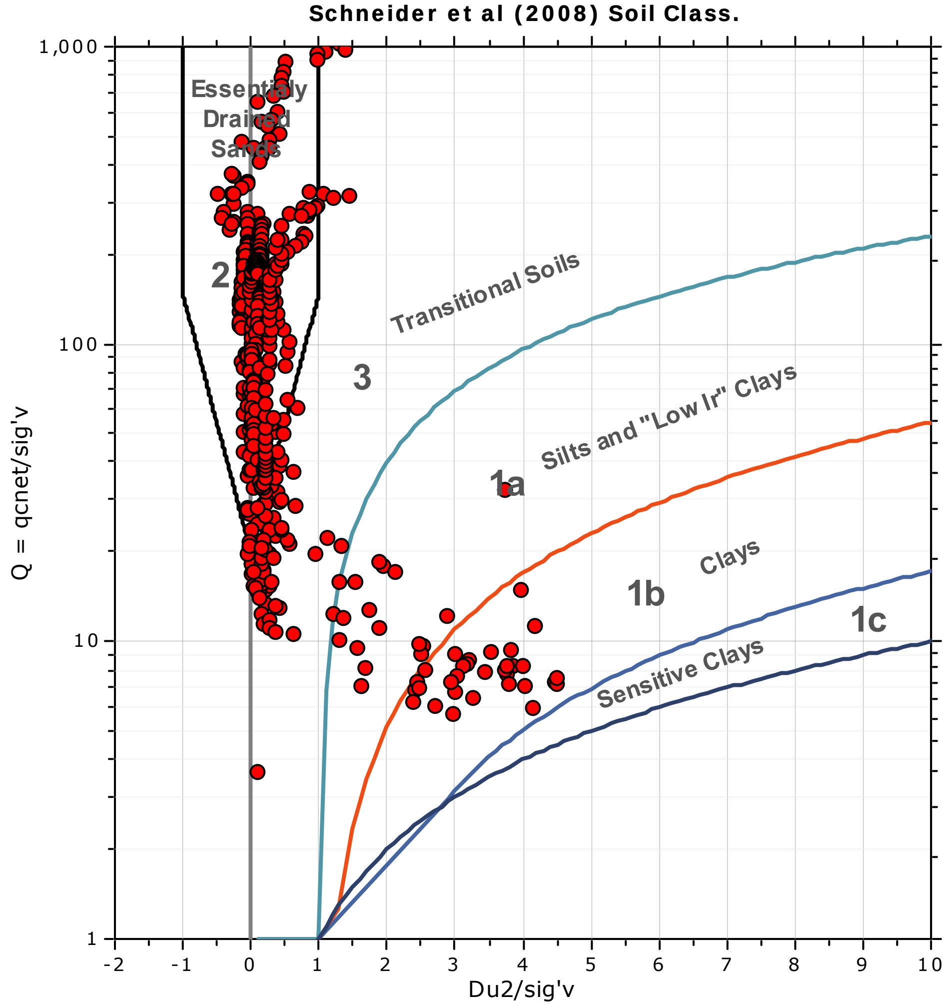

SBTn plot

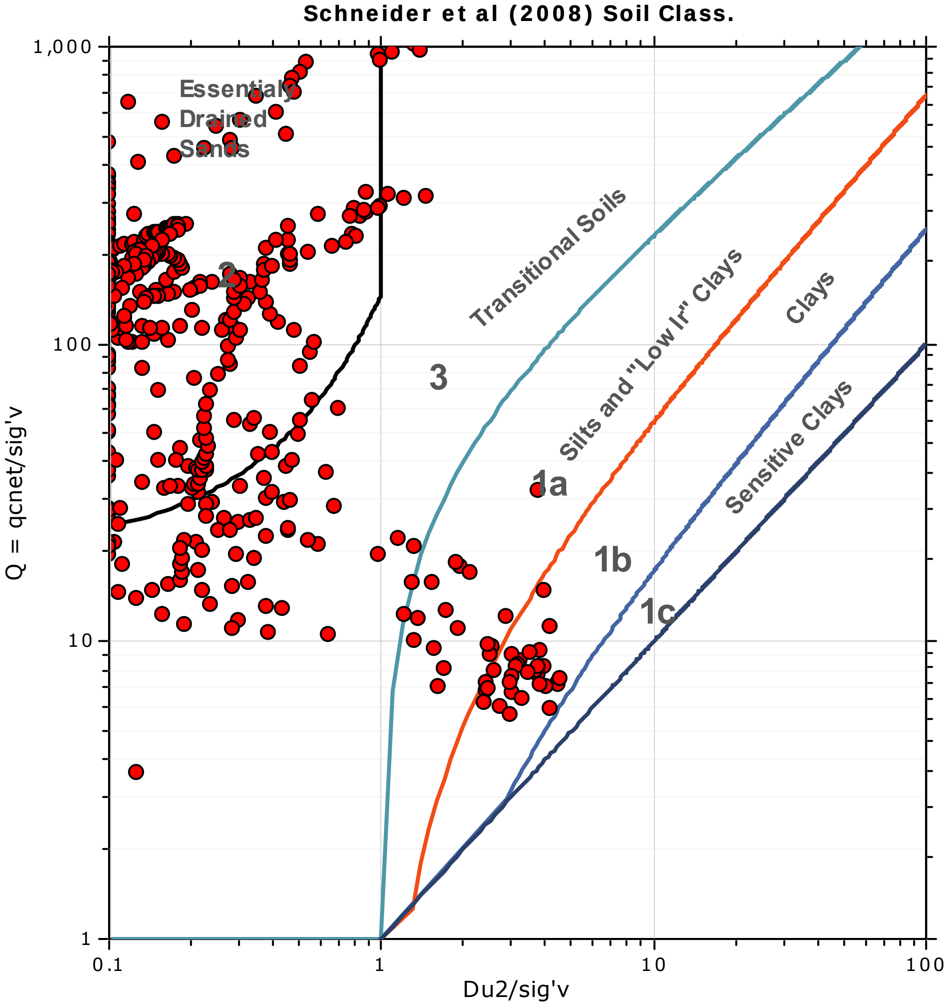

Normalized Bq plot

SBTn legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟫 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬜ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

Bq plots (Schneider)



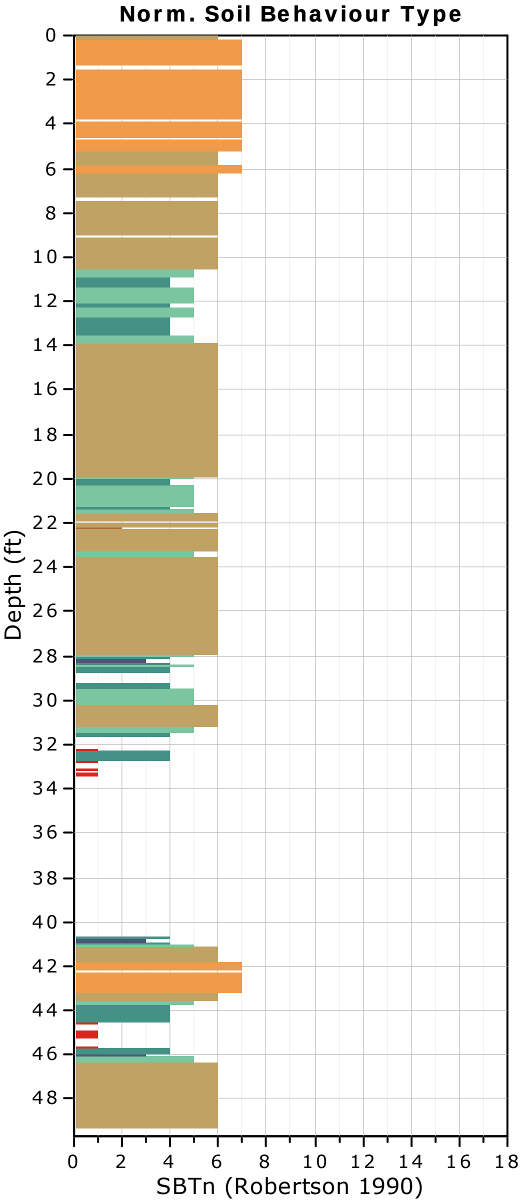


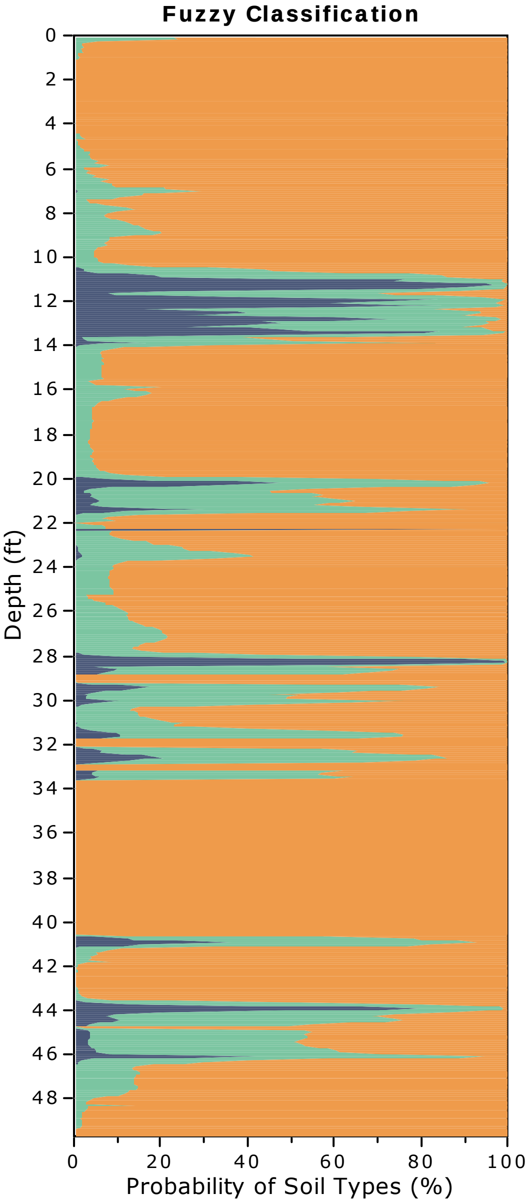
Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-16

Total depth: 49.67 ft





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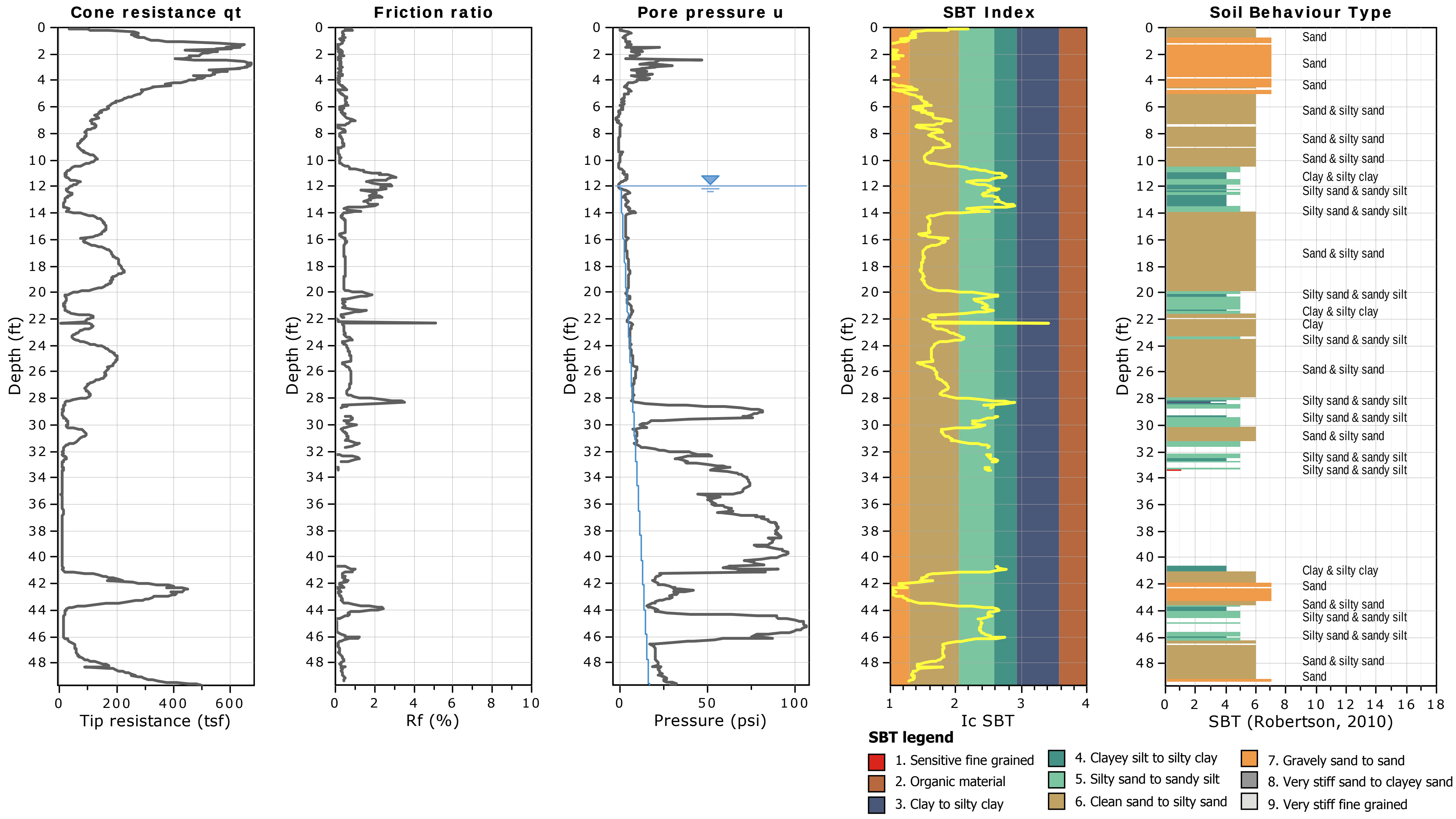
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-16
Total depth: 49.67 ft



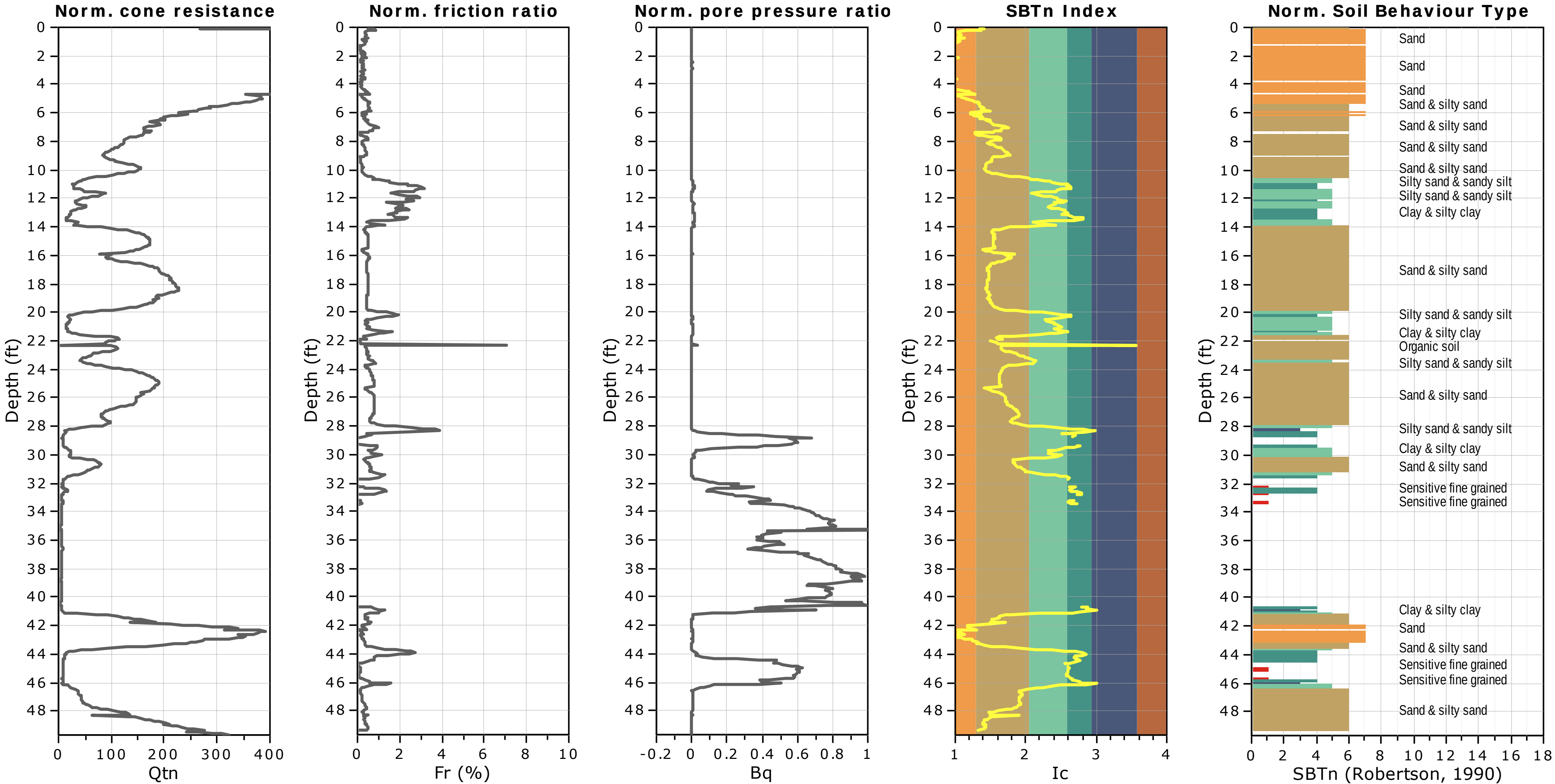
Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-16

Total depth: 49.67 ft



SBTn legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty clay	🟧 7. Gravely sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬜ 8. Very stiff sand to clayey sand
🟦 3. Clay to silty clay	🟨 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

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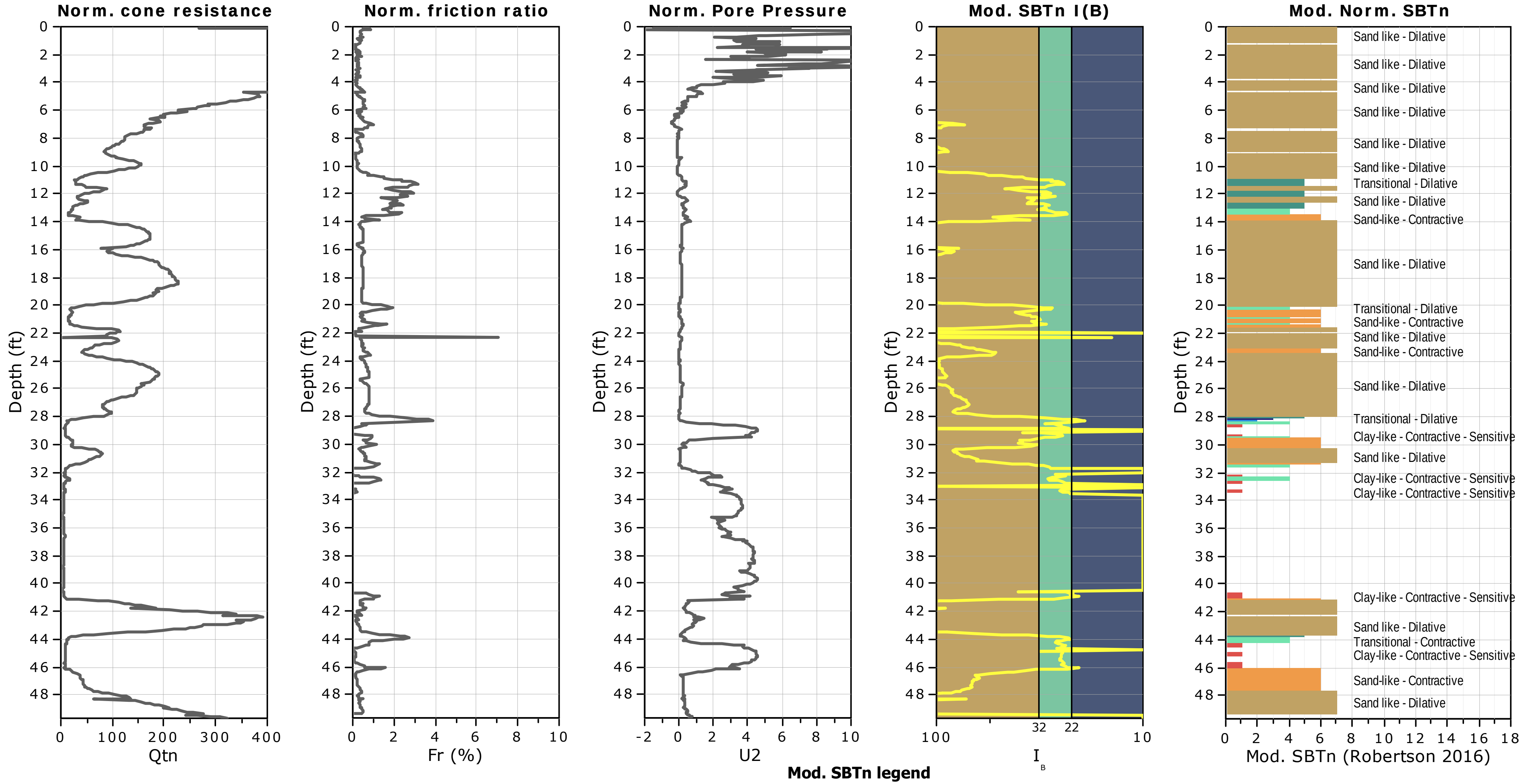
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

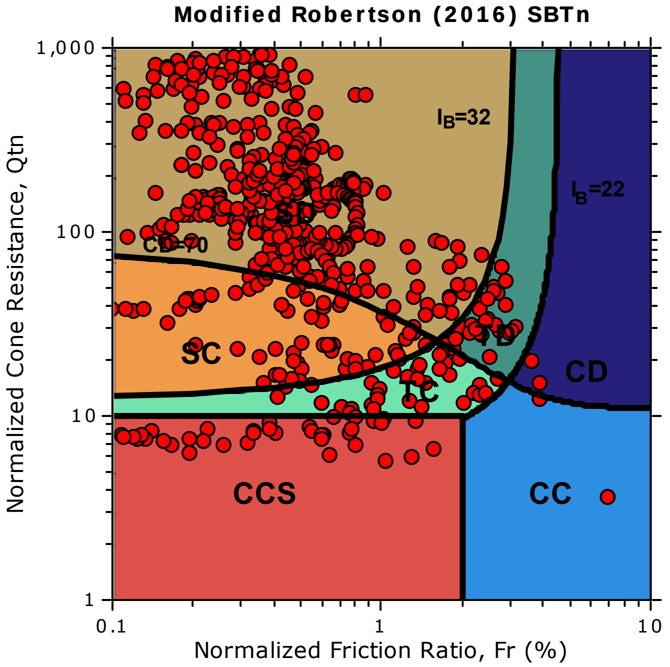
CPT: CPT-16
Total depth: 49.67 ft

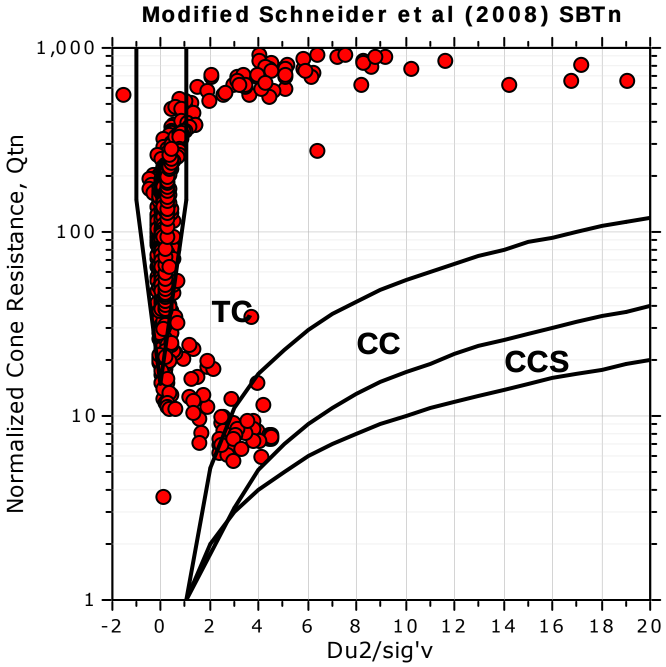


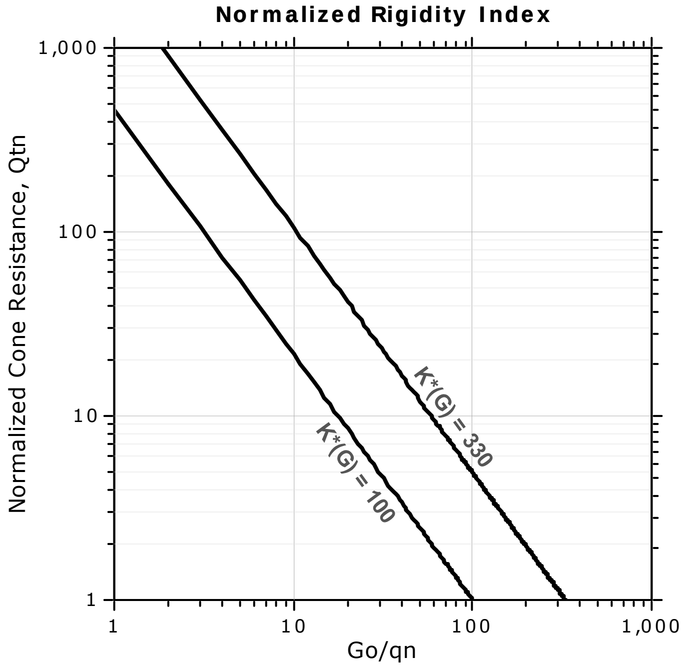
Mod. SBTn legend

🟥 1. CCS: ClayLike - Contractive, Sensitive
🟦 2. CC: Clay-like - Contractive
🟦 3. CD: Clay-Like: Dilative
🟩 4. TC: Transitional - Contractive
🟩 5. TD: Transitional - Dilative
🟧 6. SC: Sand-like - Contractive
🟫 7. SD: Sand-like - Dilative

Updated SBTn plots


Modified Robertson (2016) SBTn


Modified Schneider et al (2008) SBTn


Normalized Rigidity Index

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure
(e.g. age/cementation)

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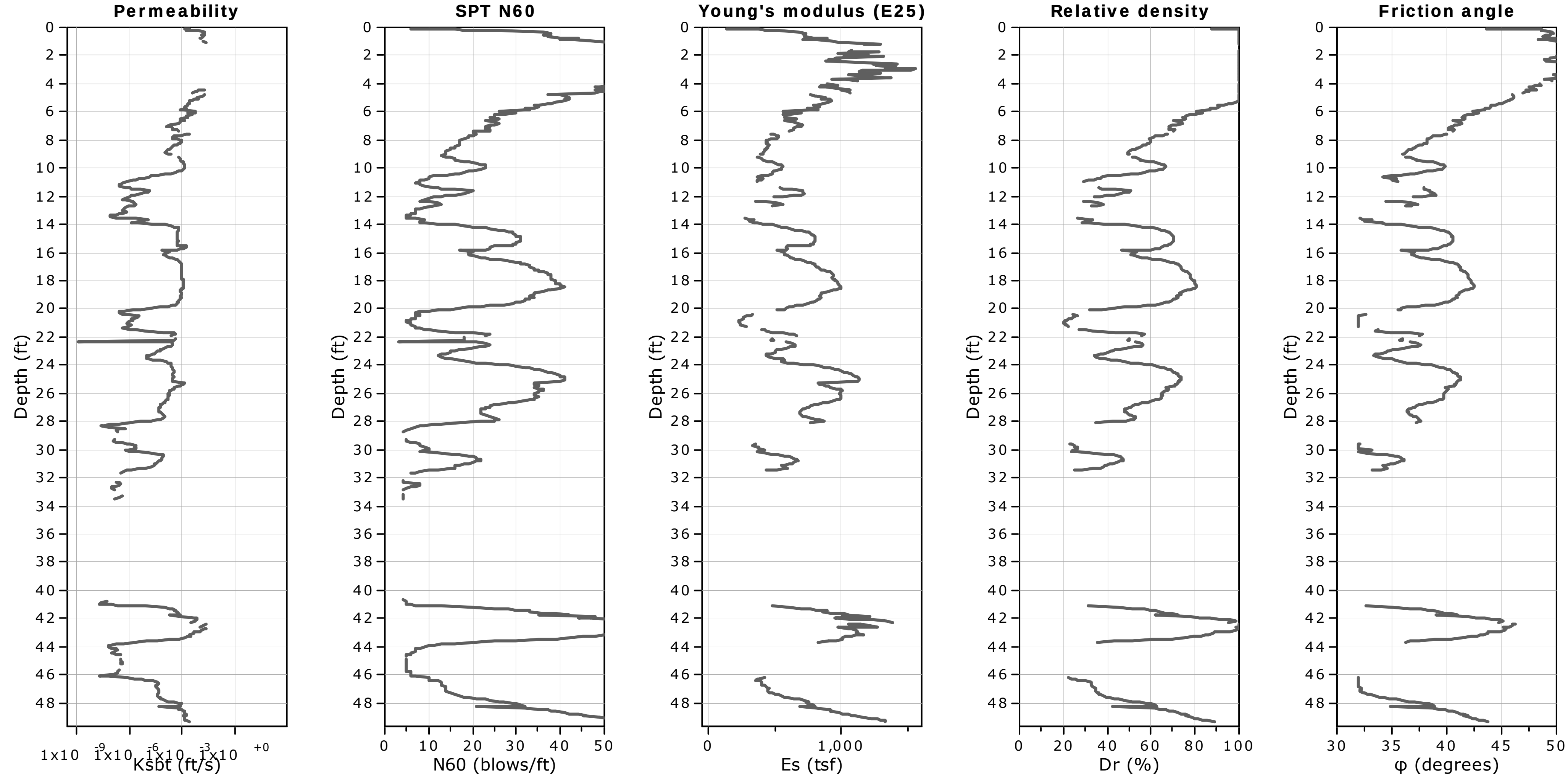
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-16
Total depth: 49.67 ft

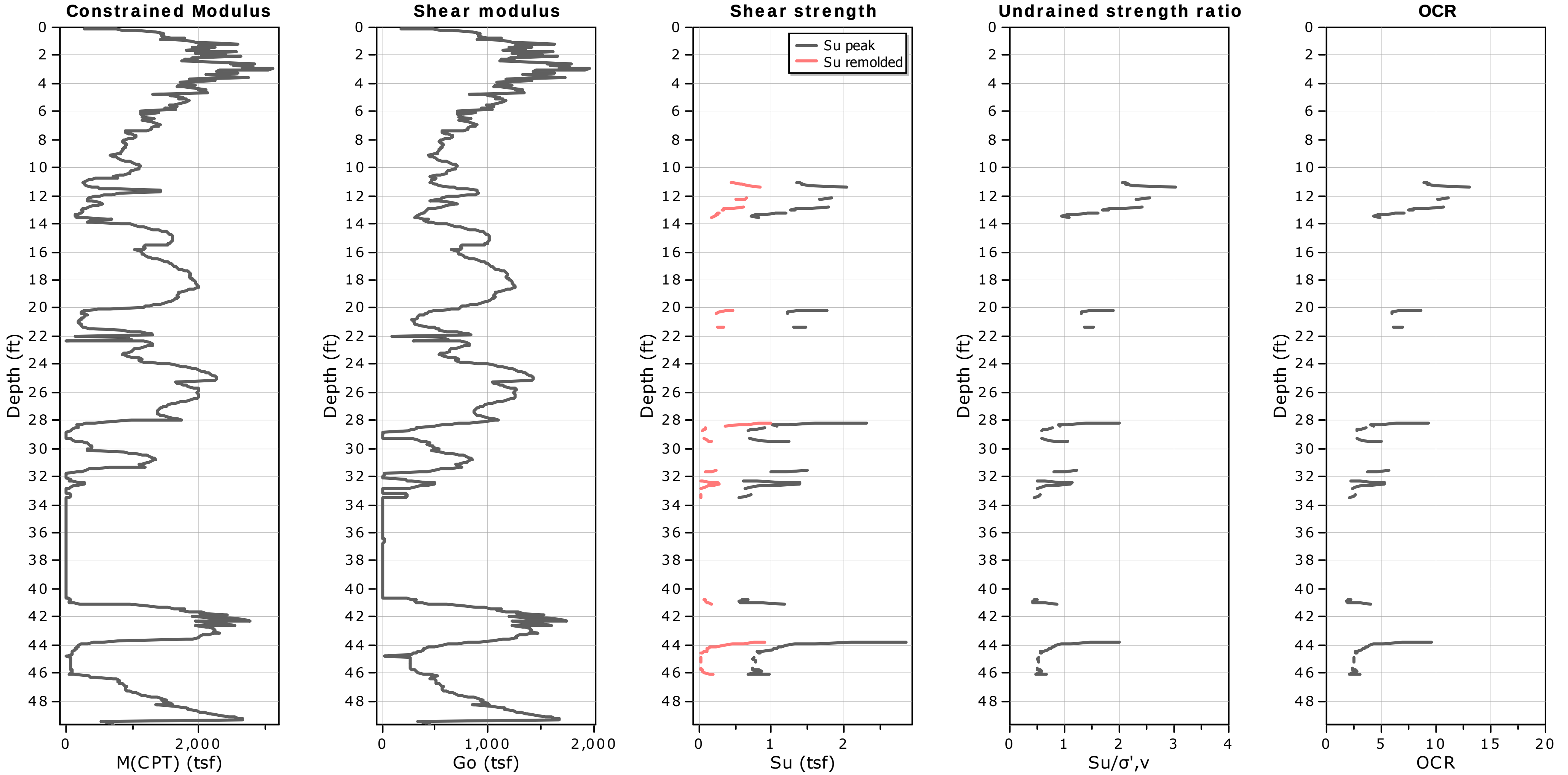


Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
● User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-16
Total depth: 49.67 ft



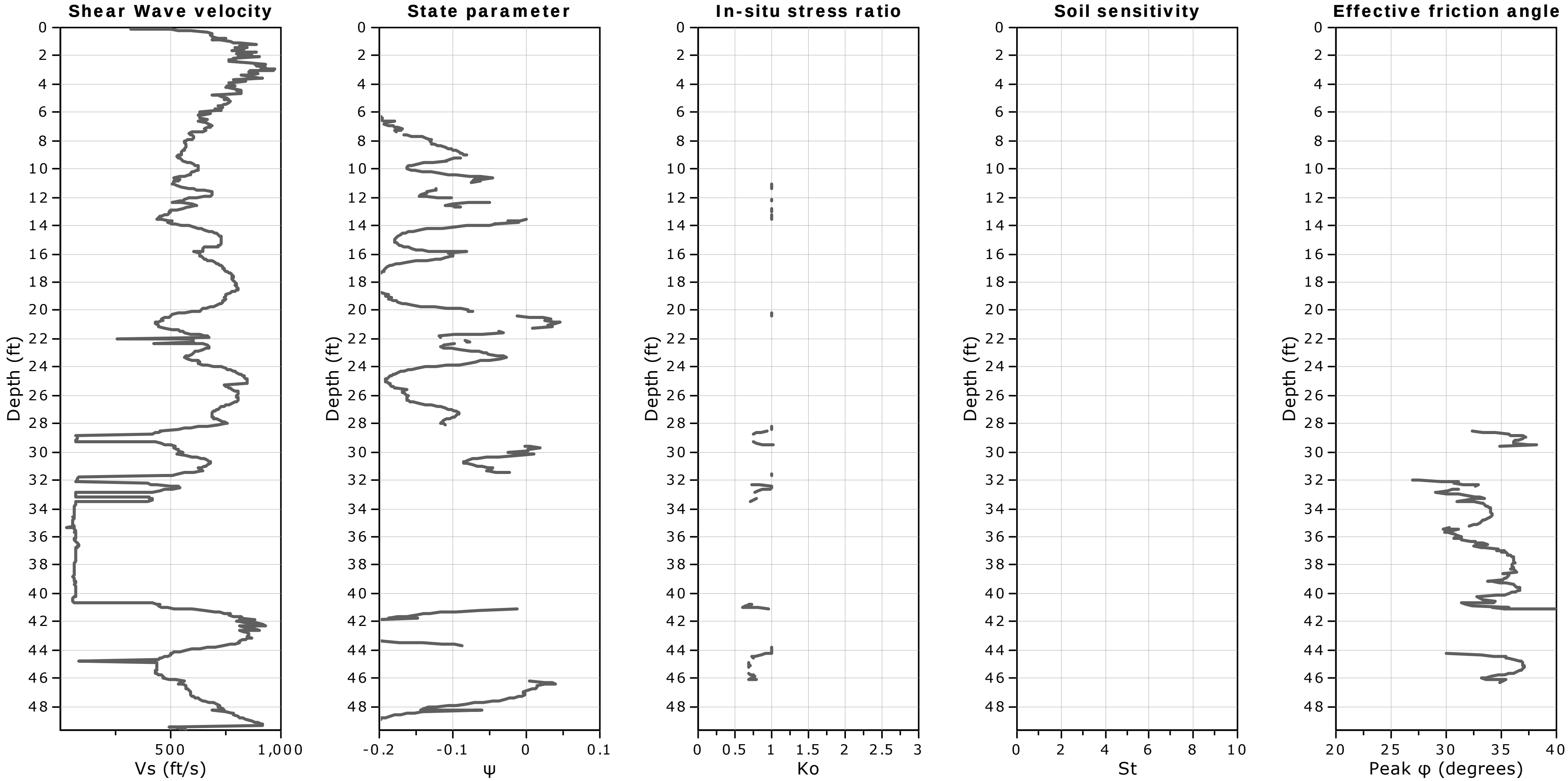
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

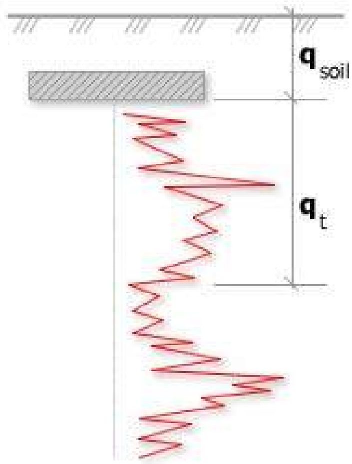
CPT: CPT-16
Total depth: 49.67 ft



Calculation parameters

Soil Sensitivity factor, N_S: 350.00
—●— User defined estimation data

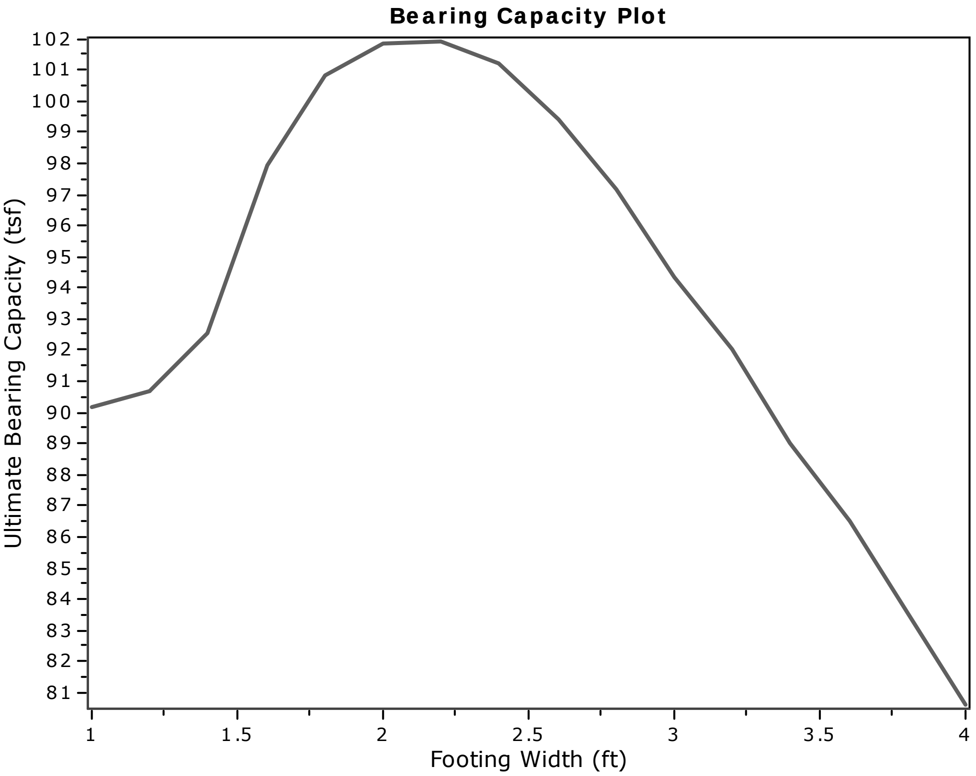
Project: **Langan** **CPT: CPT-16**
Location: **BL England Substation - Marmora NJ** Total depth: 49.67 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

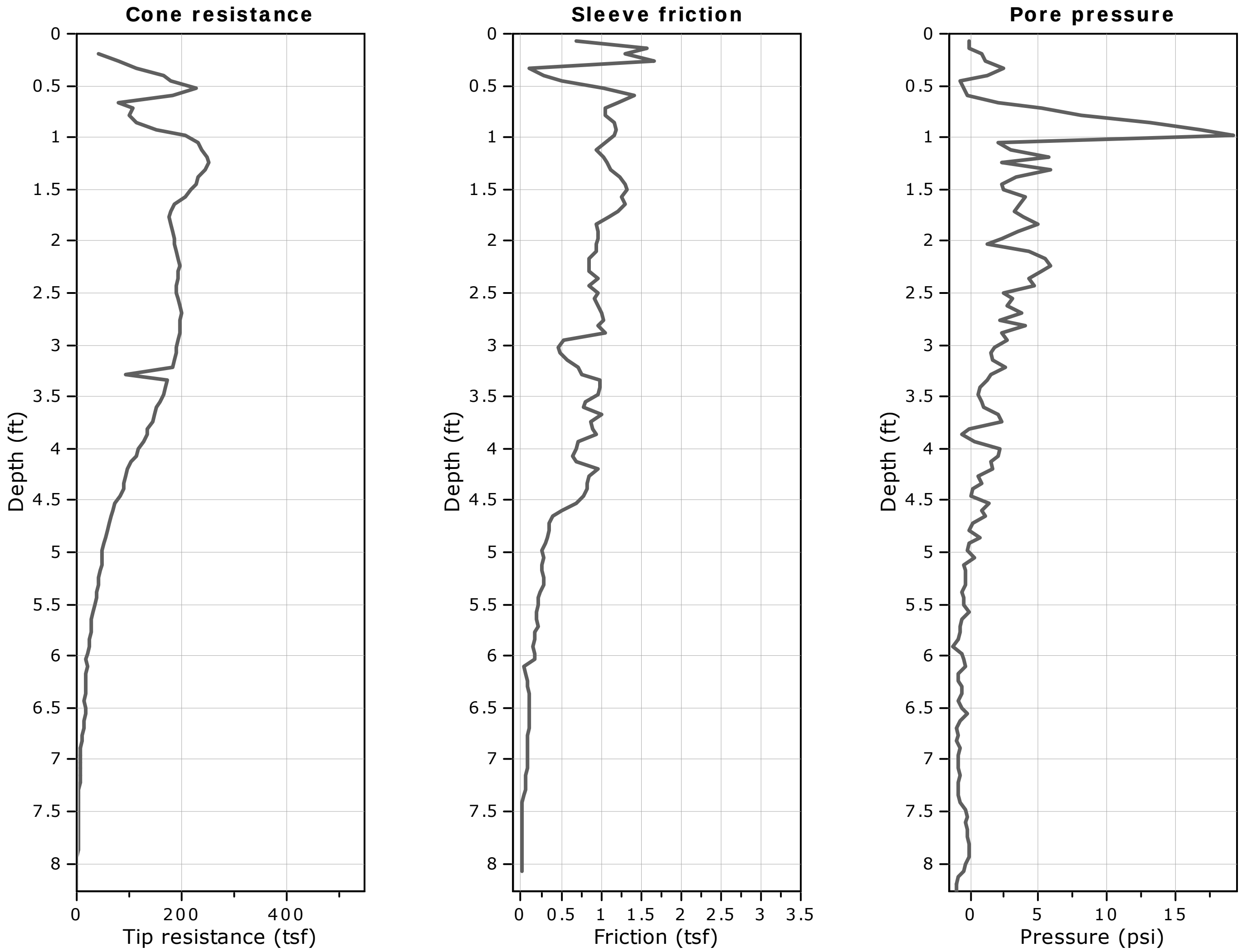
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	450.60	0.20	0.03	90.15
2	1.20	0.50	2.30	453.42	0.20	0.03	90.71
3	1.40	0.50	2.60	462.61	0.20	0.03	92.55
4	1.60	0.50	2.90	489.55	0.20	0.03	97.94
5	1.80	0.50	3.20	503.91	0.20	0.03	100.81
6	2.00	0.50	3.50	509.19	0.20	0.03	101.87
7	2.20	0.50	3.80	509.41	0.20	0.03	101.91
8	2.40	0.50	4.10	505.97	0.20	0.03	101.22
9	2.60	0.50	4.40	496.92	0.20	0.03	99.41
10	2.80	0.50	4.70	485.82	0.20	0.03	97.19
11	3.00	0.50	5.00	471.59	0.20	0.03	94.35
12	3.20	0.50	5.30	460.12	0.20	0.03	92.05
13	3.40	0.50	5.60	444.77	0.20	0.03	88.98
14	3.60	0.50	5.90	432.33	0.20	0.03	86.50
15	3.80	0.50	6.20	417.50	0.20	0.03	83.53
16	4.00	0.50	6.50	402.89	0.20	0.03	80.61

Project: **Langan**

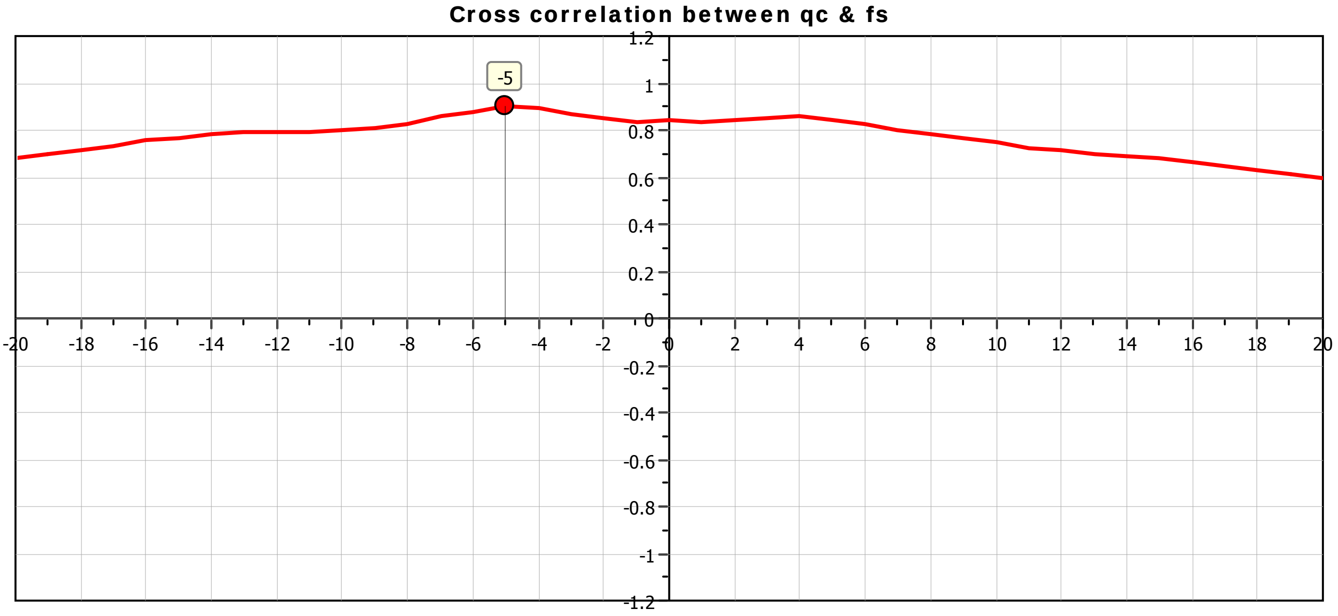
Location: **BL England Substation - Marmora NJ**

CPT: CPT-2

Total depth: 10.76 ft



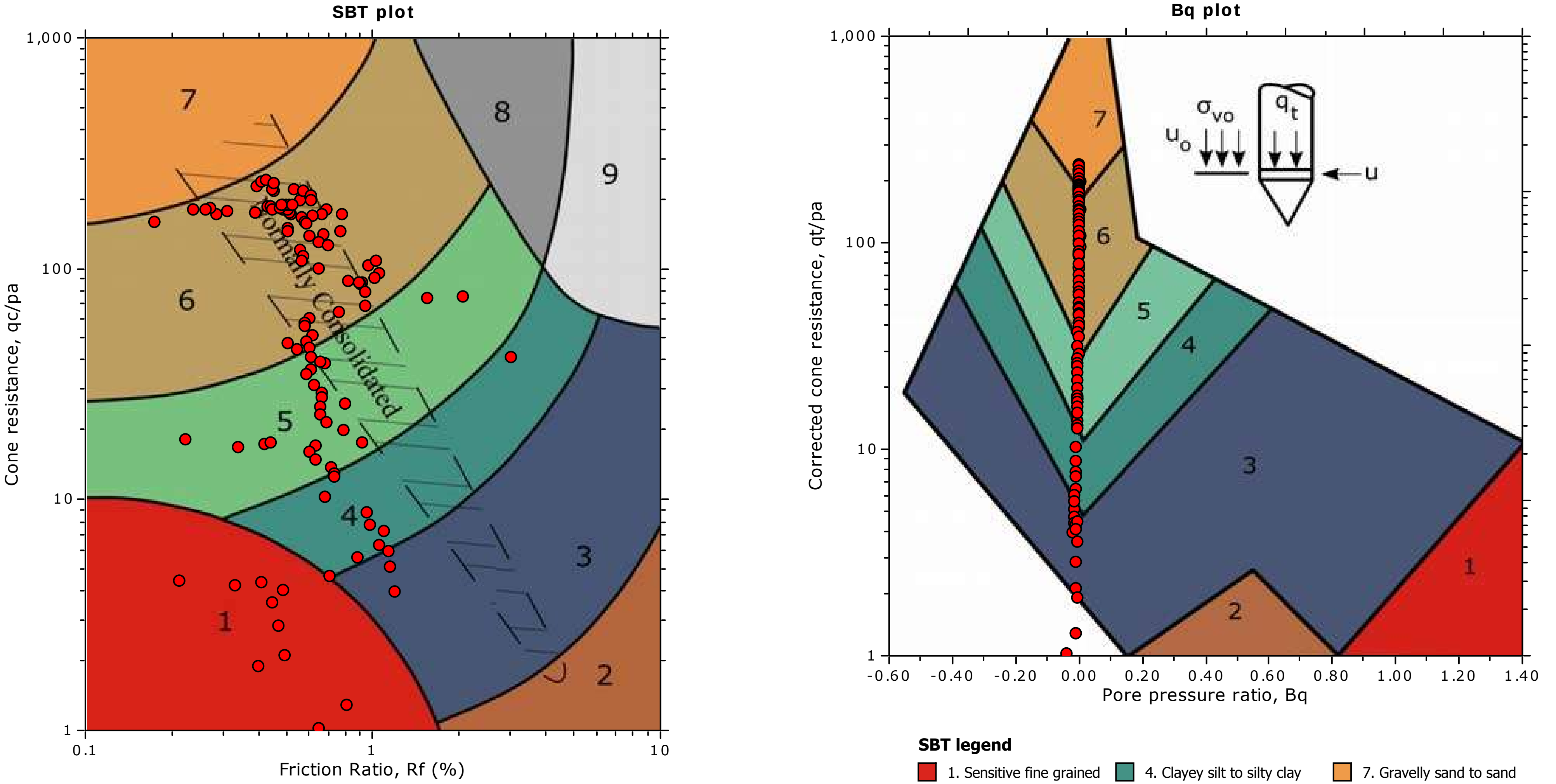
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-2
Total depth: 10.76 ft

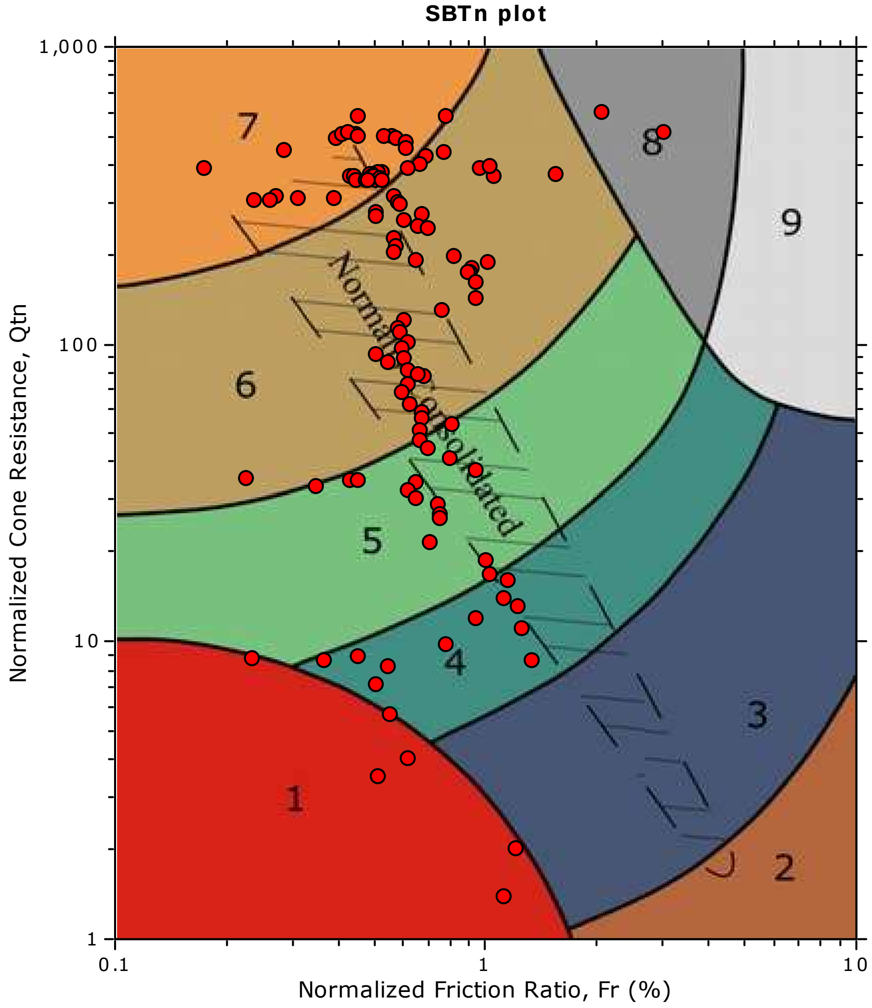
SBT - Bq plots

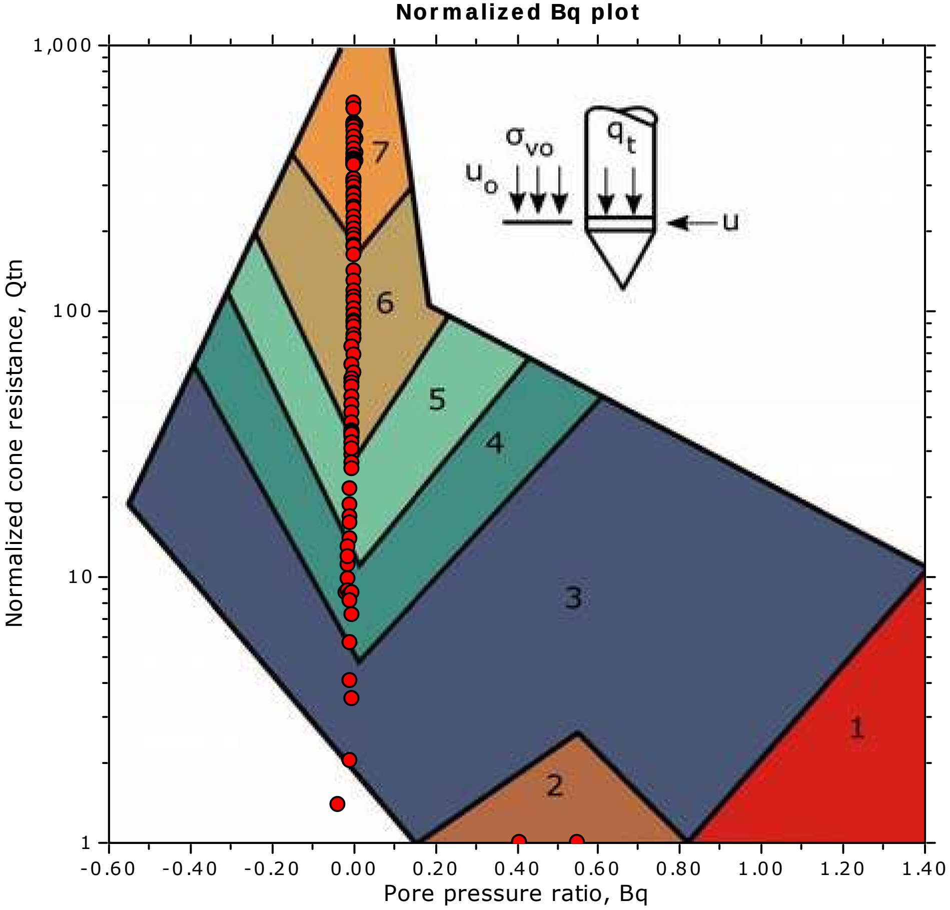


SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

SBT - Bq plots (normalized)

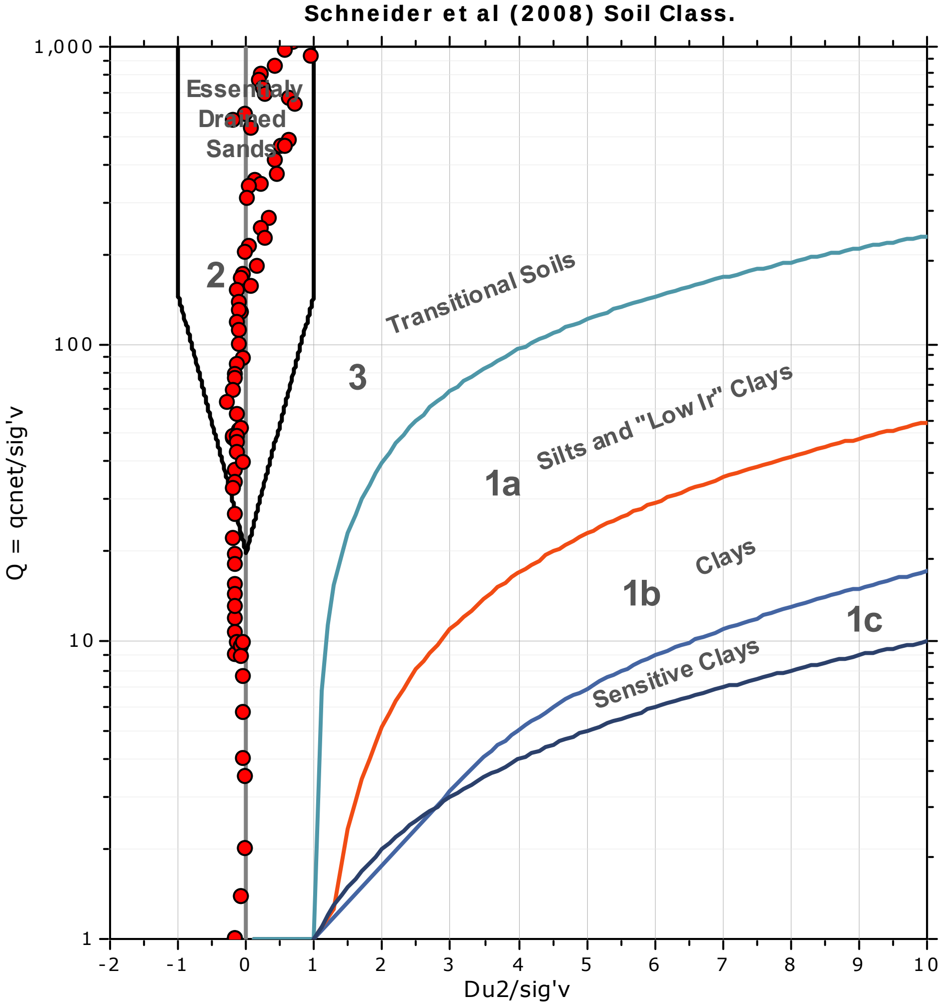


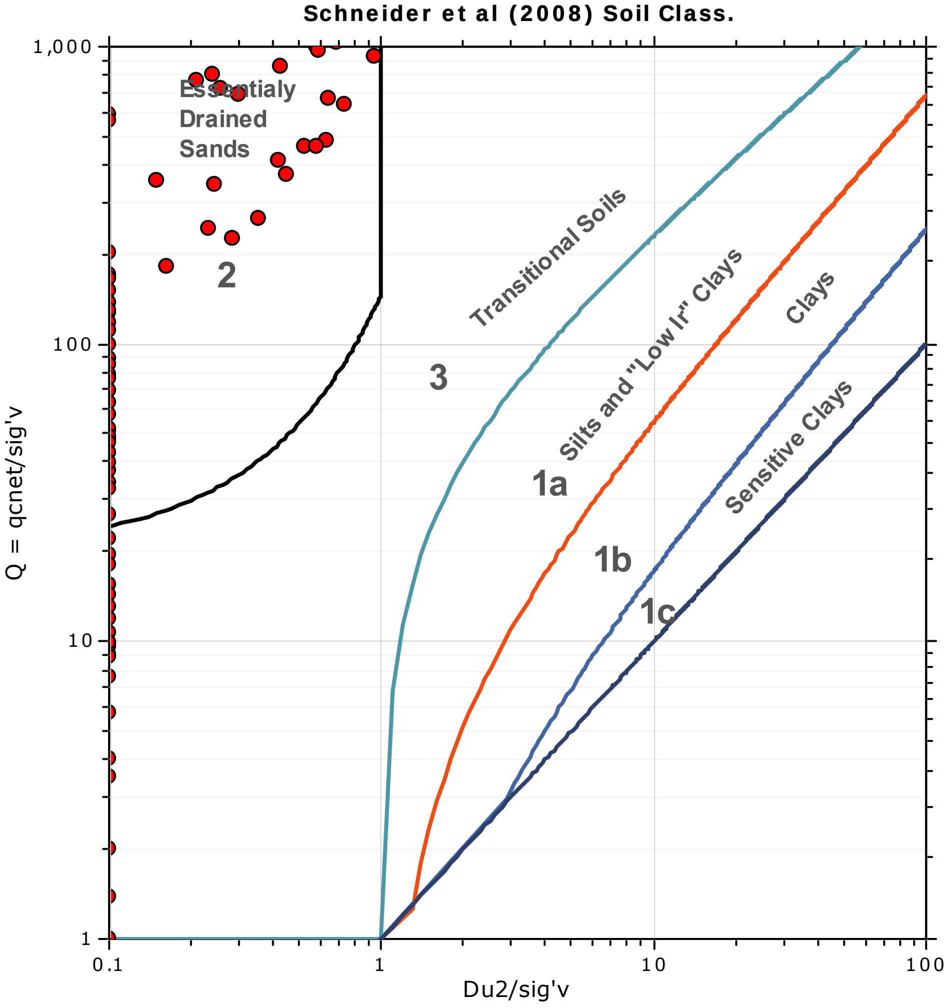


SBTn legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty clay	🟧 7. Gravelly sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬛ 8. Very stiff sand to clayey sand
🟦 3. Clay to silty clay	🟫 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

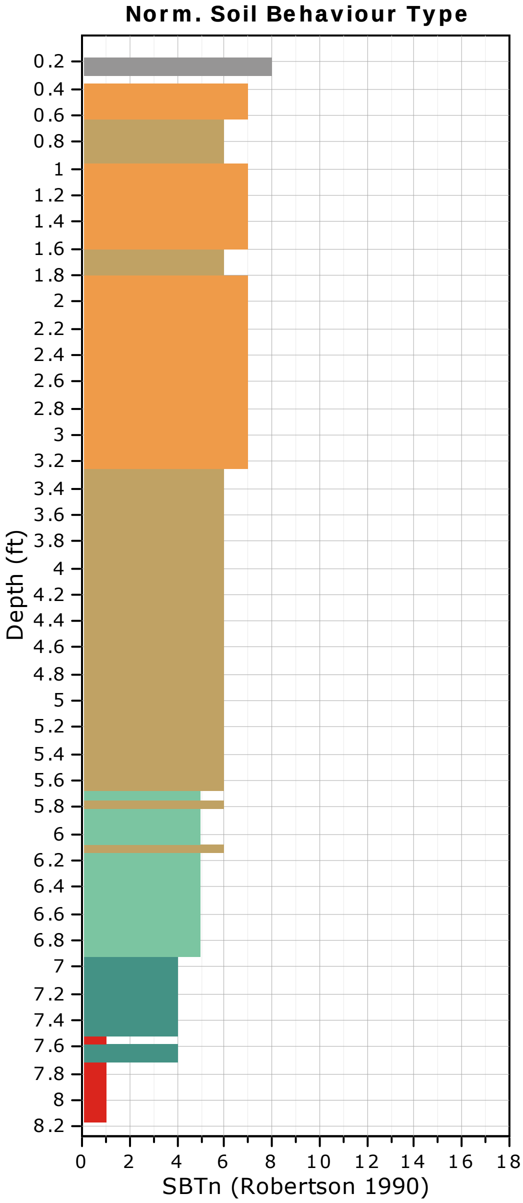
Bq plots (Schneider)

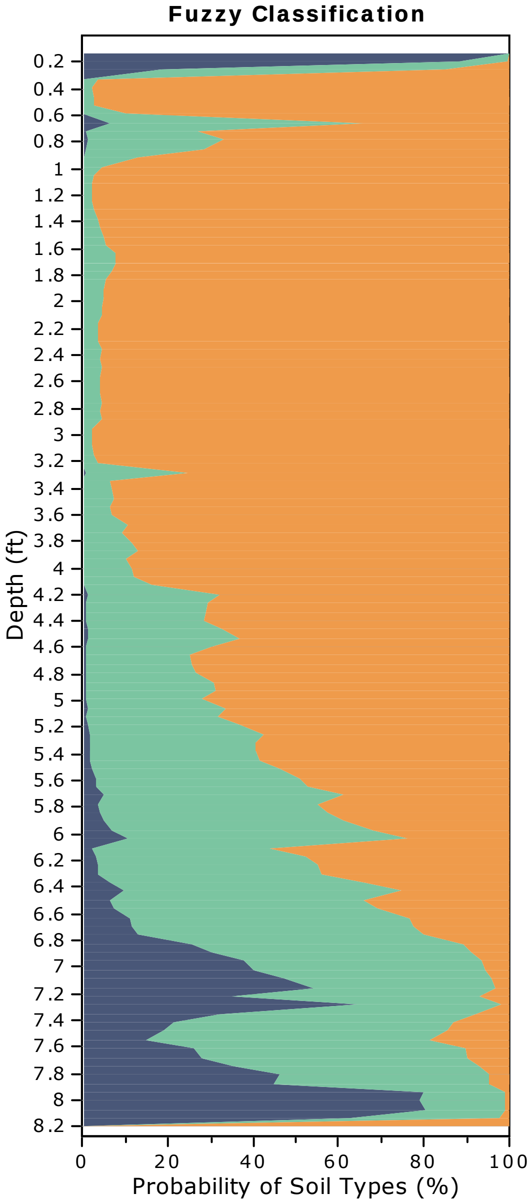




Project: **Langan**
Location: **BL England Substation - Marmora NJ**

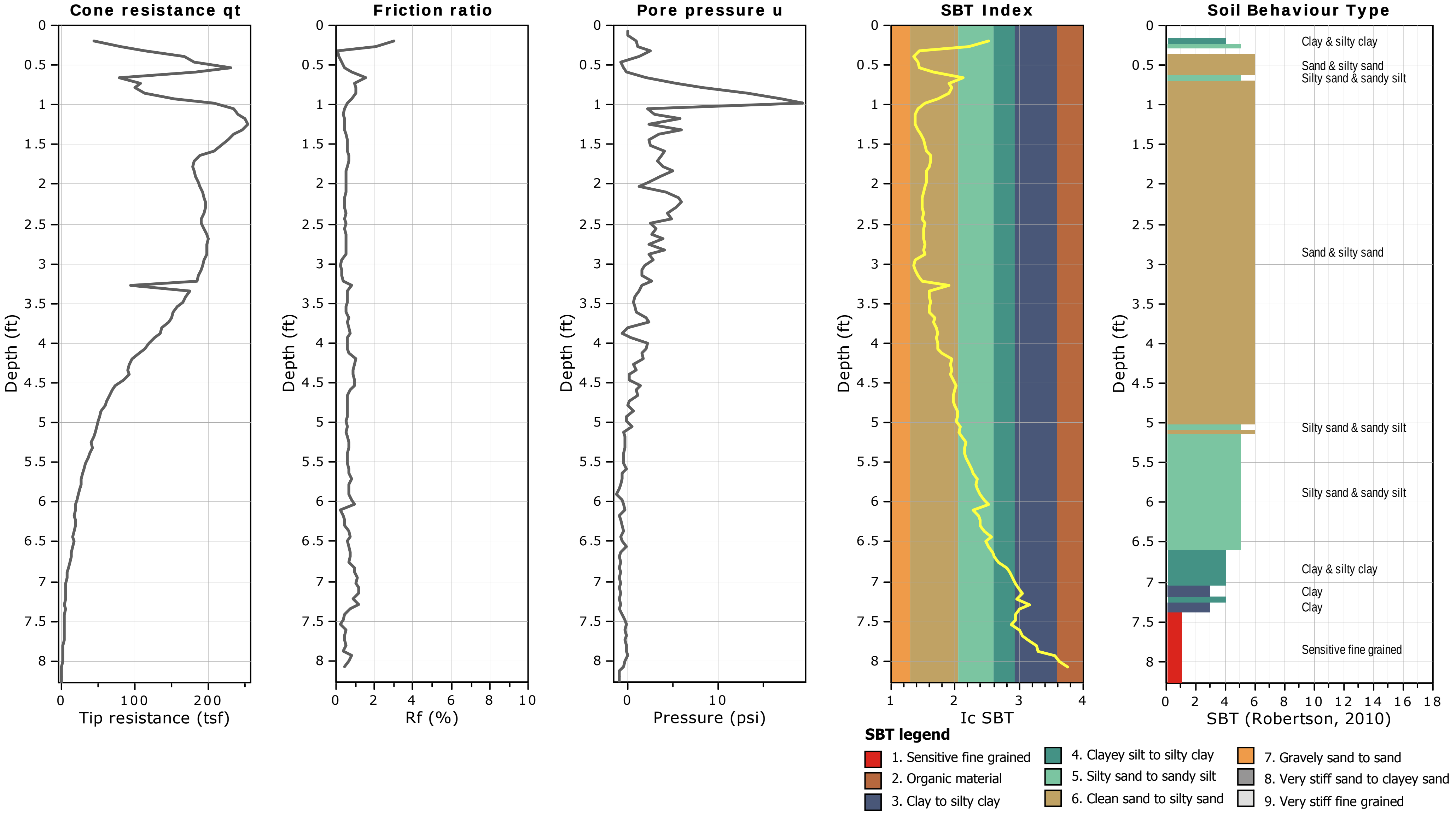
CPT: CPT-2
Total depth: 10.76 ft





Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-2
Total depth: 10.76 ft



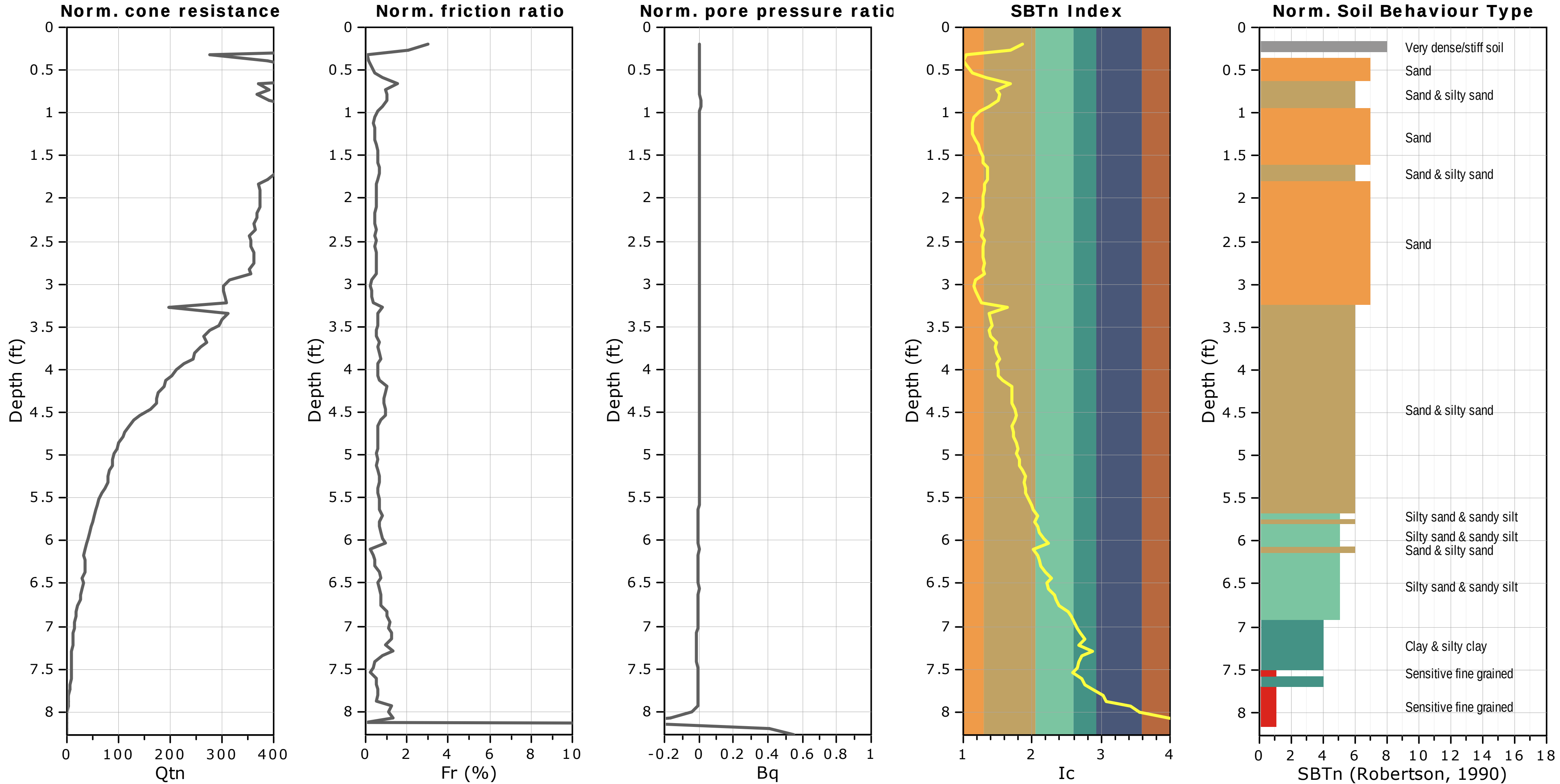
Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-2

Total depth: 10.76 ft



SBTn legend

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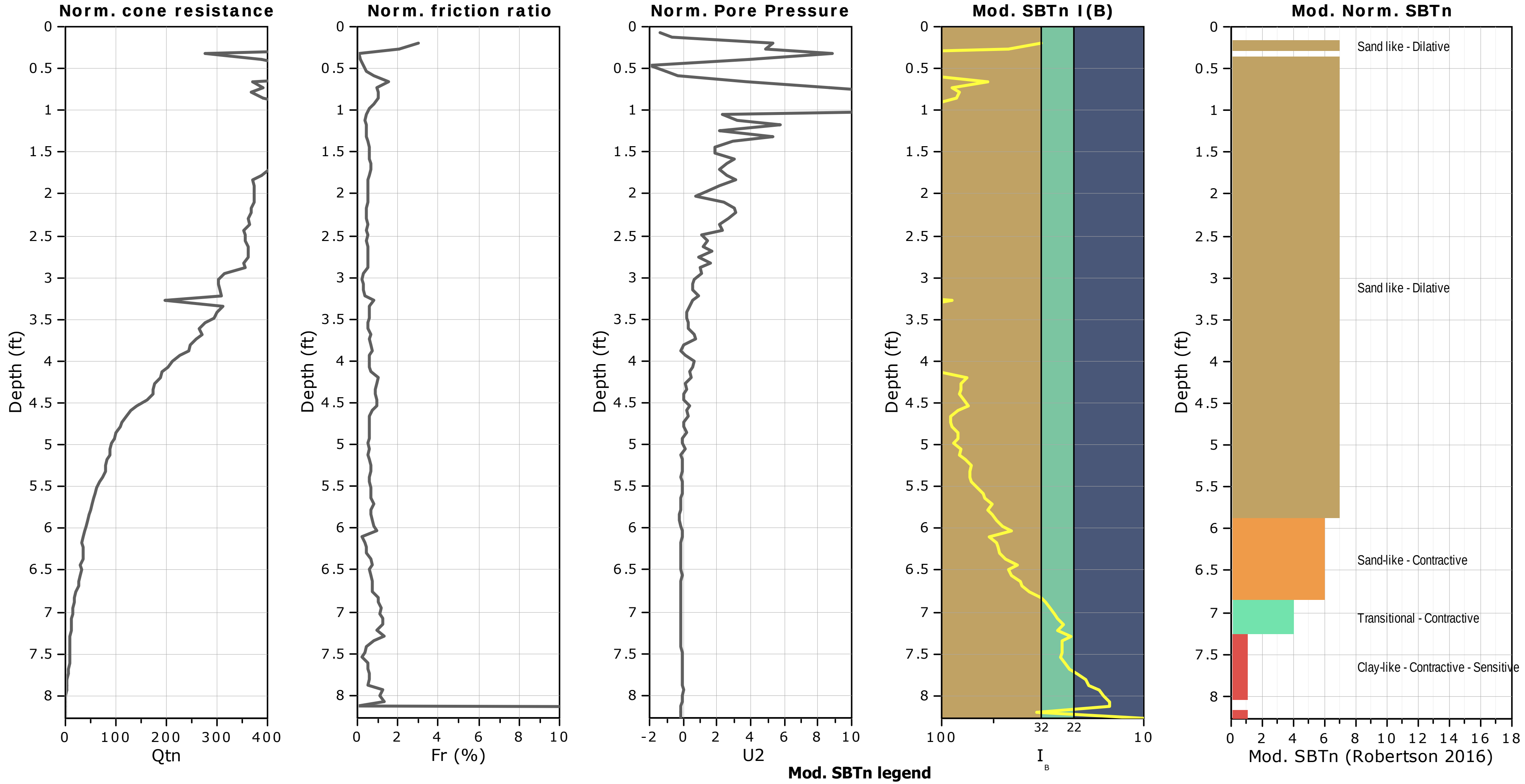
Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-2

Total depth: 10.76 ft

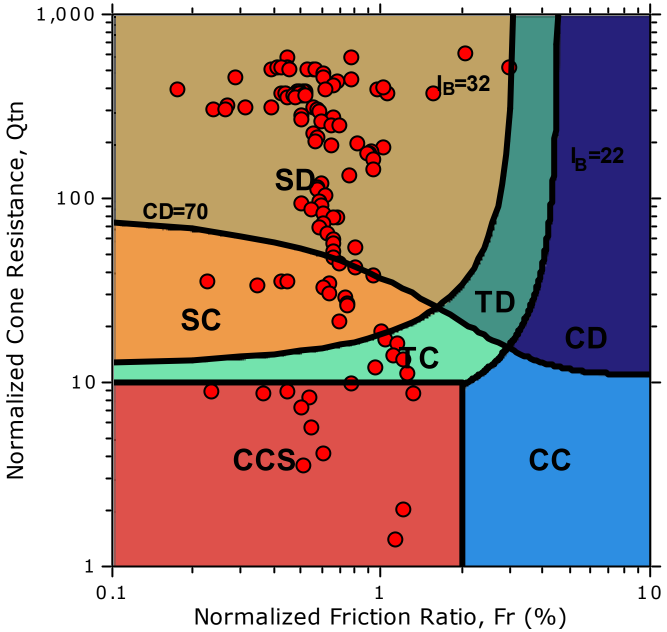


Mod. SBTn legend

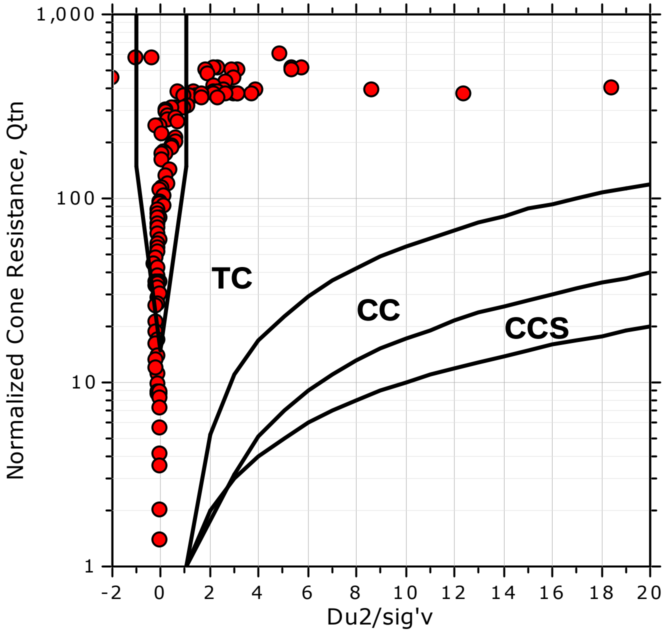
- 🟥 1. CCS: ClayLike - Contractive, Sensitive
- 🟦 2. CC: Clay-like - Contractive
- 🟦 3. CD: Clay-Like: Dilative
- 🟩 4. TC: Transitional - Contractive
- 🟩 5. TD: Transitional - Dilative
- 🟧 6. SC: Sand-like - Contractive
- 🟫 7. SD: Sand-like - Dilative

Updated SBTn plots

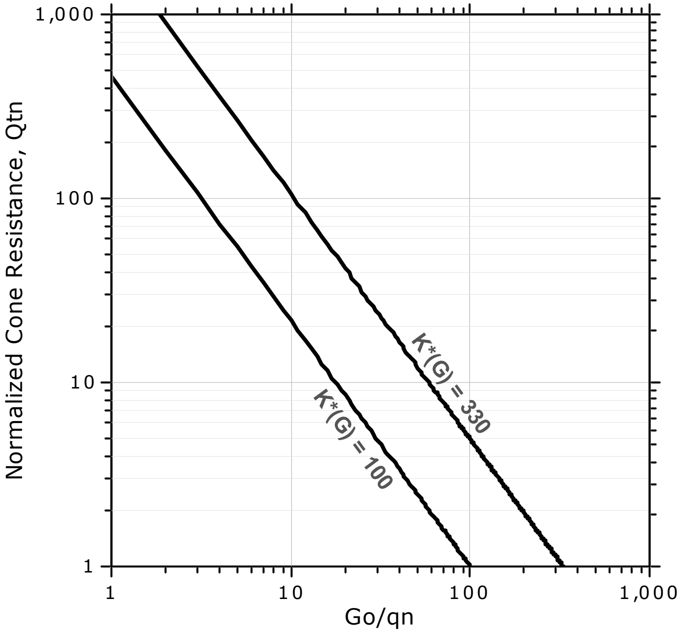
Modified Robertson (2016) SBTn



Modified Schneider et al (2008) SBTn



Normalized Rigidity Index

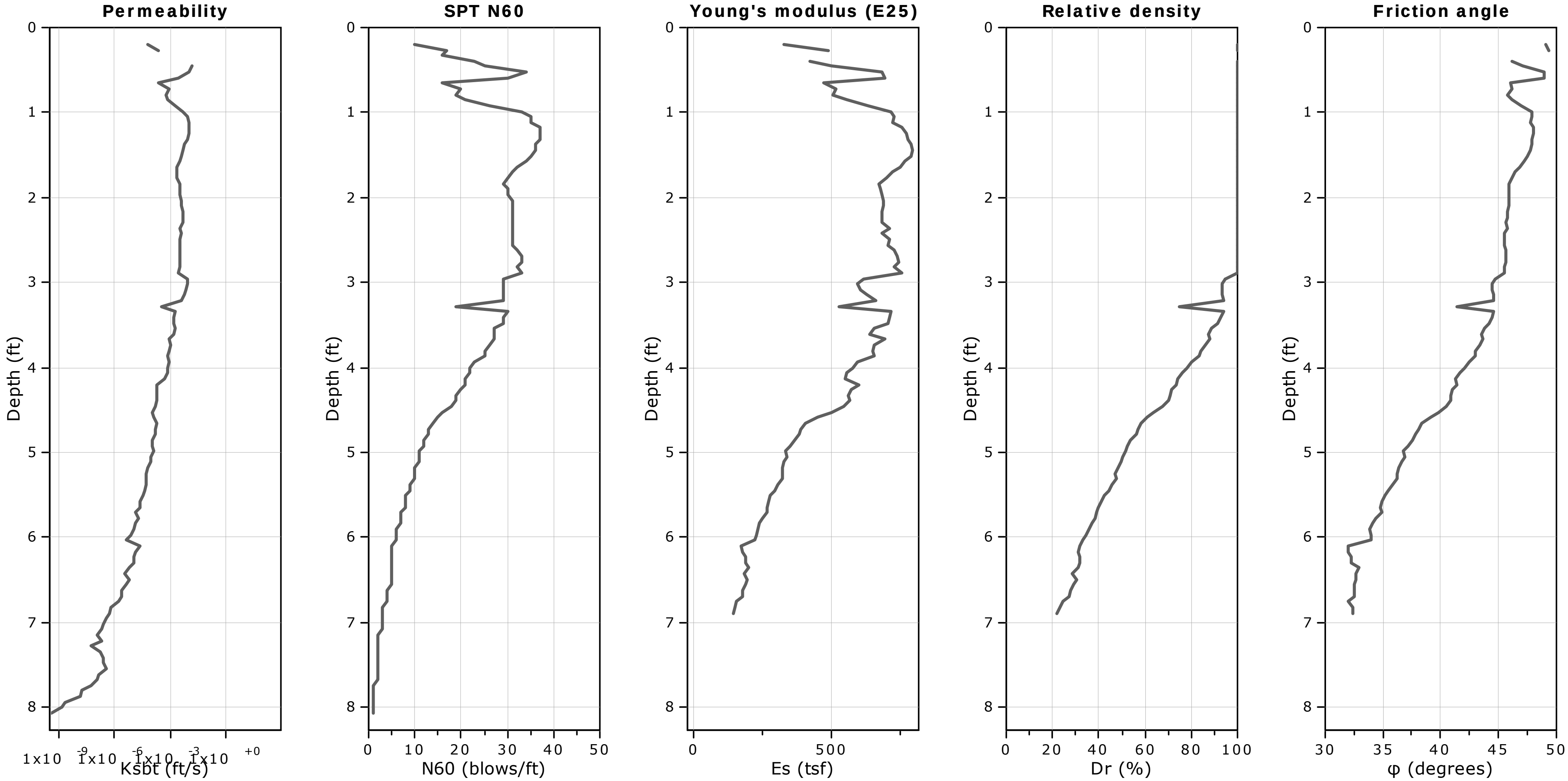


CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure
(e.g. age/cementation)

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-2
Total depth: 10.76 ft



Calculation parameters

Permeability: Based on SBT_n

SPT N_{60}: Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0

Phi: Based on Kulhawy & Mayne (1990)

—●— User defined estimation data

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Project: **Langan**
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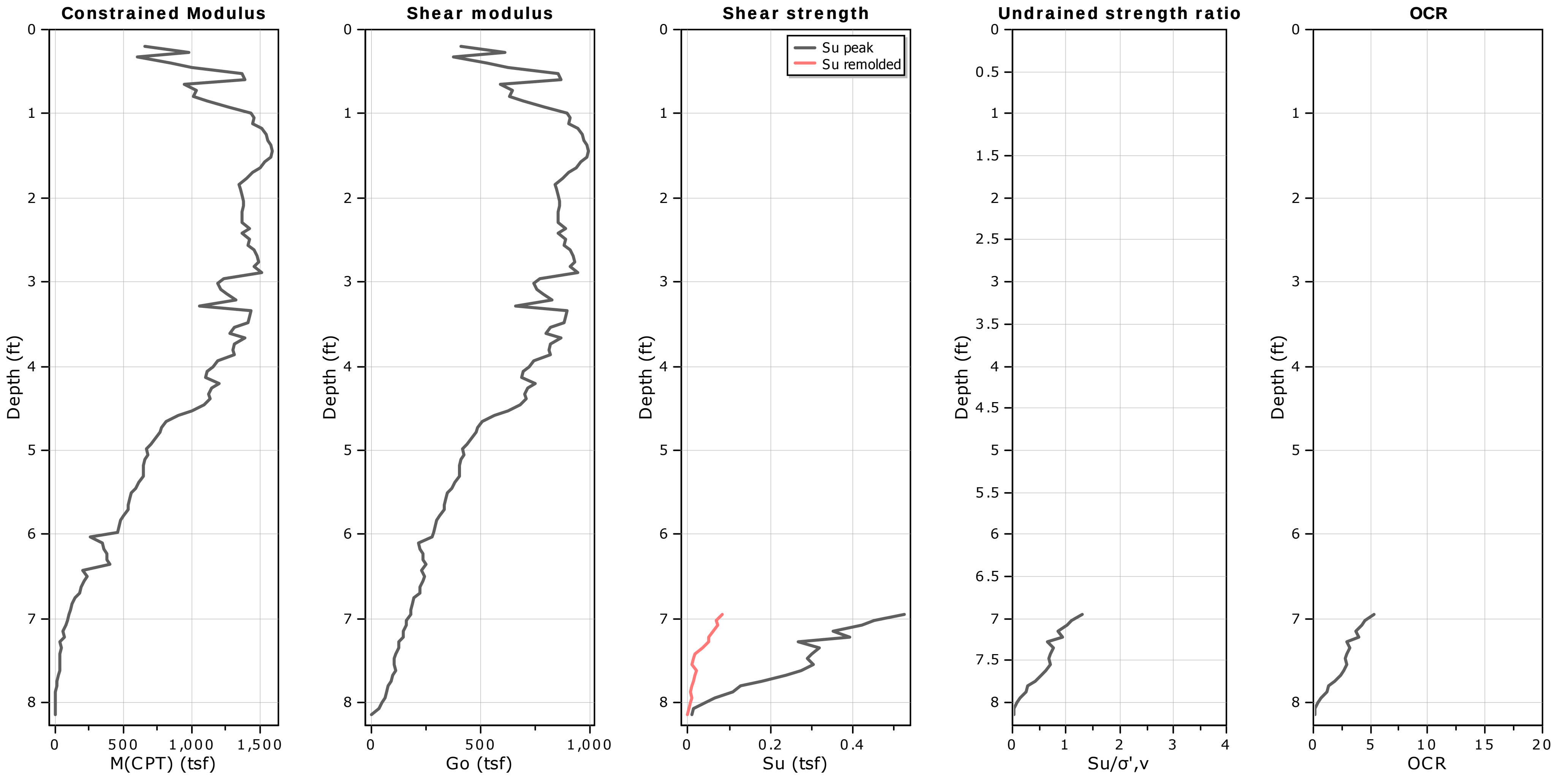
CPT: CPT-2
Total depth: 10.76 ft



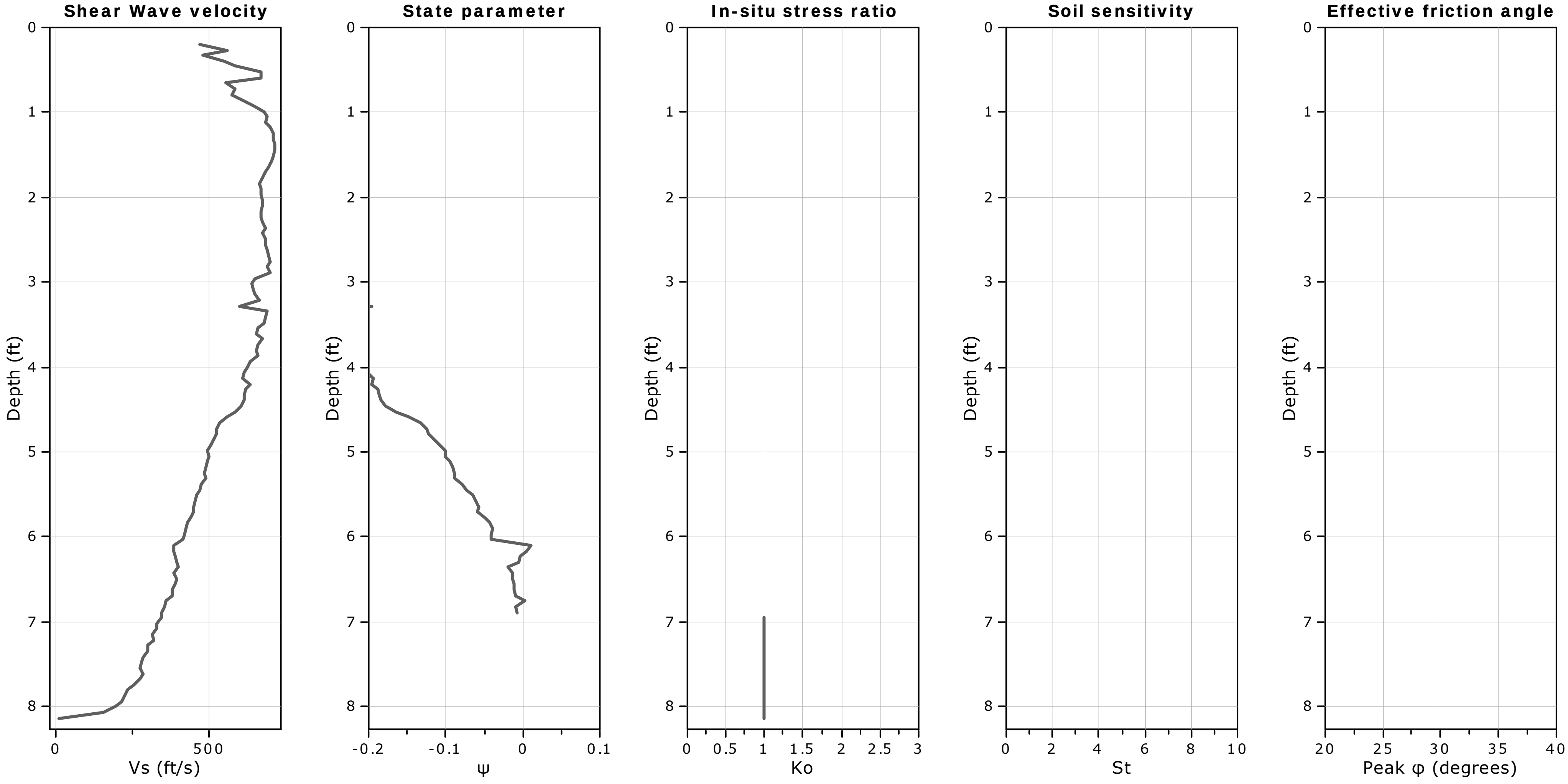
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

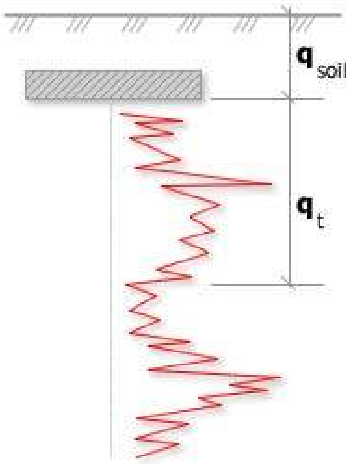
CPT: CPT-2
Total depth: 10.76 ft



Calculation parameters

Soil Sensitivity factor, N_S: 350.00

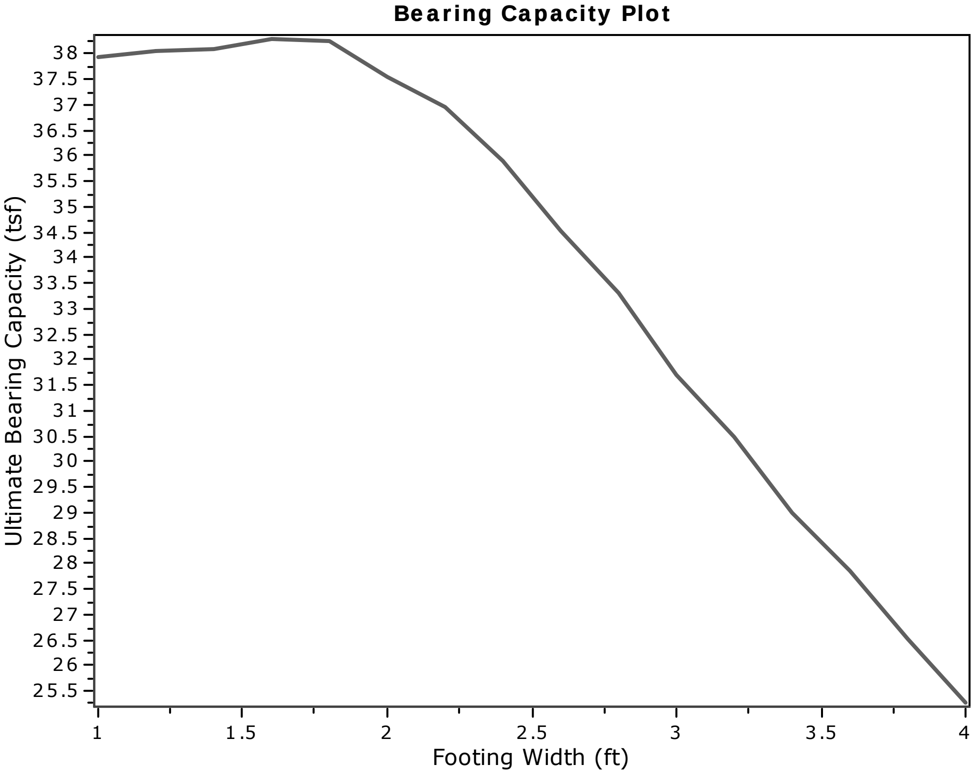
● User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

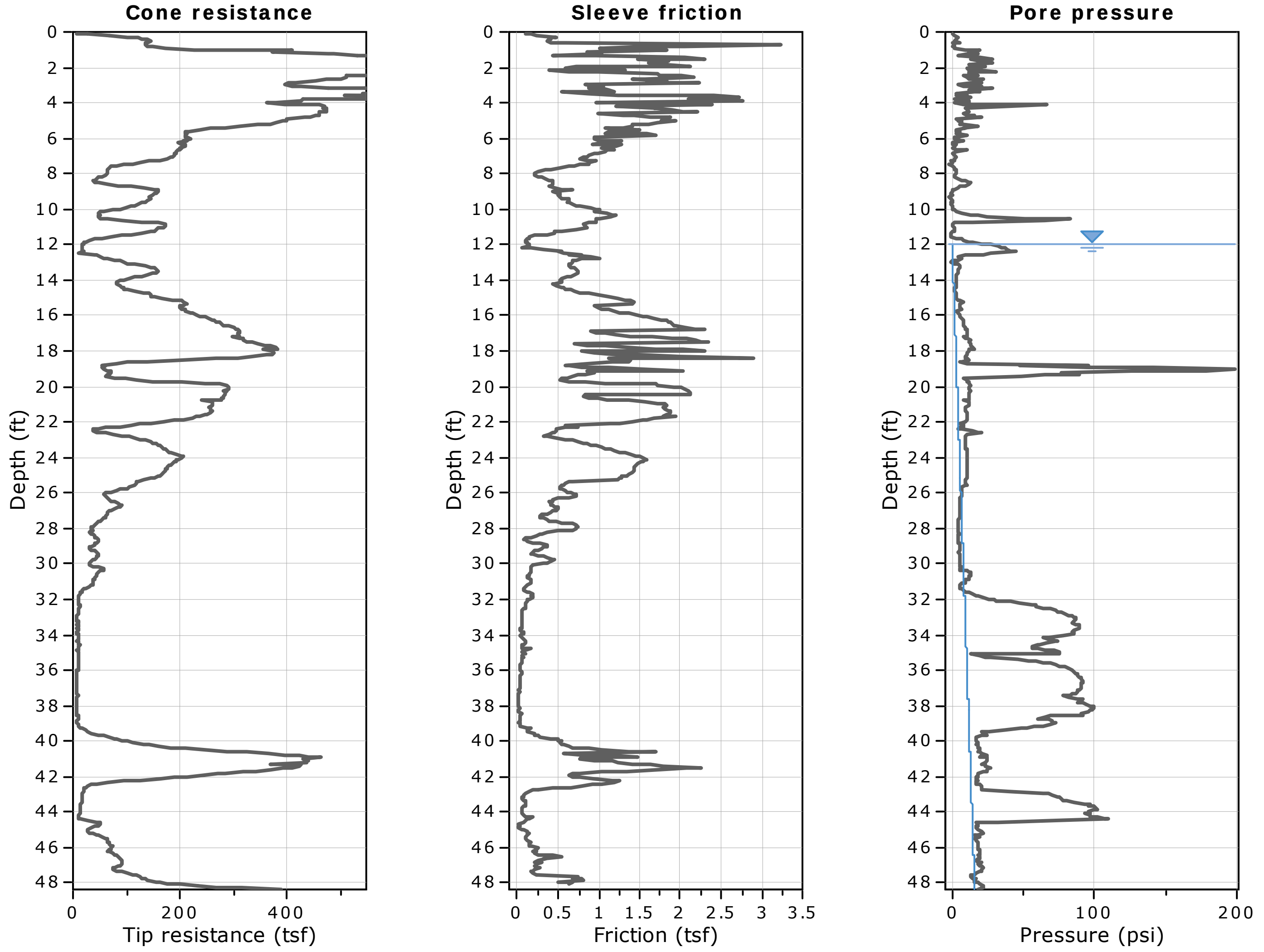


:: Tabular results ::

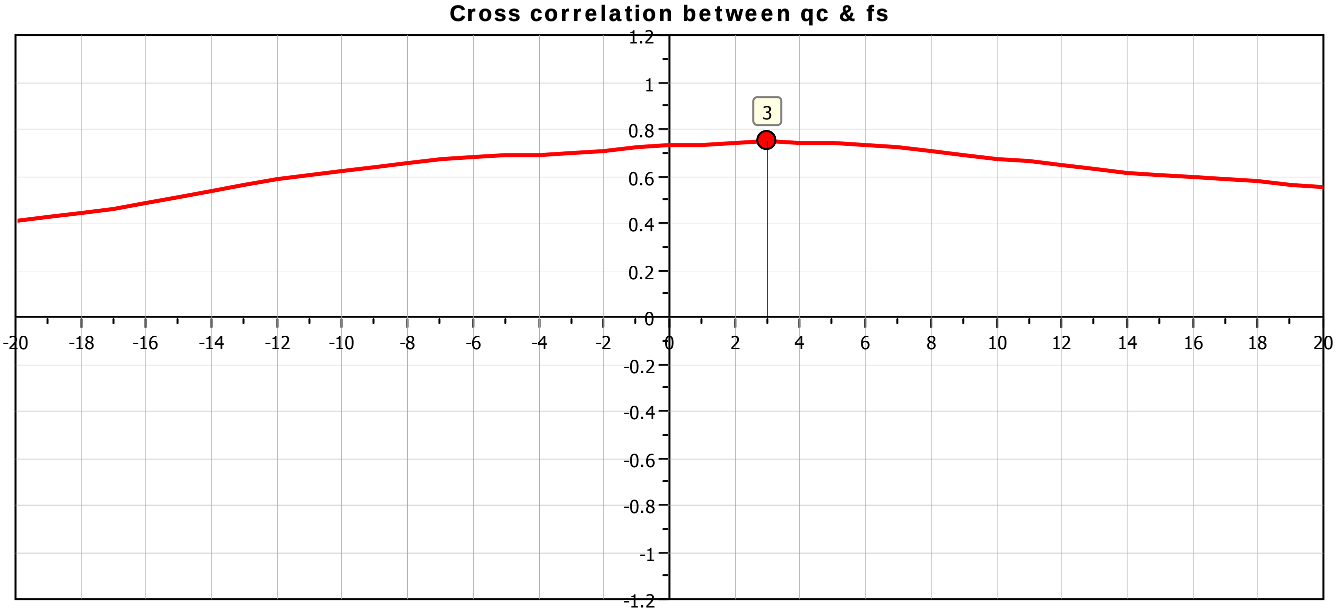
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	189.48	0.20	0.03	37.93
2	1.20	0.50	2.30	190.04	0.20	0.03	38.04
3	1.40	0.50	2.60	190.25	0.20	0.03	38.08
4	1.60	0.50	2.90	191.29	0.20	0.03	38.29
5	1.80	0.50	3.20	191.18	0.20	0.03	38.27
6	2.00	0.50	3.50	187.52	0.20	0.03	37.53
7	2.20	0.50	3.80	184.66	0.20	0.03	36.96
8	2.40	0.50	4.10	179.42	0.20	0.03	35.91
9	2.60	0.50	4.40	172.49	0.20	0.03	34.53
10	2.80	0.50	4.70	166.33	0.20	0.03	33.30
11	3.00	0.50	5.00	158.37	0.20	0.03	31.70
12	3.20	0.50	5.30	152.22	0.20	0.03	30.47
13	3.40	0.50	5.60	144.87	0.20	0.03	29.00
14	3.60	0.50	5.90	139.18	0.20	0.03	27.87
15	3.80	0.50	6.20	132.40	0.20	0.03	26.51
16	4.00	0.50	6.50	126.21	0.20	0.03	25.27

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-23
Total depth: 48.36 ft



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



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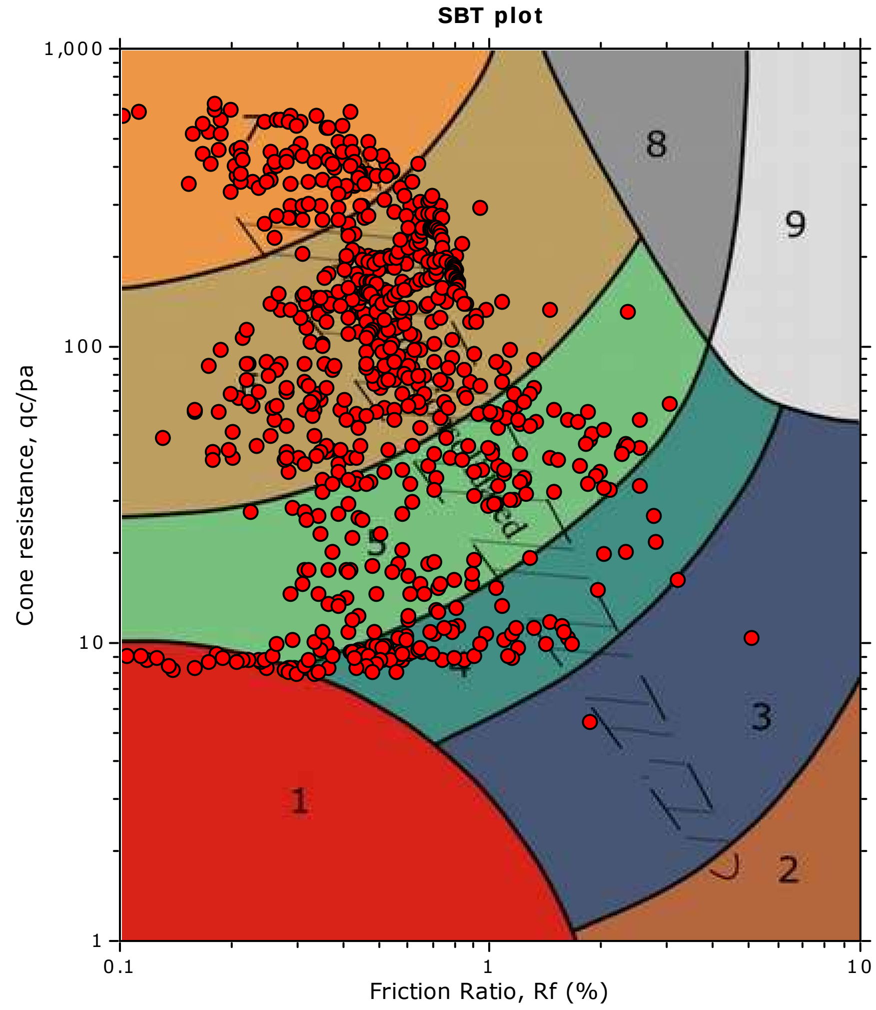
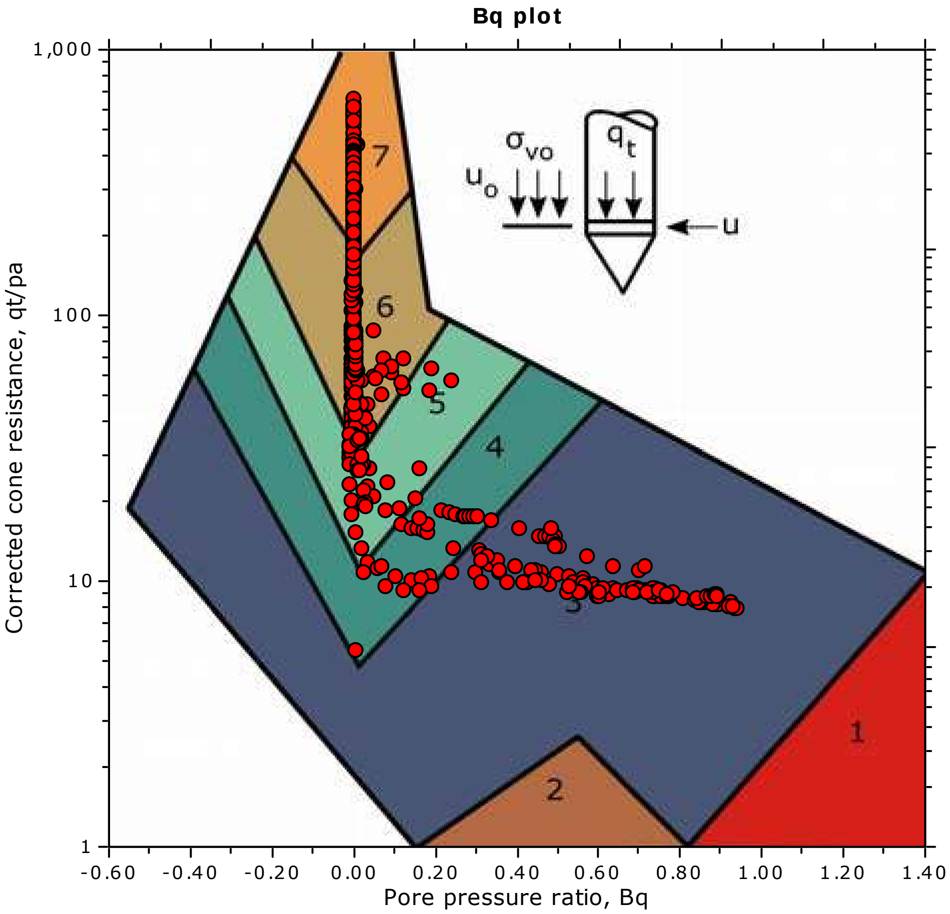
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-23
Total depth: 48.36 ft

SBT - Bq plots



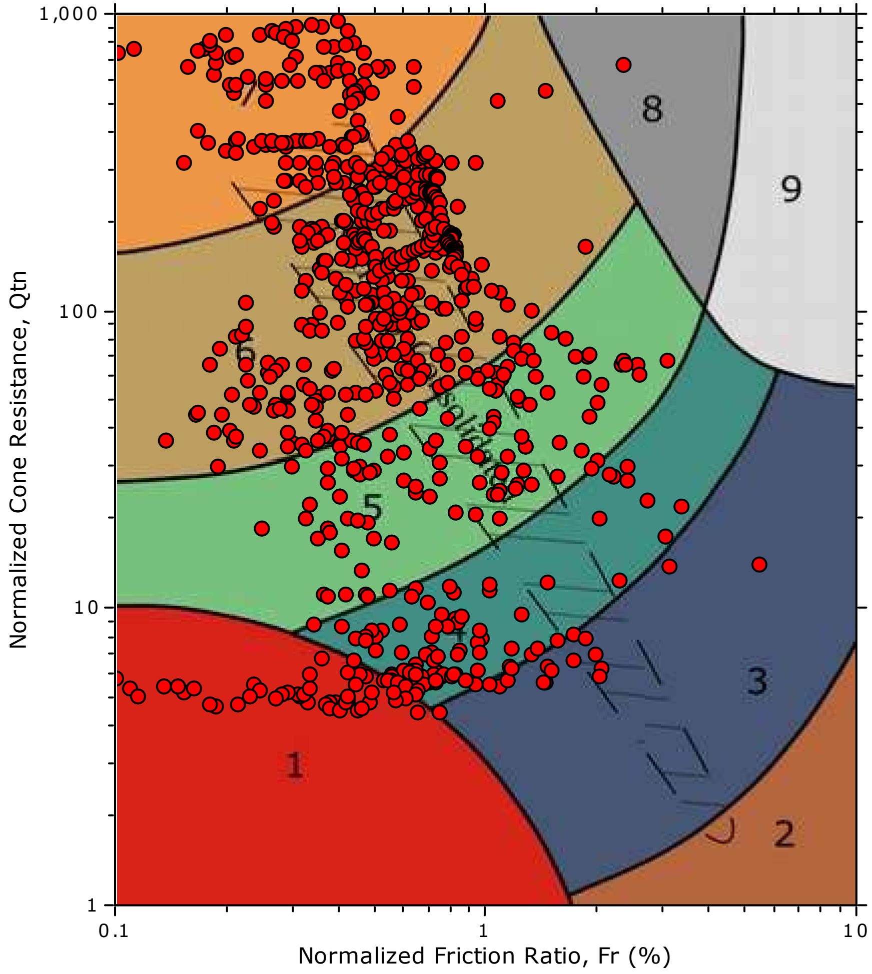


SBT legend

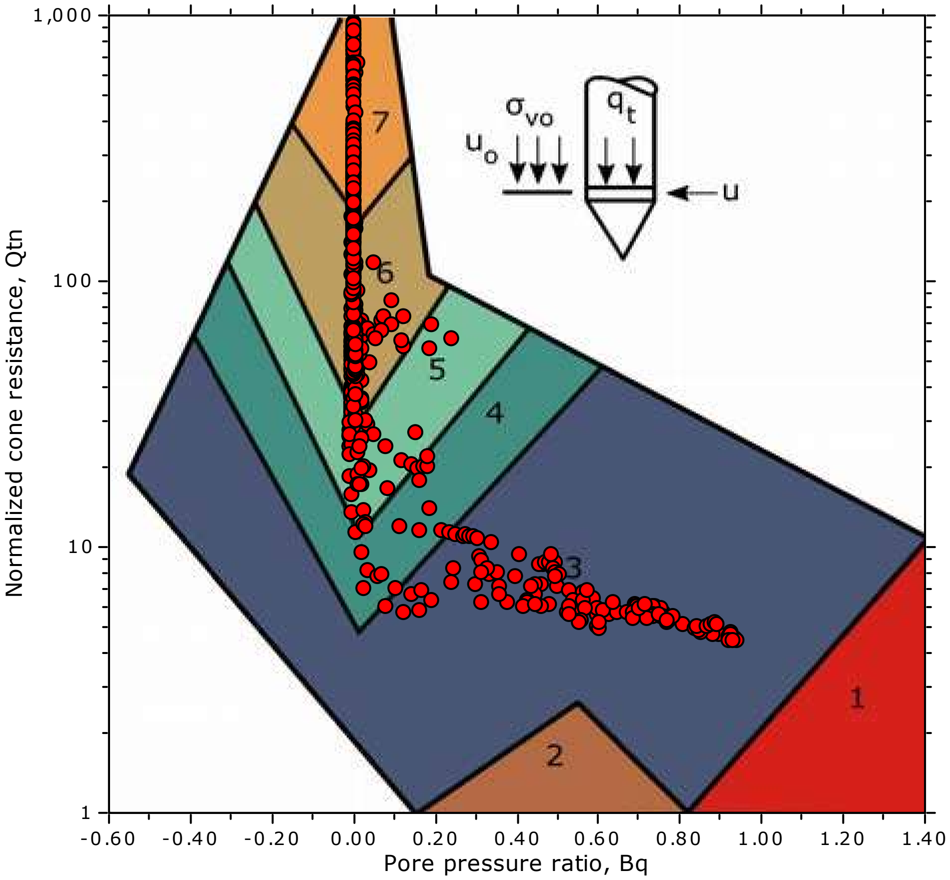
🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬛ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

SBT - Bq plots (normalized)

SBTn plot



Normalized Bq plot



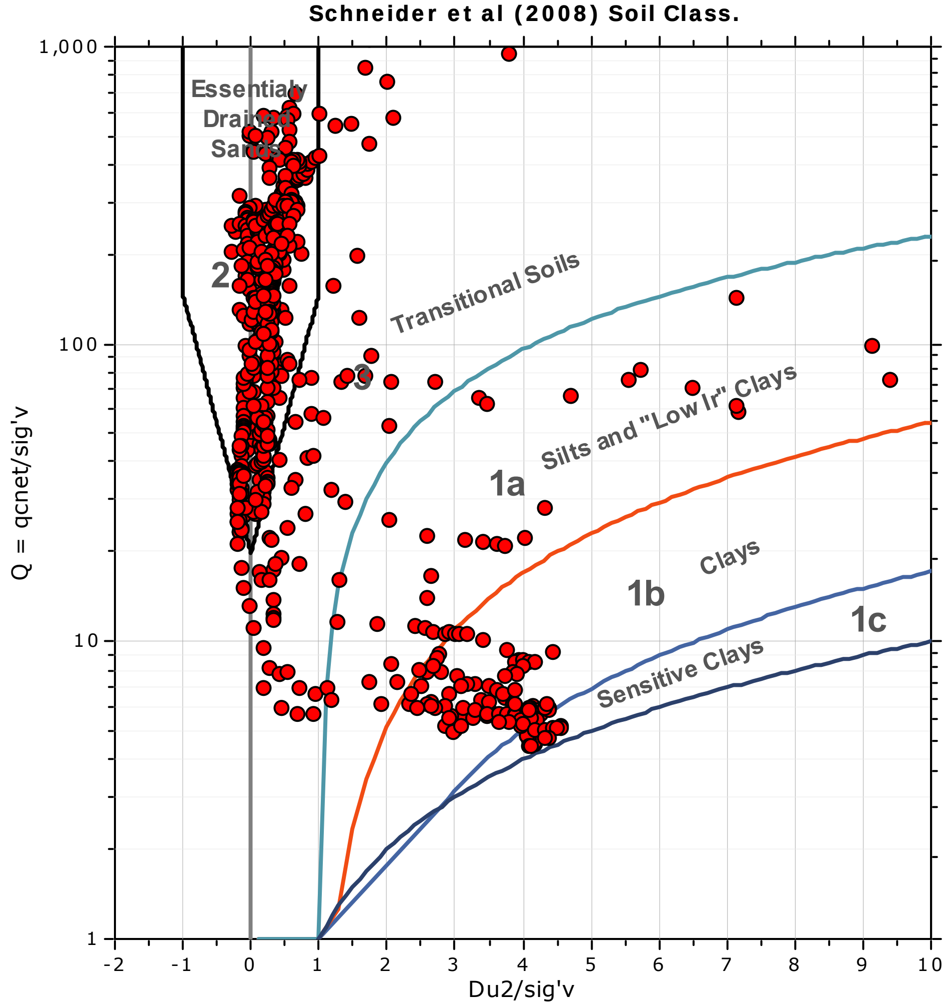
SBTn legend

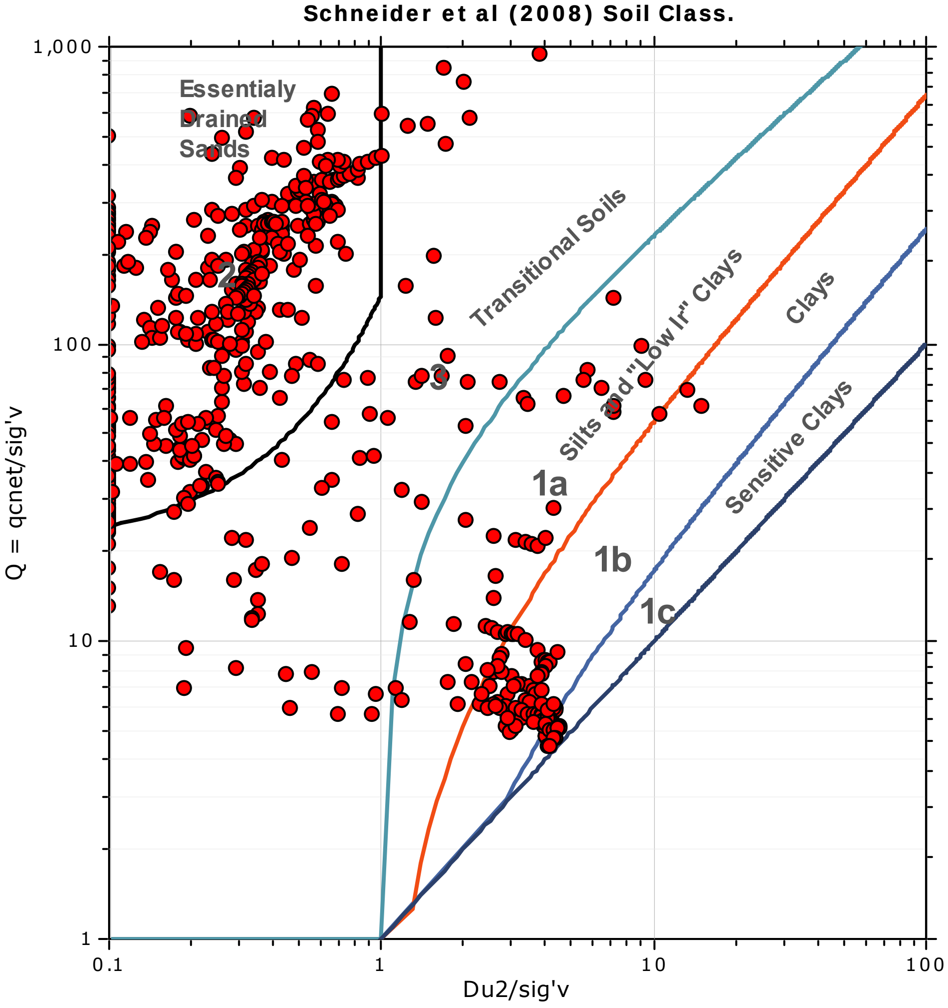
- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

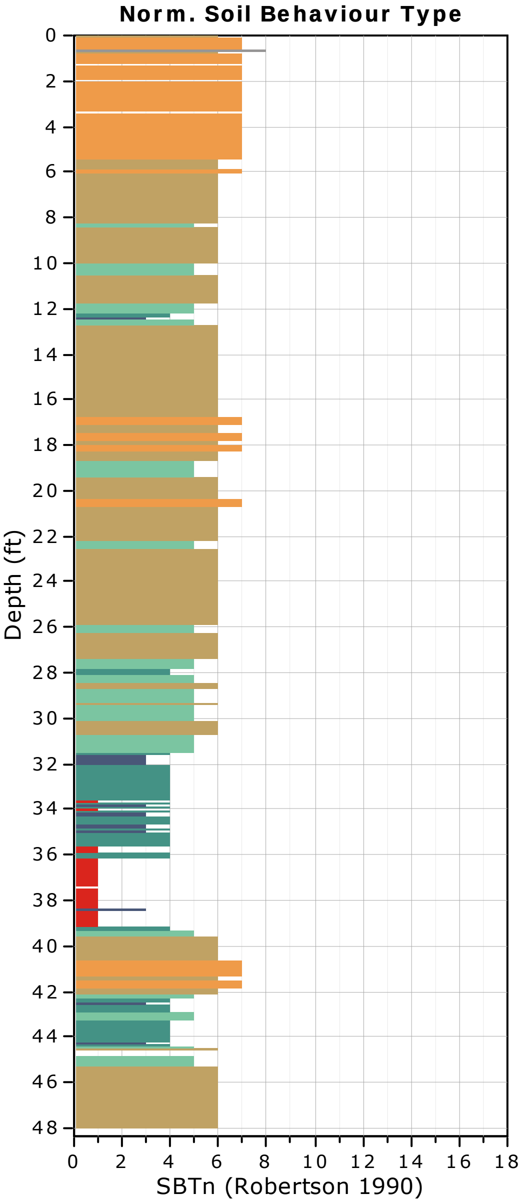
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

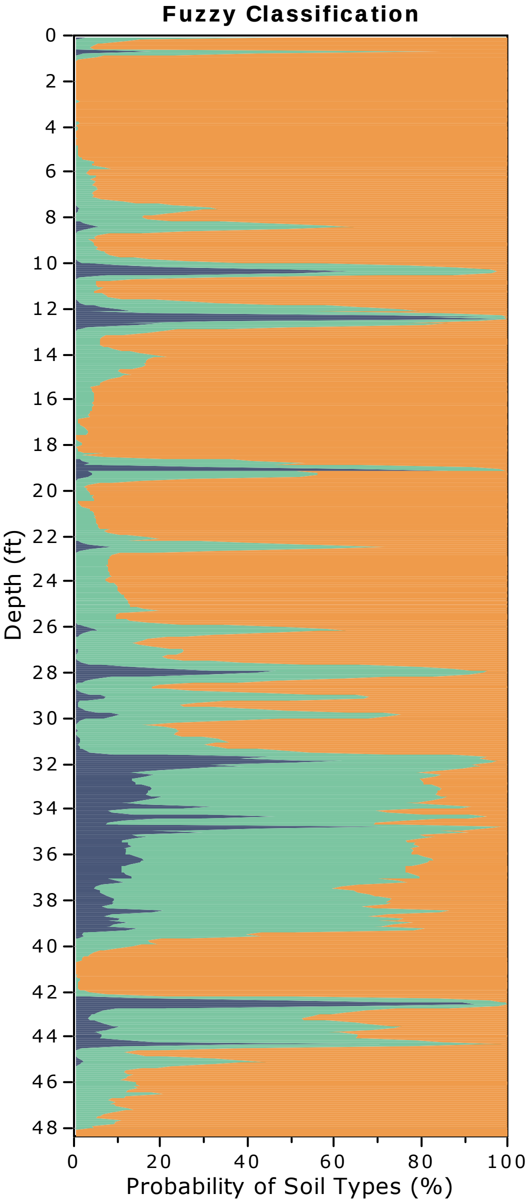
CPT: CPT-23
Total depth: 48.36 ft

Bq plots (Schneider)



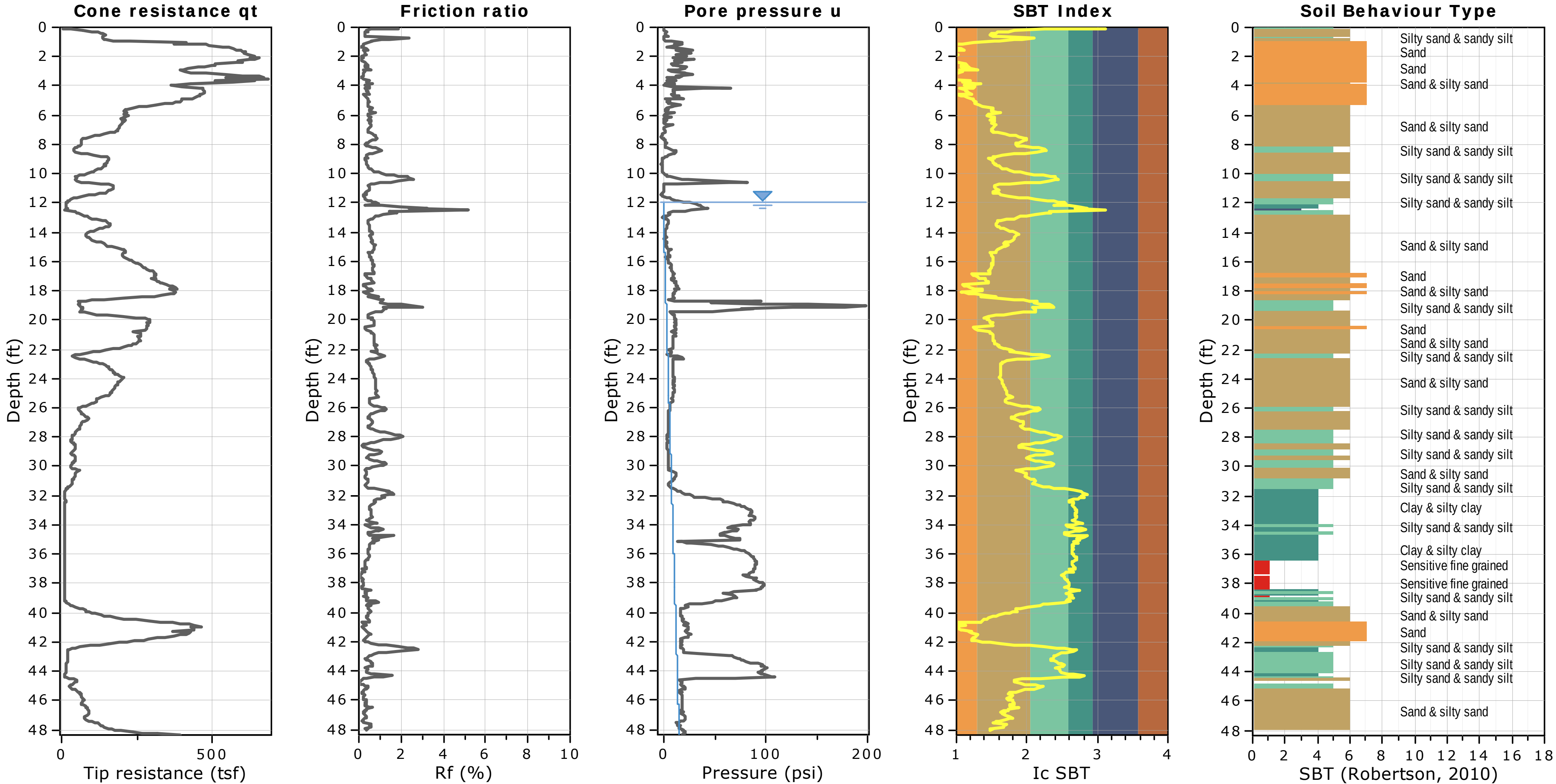



Norm. Soil Behaviour Type
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
0
2
4
6
8
10
12
14
16
18
SBTn (Robertson 1990)


Fuzzy Classification
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
0
20
40
60
80
100
Probability of Soil Types (%)

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-23
Total depth: 48.36 ft



SBT legend

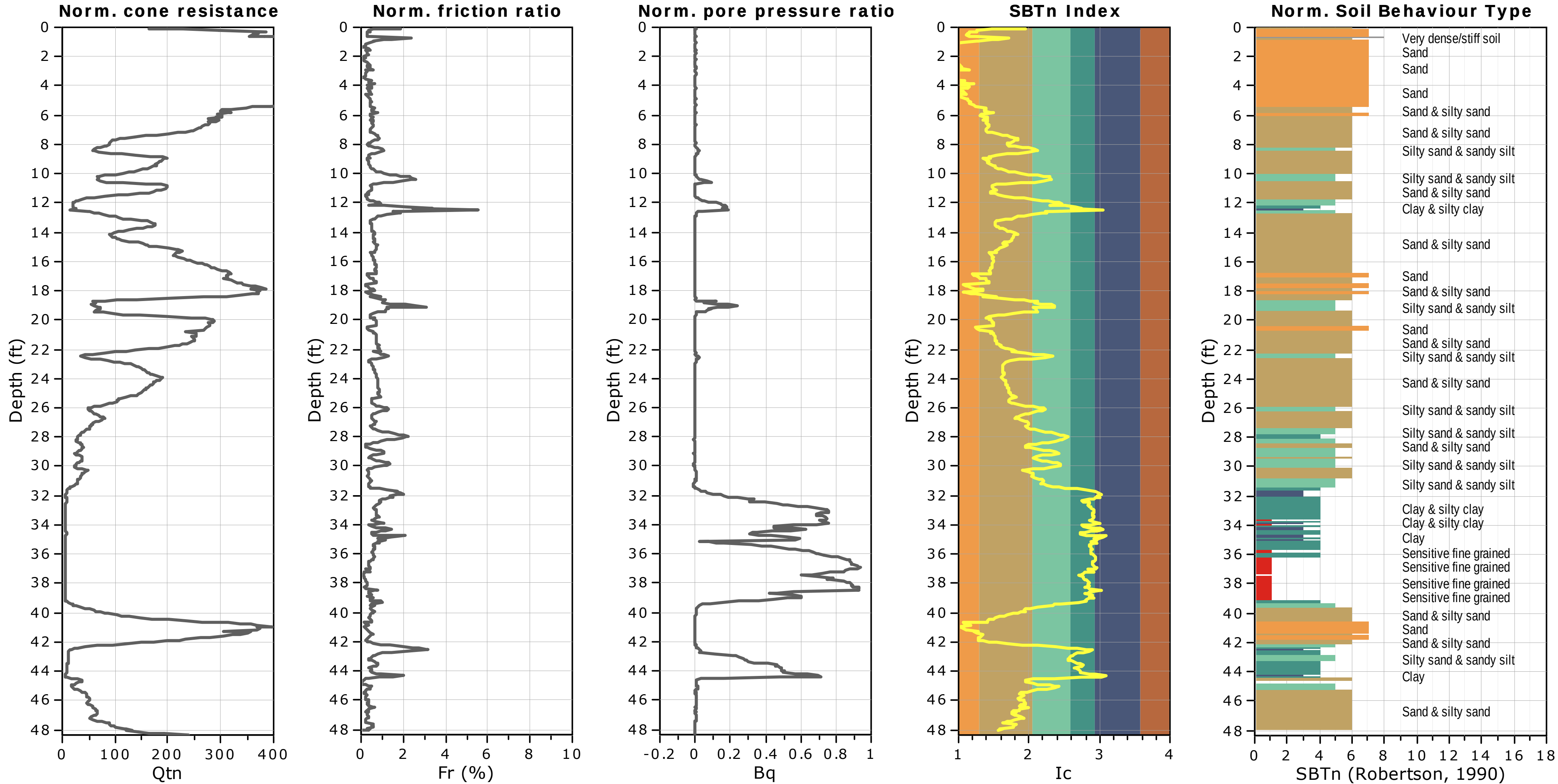
- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-23

Total depth: 48.36 ft



SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
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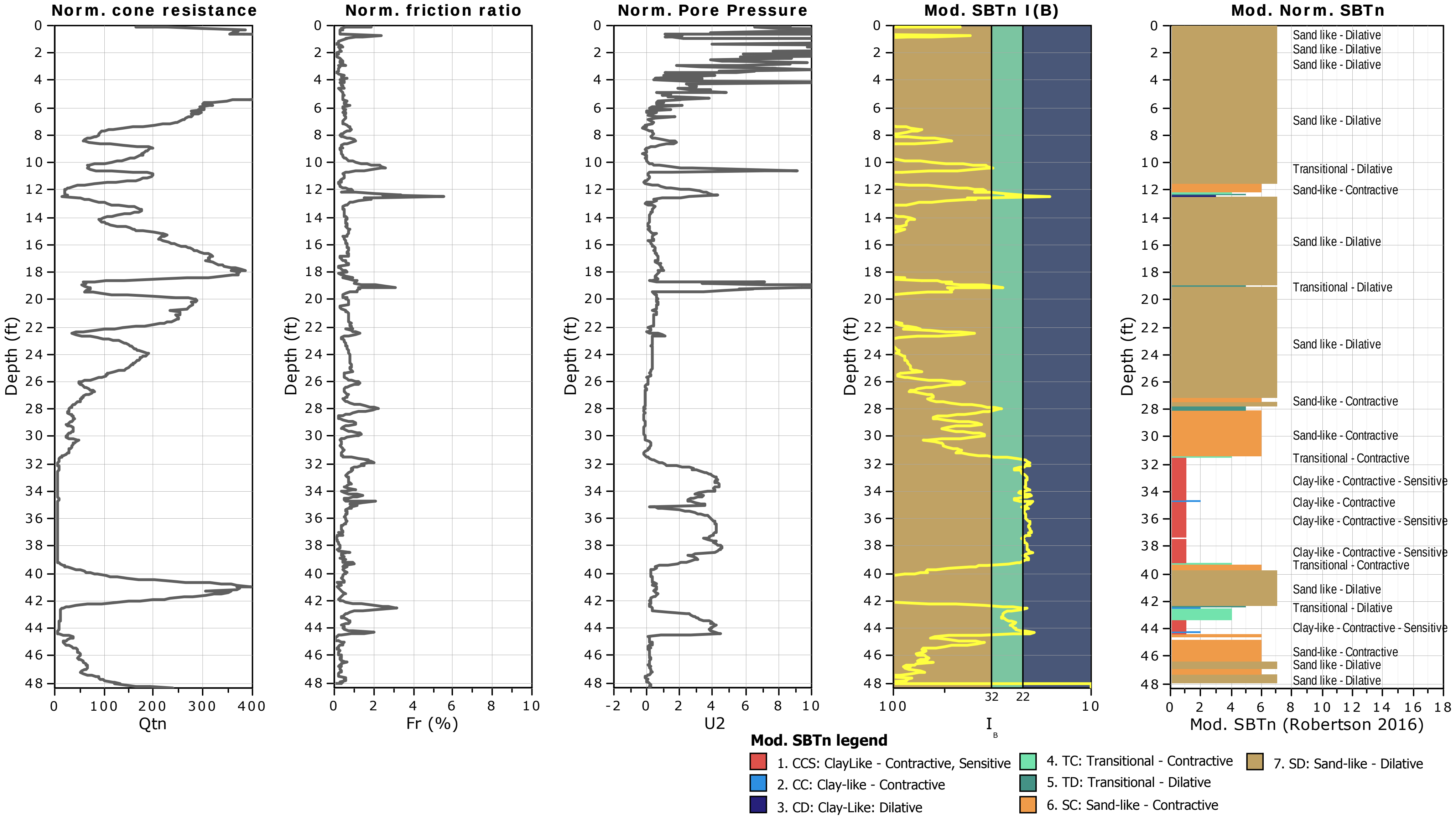
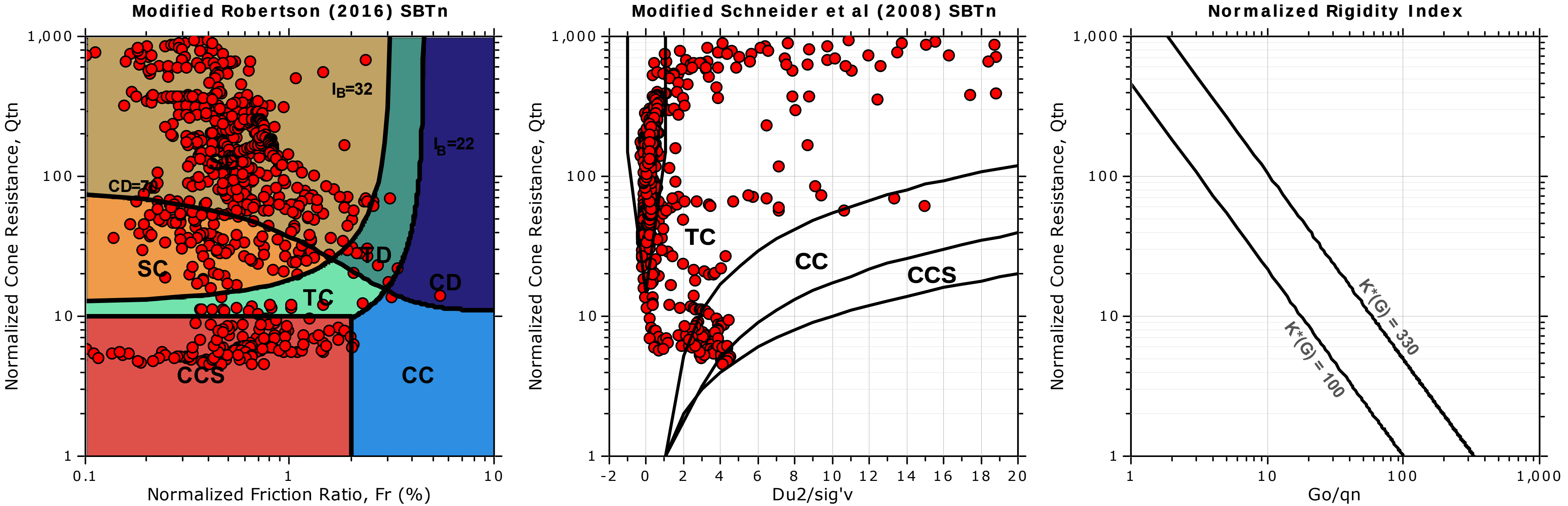
- ⬜ 9. Very stiff fine grained

Project: Langan
Location: BL England Substation - Marmora NJ

CPT: CPT-23
Total depth: 48.36 ft



Updated SBTn plots



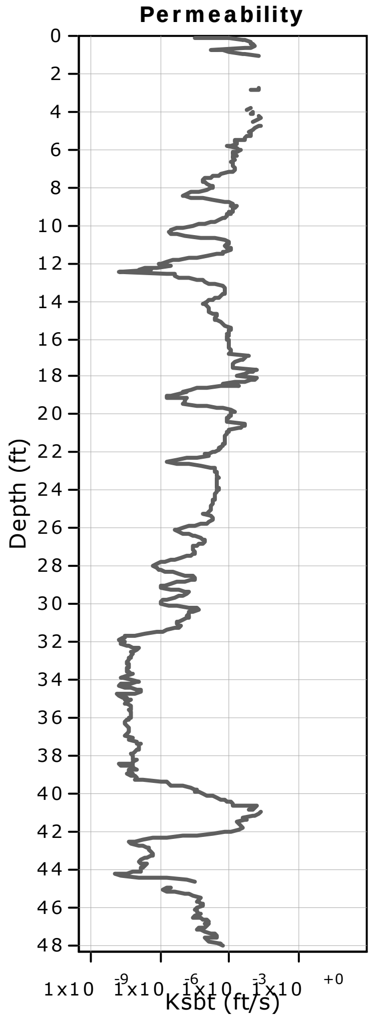
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

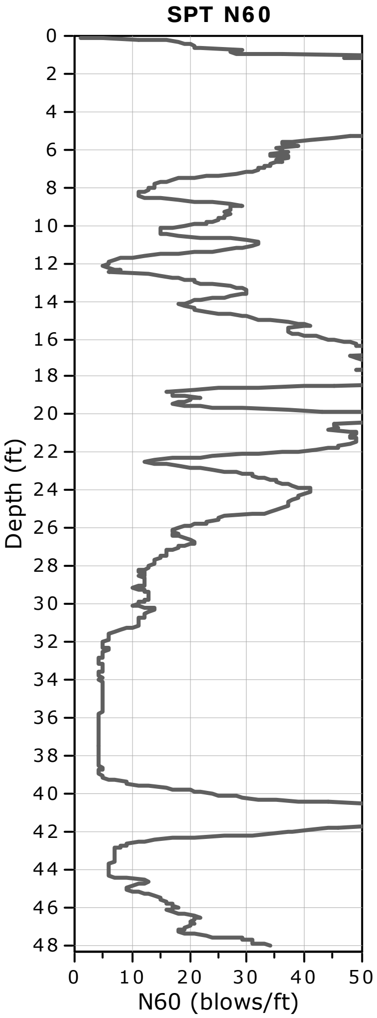
K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

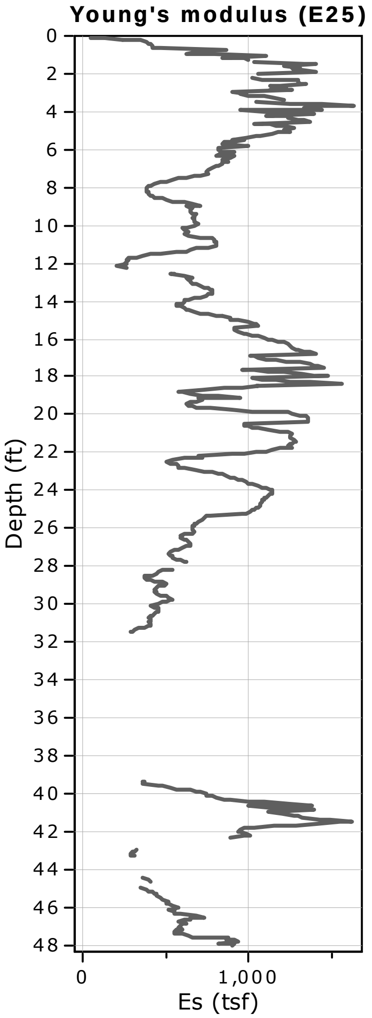
Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

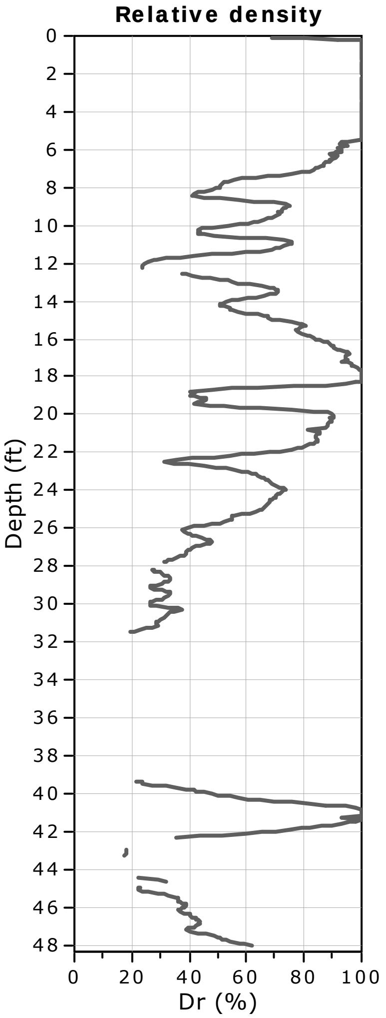
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

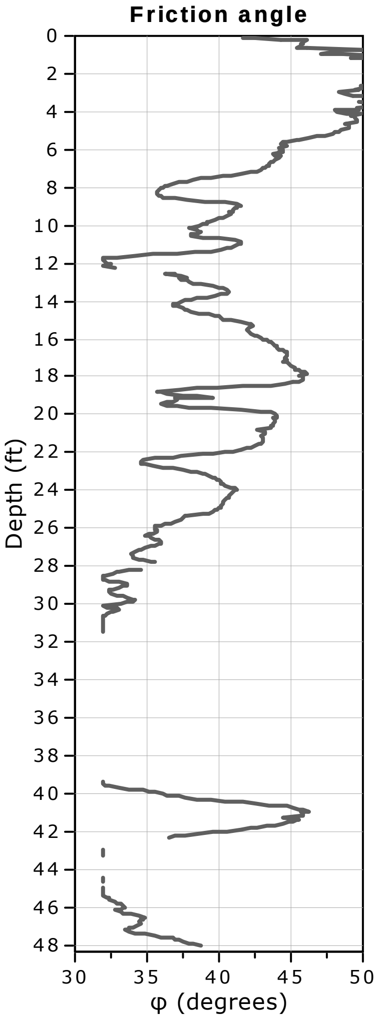
CPT: CPT-23
Total depth: 48.36 ft











Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
● User defined estimation data

Craig Geotechnical Drilling
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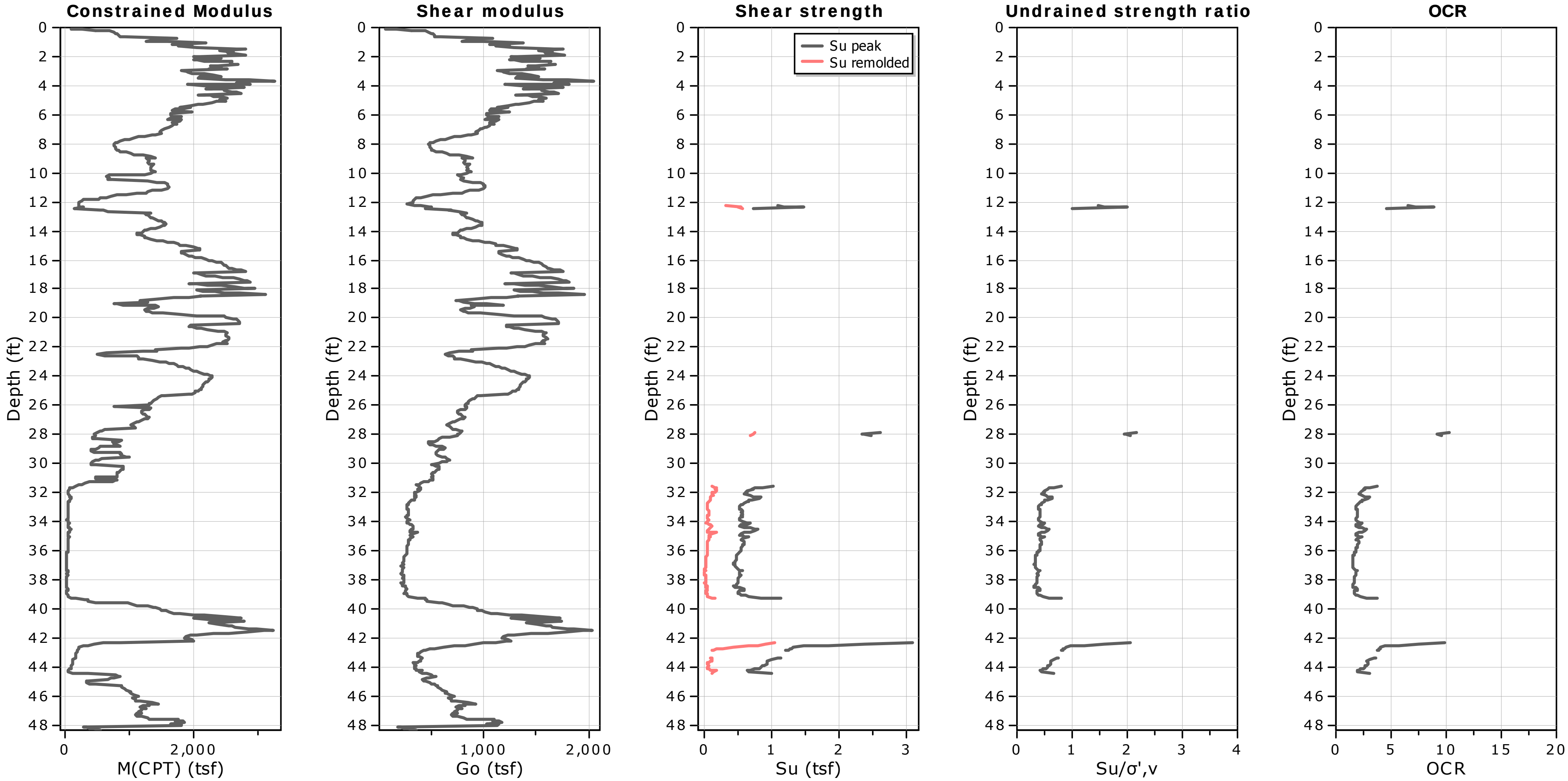
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-23
Total depth: 48.36 ft



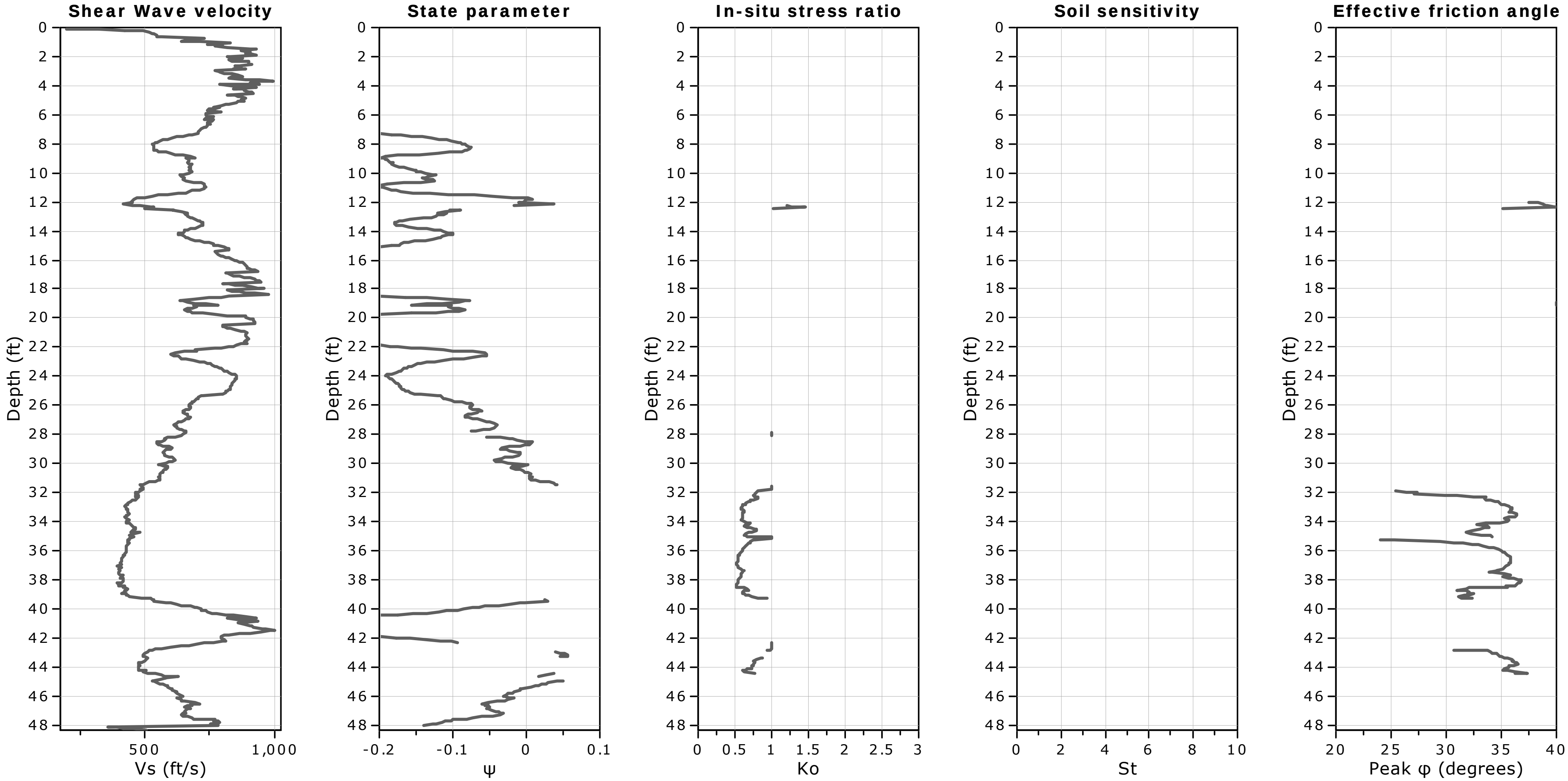
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-23
Total depth: 48.36 ft



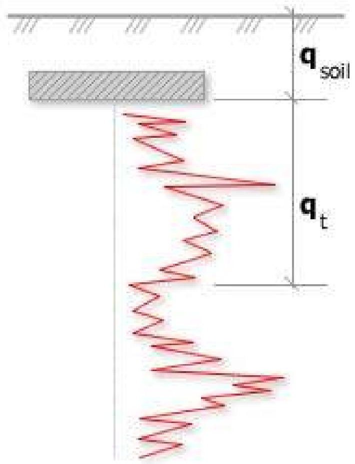
Calculation parameters

Soil Sensitivity factor, N_S: 350.00

● User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

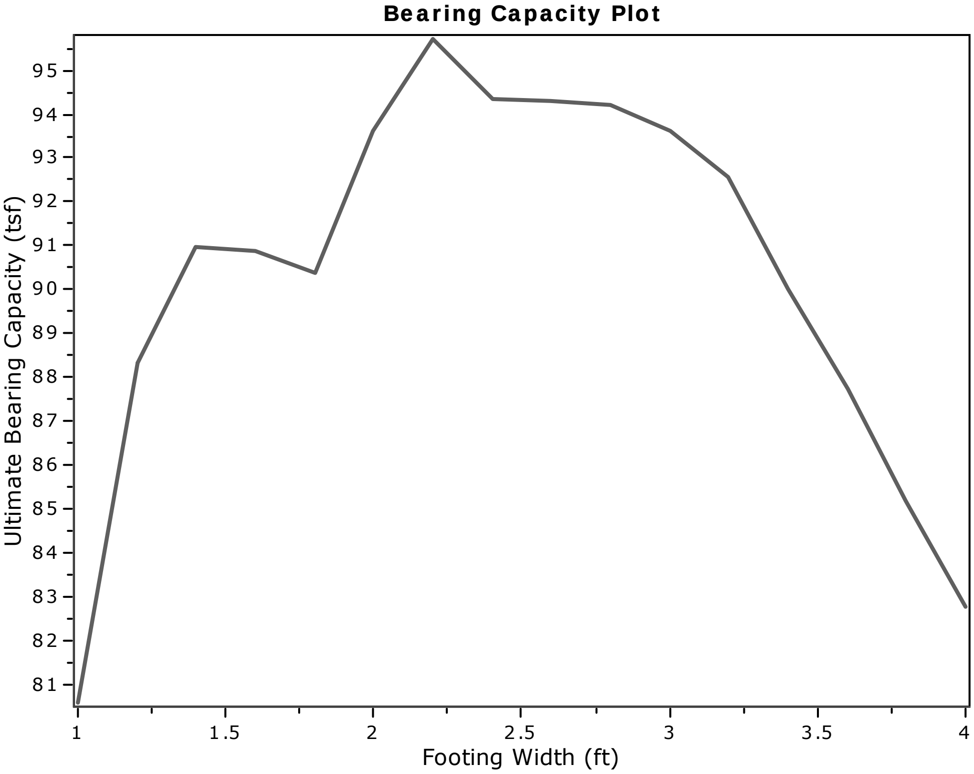
CPT: CPT-23
Total depth: 48.36 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	402.78	0.20	0.03	80.59
2	1.20	0.50	2.30	441.49	0.20	0.03	88.33
3	1.40	0.50	2.60	454.69	0.20	0.03	90.97
4	1.60	0.50	2.90	454.16	0.20	0.03	90.86
5	1.80	0.50	3.20	451.69	0.20	0.03	90.37
6	2.00	0.50	3.50	467.83	0.20	0.03	93.60
7	2.20	0.50	3.80	478.40	0.20	0.03	95.71
8	2.40	0.50	4.10	471.46	0.20	0.03	94.32
9	2.60	0.50	4.40	471.36	0.20	0.03	94.30
10	2.80	0.50	4.70	470.93	0.20	0.03	94.22
11	3.00	0.50	5.00	467.82	0.20	0.03	93.59
12	3.20	0.50	5.30	462.63	0.20	0.03	92.56
13	3.40	0.50	5.60	449.97	0.20	0.03	90.02
14	3.60	0.50	5.90	438.47	0.20	0.03	87.72
15	3.80	0.50	6.20	425.67	0.20	0.03	85.16
16	4.00	0.50	6.50	413.77	0.20	0.03	82.78

Craig Geotechnical Drilling
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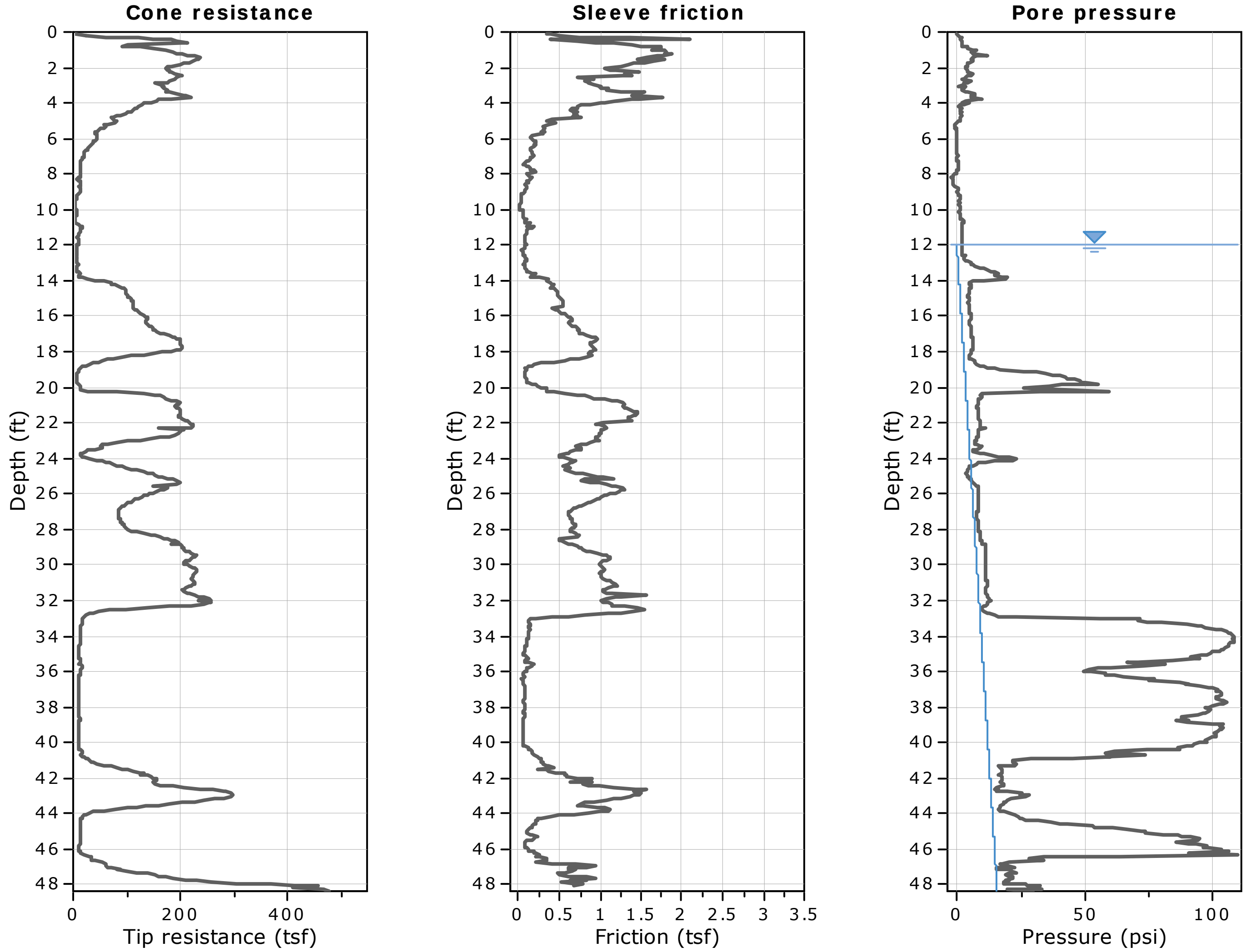
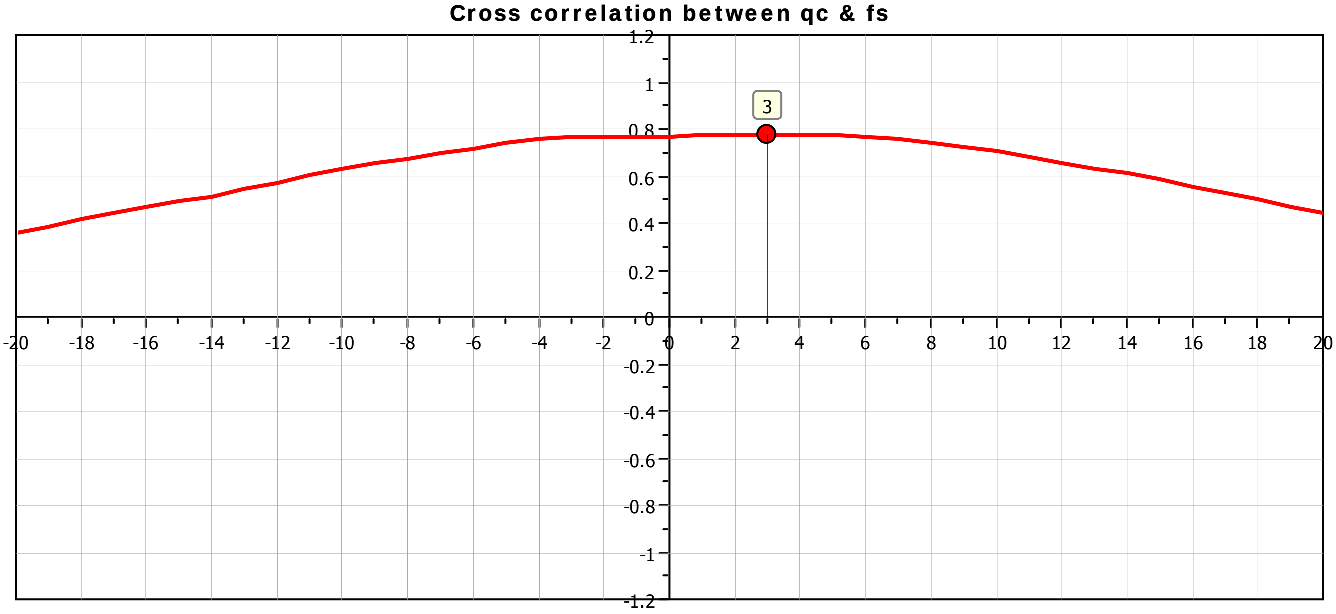
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

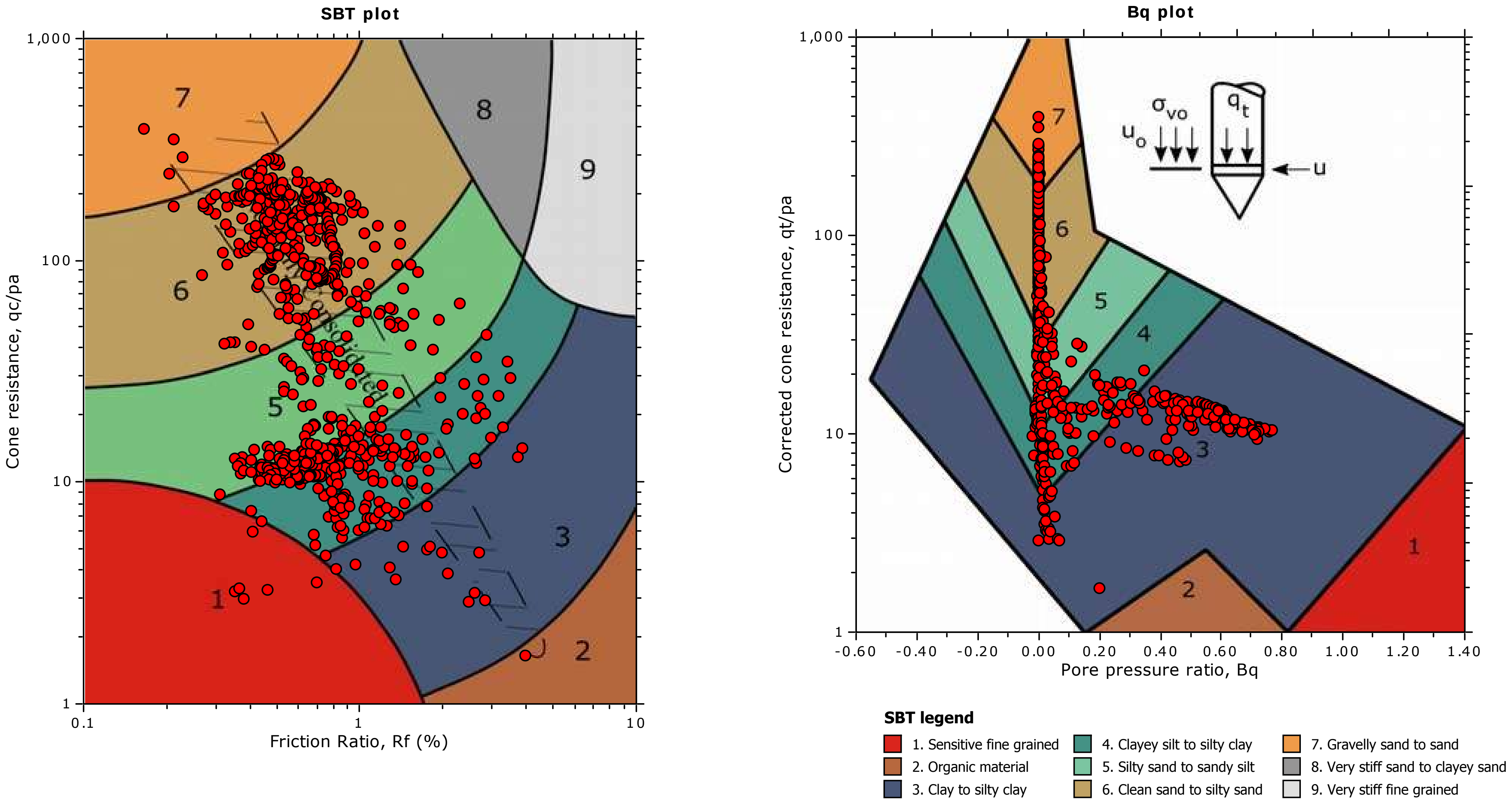
CPT: CPT-2a
Total depth: 48.36 ft



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



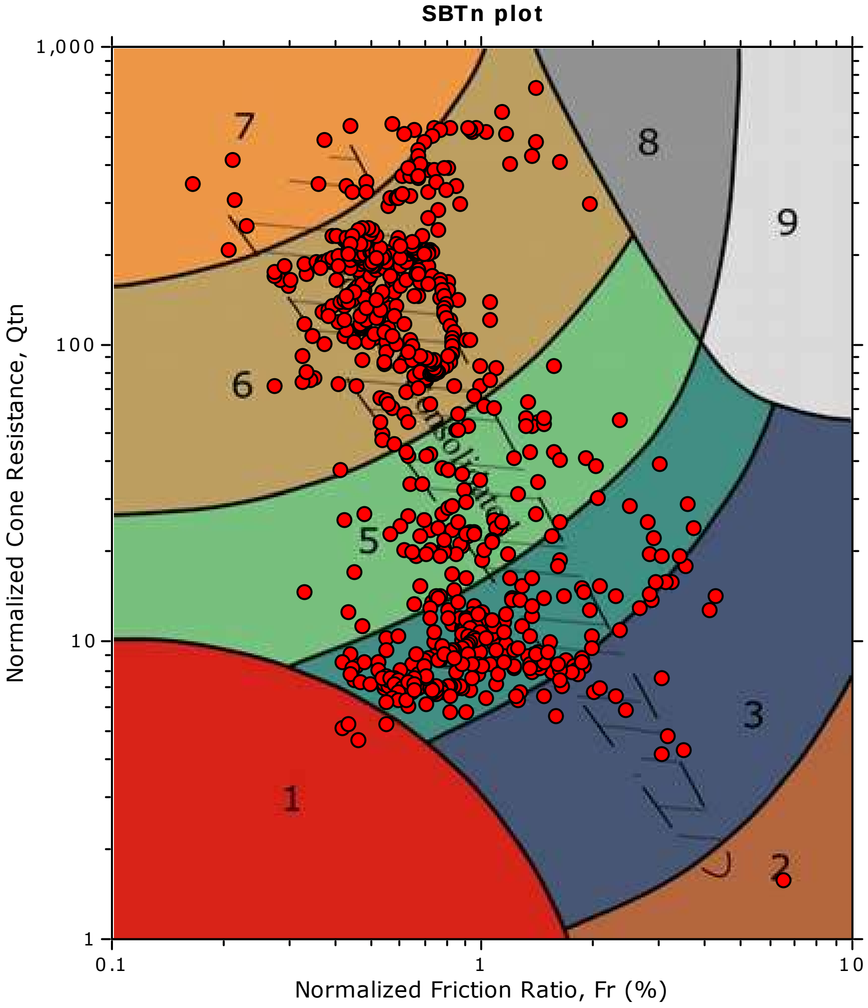
SBT - Bq plots

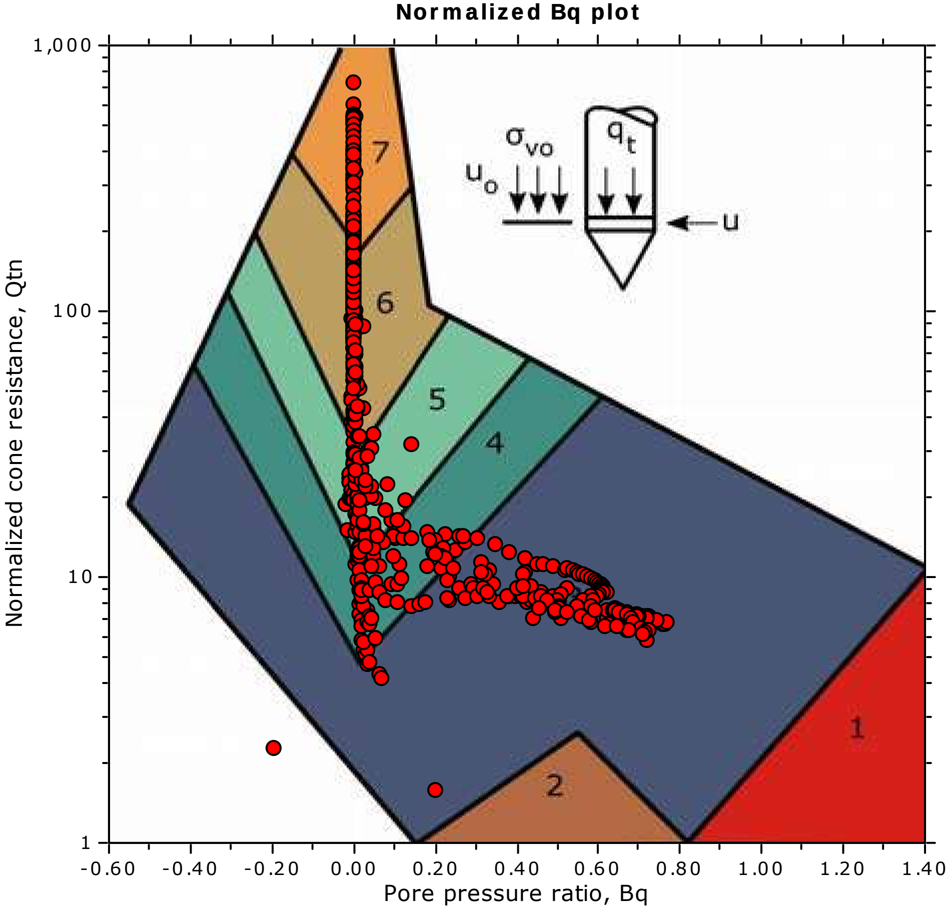

SBT plot
1,000
100
10
1
0.1
1
10
Cone resistance, qc/pa
Friction Ratio, Rf (%)
1
2
3
5
6
7
8
9
Bq plot
1,000
100
10
1
-0.60
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Corrected cone resistance, qt/pa
Pore pressure ratio, Bq
σvo
qt
uo
u
1
2
3
4
5
6
7
SBT legend
🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬜ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-2a
Total depth: 48.36 ft

SBT - Bq plots (normalized)





SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
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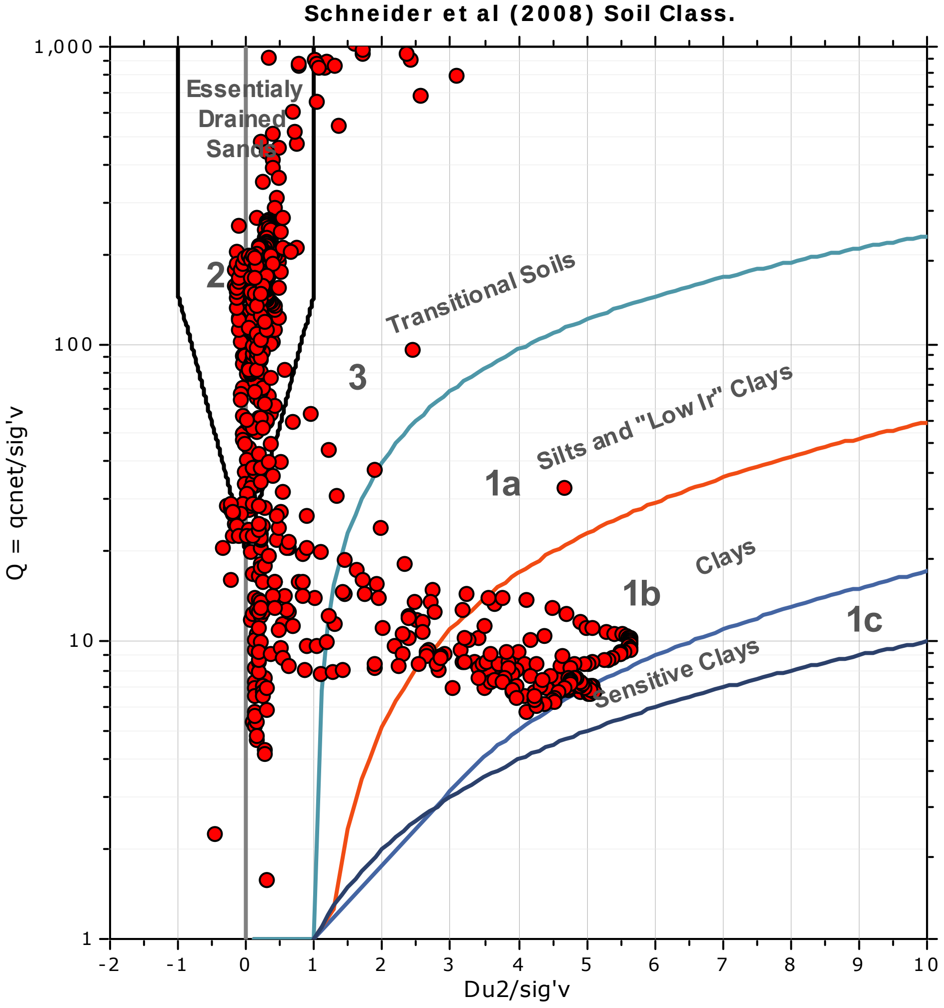
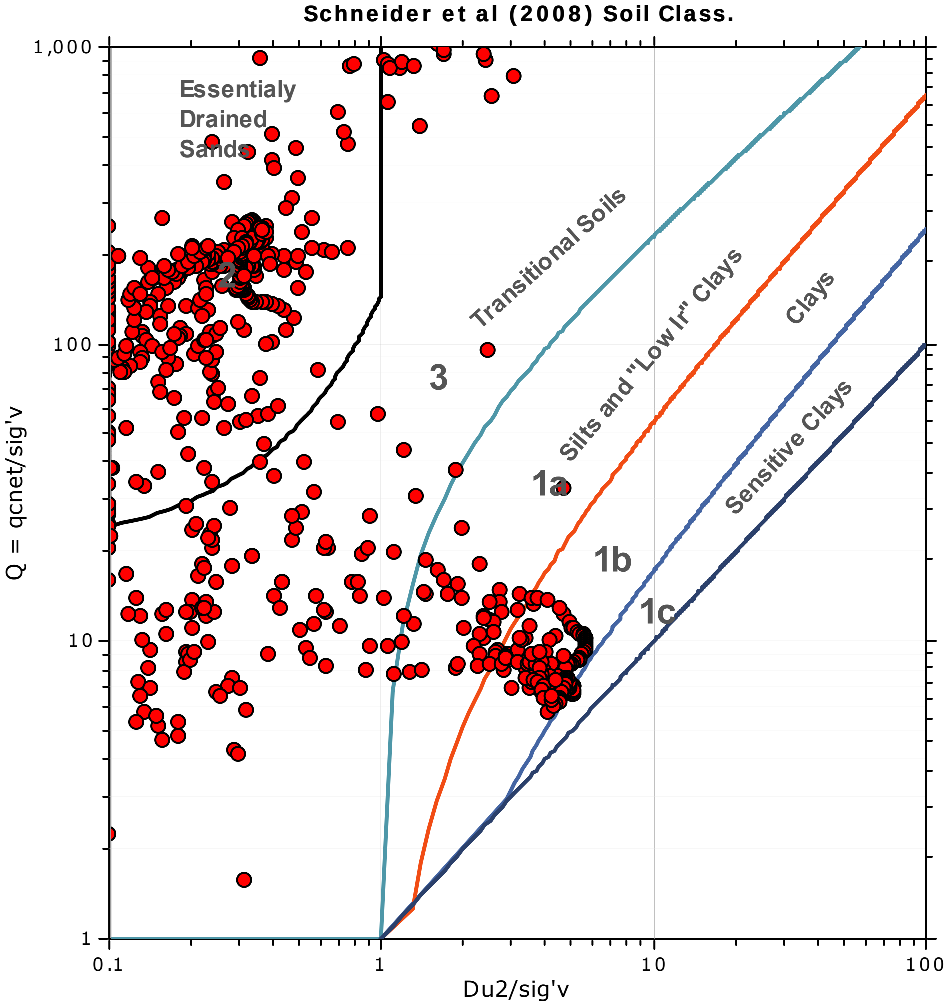
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬜ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

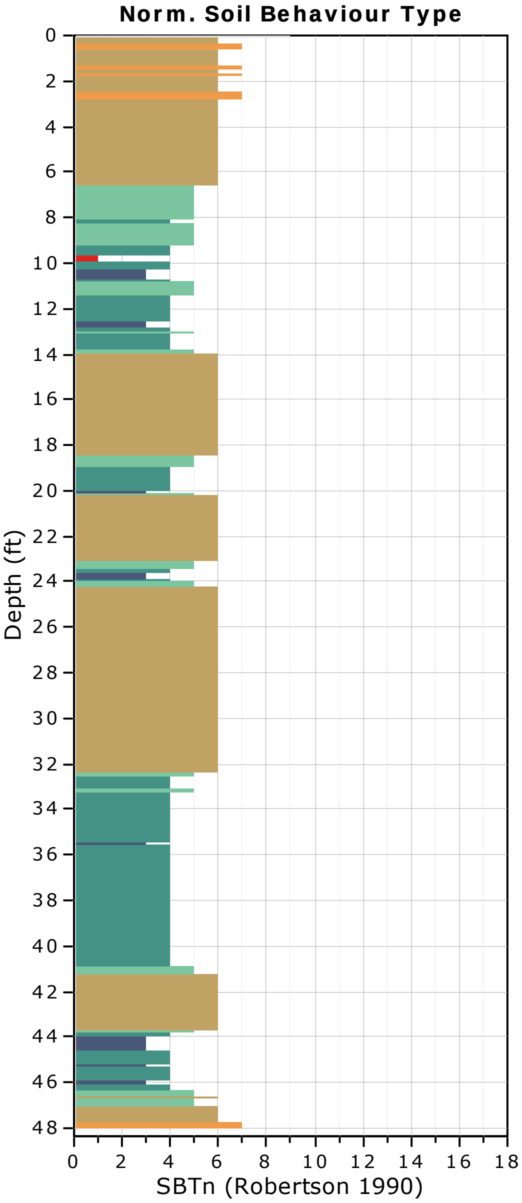
Bq plots (Schneider)

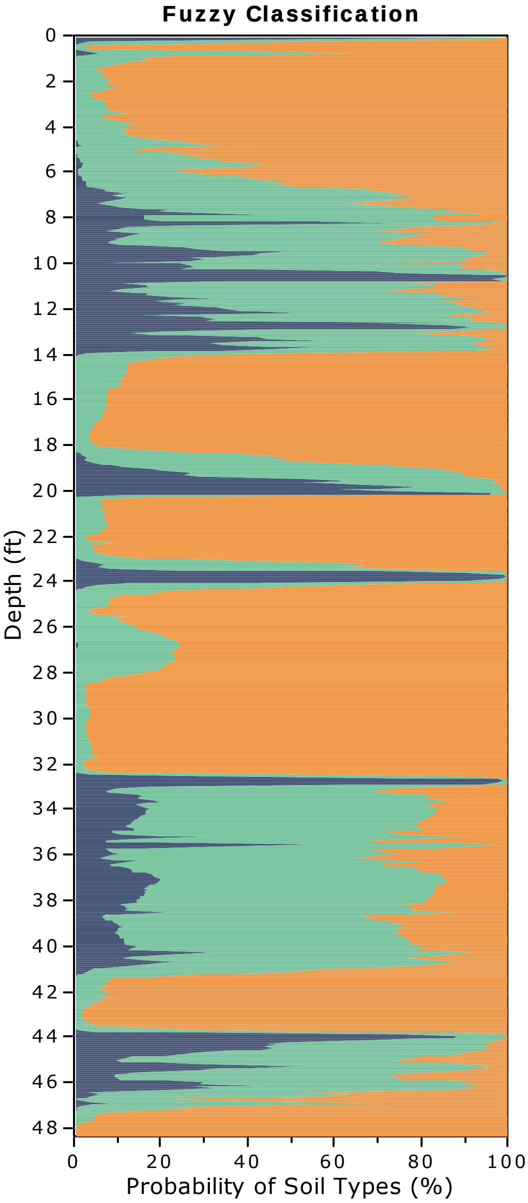




Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-2a
Total depth: 48.36 ft





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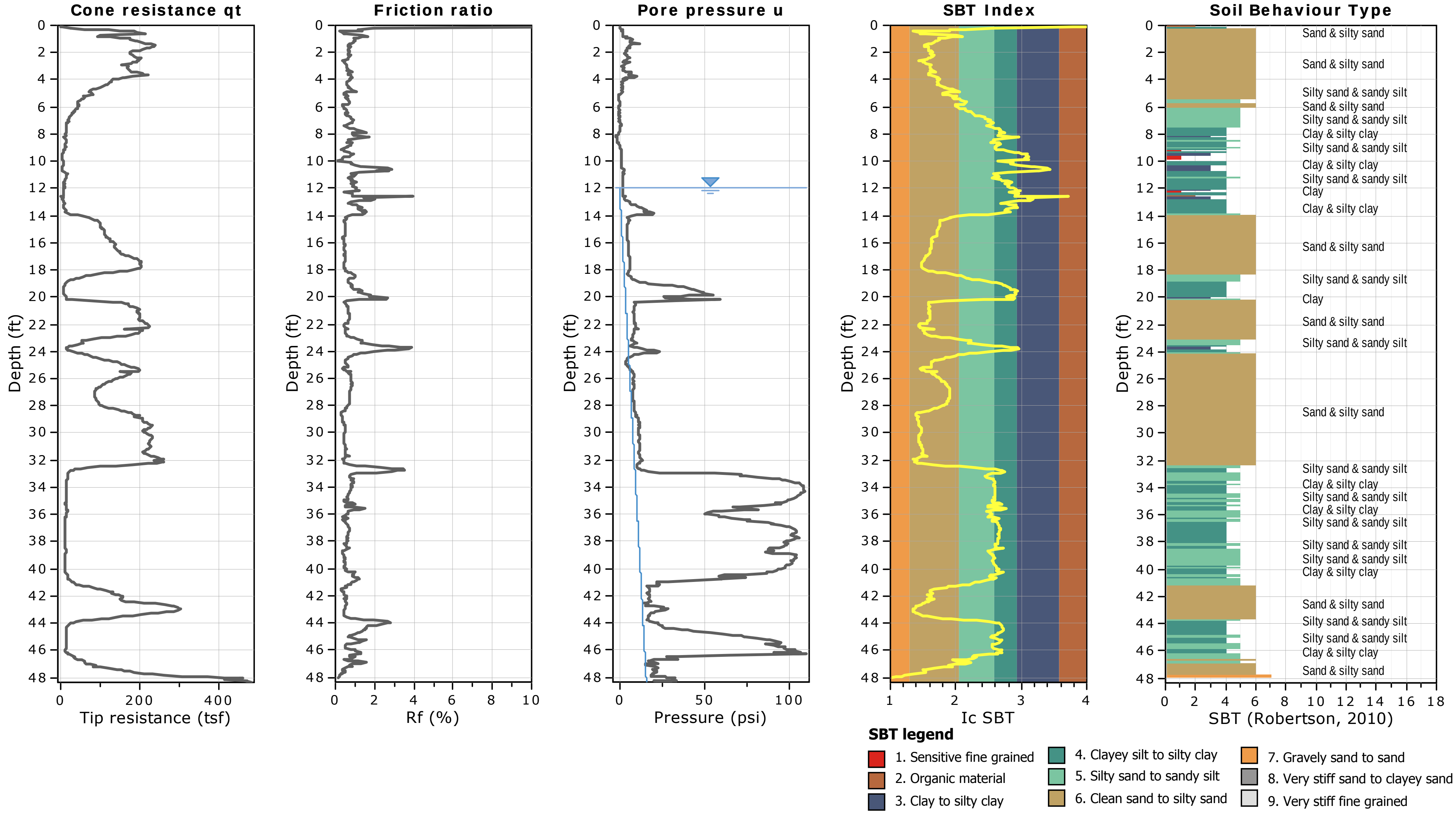
Mays Landing, NJ

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-2a

Total depth: 48.36 ft



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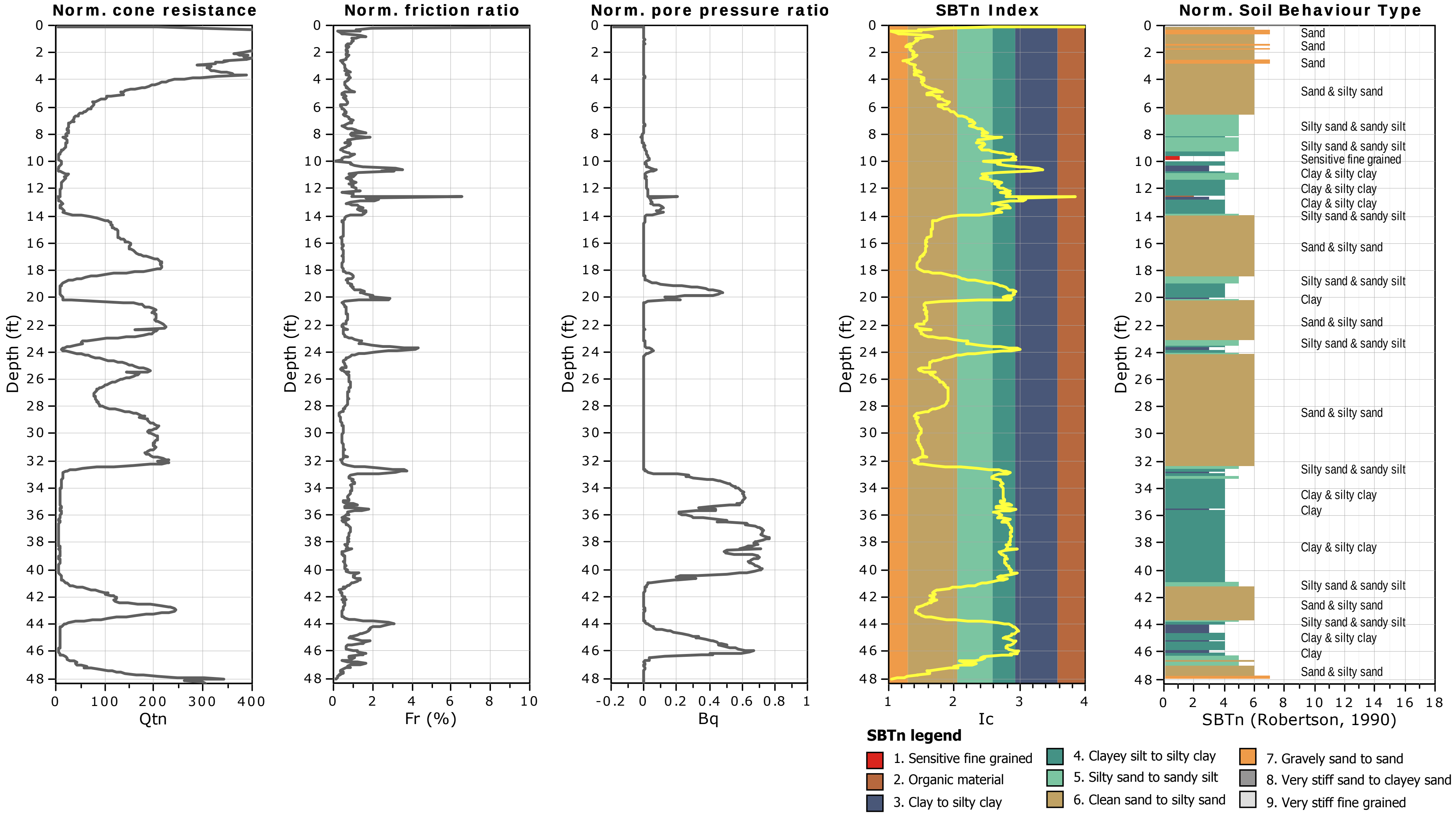
5230 Atlantic Ave
Mays Landing, NJ

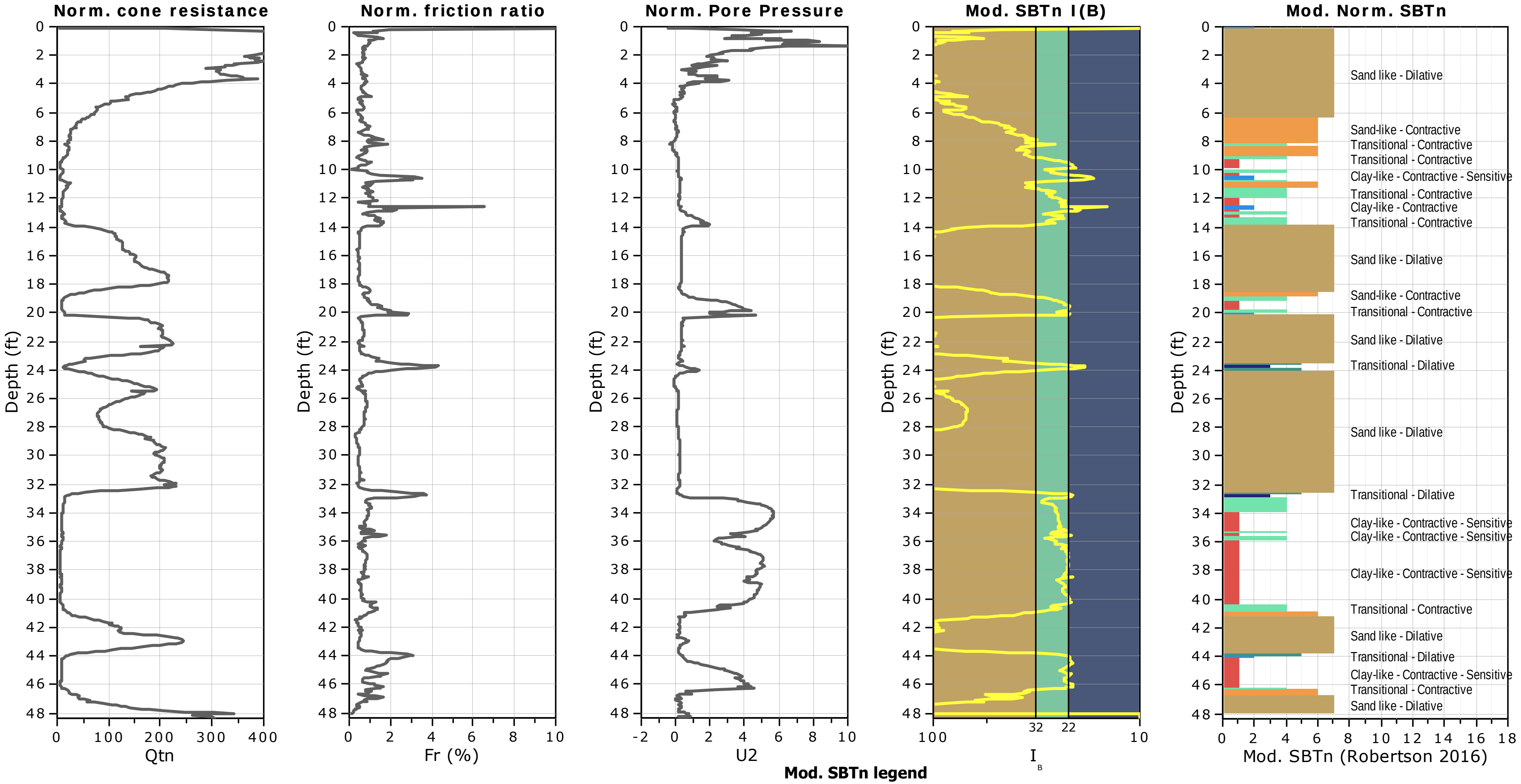
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-2a
Total depth: 48.36 ft



Project: **Langan**
Location: **BL England Substation - Marmora NJ**

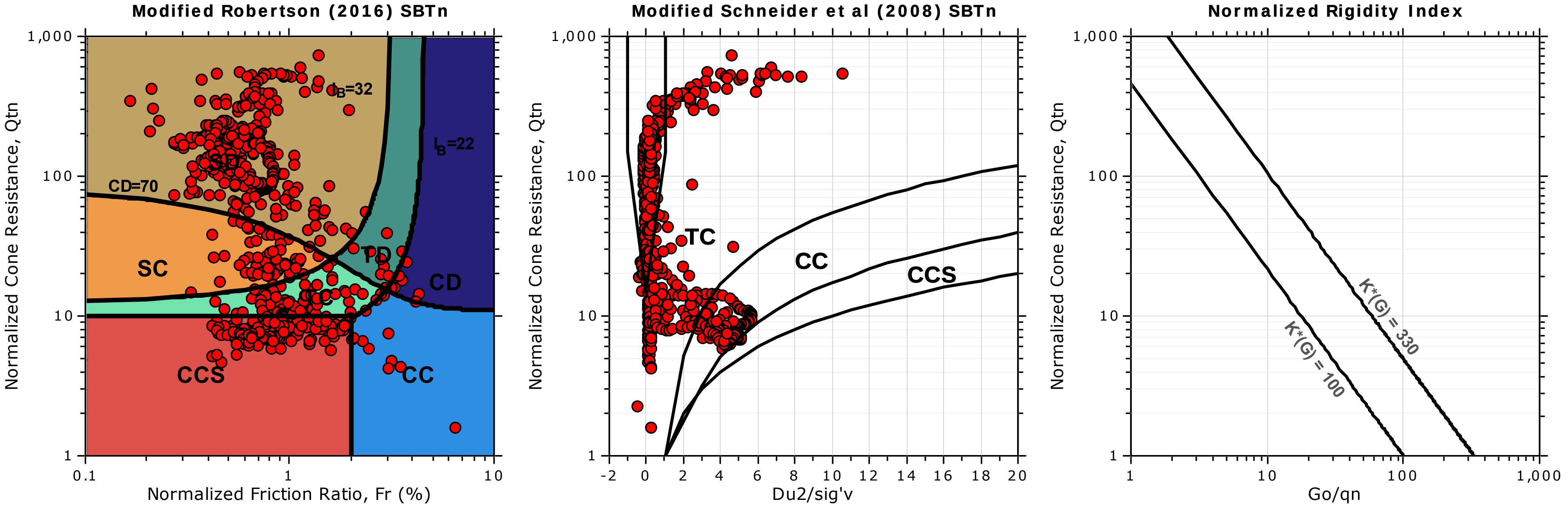
CPT: CPT-2a
Total depth: 48.36 ft



Mod. SBTn legend

🟥 1. CCS: ClayLike - Contractive, Sensitive
🟦 2. CC: Clay-like - Contractive
🟦 3. CD: Clay-Like: Dilative
🟩 4. TC: Transitional - Contractive
🟩 5. TD: Transitional - Dilative
🟧 6. SC: Sand-like - Contractive
🟫 7. SD: Sand-like - Dilative

Updated SBTn plots


Modified Robertson (2016) SBTn

Modified Schneider et al (2008) SBTn

Normalized Rigidity Index

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure
(e.g. age/cementation)

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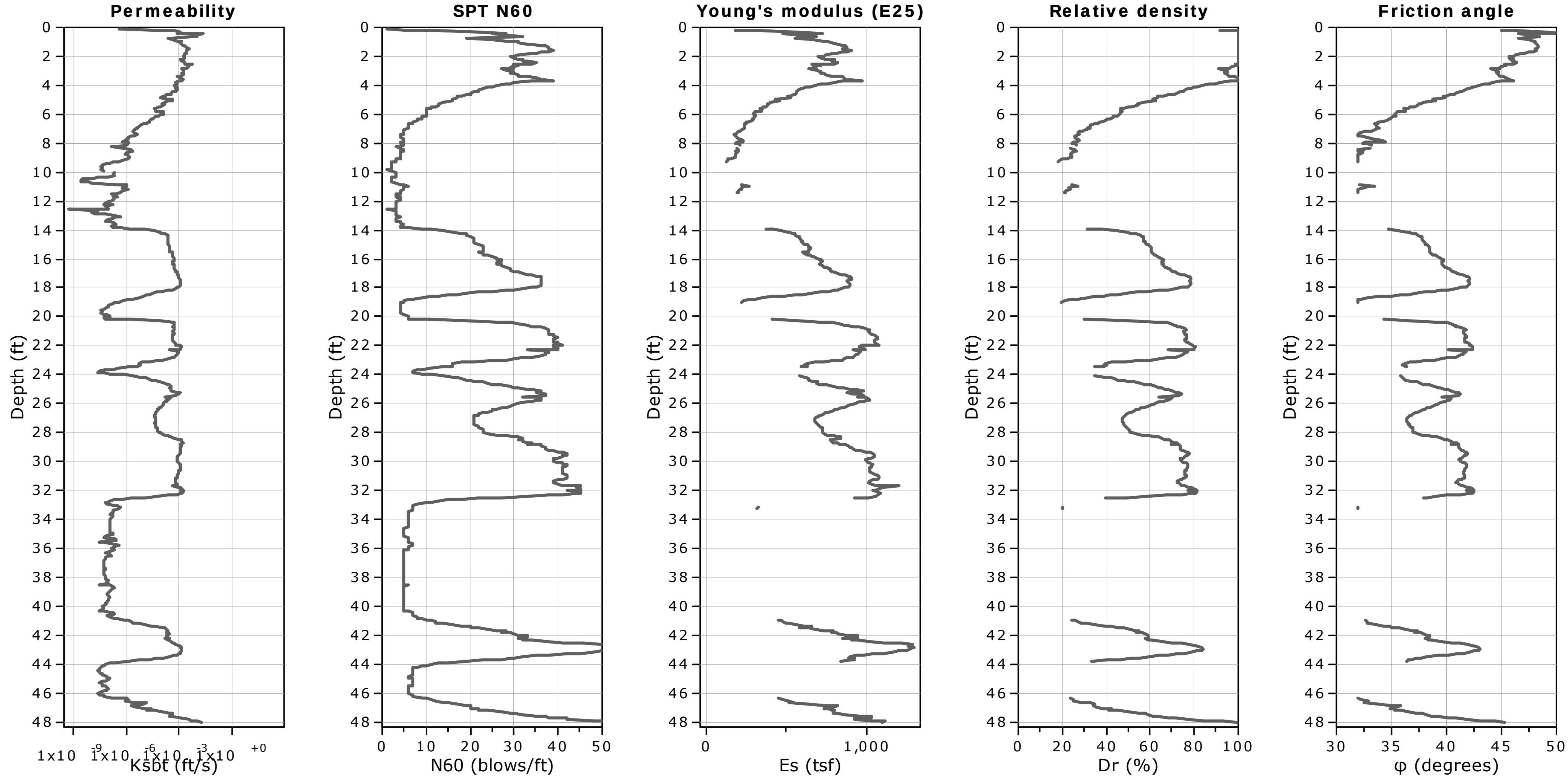
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-2a
Total depth: 48.36 ft



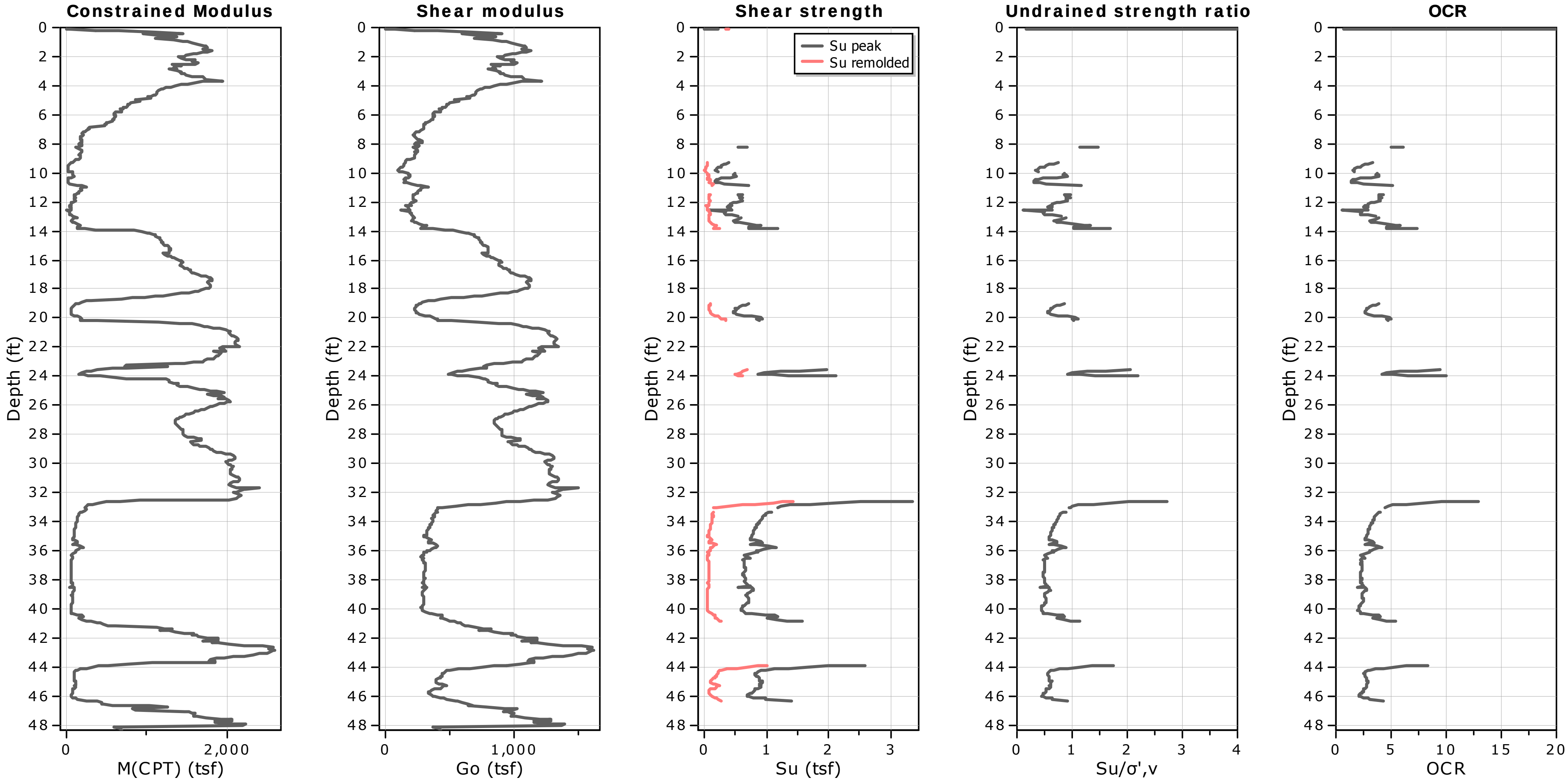
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
—●— User defined estimation data

Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-2a
Total depth: 48.36 ft



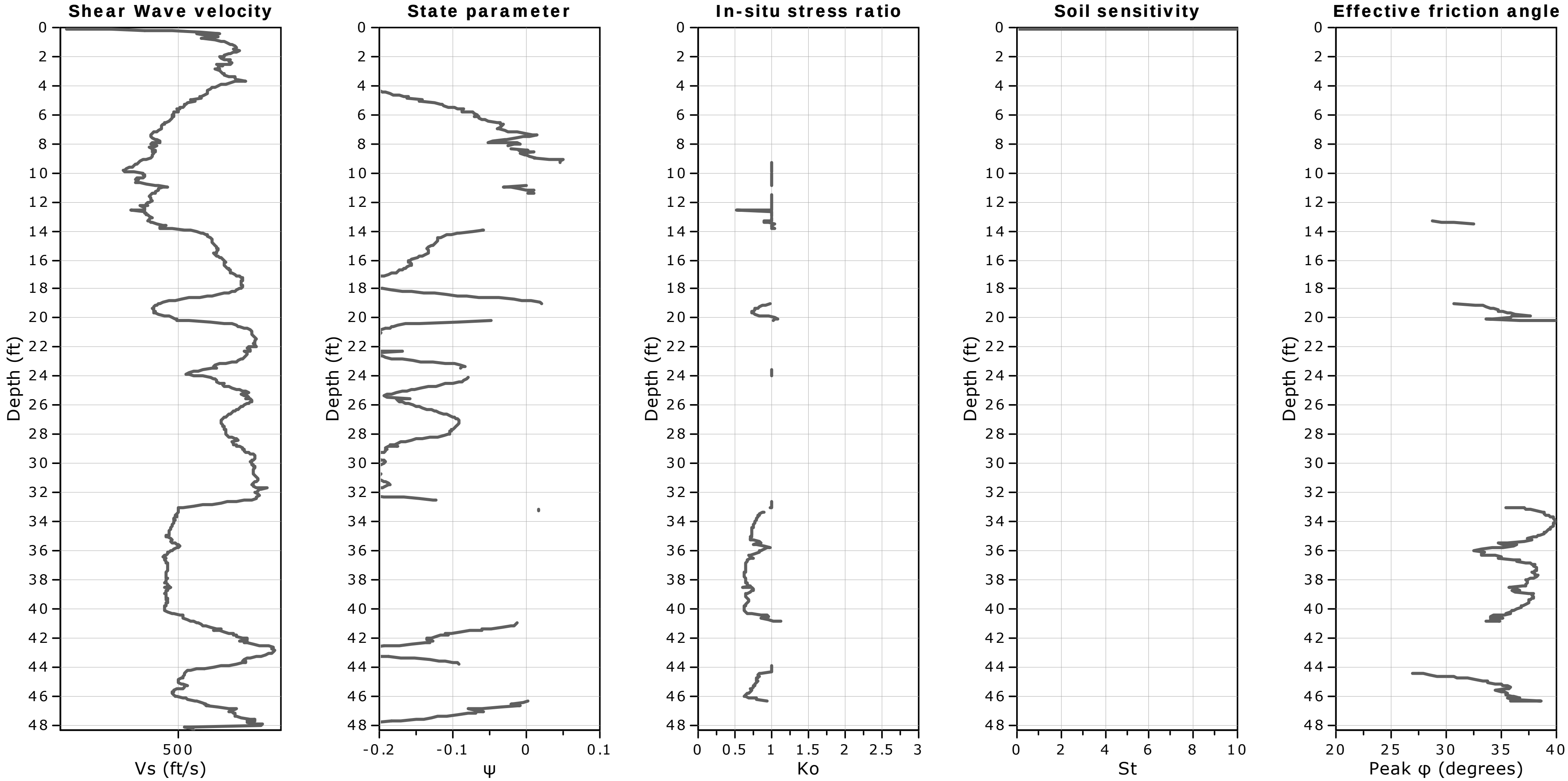
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-2a
Total depth: 48.36 ft

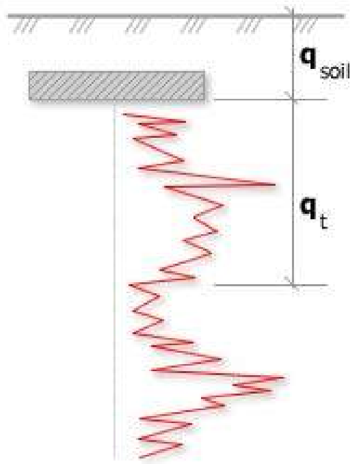


Calculation parameters

Soil Sensitivity factor, N_S: 350.00
● User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

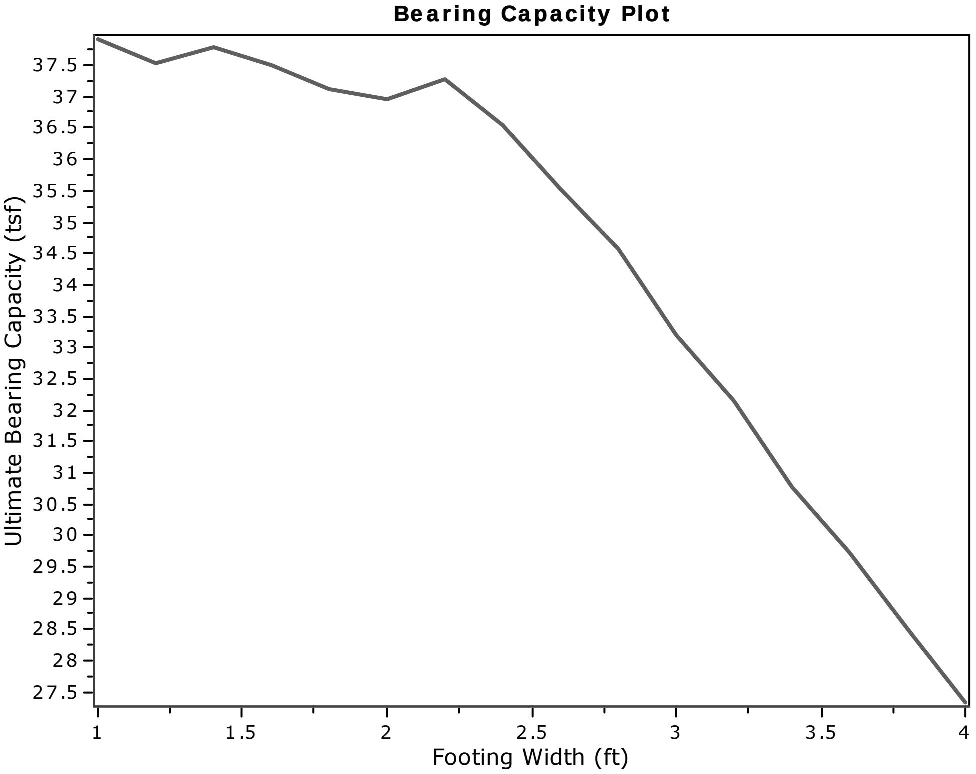
CPT: CPT-2a
Total depth: 48.36 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

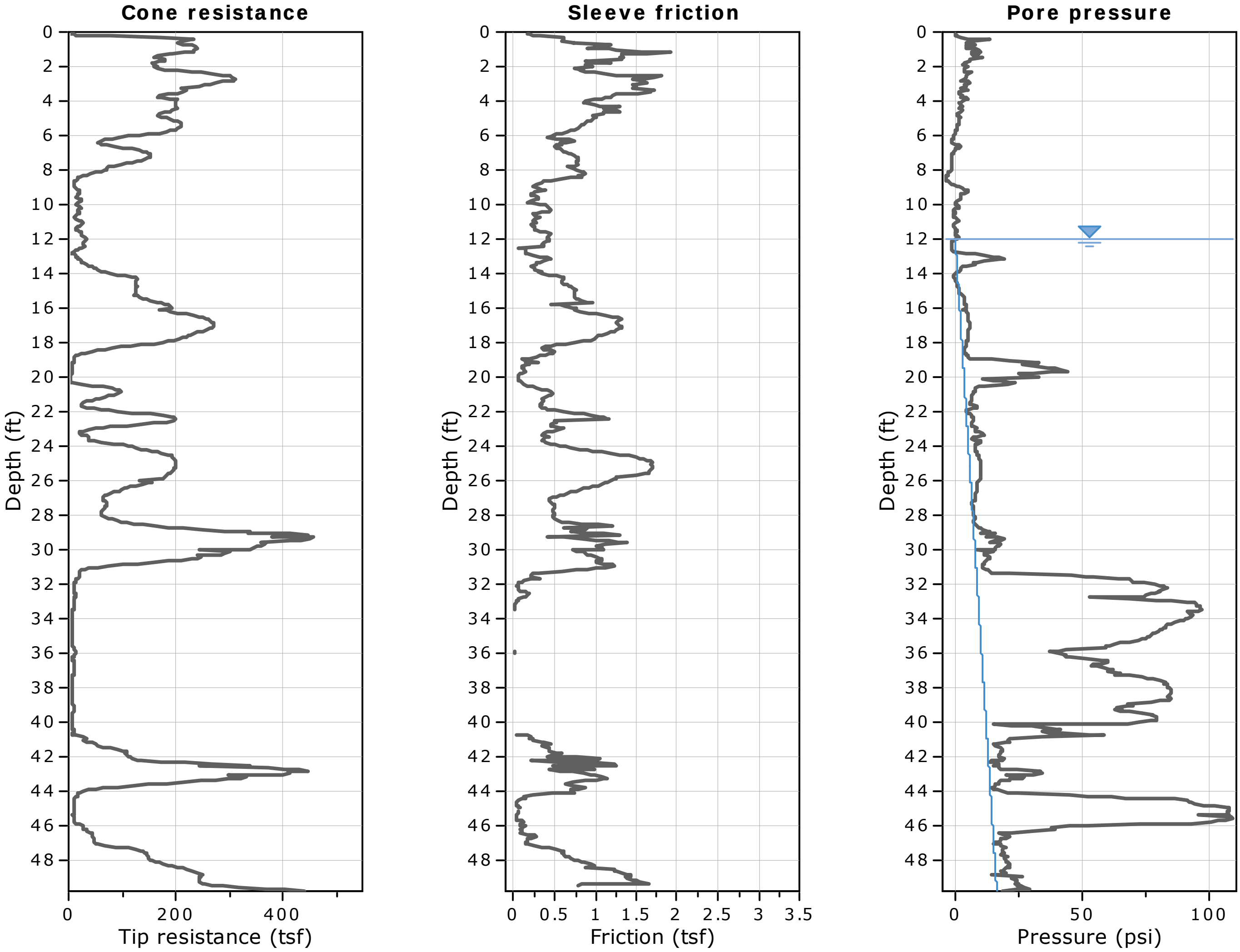


:: Tabular results ::

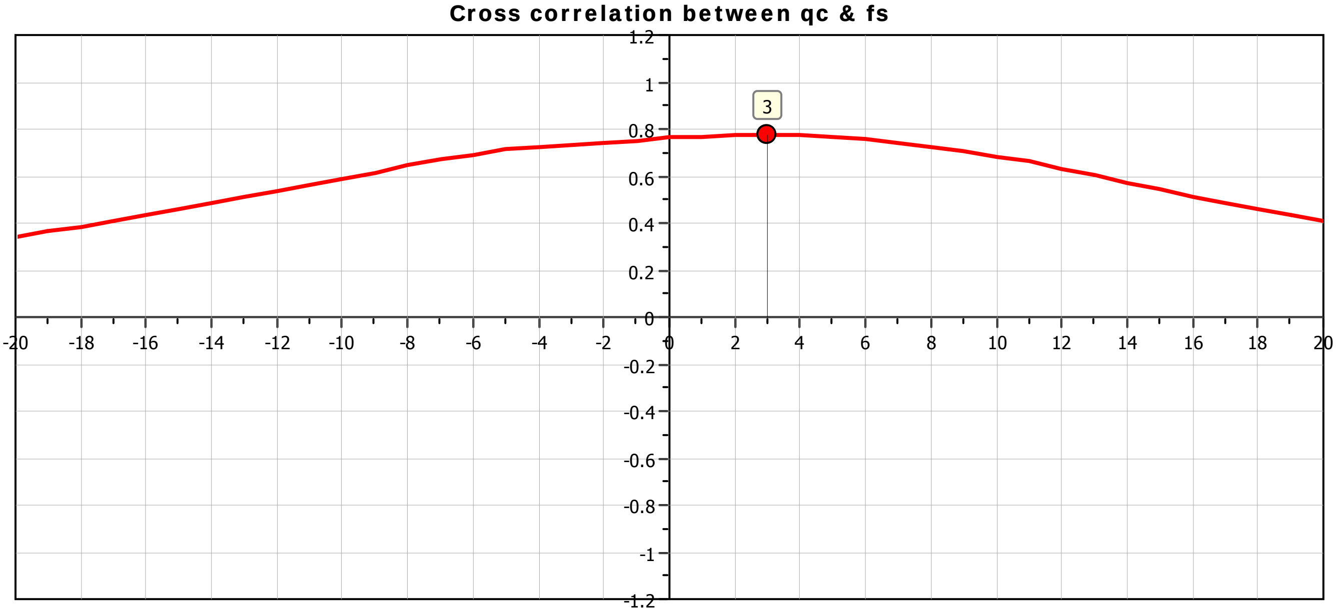
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	189.44	0.20	0.03	37.92
2	1.20	0.50	2.30	187.59	0.20	0.03	37.55
3	1.40	0.50	2.60	188.79	0.20	0.03	37.79
4	1.60	0.50	2.90	187.38	0.20	0.03	37.51
5	1.80	0.50	3.20	185.48	0.20	0.03	37.13
6	2.00	0.50	3.50	184.72	0.20	0.03	36.97
7	2.20	0.50	3.80	186.30	0.20	0.03	37.29
8	2.40	0.50	4.10	182.56	0.20	0.03	36.54
9	2.60	0.50	4.40	177.47	0.20	0.03	35.52
10	2.80	0.50	4.70	172.65	0.20	0.03	34.56
11	3.00	0.50	5.00	165.81	0.20	0.03	33.19
12	3.20	0.50	5.30	160.65	0.20	0.03	32.16
13	3.40	0.50	5.60	153.79	0.20	0.03	30.79
14	3.60	0.50	5.90	148.45	0.20	0.03	29.72
15	3.80	0.50	6.20	142.42	0.20	0.03	28.51
16	4.00	0.50	6.50	136.51	0.20	0.03	27.33

Project: Langan
Location: BL England Substation - Marmora NJ

CPT: CPT-6
Total depth: 49.74 ft



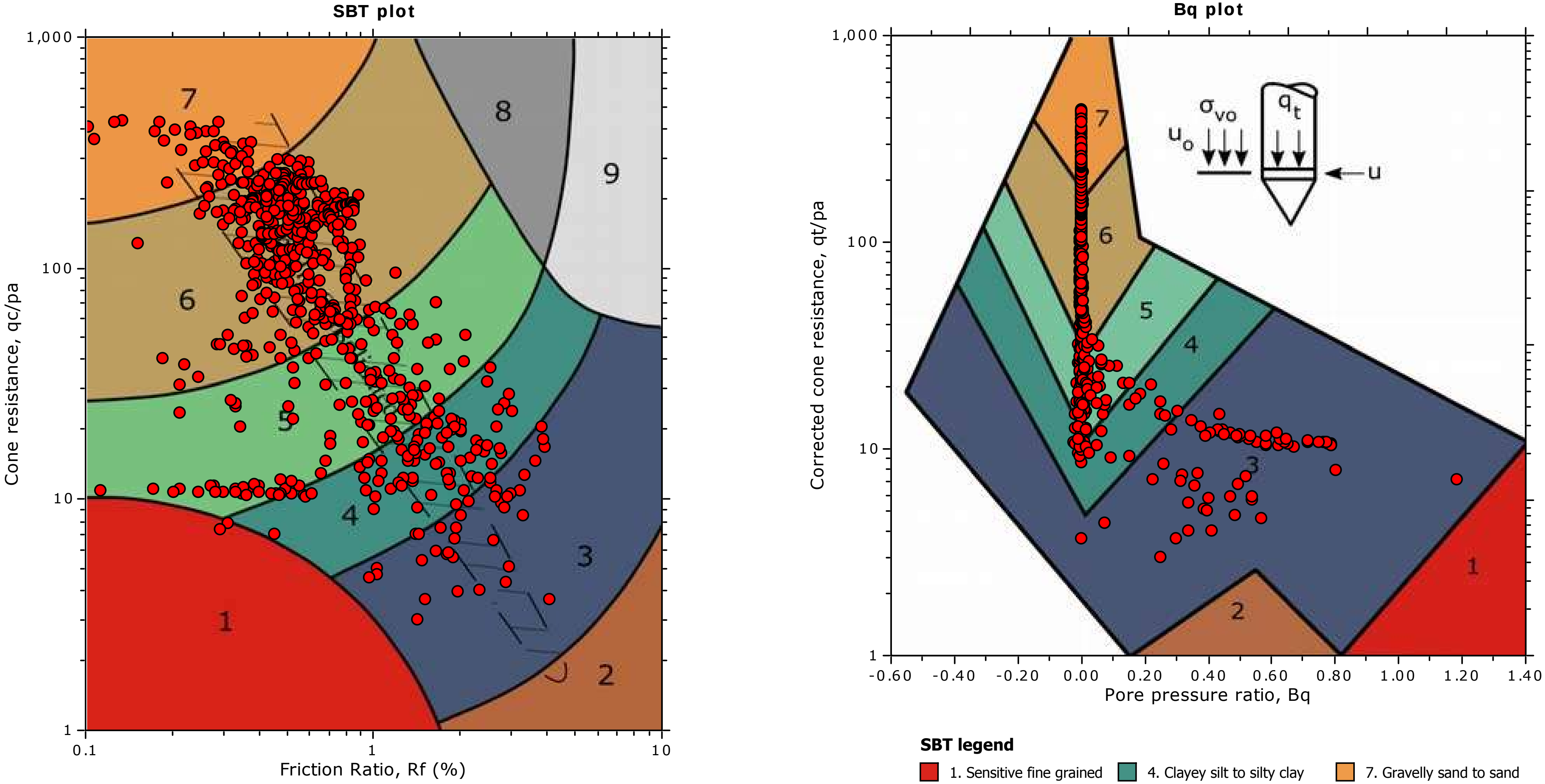
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



Project: Langan
Location: BL England Substation - Marmora NJ

CPT: CPT-6
Total depth: 49.74 ft

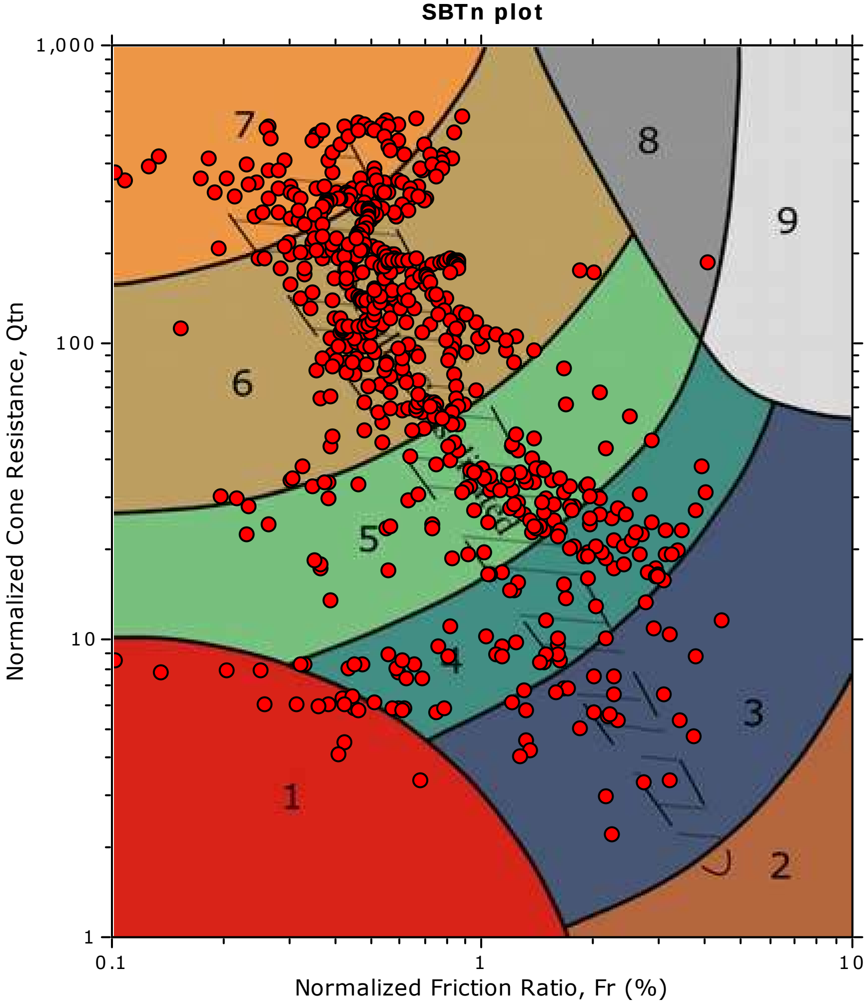
SBT - Bq plots

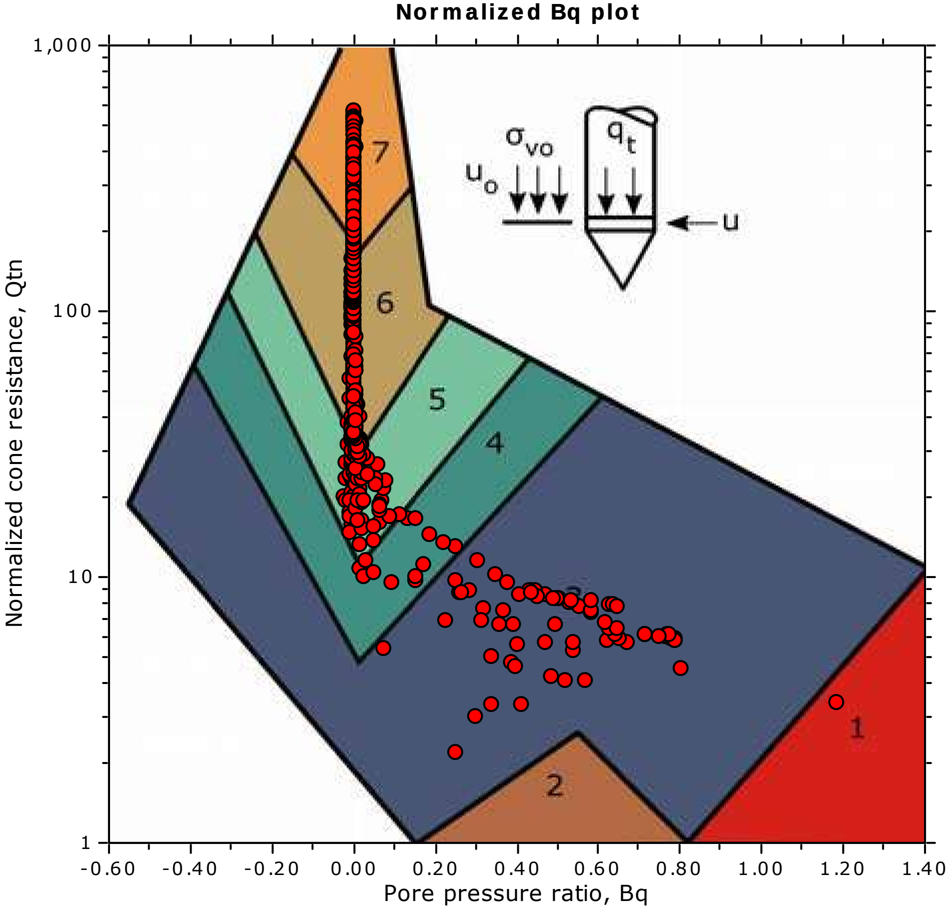


SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

SBT - Bq plots (normalized)

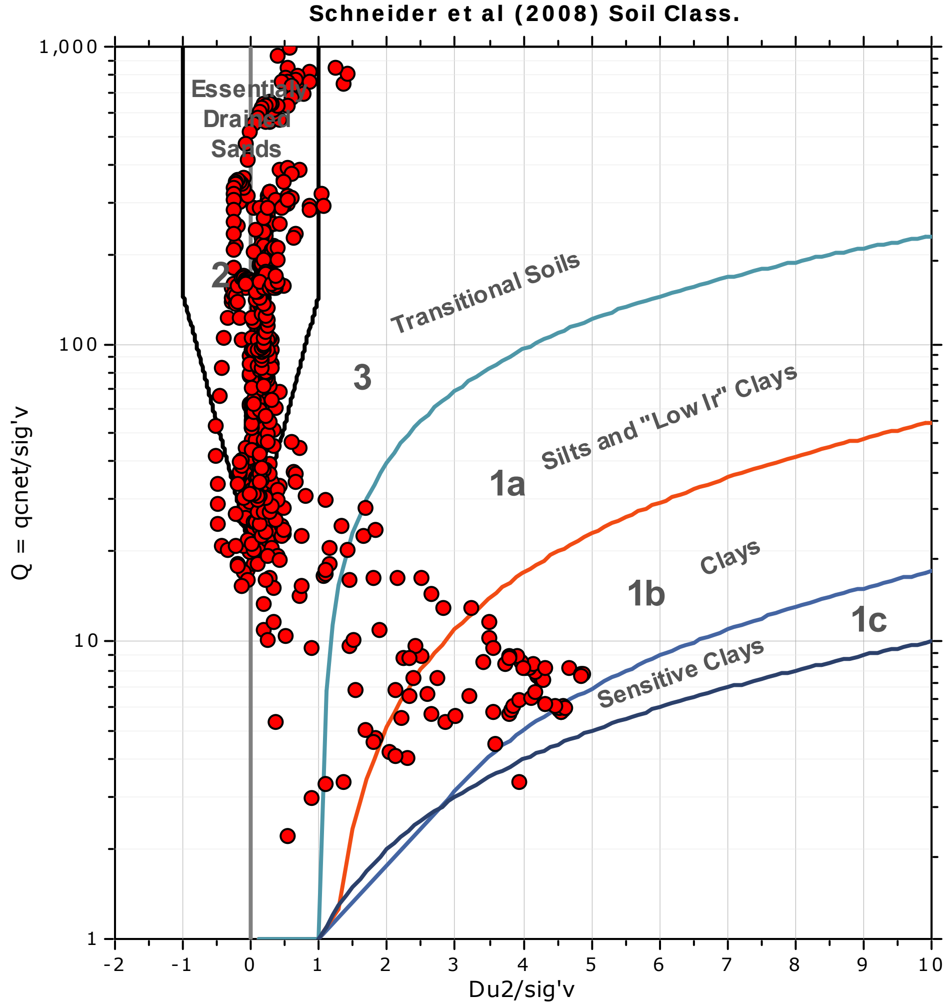


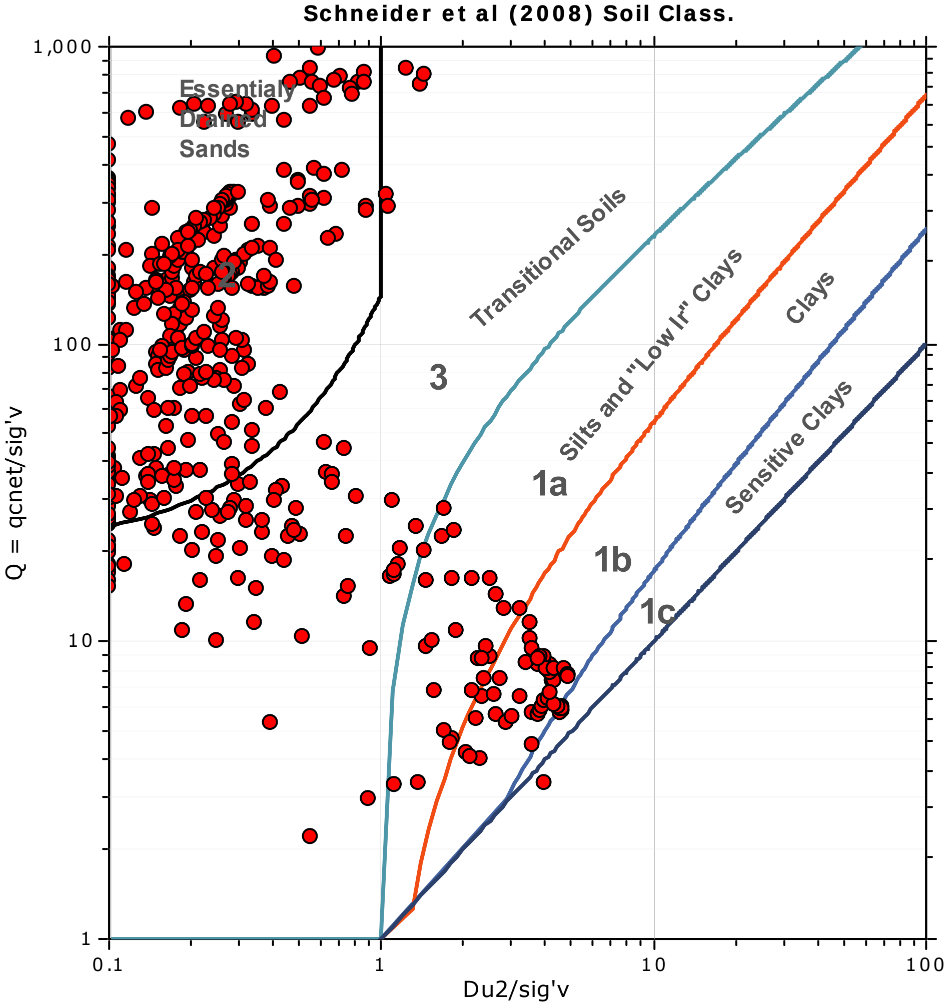


SBTn legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty clay	🟧 7. Gravelly sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬜ 8. Very stiff sand to clayey sand
🟦 3. Clay to silty clay	🟫 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

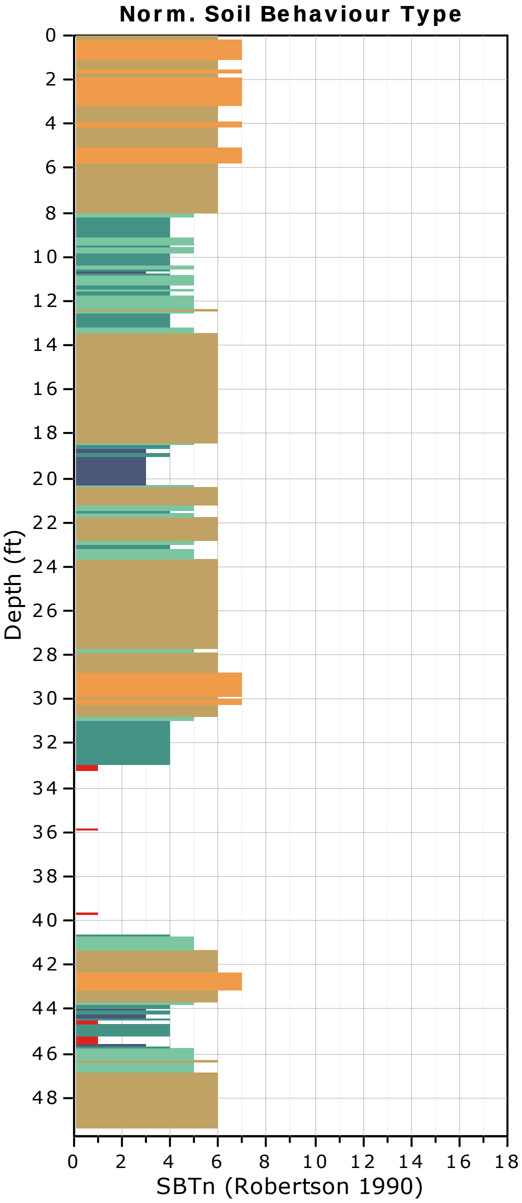
Bq plots (Schneider)

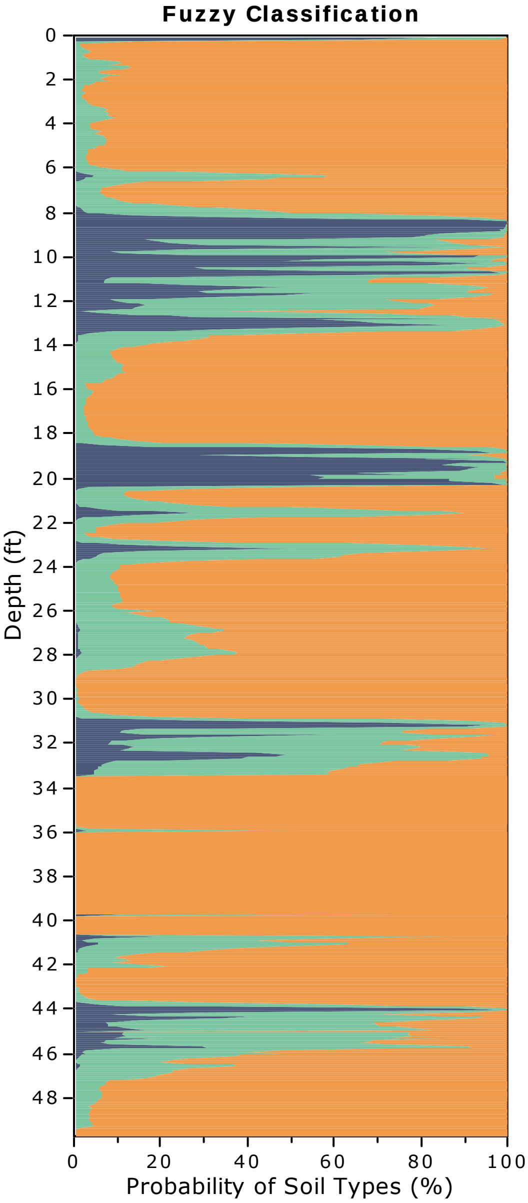




Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-6
Total depth: 49.74 ft





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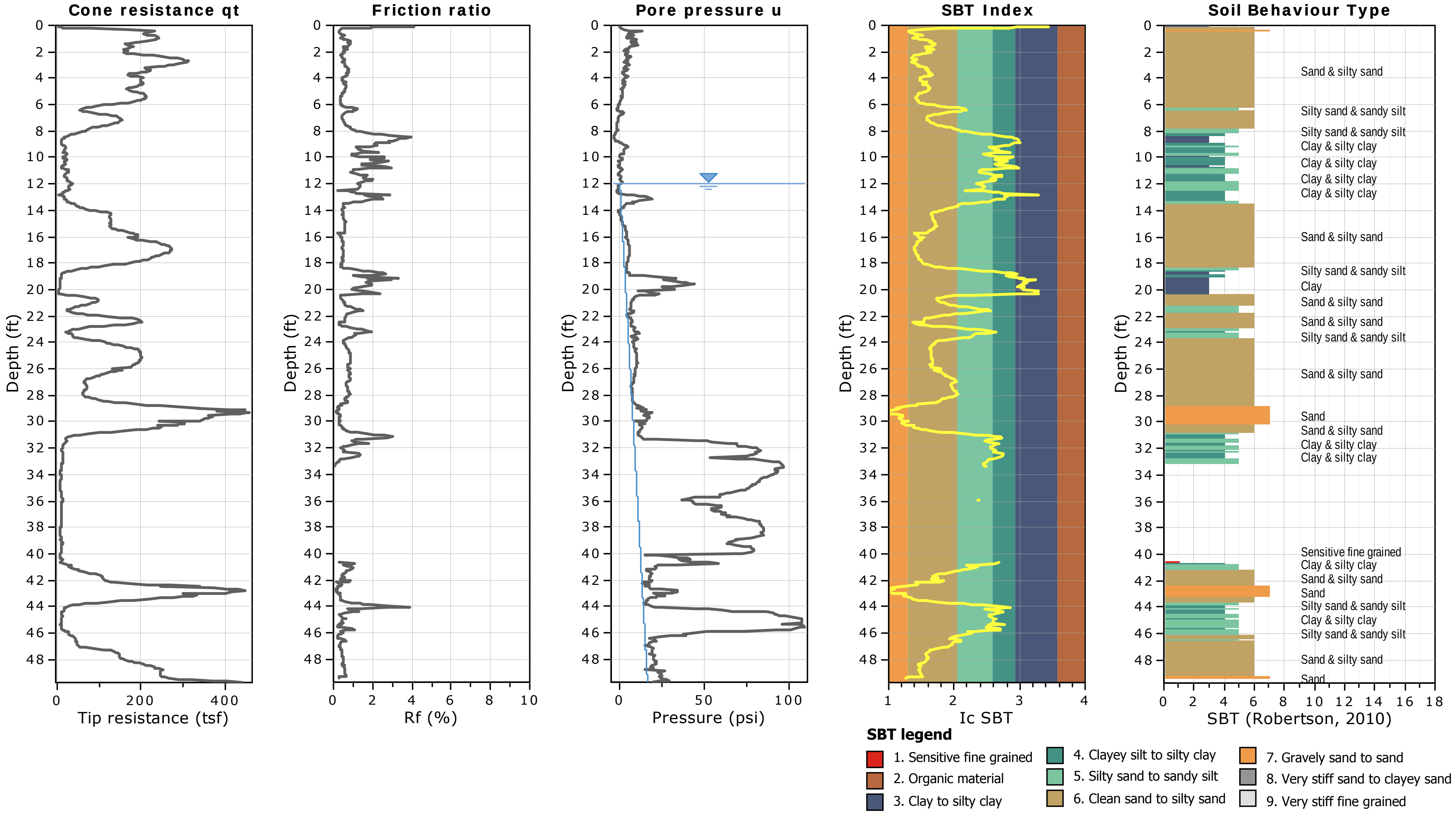
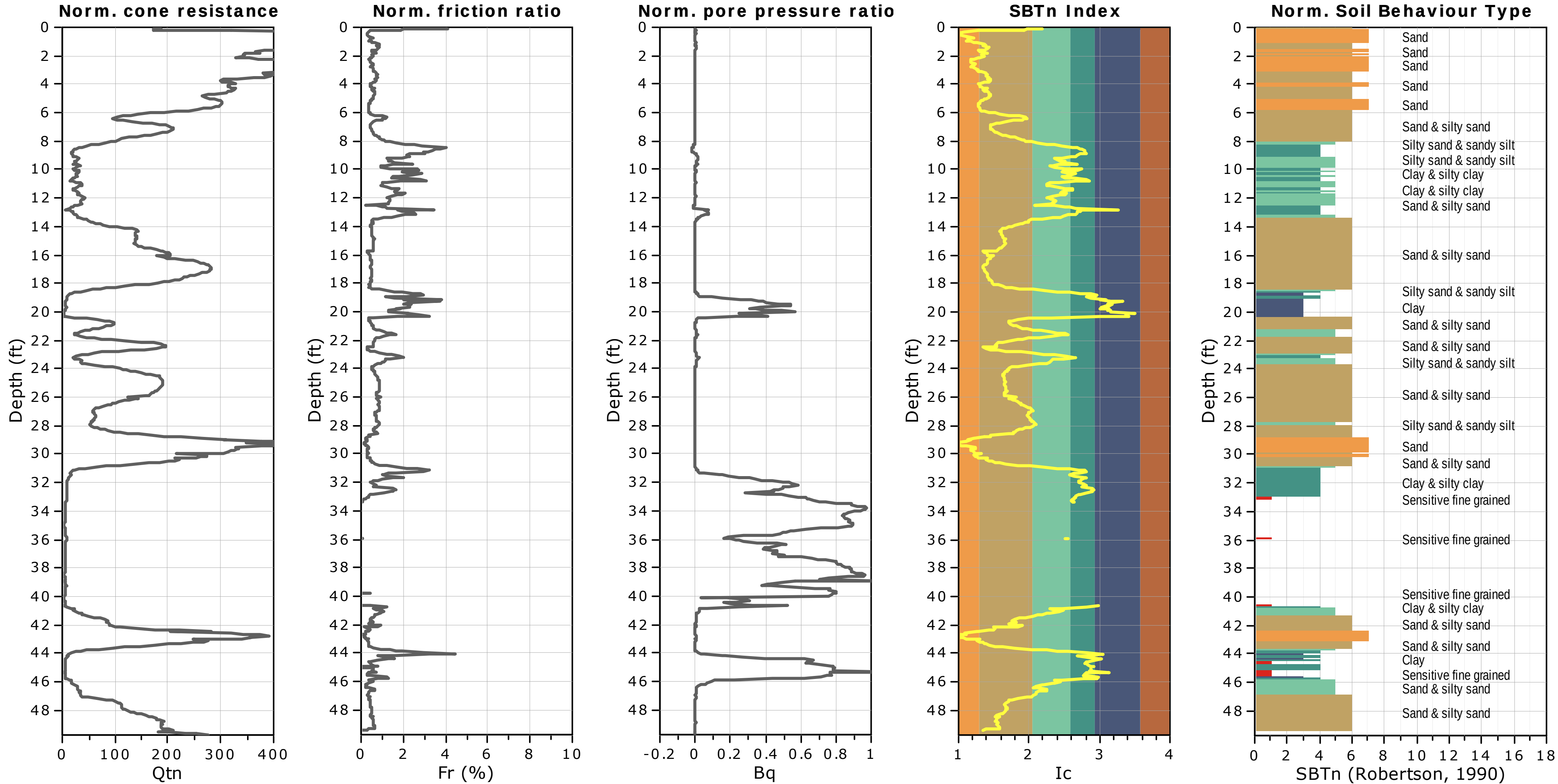
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-6
Total depth: 49.74 ft



Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-6
Total depth: 49.74 ft

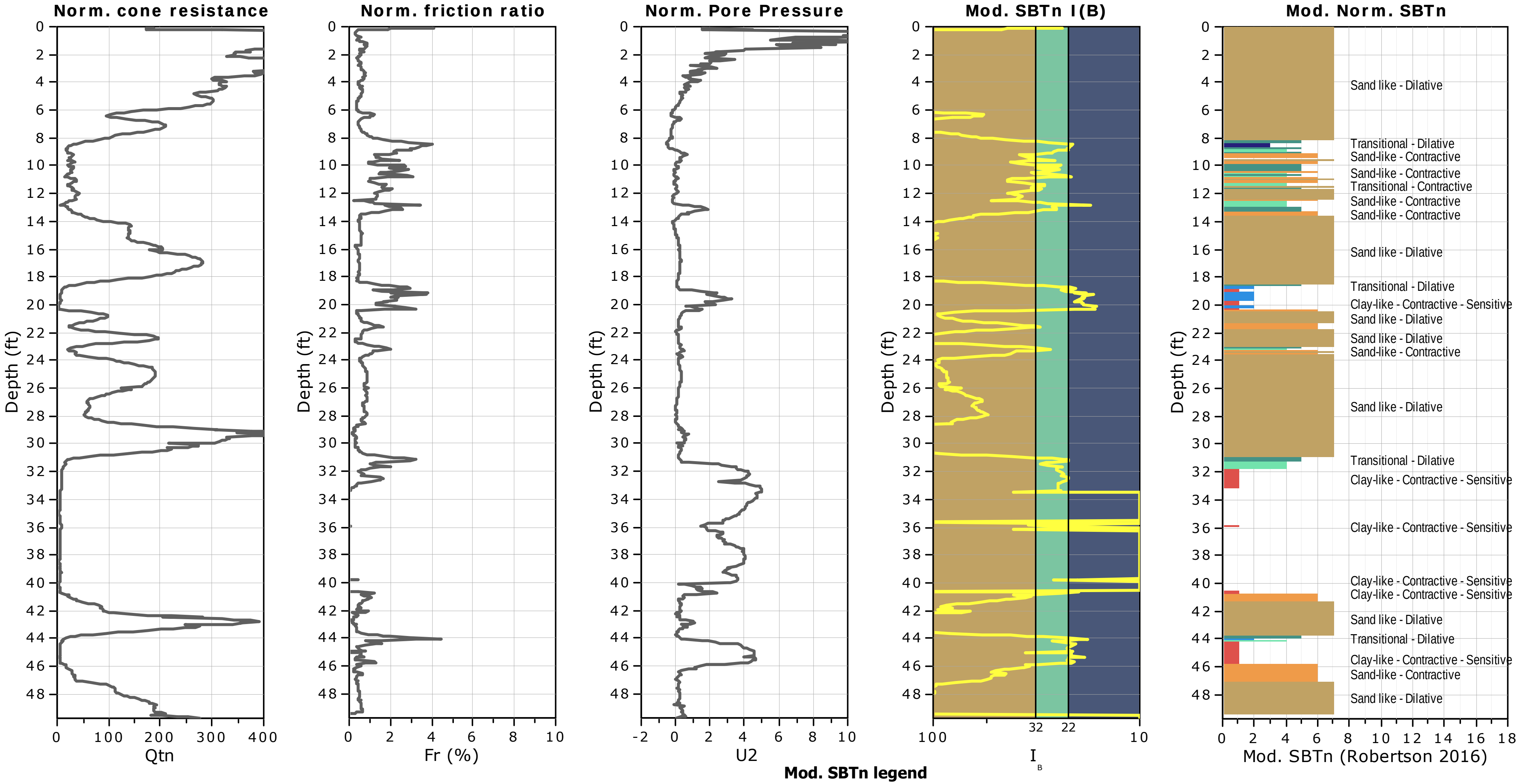


SBTn legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravely sand to sand
⬛ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-6
Total depth: 49.74 ft

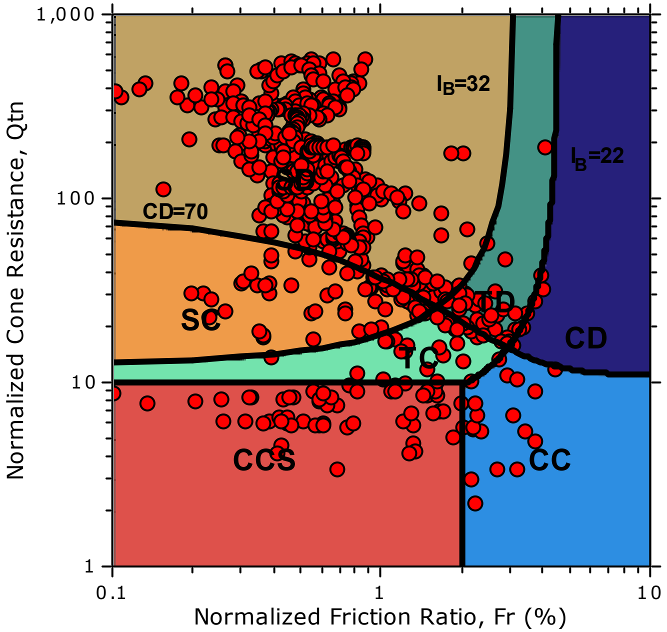


Mod. SBTn legend

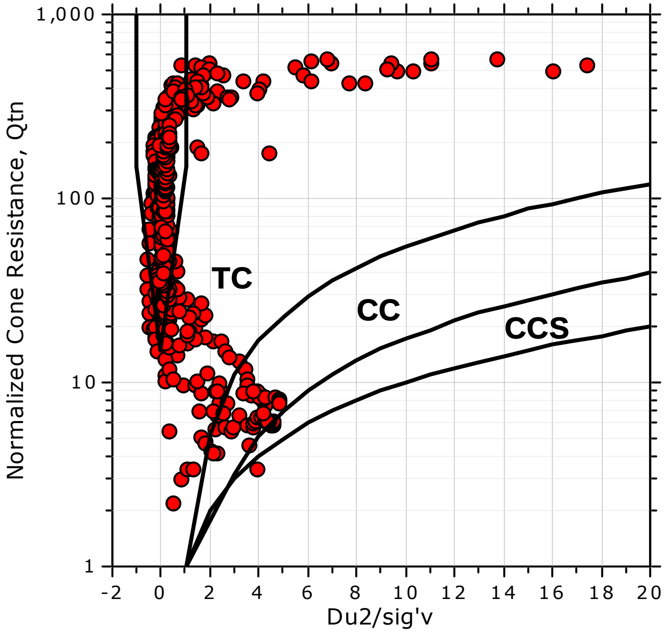
🟥 1. CCS: ClayLike - Contractive, Sensitive
🟦 2. CC: Clay-like - Contractive
🟦 3. CD: Clay-Like: Dilative
🟩 4. TC: Transitional - Contractive
🟩 5. TD: Transitional - Dilative
🟧 6. SC: Sand-like - Contractive
🟫 7. SD: Sand-like - Dilative

Updated SBTn plots

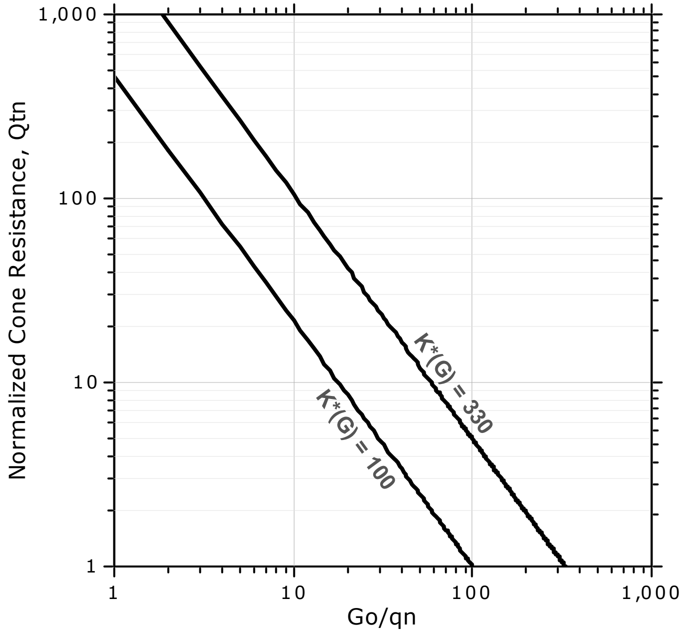
Modified Robertson (2016) SBTn



Modified Schneider et al (2008) SBTn



Normalized Rigidity Index



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure
(e.g. age/cementation)

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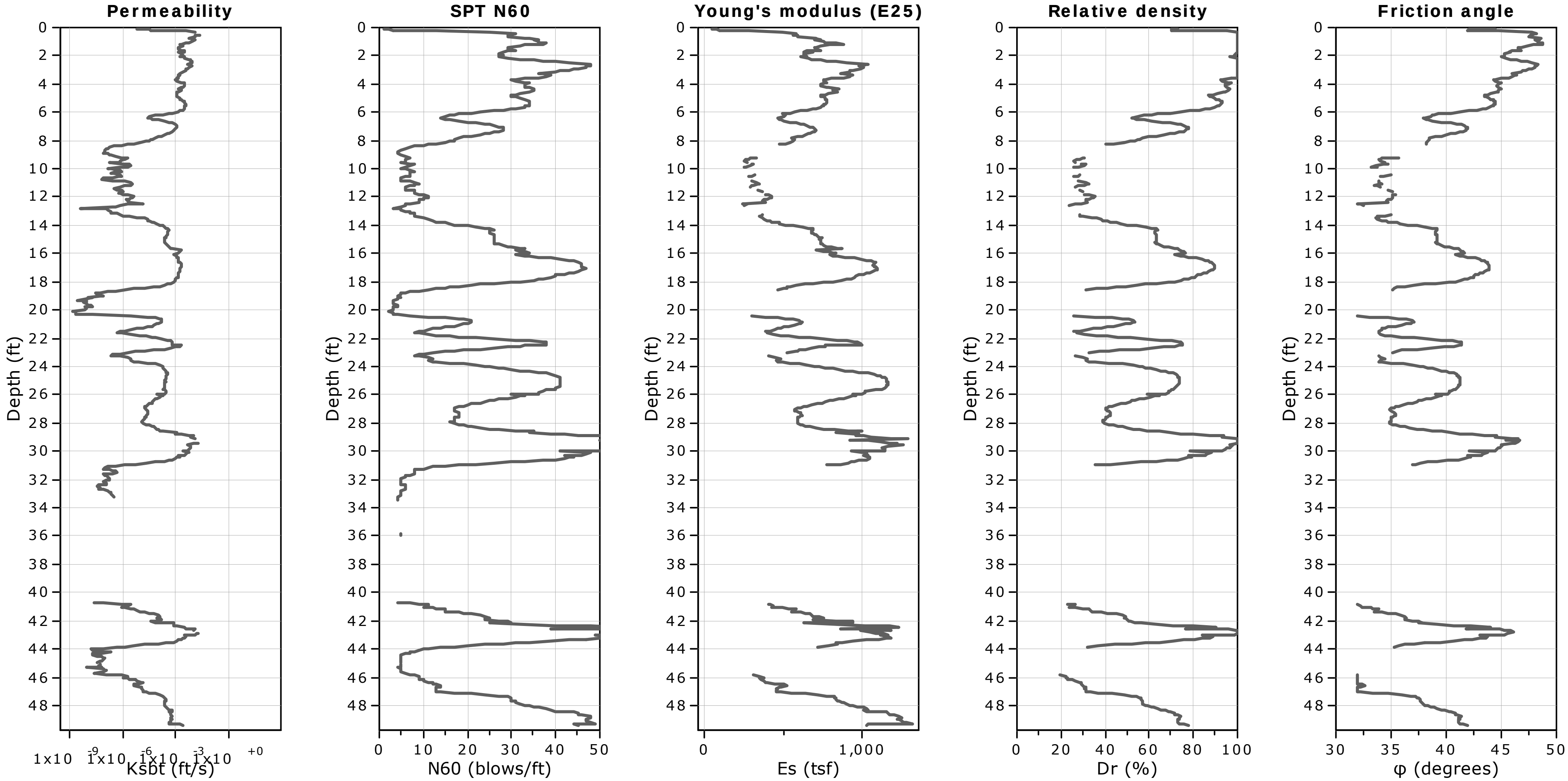
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-6
Total depth: 49.74 ft



Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
—●— User defined estimation data

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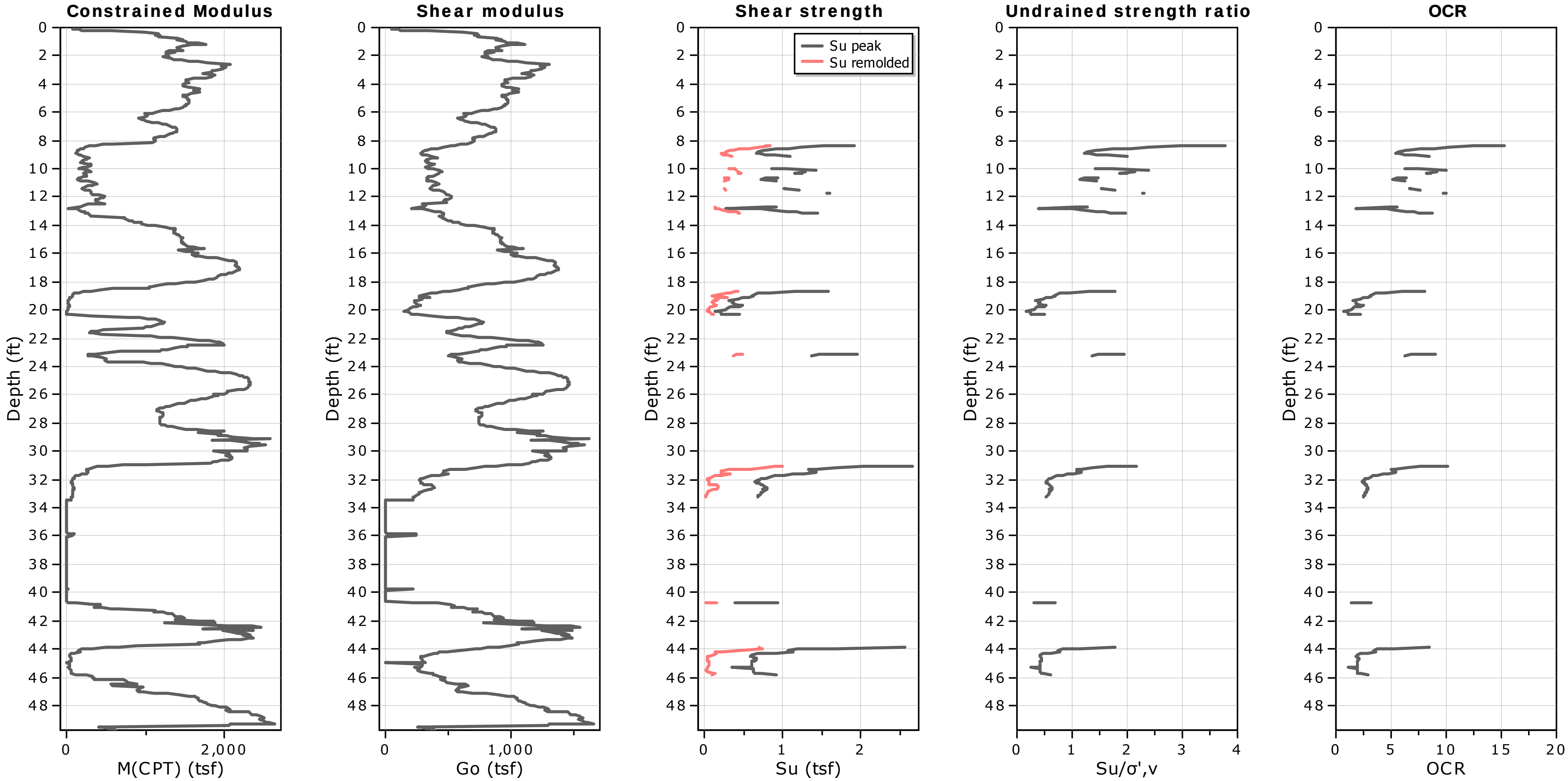
CPT: CPT-6
Total depth: 49.74 ft



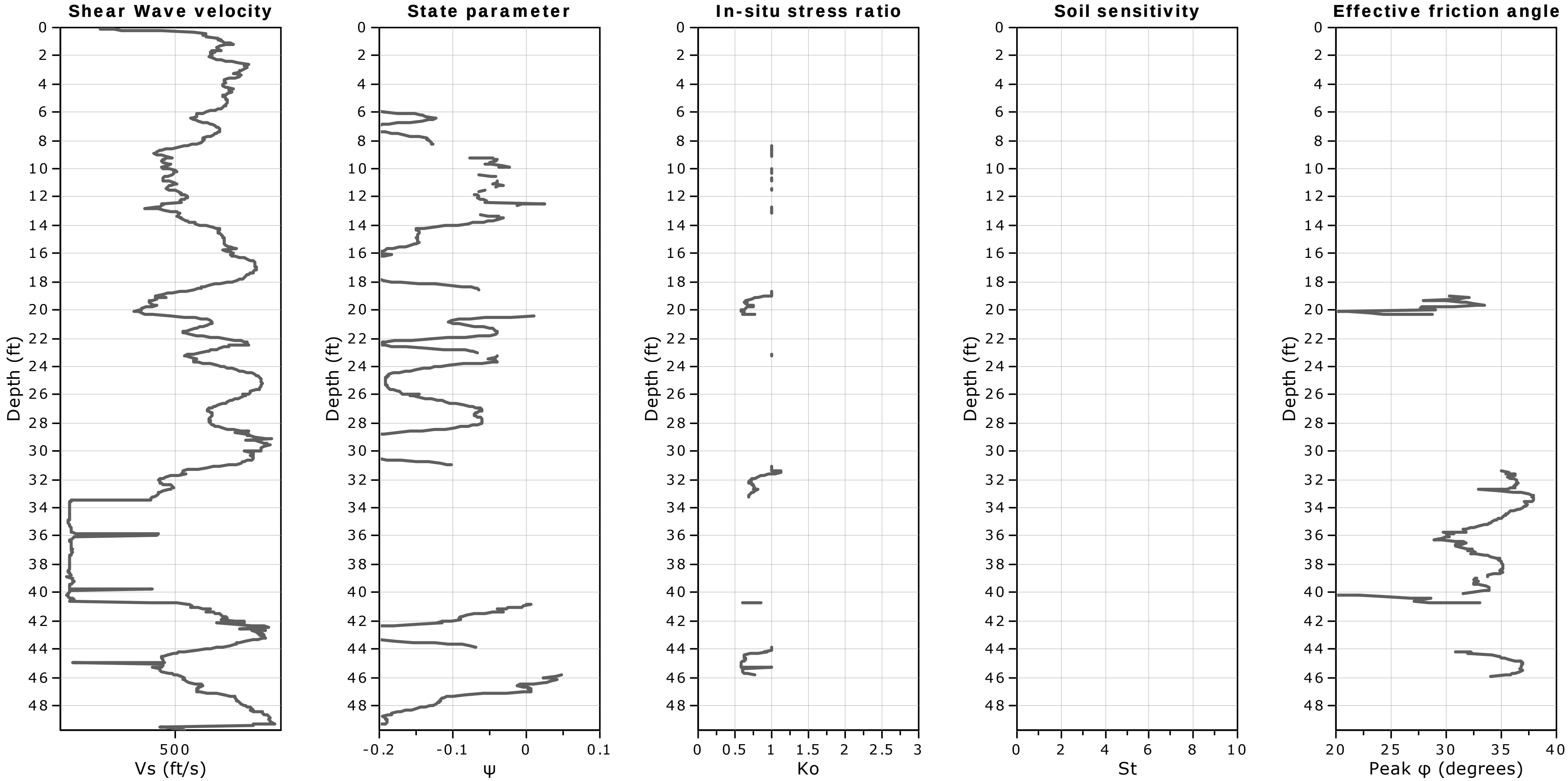
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-6
Total depth: 49.74 ft

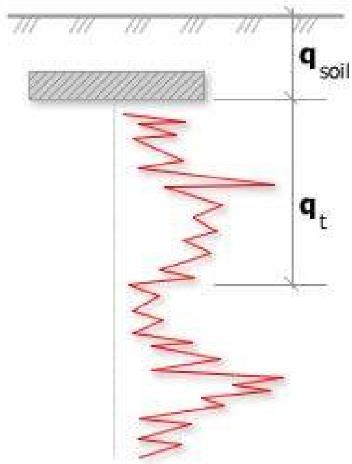


Calculation parameters

Soil Sensitivity factor, N_S: 350.00
● User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

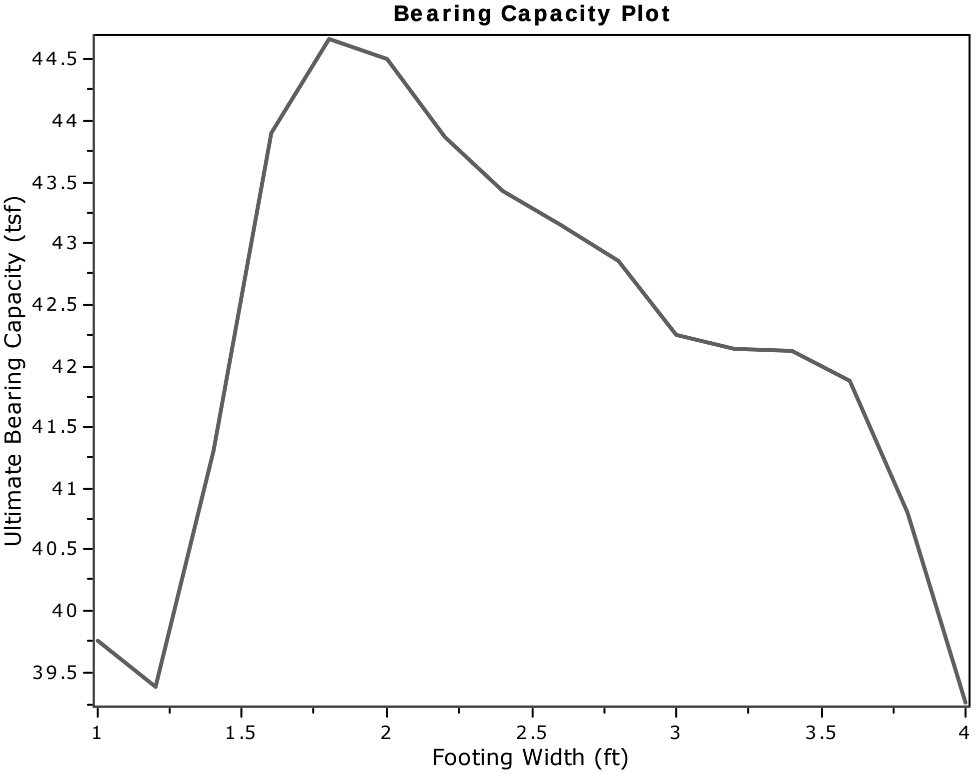
CPT: CPT-6
Total depth: 49.74 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

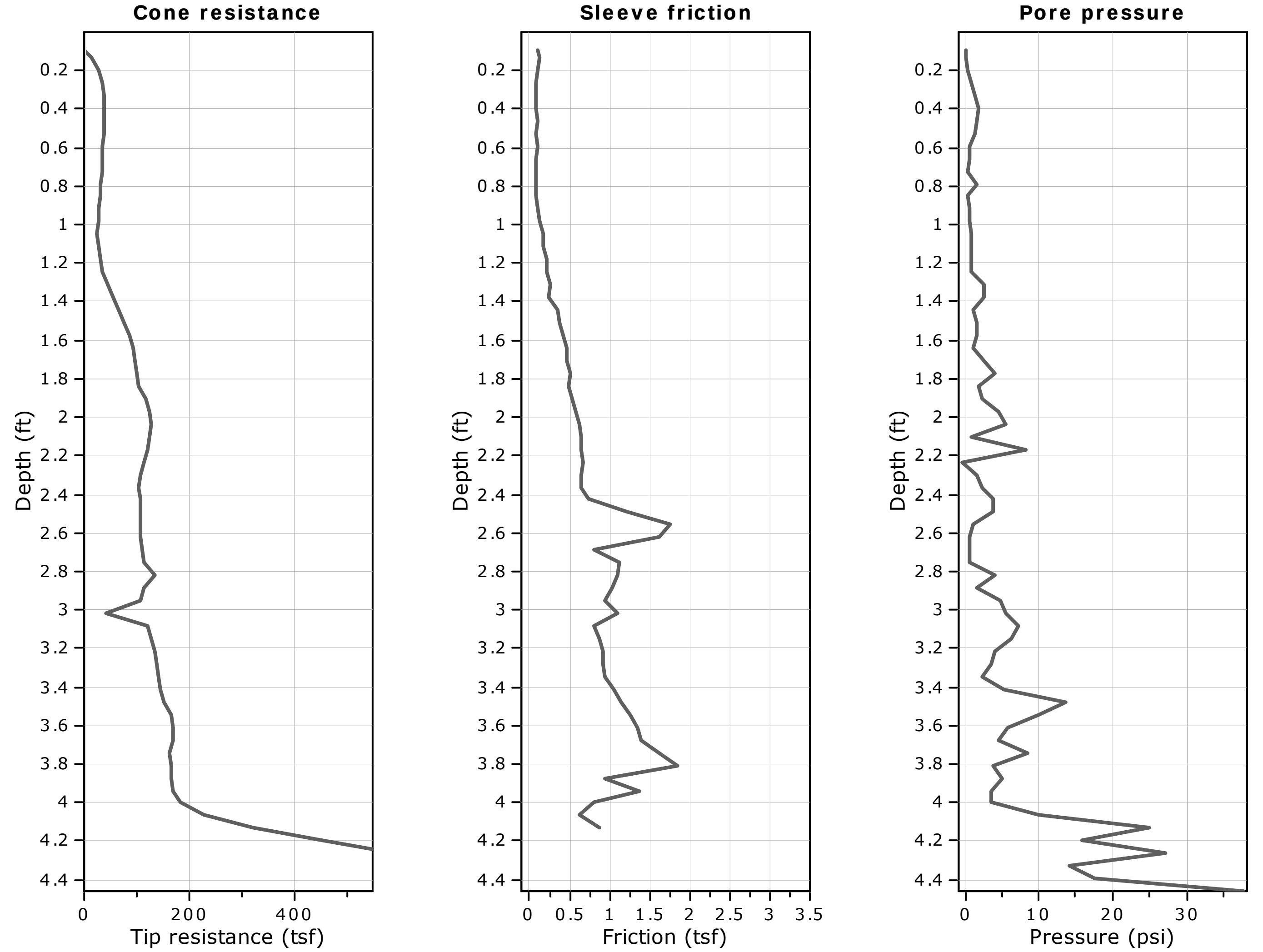


:: Tabular results ::

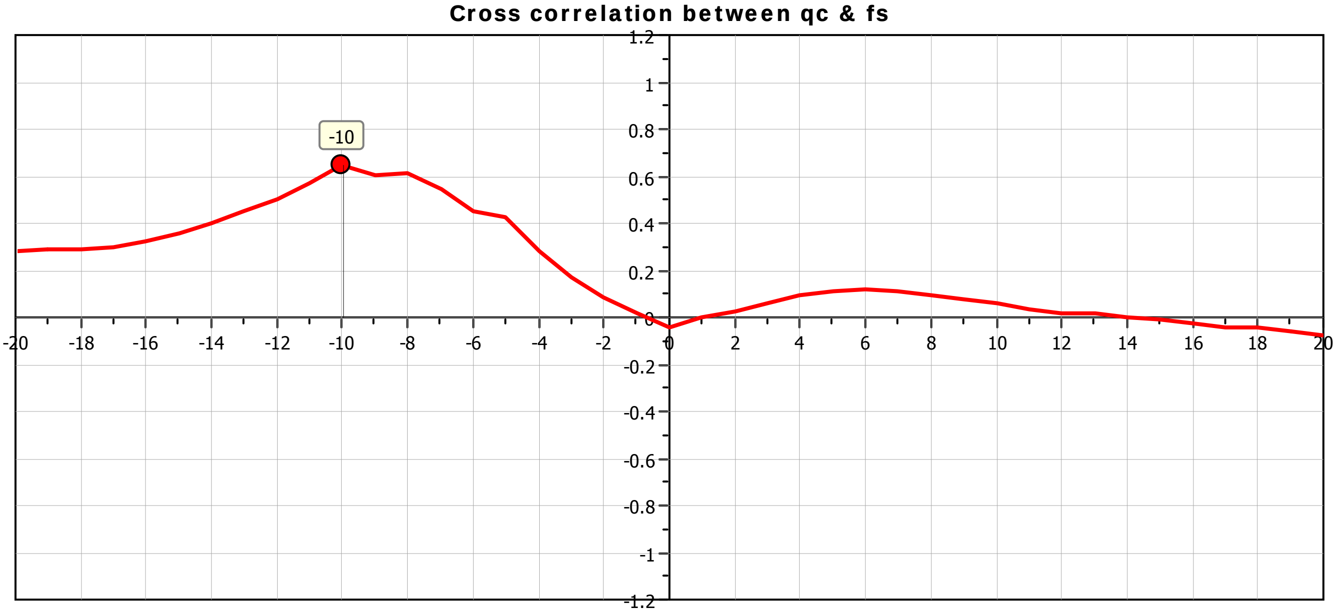
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	198.60	0.20	0.03	39.75
2	1.20	0.50	2.30	196.76	0.20	0.03	39.38
3	1.40	0.50	2.60	206.39	0.20	0.03	41.31
4	1.60	0.50	2.90	219.35	0.20	0.03	43.90
5	1.80	0.50	3.20	223.21	0.20	0.03	44.67
6	2.00	0.50	3.50	222.41	0.20	0.03	44.51
7	2.20	0.50	3.80	219.22	0.20	0.03	43.87
8	2.40	0.50	4.10	217.00	0.20	0.03	43.43
9	2.60	0.50	4.40	215.65	0.20	0.03	43.16
10	2.80	0.50	4.70	214.17	0.20	0.03	42.86
11	3.00	0.50	5.00	211.12	0.20	0.03	42.25
12	3.20	0.50	5.30	210.54	0.20	0.03	42.14
13	3.40	0.50	5.60	210.46	0.20	0.03	42.12
14	3.60	0.50	5.90	209.25	0.20	0.03	41.88
15	3.80	0.50	6.20	203.83	0.20	0.03	40.80
16	4.00	0.50	6.50	196.10	0.20	0.03	39.25

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-8
Total depth: 4.46 ft



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

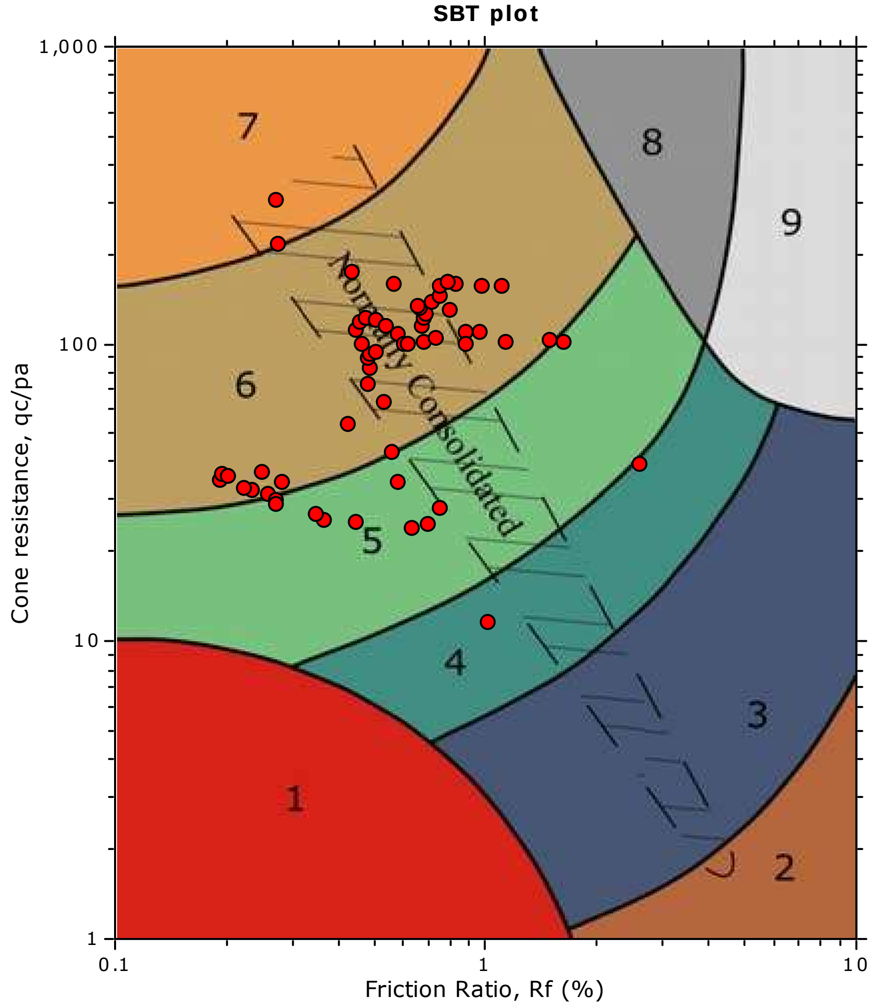


Project: **Langan**
Location: **BL England Substation - Marmora NJ**

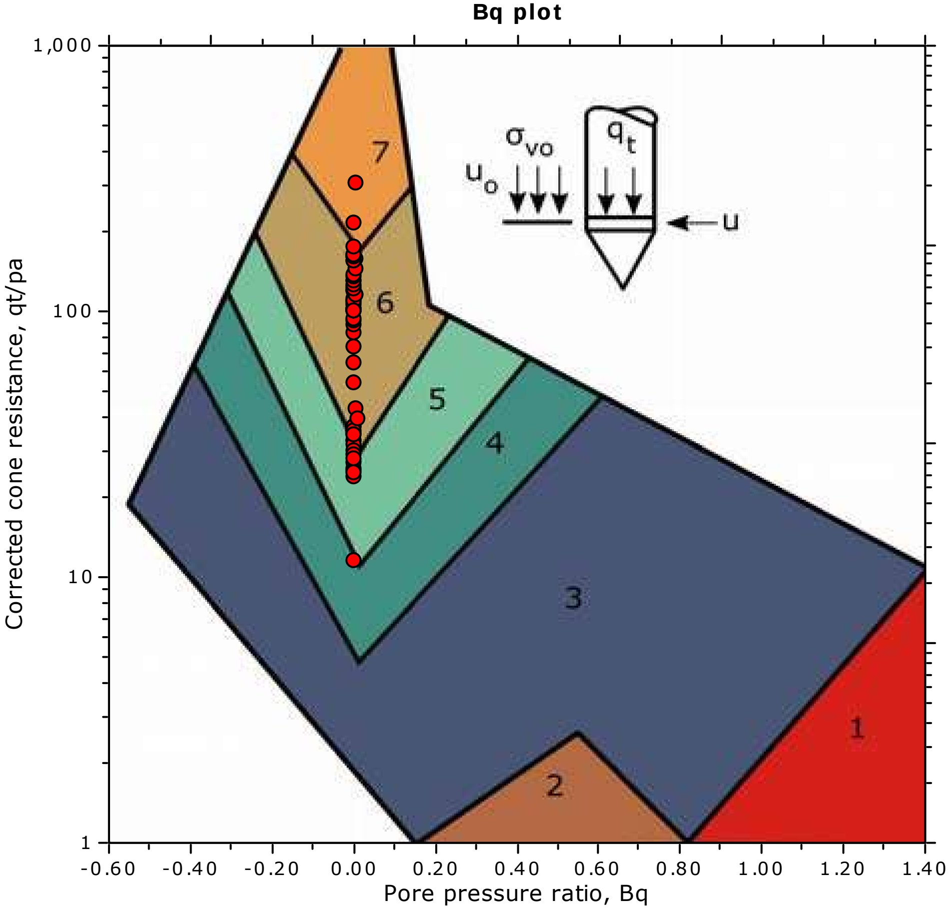
CPT: CPT-8
Total depth: 4.46 ft

SBT - Bq plots

SBT plot



Bq plot



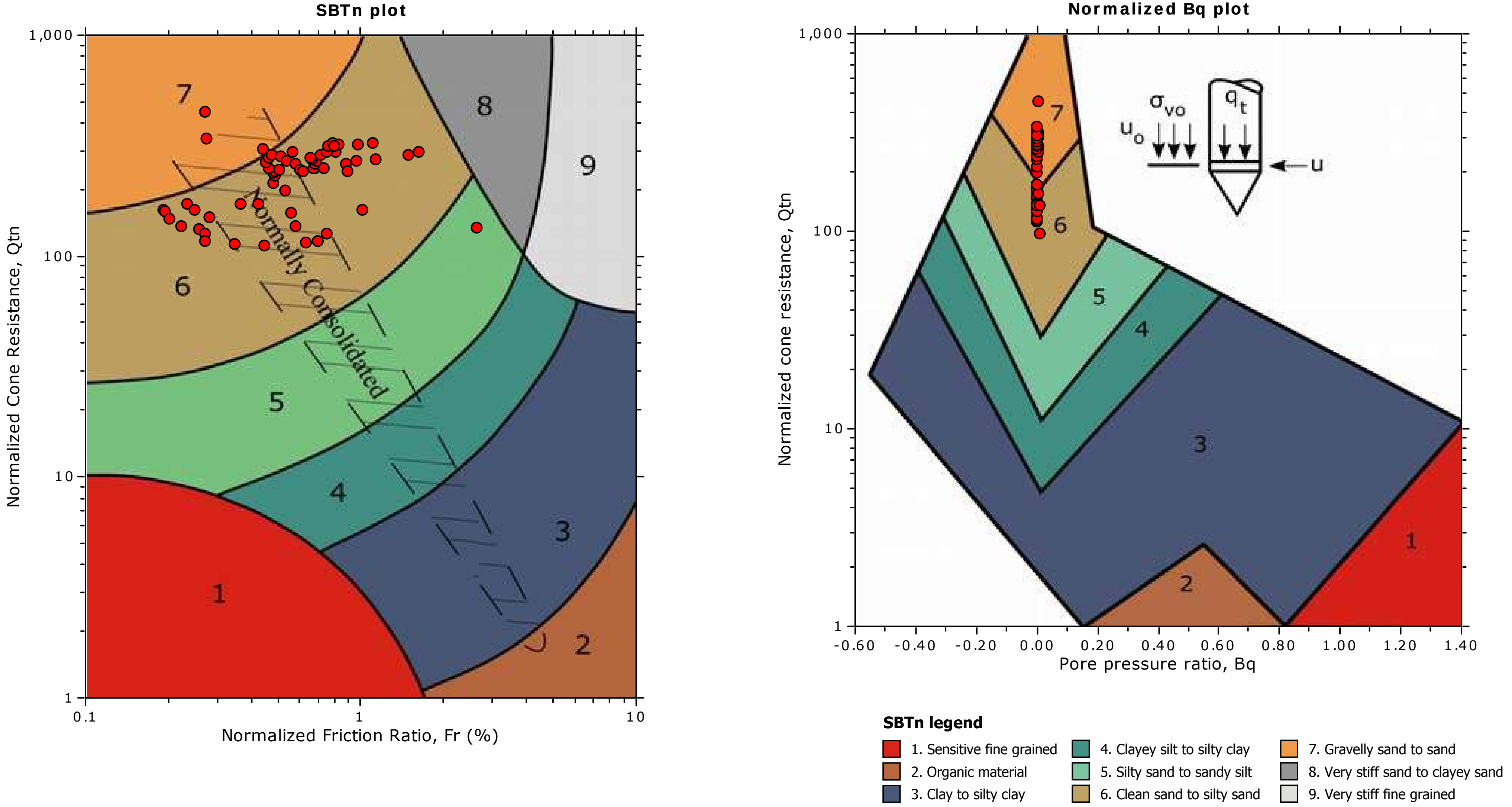
SBT legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬛ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

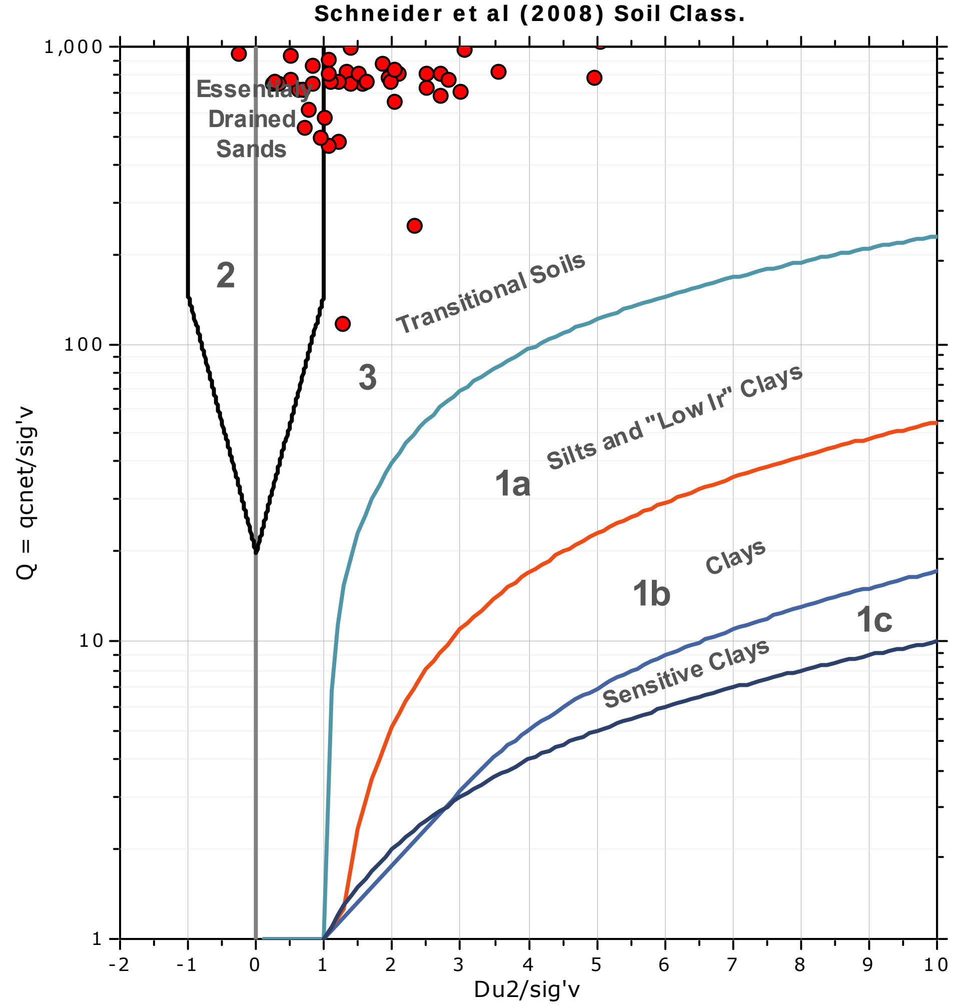
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

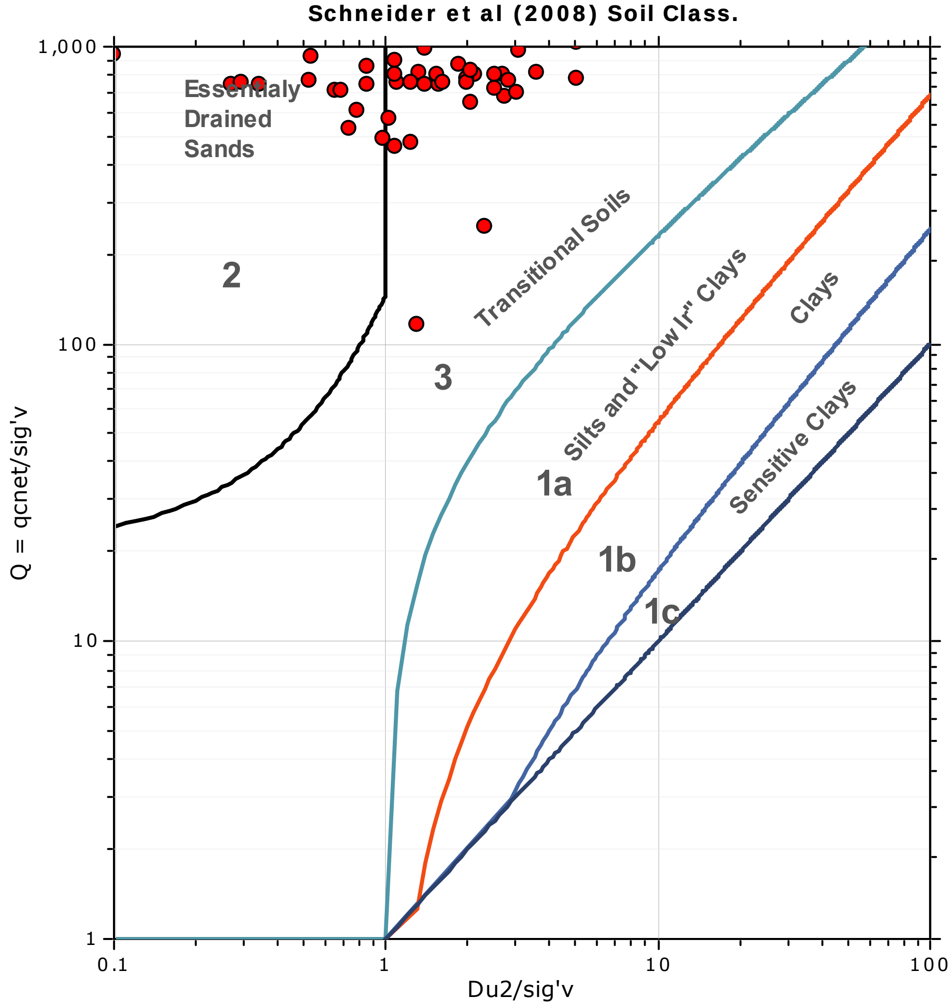
CPT: CPT-8
Total depth: 4.46 ft

SBT - Bq plots (normalized)



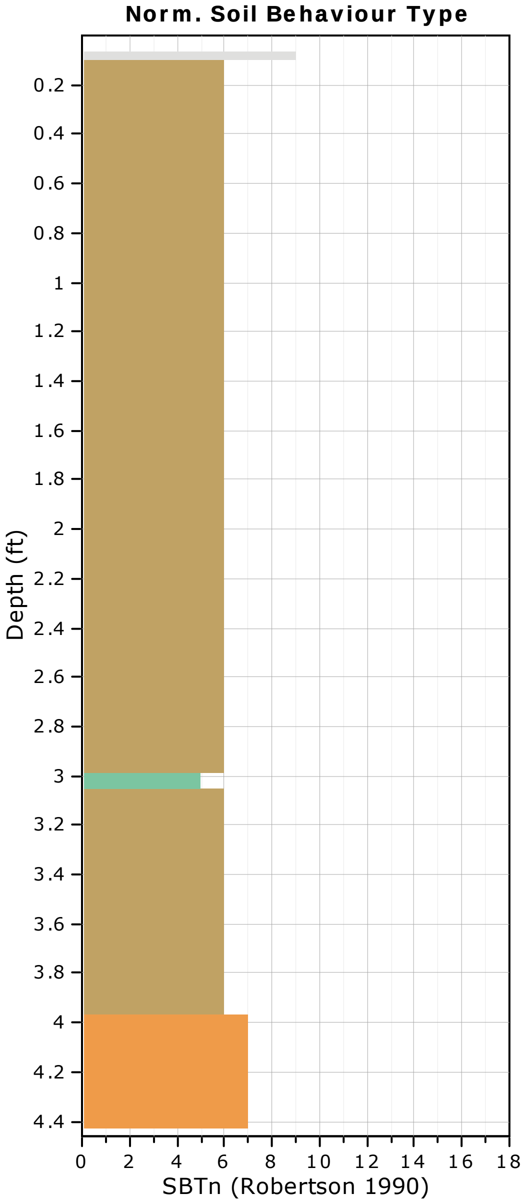
Bq plots (Schneider)

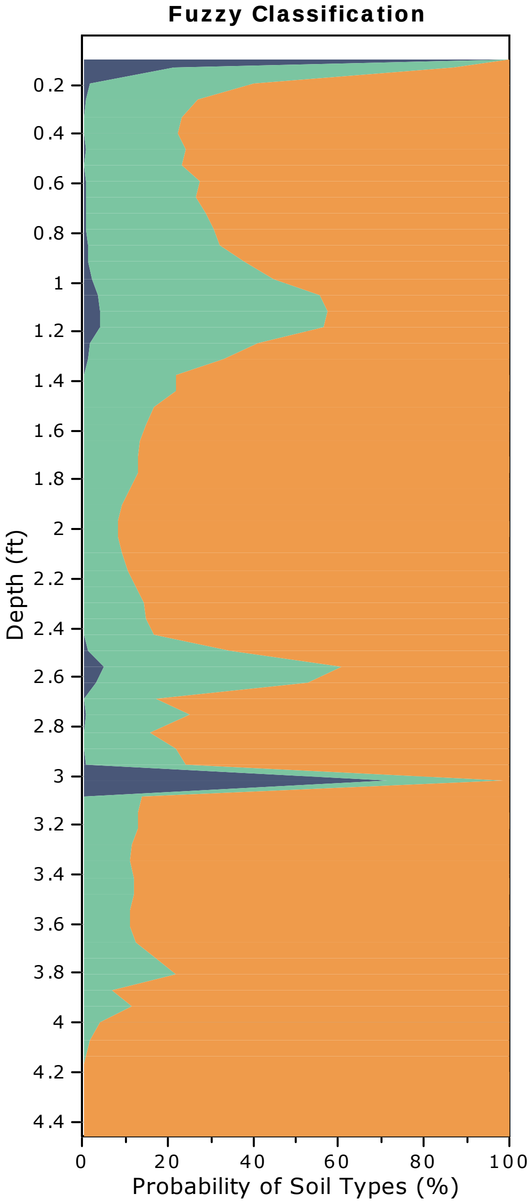




Project: **Langan**
Location: **BL England Substation - Marmora NJ**

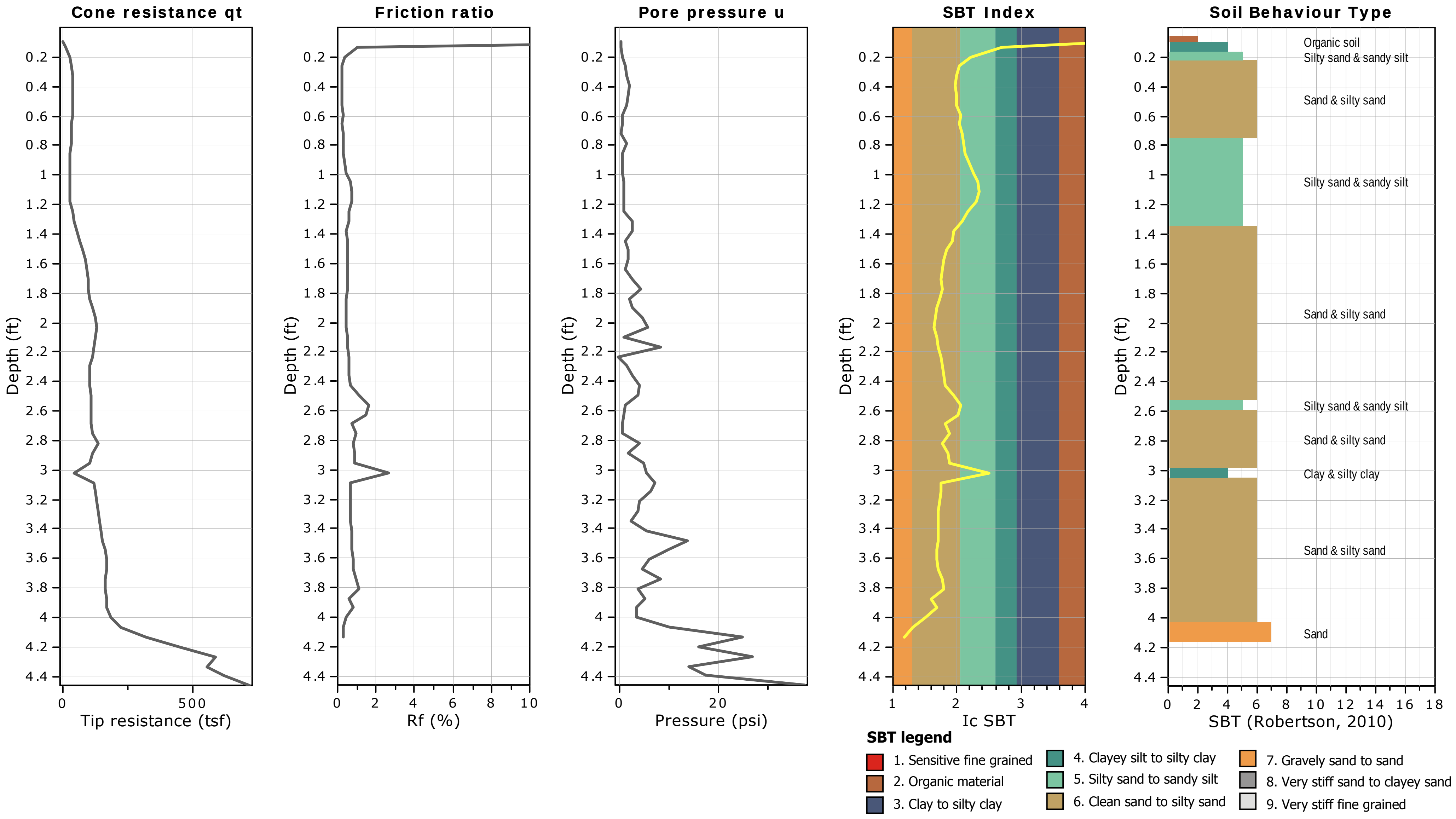
CPT: CPT-8
Total depth: 4.46 ft





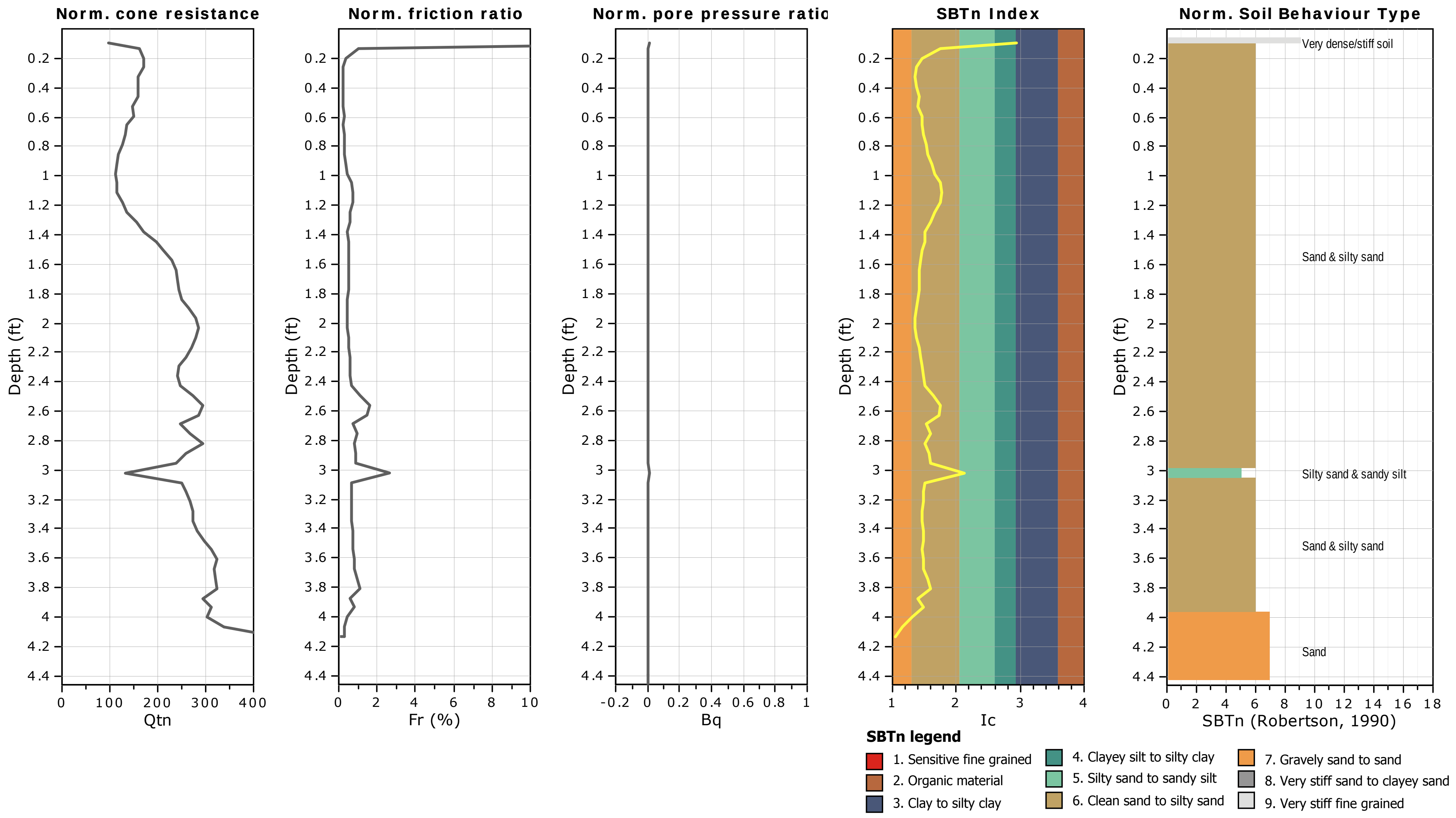
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-8
Total depth: 4.46 ft



Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-8
Total depth: 4.46 ft

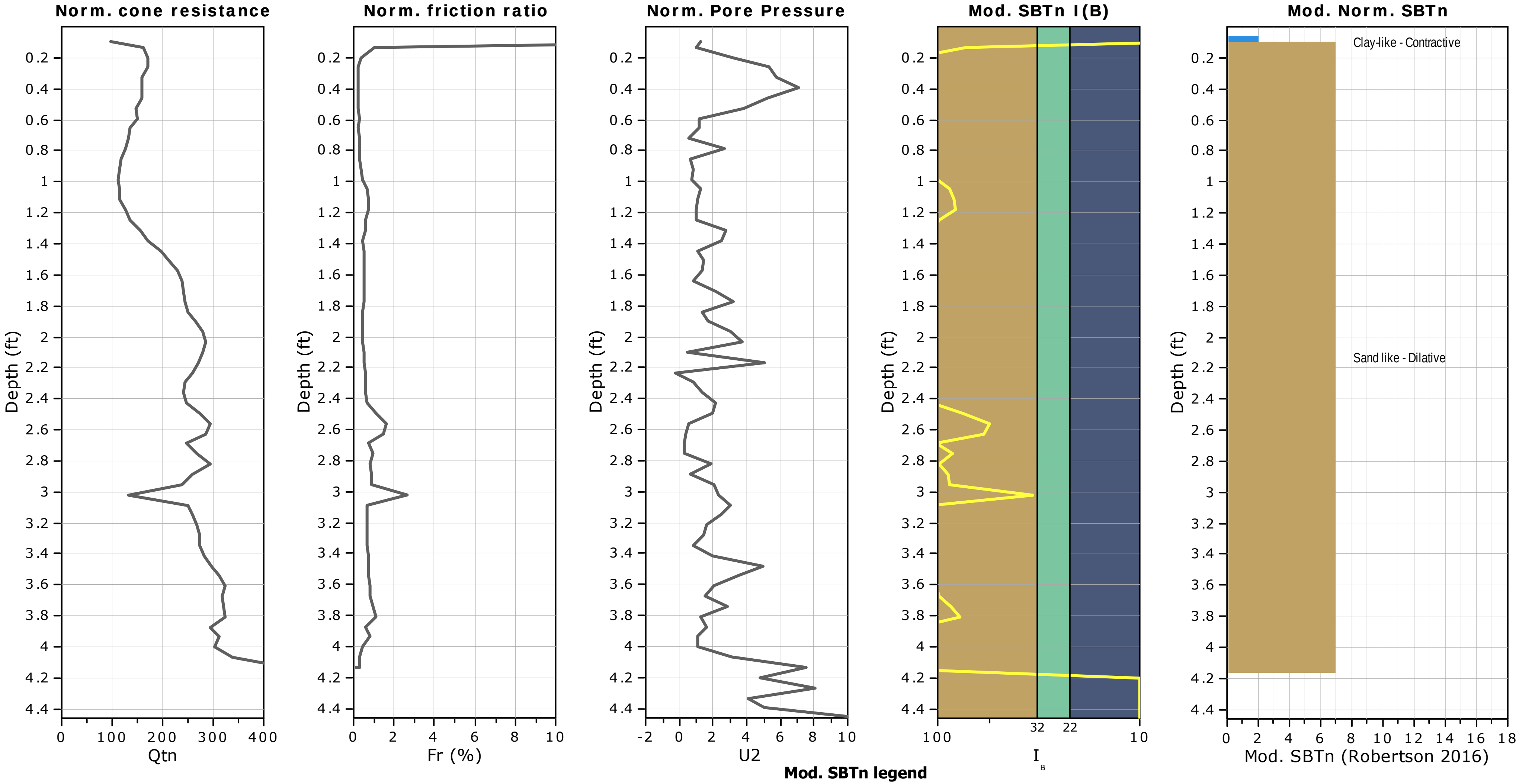


Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-8

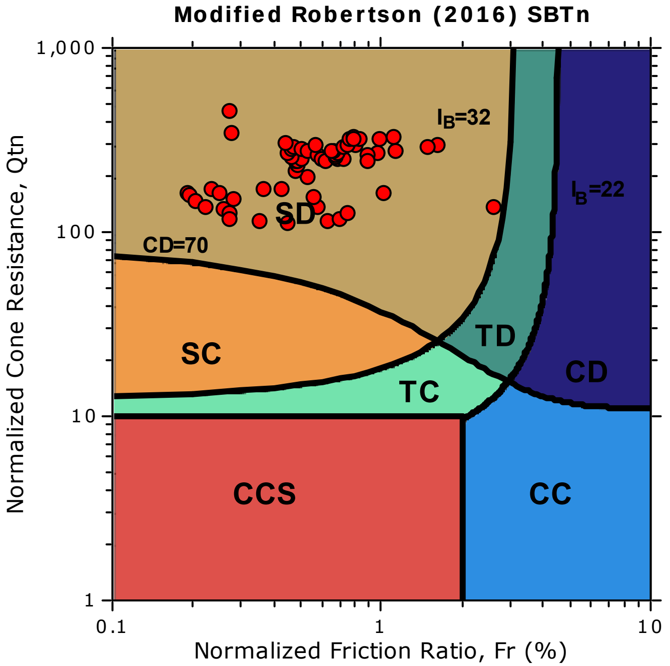
Total depth: 4.46 ft

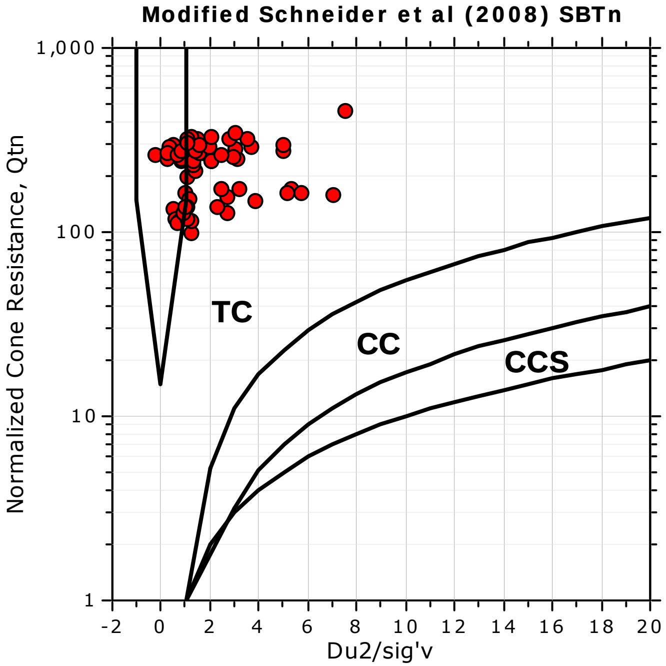


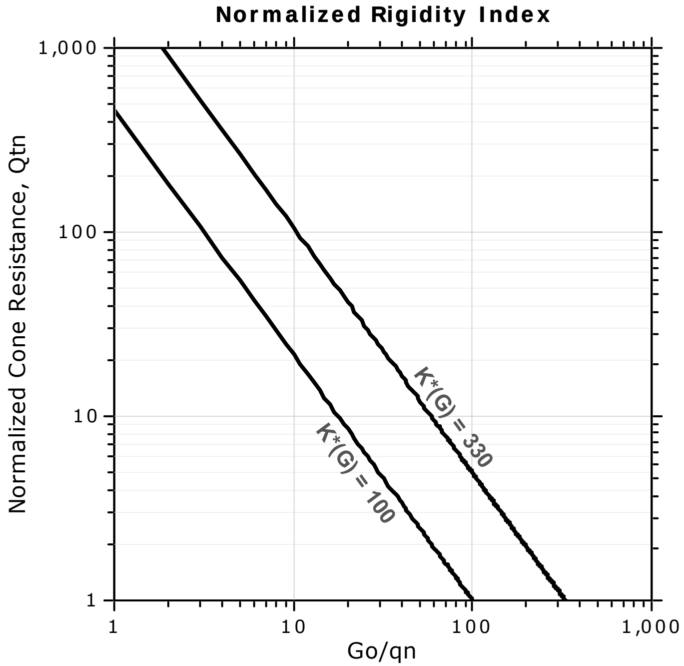
Mod. SBTn legend

🟥 1. CCS: ClayLike - Contractive, Sensitive
🟦 2. CC: Clay-like - Contractive
■ 3. CD: Clay-Like: Dilative
🟩 4. TC: Transitional - Contractive
🟩 5. TD: Transitional - Dilative
🟧 6. SC: Sand-like - Contractive
🟫 7. SD: Sand-like - Dilative

Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure
(e.g. age/cementation)

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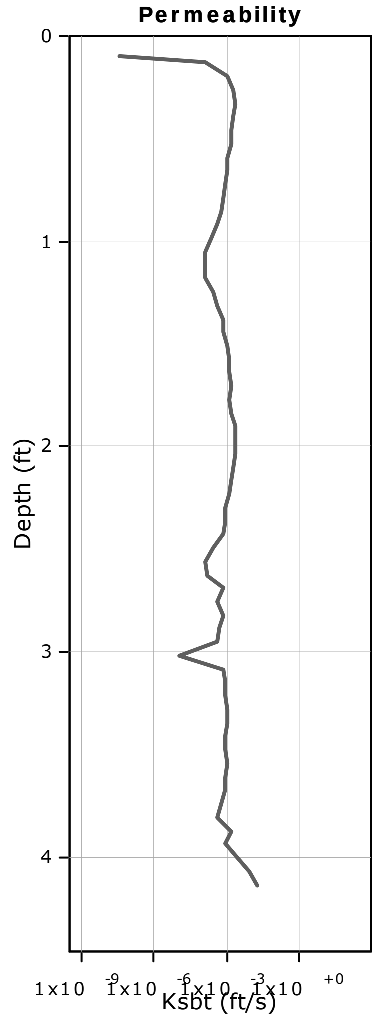
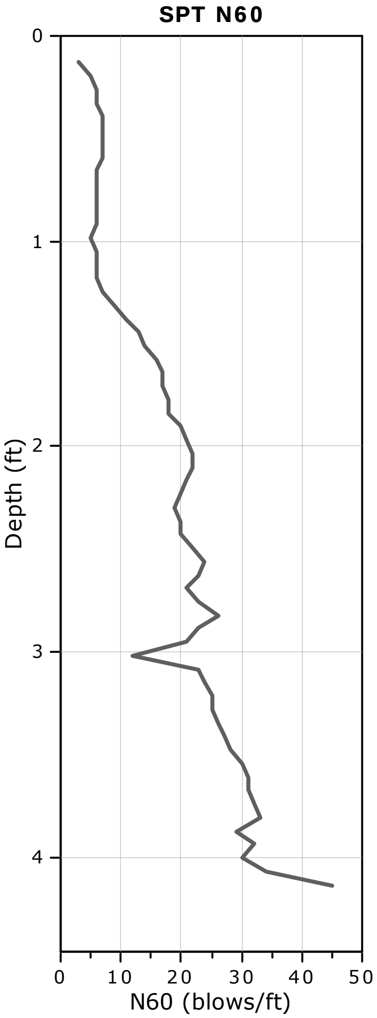
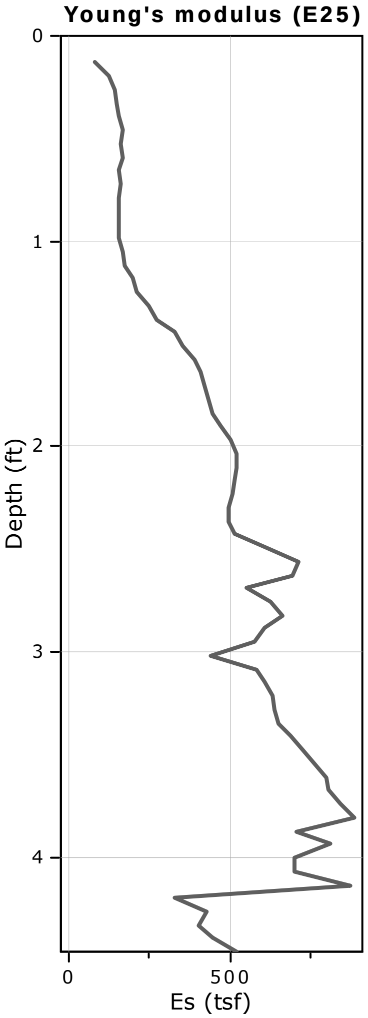
Mays Landing, NJ

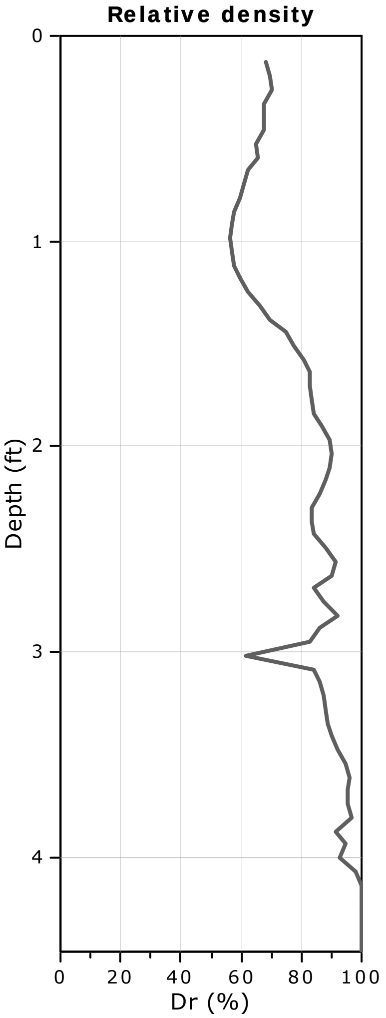
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

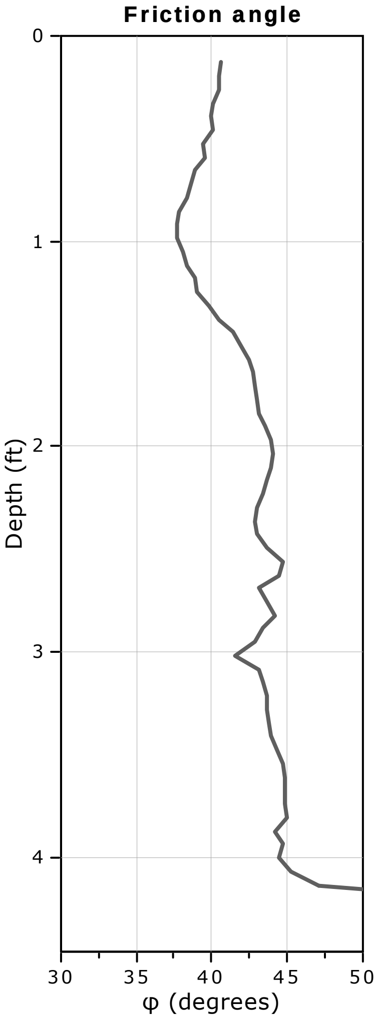
CPT: CPT-8
Total depth: 4.46 ft











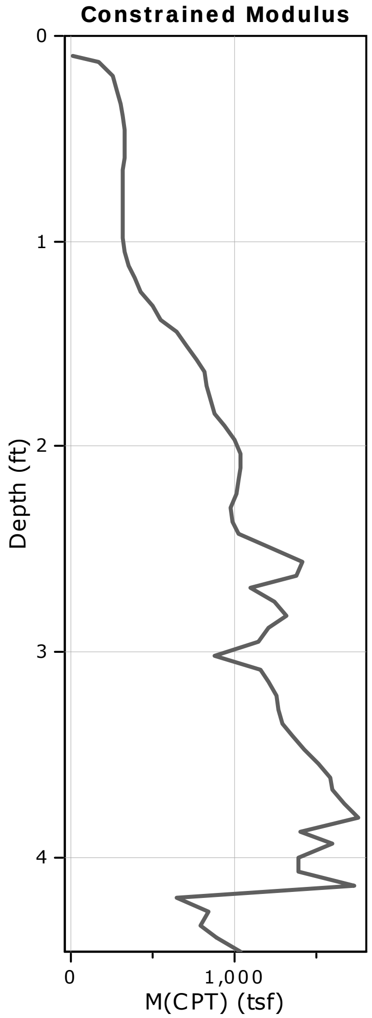
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

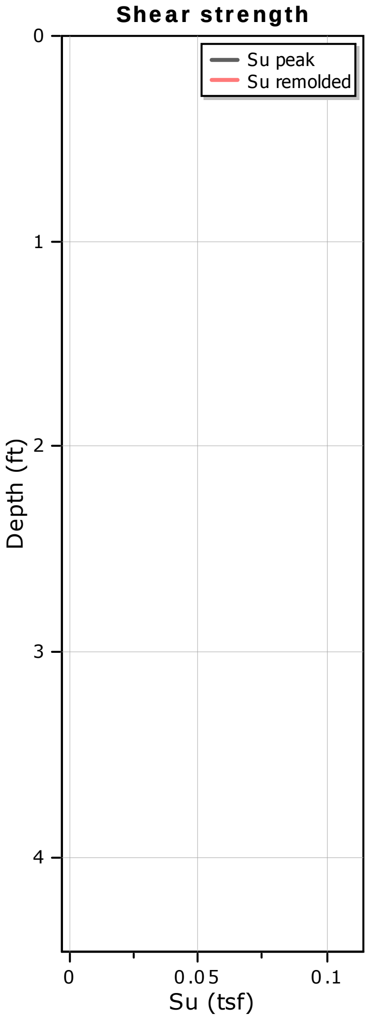
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
● User defined estimation data

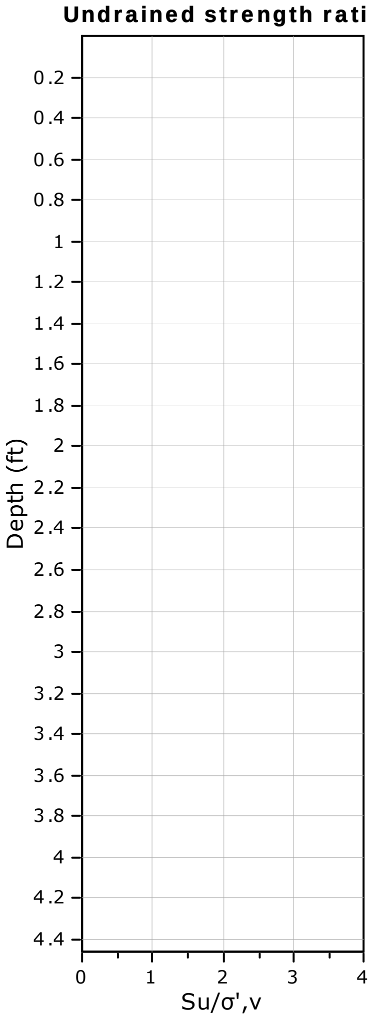
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

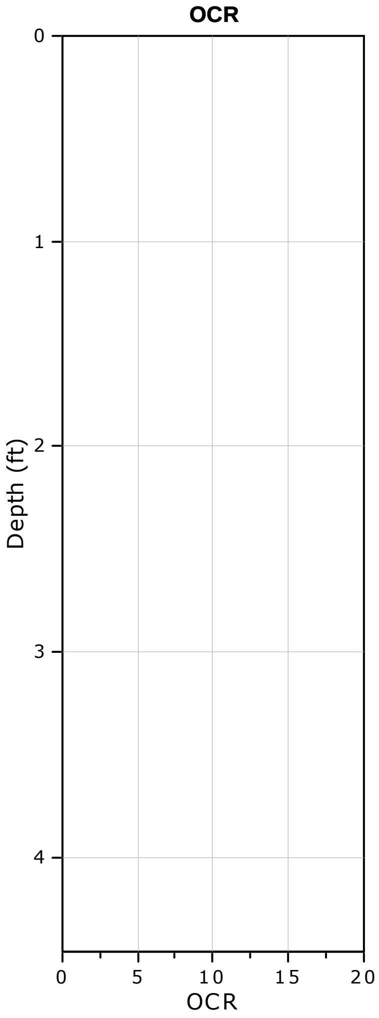
CPT: CPT-8
Total depth: 4.46 ft


Constrained Modulus


Shear modulus


Shear strength


Undrained strength ratio


OCR

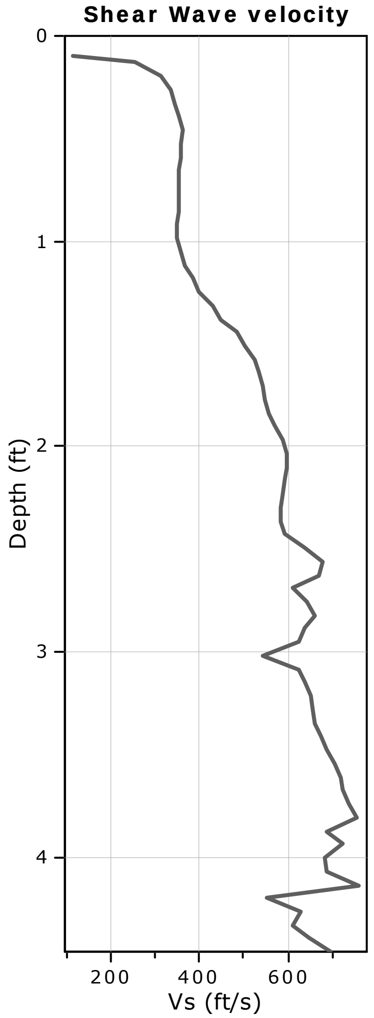
Calculation parameters

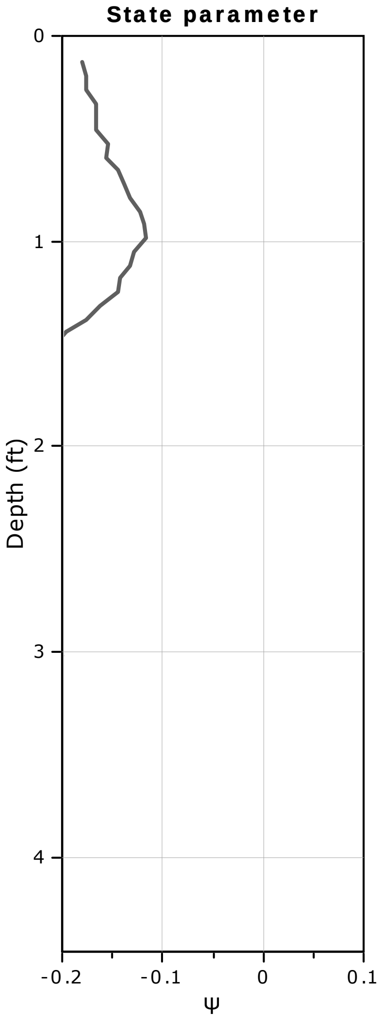
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

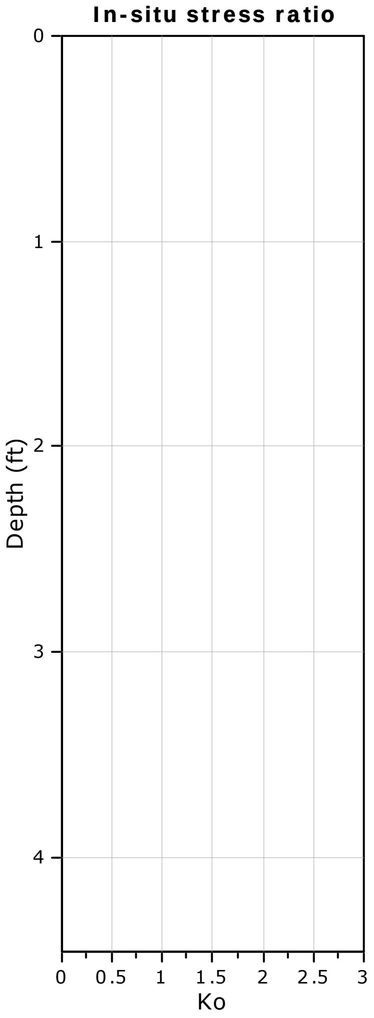
OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

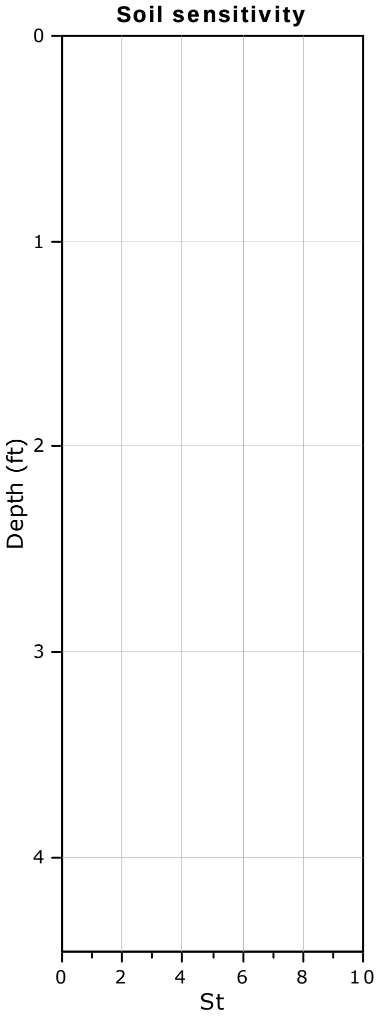
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

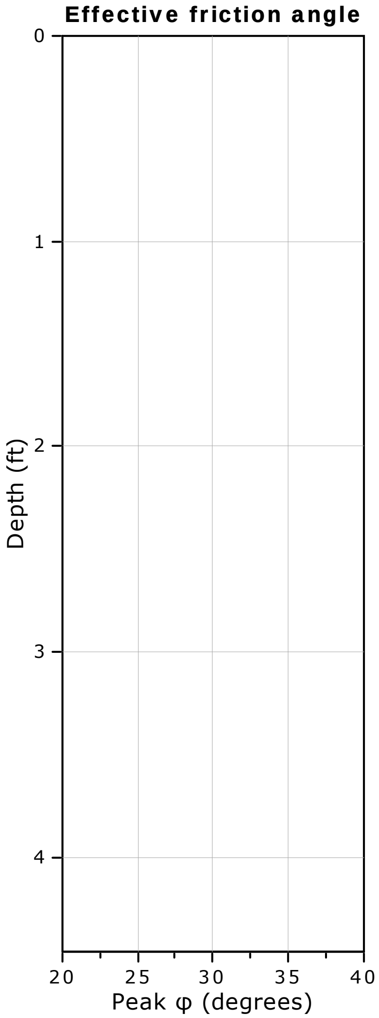
CPT: CPT-8
Total depth: 4.46 ft









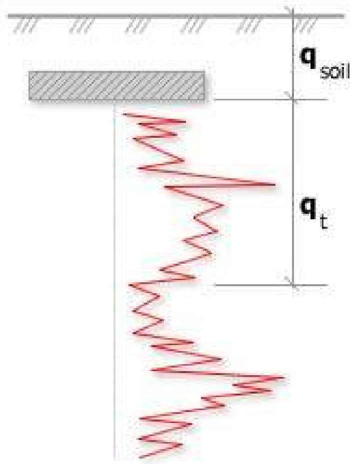


Calculation parameters

Soil Sensitivity factor, N_S: 350.00

—●— User defined estimation data

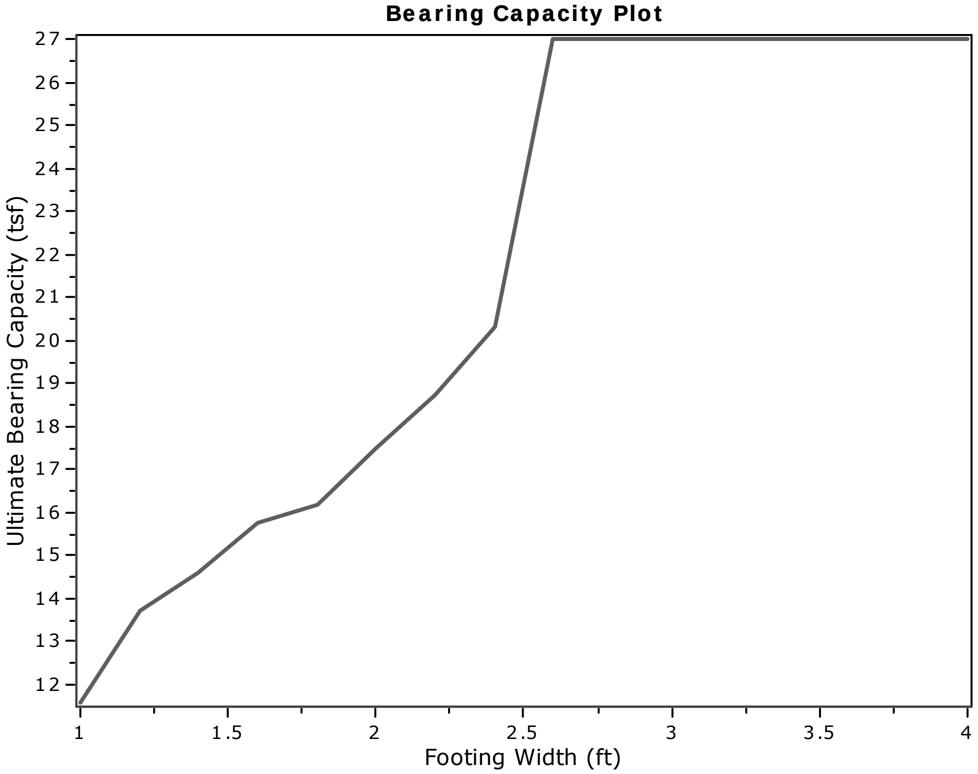
Project: **Langan** **CPT: CPT-8**
Location: **BL England Substation - Marmora NJ** Total depth: 4.46 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

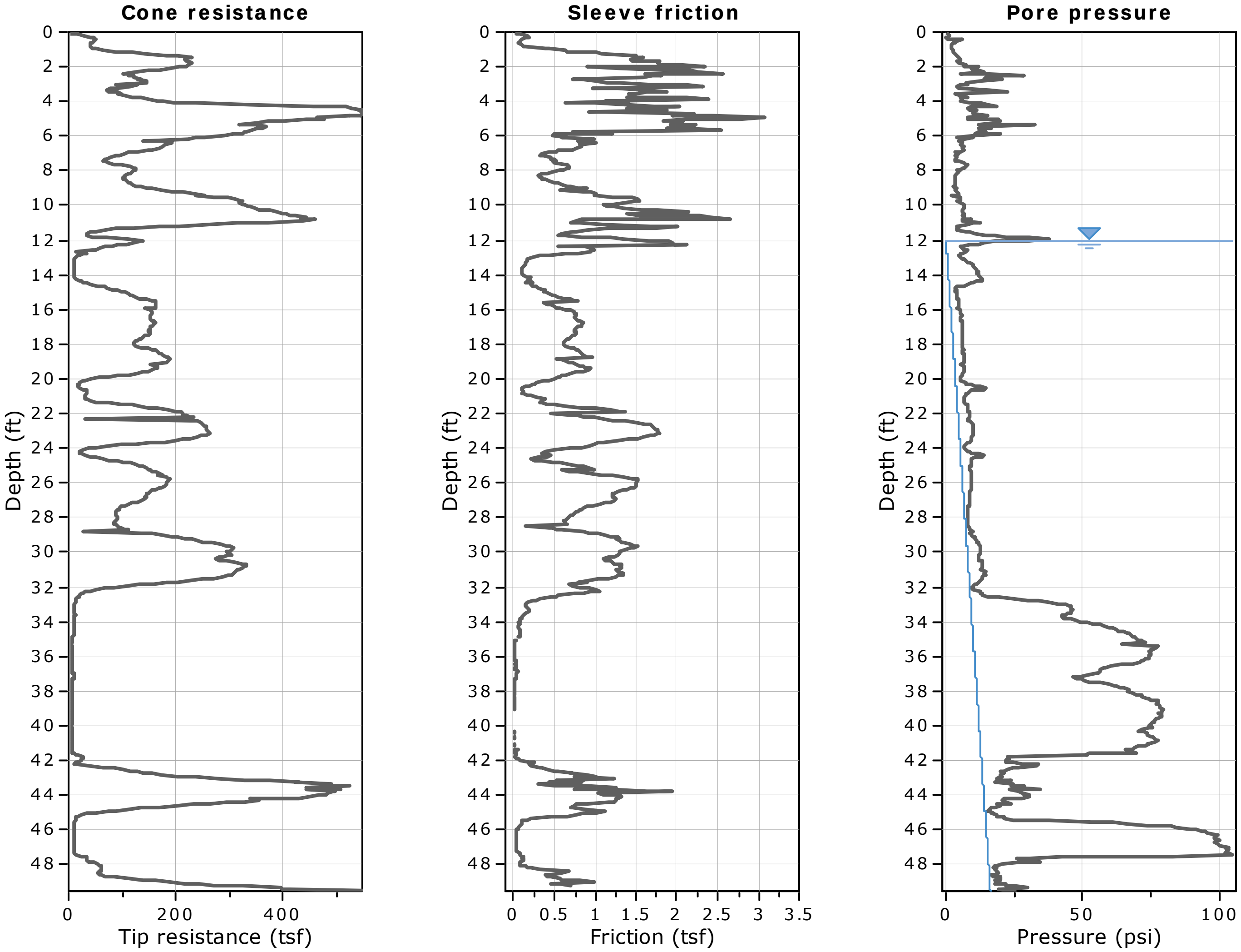


:: Tabular results ::

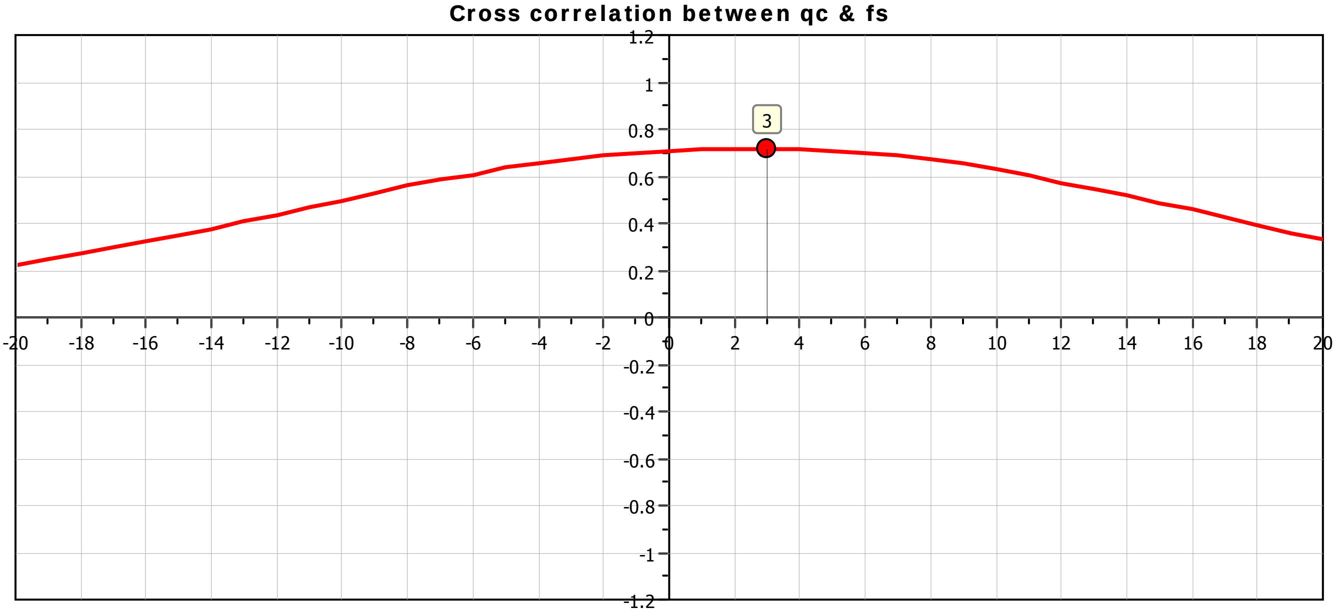
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	57.69	0.20	0.03	11.57
2	1.20	0.50	2.30	68.27	0.20	0.03	13.68
3	1.40	0.50	2.60	72.91	0.20	0.03	14.61
4	1.60	0.50	2.90	78.71	0.20	0.03	15.77
5	1.80	0.50	3.20	80.66	0.20	0.03	16.16
6	2.00	0.50	3.50	87.21	0.20	0.03	17.47
7	2.20	0.50	3.80	93.47	0.20	0.03	18.72
8	2.40	0.50	4.10	101.44	0.20	0.03	20.32
9	2.60	0.50	4.40	134.89	0.20	0.03	27.01
10	2.80	0.50	4.70	134.89	0.20	0.03	27.01
11	3.00	0.50	5.00	134.89	0.20	0.03	27.01
12	3.20	0.50	5.30	134.89	0.20	0.03	27.01
13	3.40	0.50	5.60	134.89	0.20	0.03	27.01
14	3.60	0.50	5.90	134.89	0.20	0.03	27.01
15	3.80	0.50	6.20	134.89	0.20	0.03	27.01
16	4.00	0.50	6.50	134.89	0.20	0.03	27.01

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

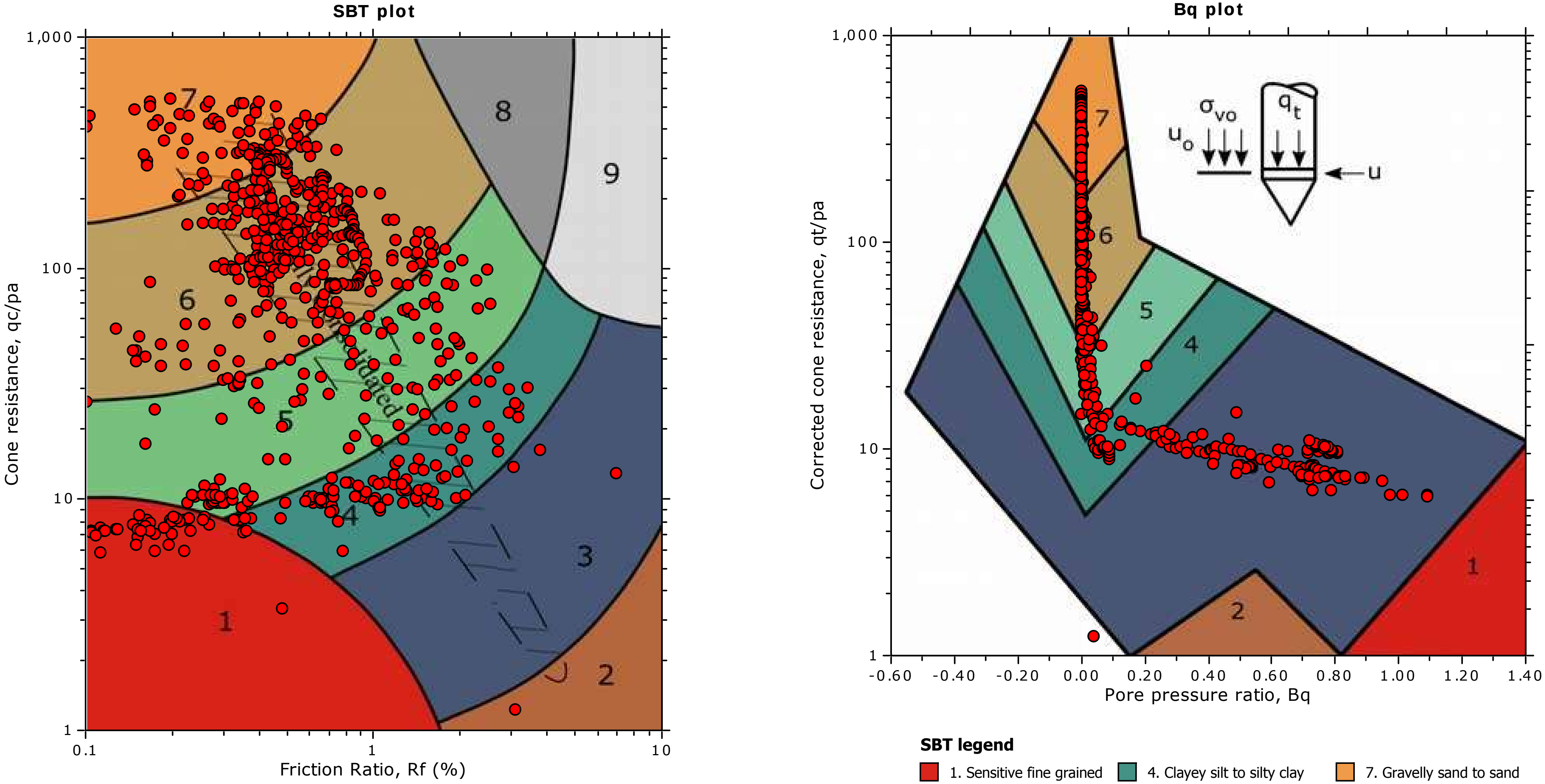
CPT: CPT-8a
Total depth: 49.54 ft



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



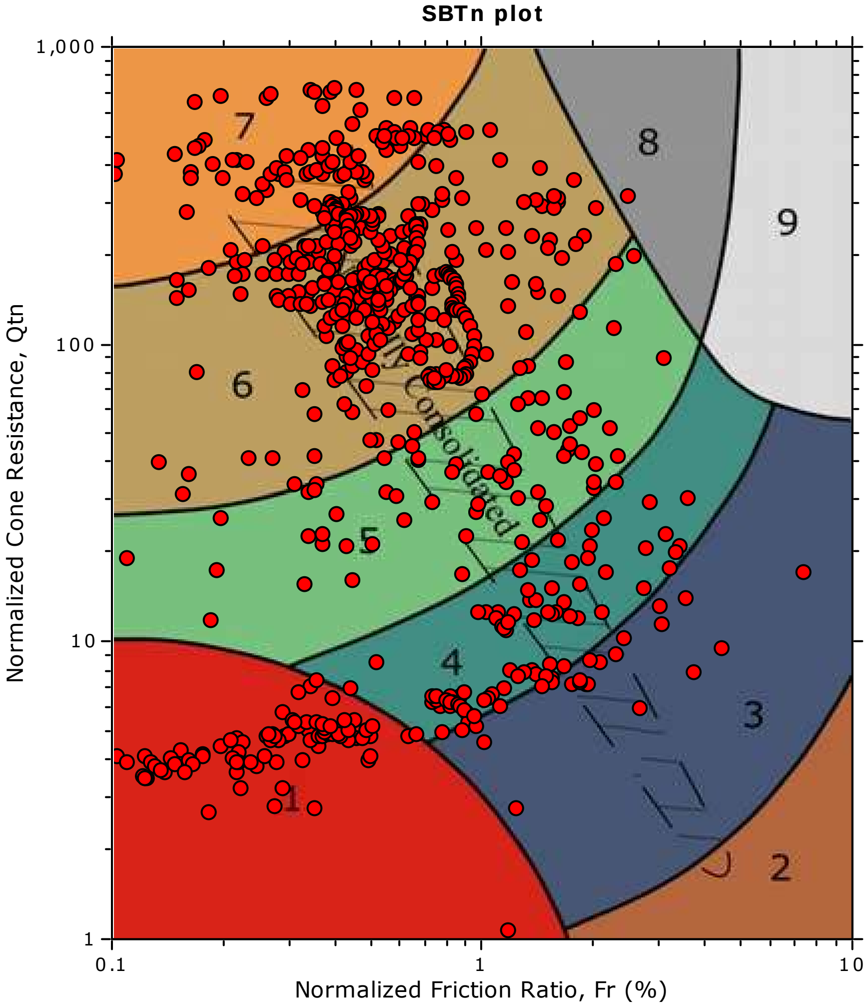
SBT - Bq plots

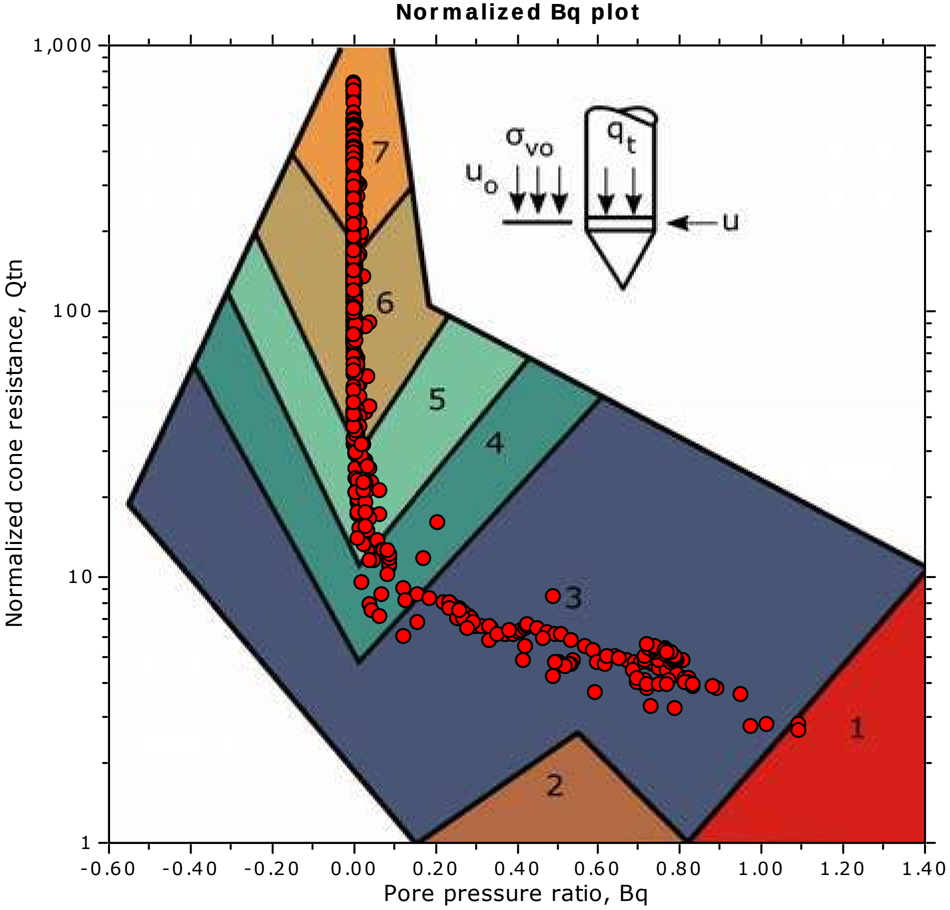


SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬜ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

SBT - Bq plots (normalized)

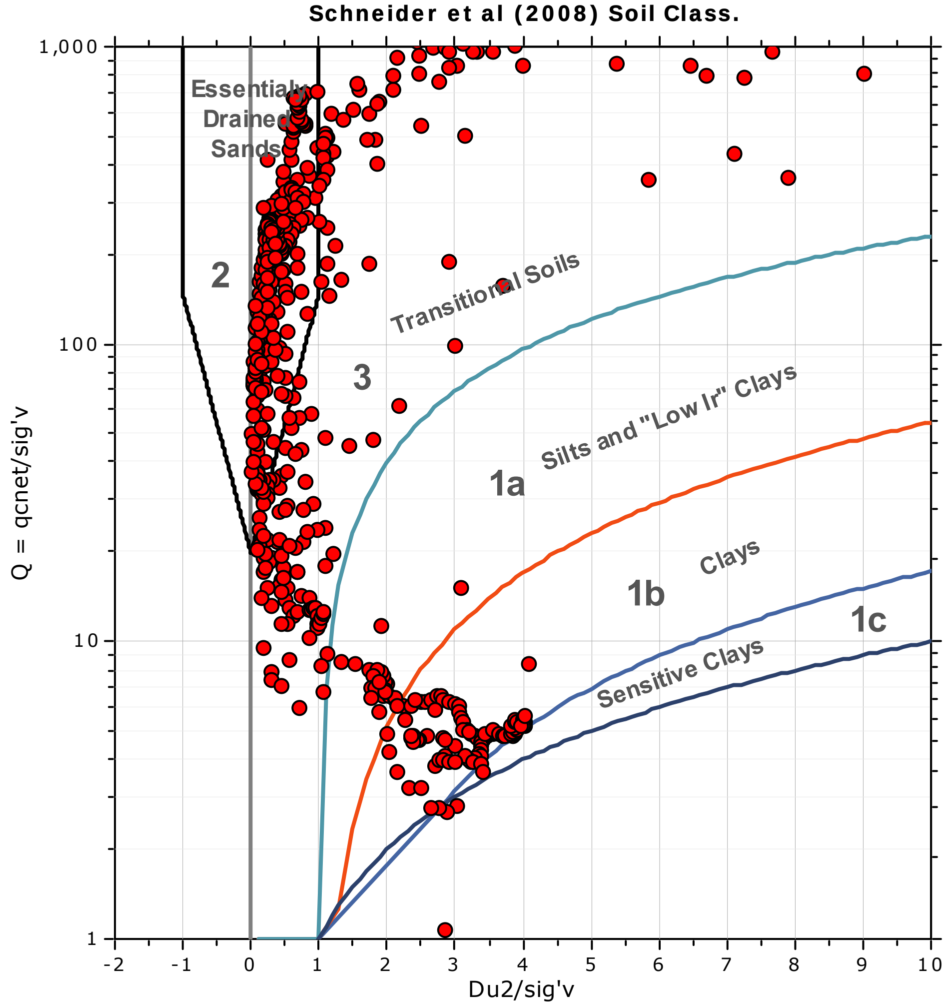


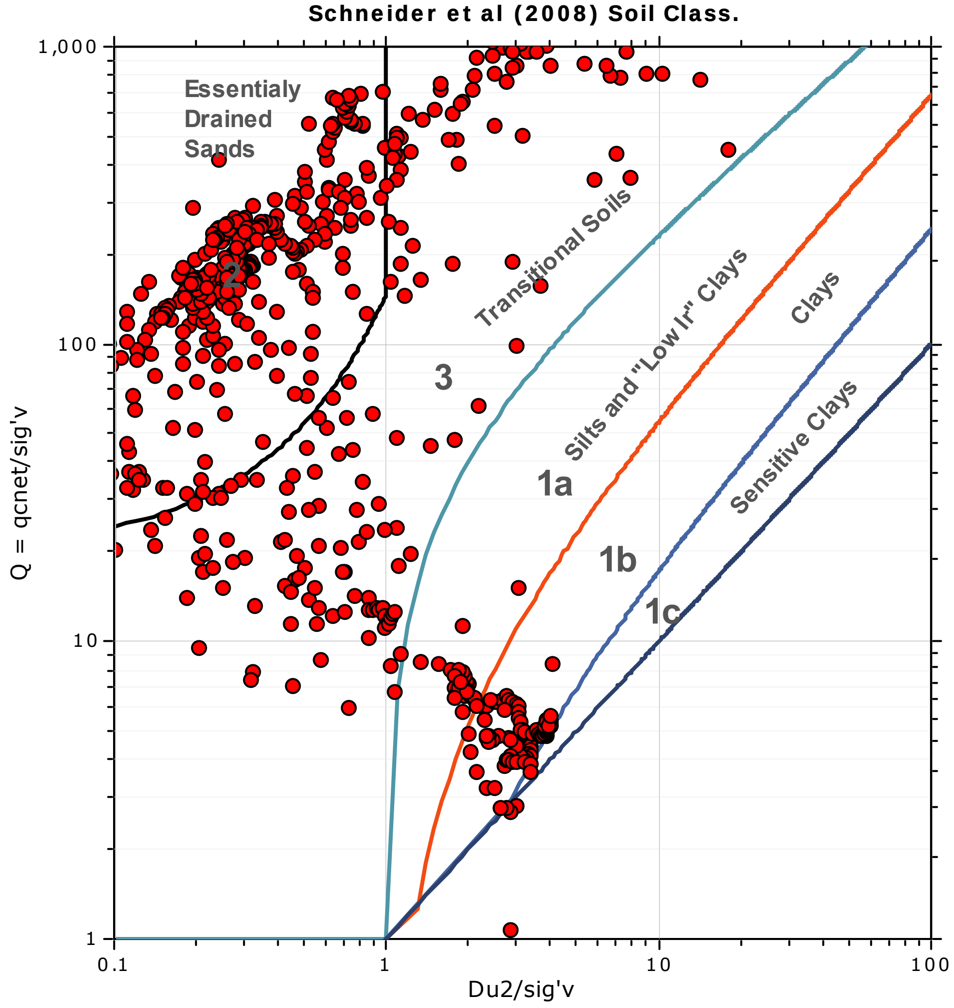


SBTn legend

🟥 1. Sensitive fine grained
▨ 2. Organic material
▨ 3. Clay to silty clay
▨ 4. Clayey silt to silty clay
▨ 5. Silty sand to sandy silt
▨ 6. Clean sand to silty sand
▨ 7. Gravelly sand to sand
▨ 8. Very stiff sand to clayey sand
☐ 9. Very stiff fine grained

Bq plots (Schneider)





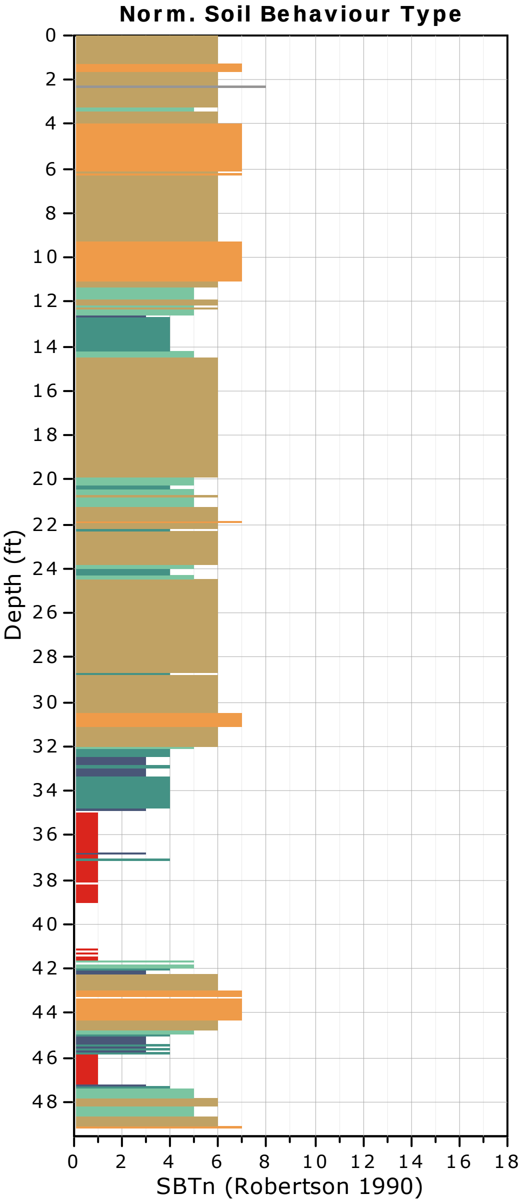
Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

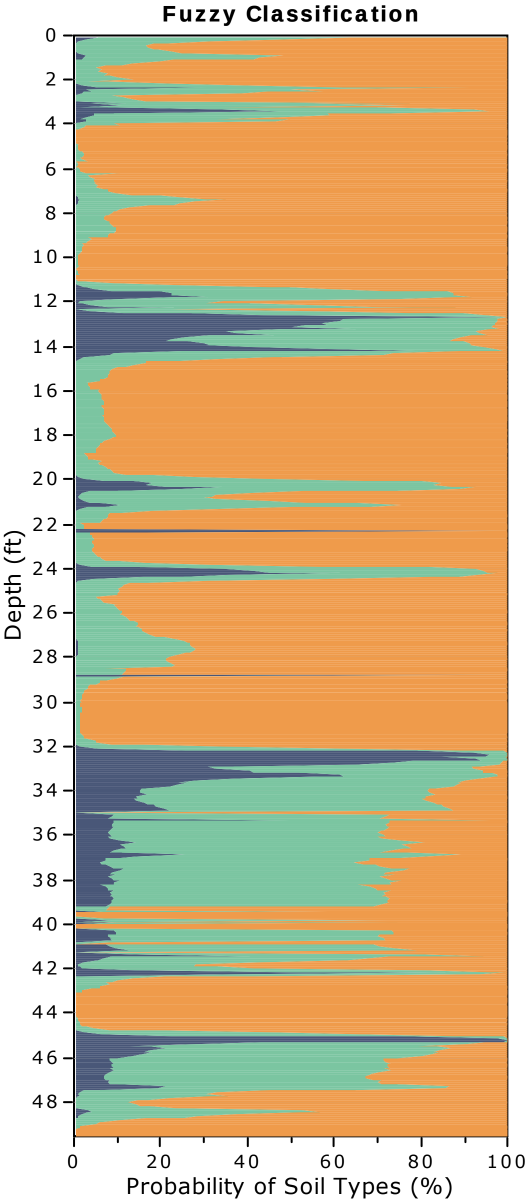
Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-8a

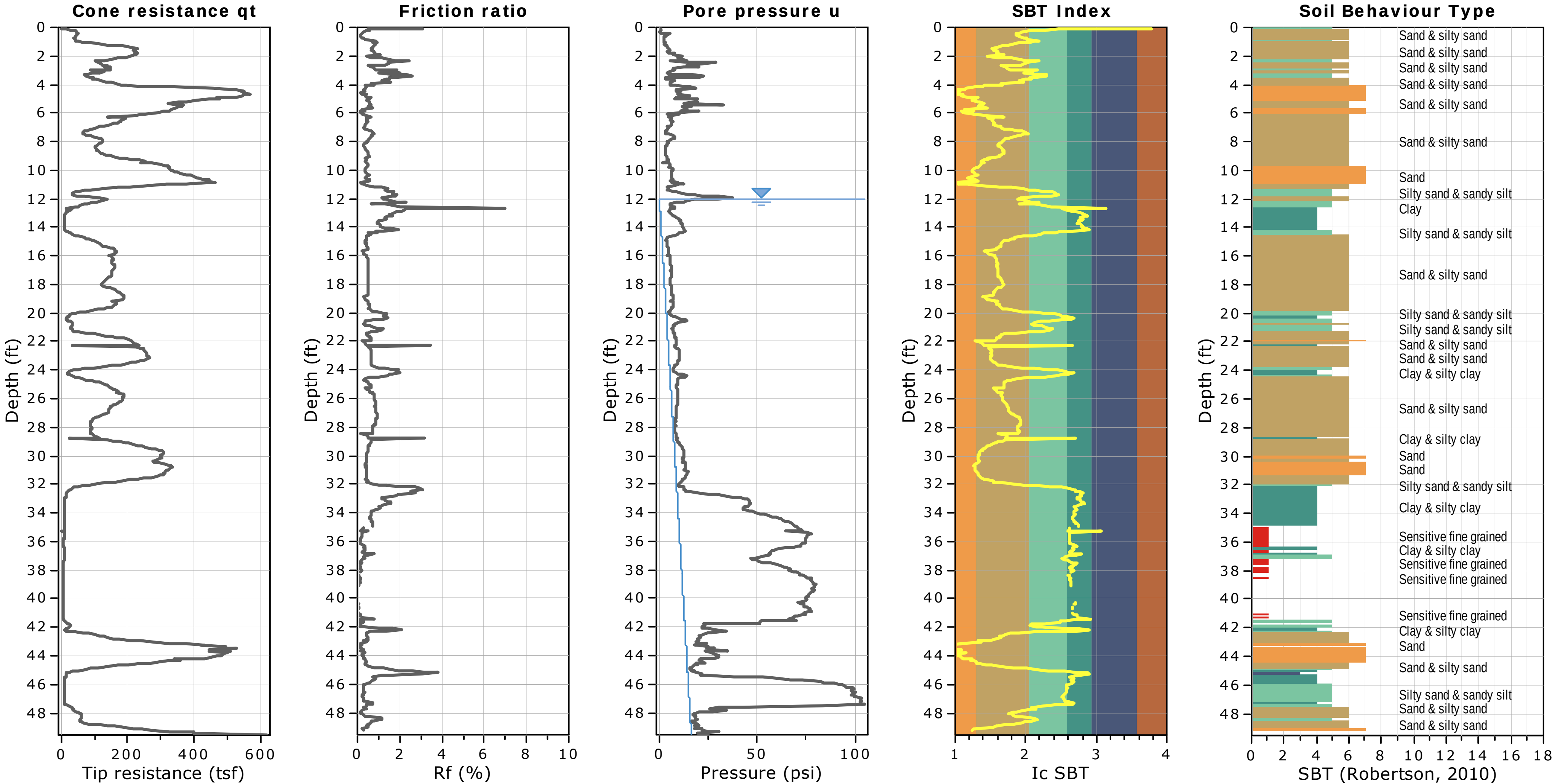
Total depth: 49.54 ft





Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-8a
Total depth: 49.54 ft



SBT legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟫 6. Clean sand to silty sand
🟧 7. Gravely sand to sand
⬜ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

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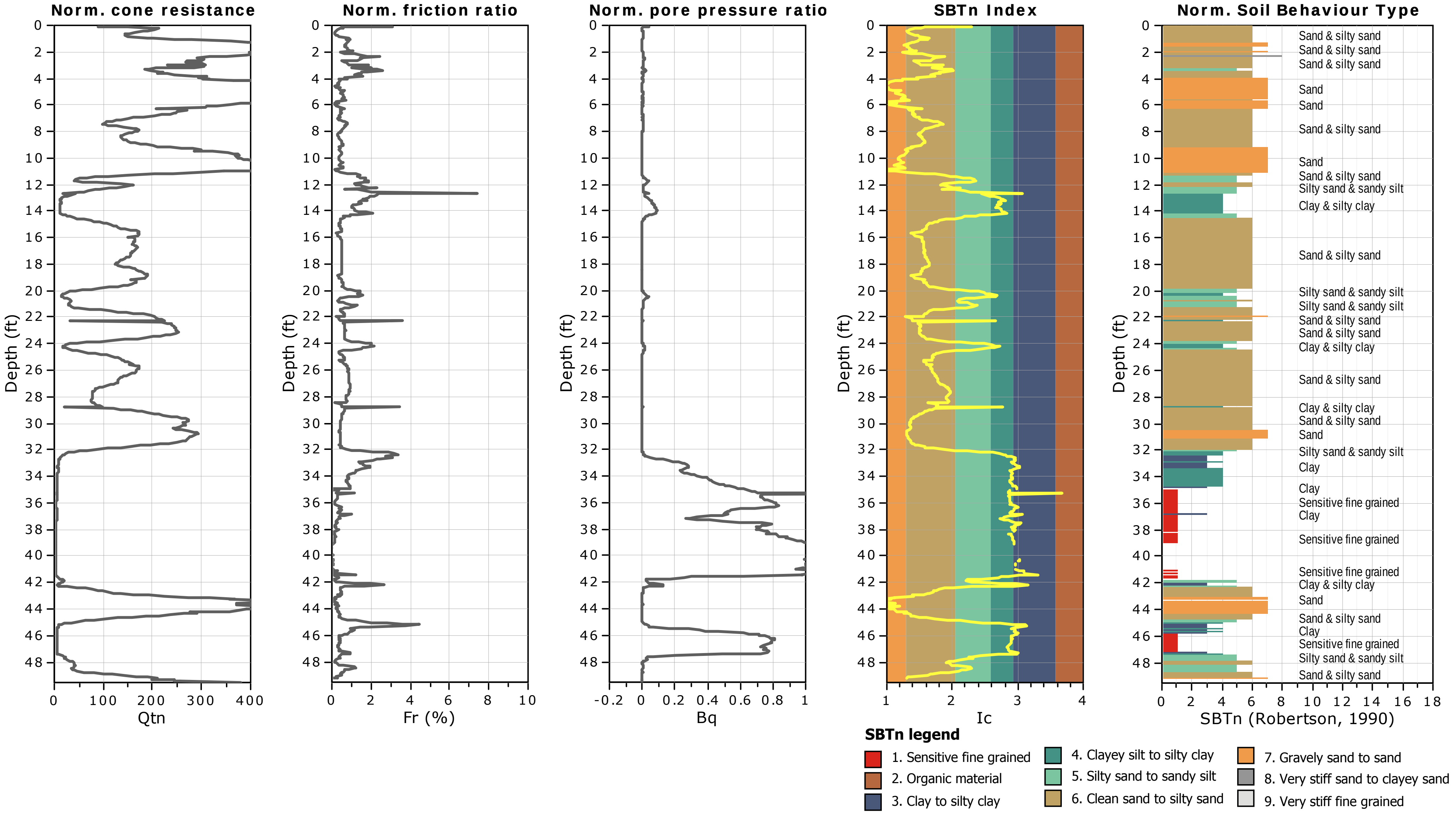
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-8a
Total depth: 49.54 ft

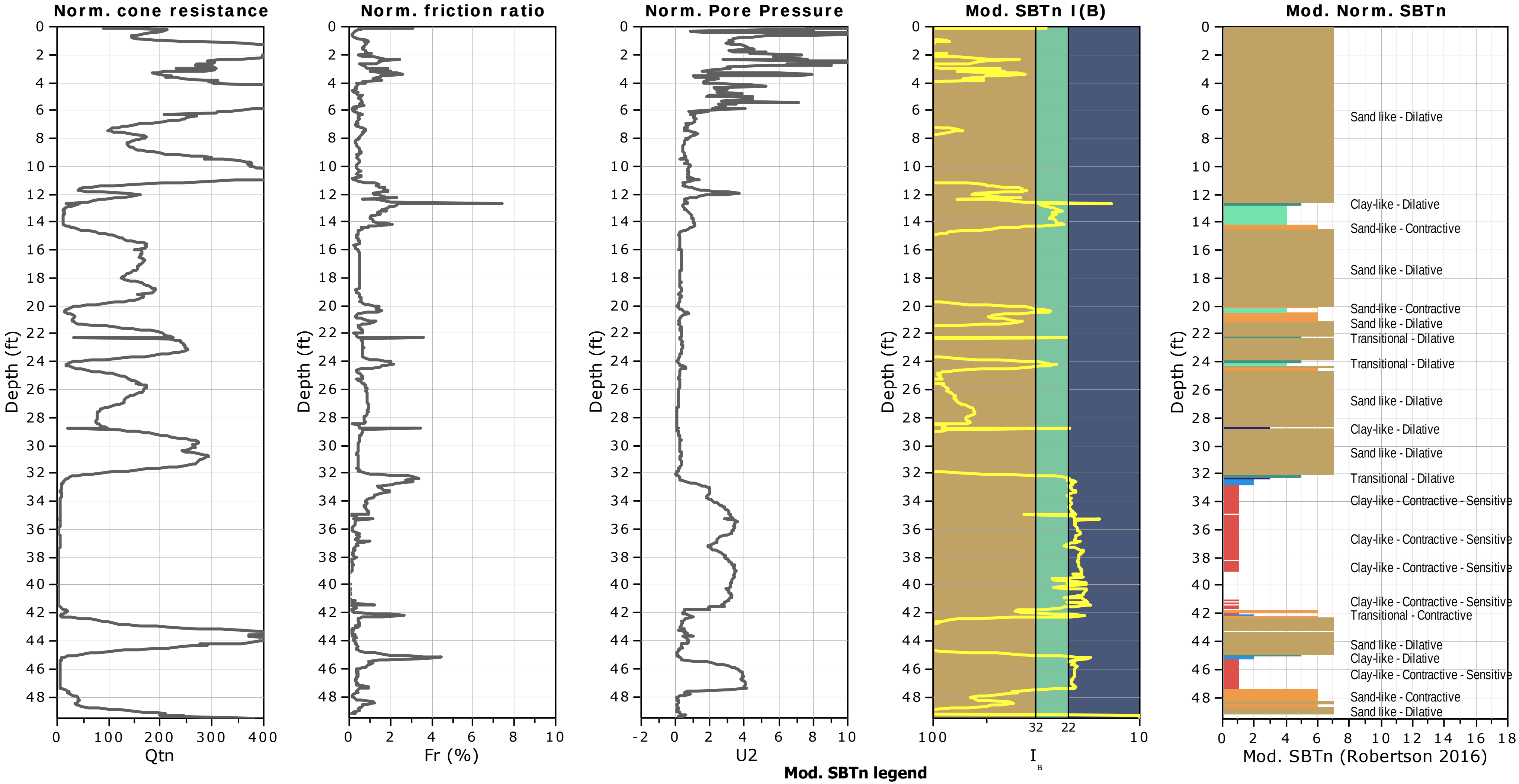


Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-8a

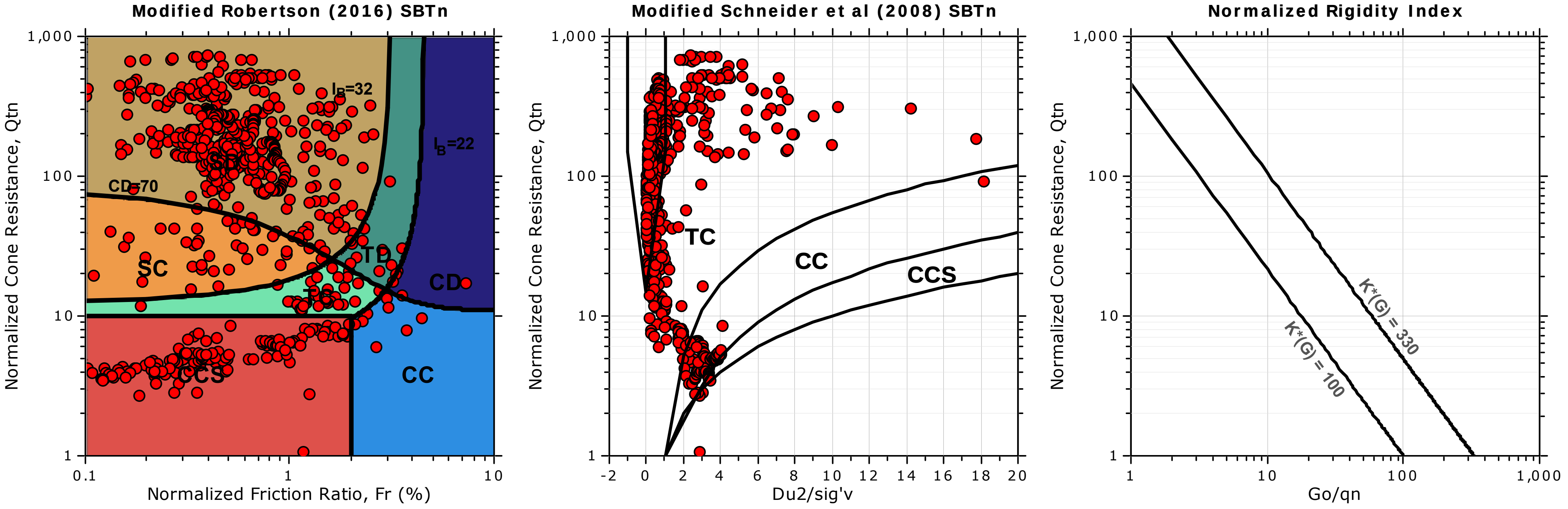
Total depth: 49.54 ft



Mod. SBTn legend

🟥 1. CCS: ClayLike - Contractive, Sensitive
🟦 2. CC: Clay-like - Contractive
■ 3. CD: Clay-Like: Dilative
🟩 4. TC: Transitional - Contractive
🟩 5. TD: Transitional - Dilative
🟧 6. SC: Sand-like - Contractive
🟫 7. SD: Sand-like - Dilative

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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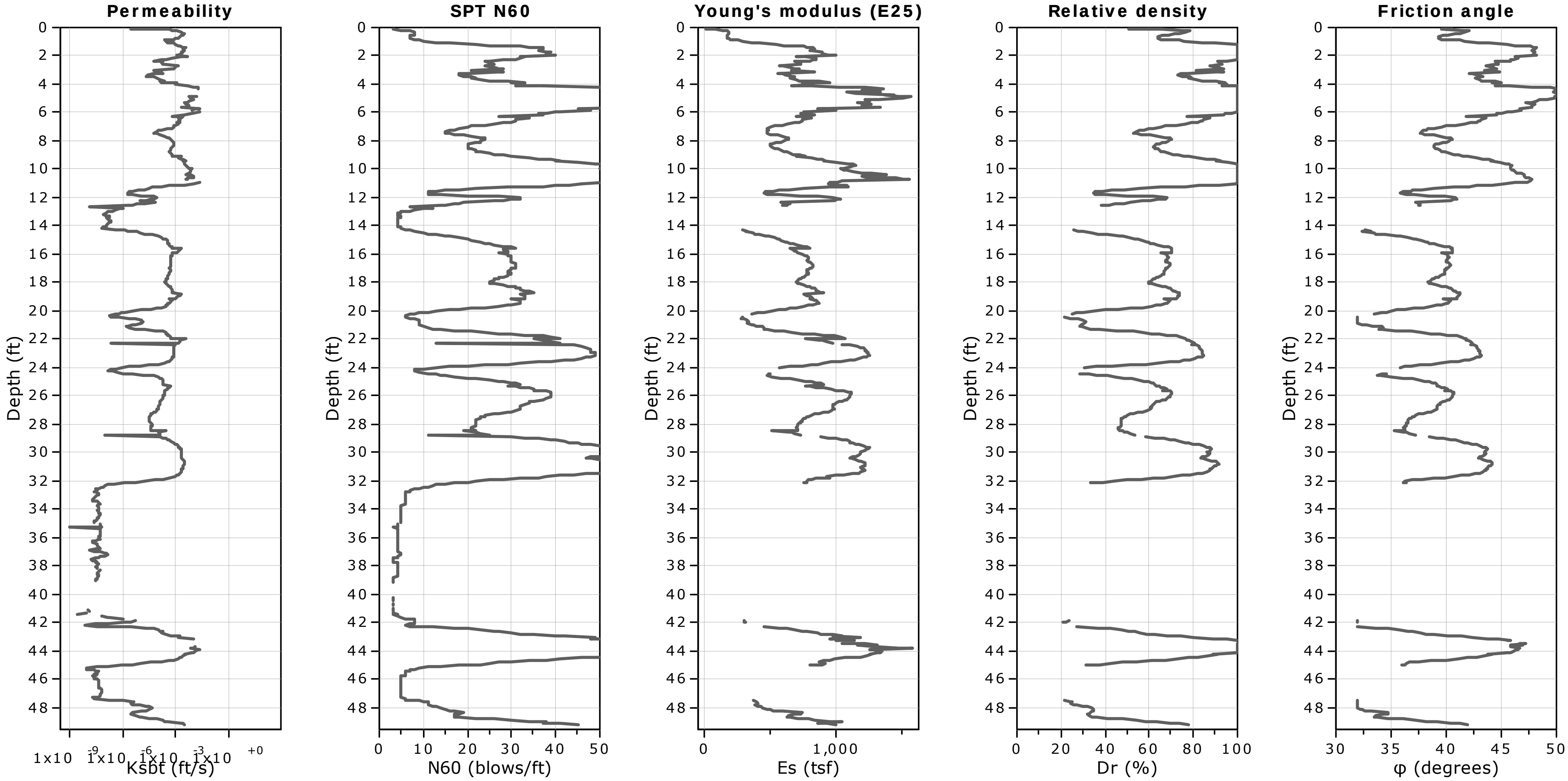
Mays Landing, NJ

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: CPT-8a

Total depth: 49.54 ft



Calculation parameters

Permeability: Based on SBT_n

SPT N_{60}: Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0

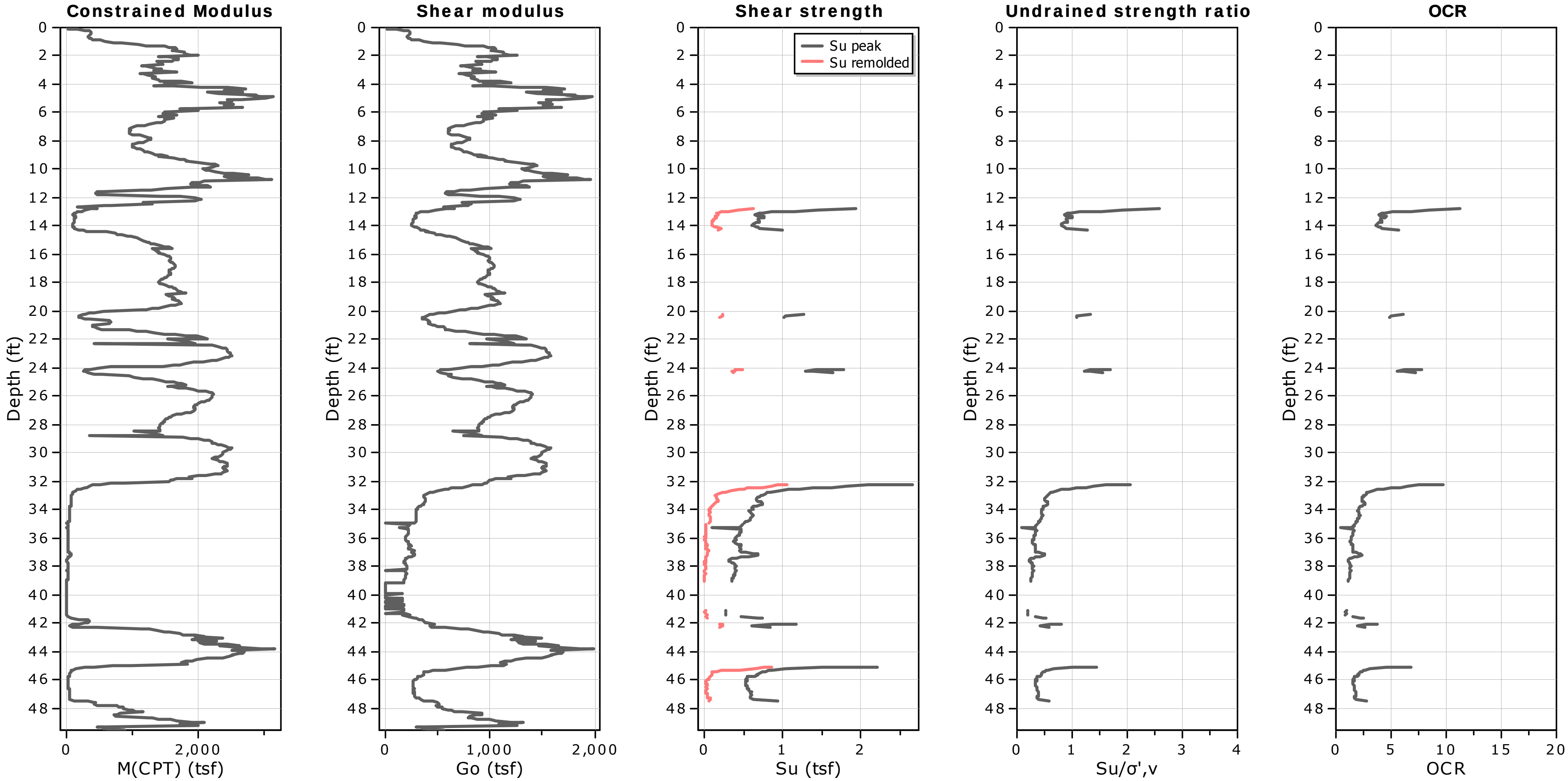
Phi: Based on Kulhawy & Mayne (1990)

—●— User defined estimation data

Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan** **CPT: CPT-8a**

Location: **BL England Substation - Marmora NJ** Total depth: 49.54 ft



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)

Go: Based on variable *alpha* using I_c (Robertson, 2009)

Undrained shear strength cone factor for clays, N_{kt}: 14

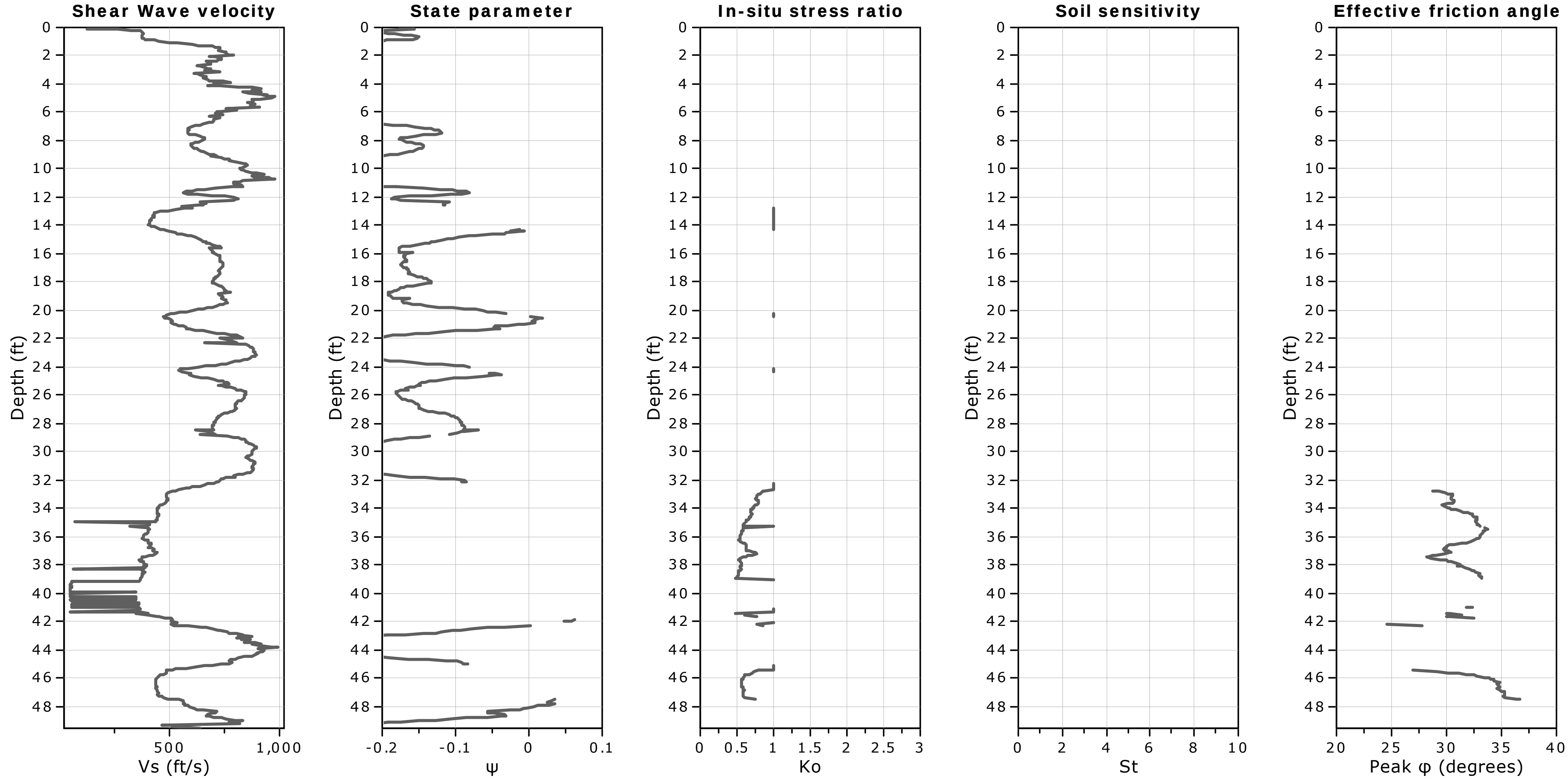
OCR factor for clays, N_{kt}: 0.33

● User defined estimation data

● Flat Dilatometer Test data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: CPT-8a
Total depth: 49.54 ft



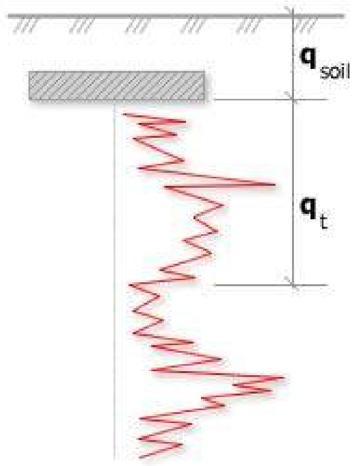
Calculation parameters

Soil Sensitivity factor, N_S: 350.00

● User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

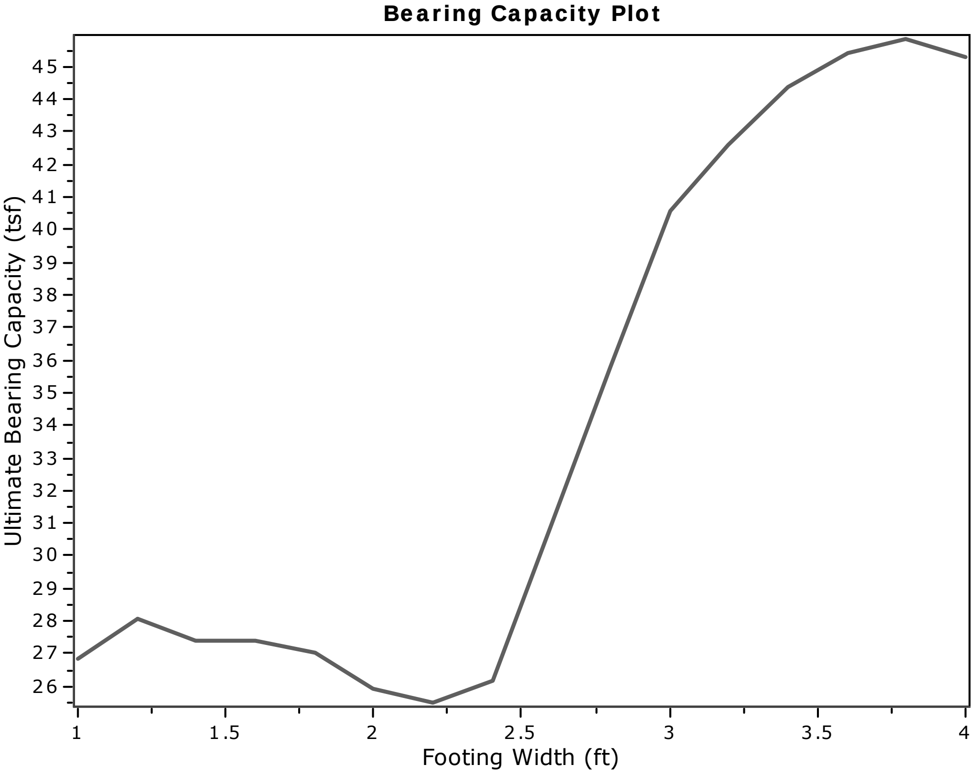
CPT: CPT-8a
Total depth: 49.54 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

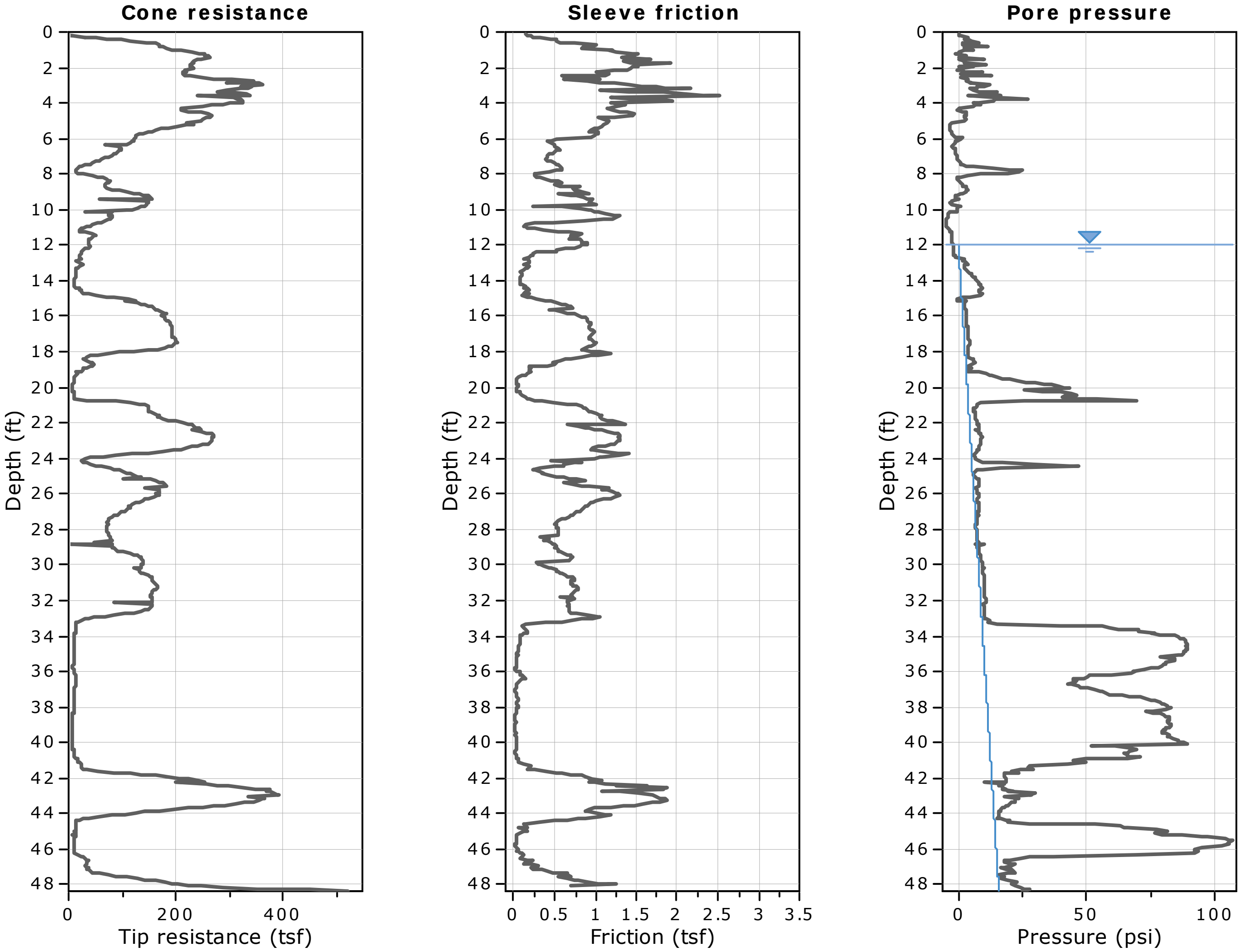
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	134.09	0.20	0.03	26.85
2	1.20	0.50	2.30	140.14	0.20	0.03	28.06
3	1.40	0.50	2.60	136.74	0.20	0.03	27.38
4	1.60	0.50	2.90	136.65	0.20	0.03	27.36
5	1.80	0.50	3.20	135.05	0.20	0.03	27.04
6	2.00	0.50	3.50	129.29	0.20	0.03	25.89
7	2.20	0.50	3.80	127.30	0.20	0.03	25.49
8	2.40	0.50	4.10	130.69	0.20	0.03	26.17
9	2.60	0.50	4.40	154.17	0.20	0.03	30.86
10	2.80	0.50	4.70	178.70	0.20	0.03	35.77
11	3.00	0.50	5.00	202.60	0.20	0.03	40.55
12	3.20	0.50	5.30	212.98	0.20	0.03	42.63
13	3.40	0.50	5.60	221.71	0.20	0.03	44.37
14	3.60	0.50	5.90	227.04	0.20	0.03	45.44
15	3.80	0.50	6.20	229.10	0.20	0.03	45.85
16	4.00	0.50	6.50	226.44	0.20	0.03	45.32

Project: Langan

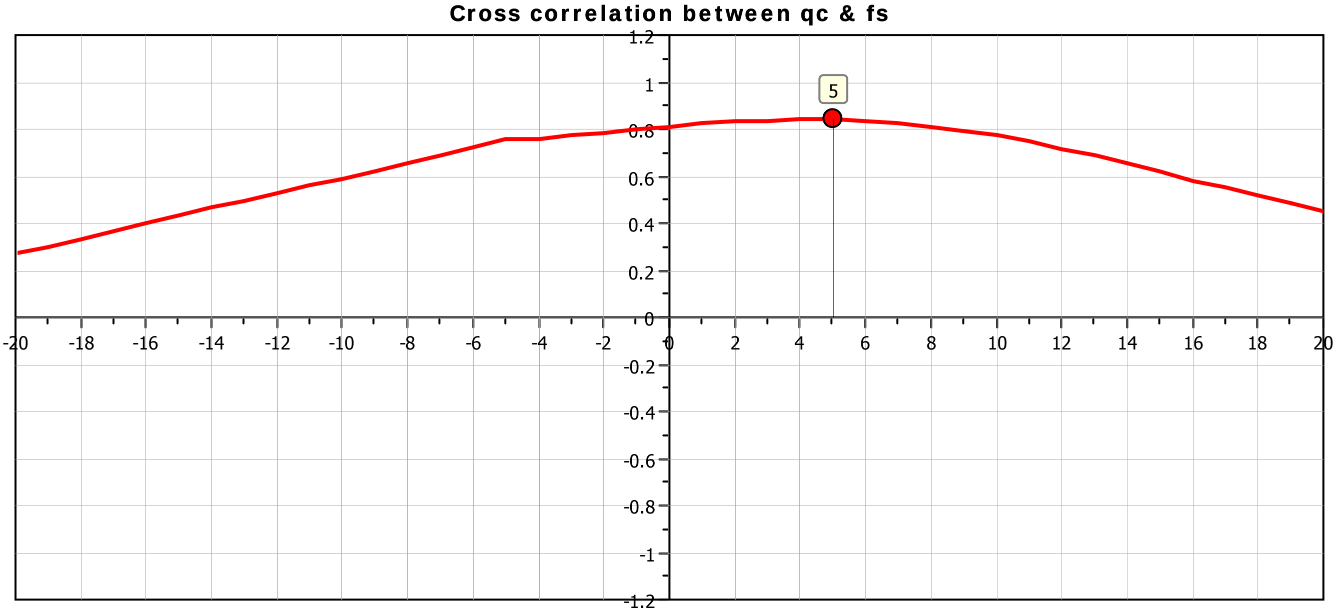
Location: BL England Substation - Marmora NJ

CPT: SCPT-1

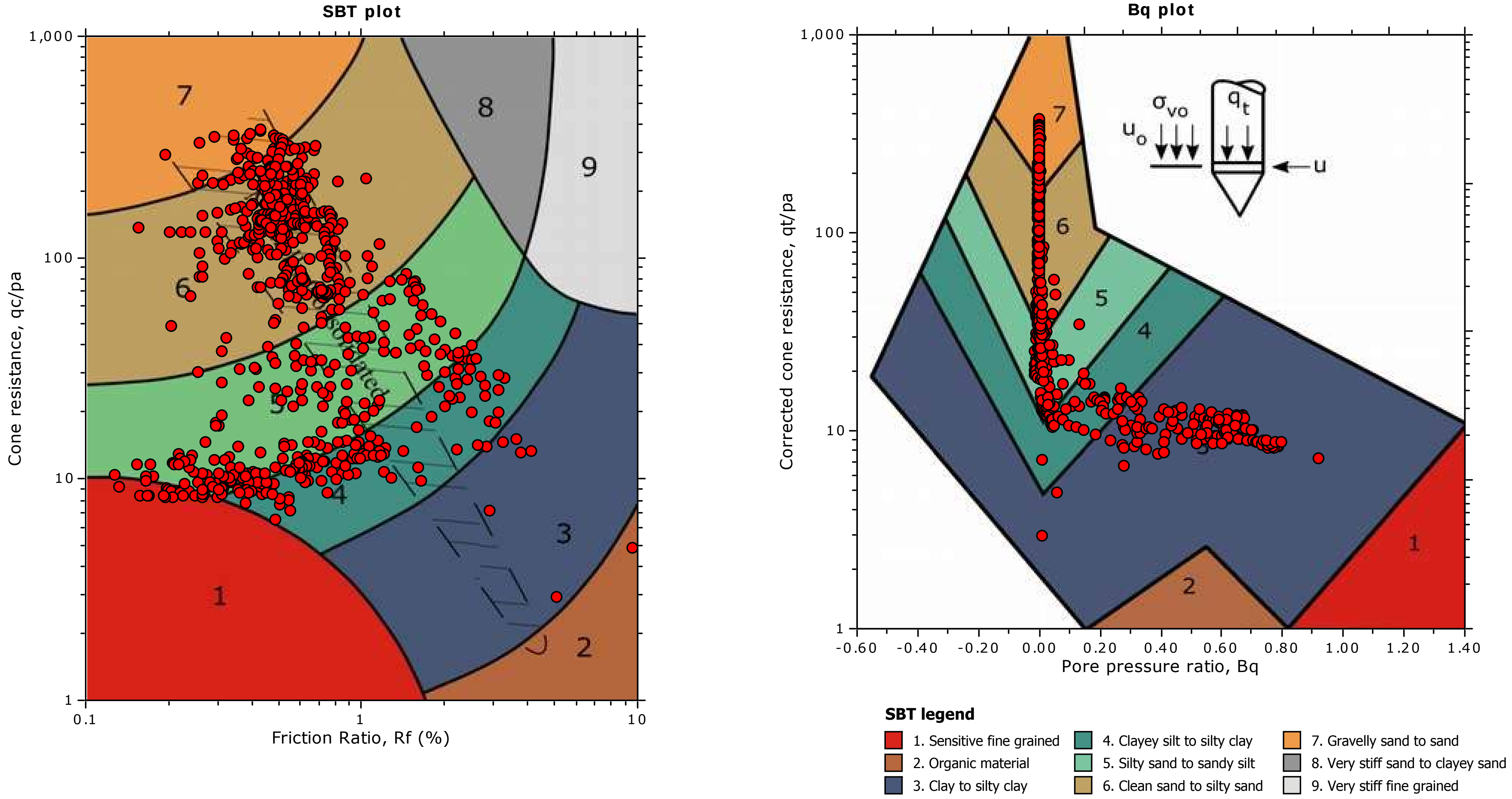
Total depth: 48.36 ft



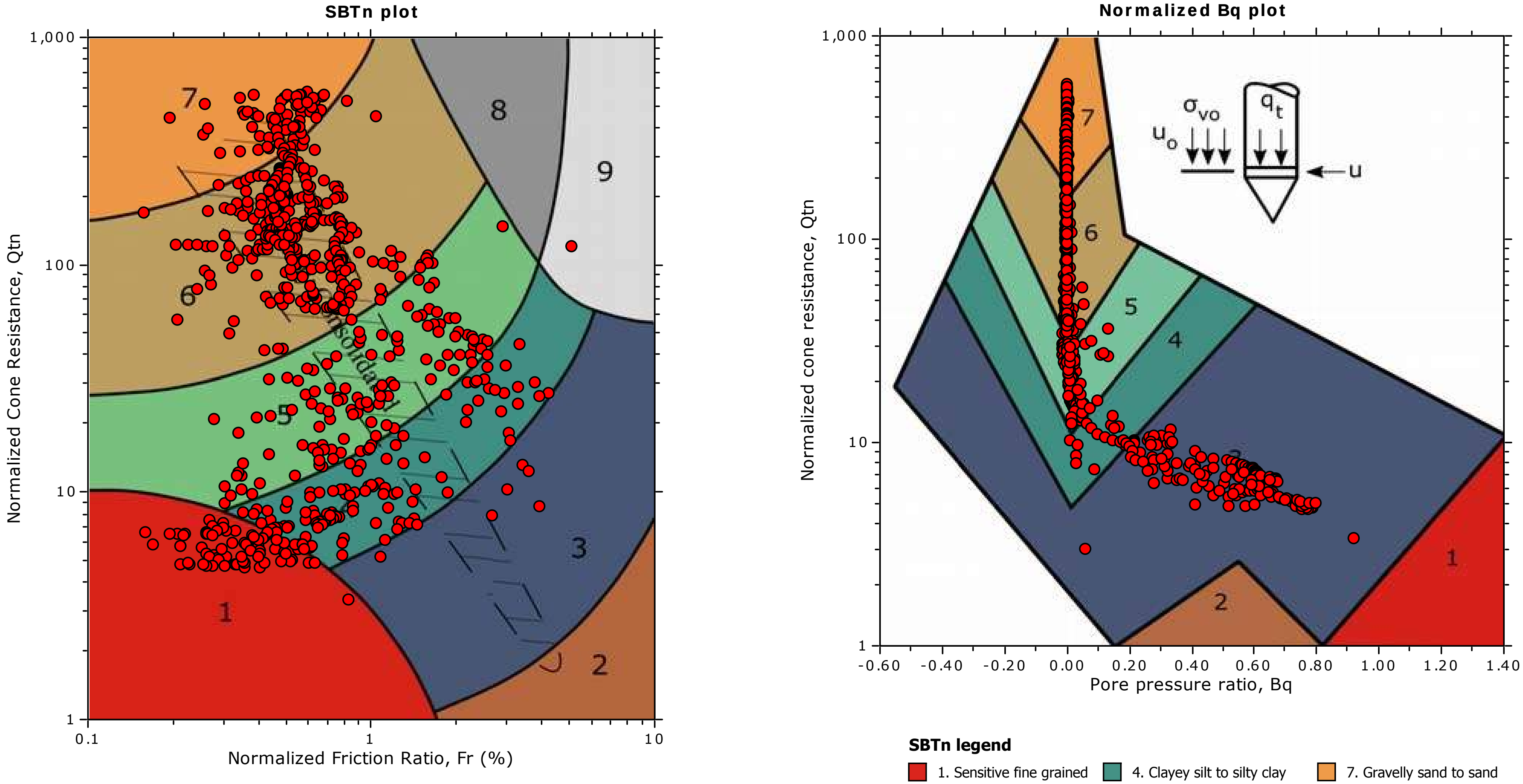
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots


SBT plot
1,000
100
10
1
Cone resistance, qc/pa
0.1
1
10
Friction Ratio, Rf (%)
1
2
3
4
5
6
7
8
9
Bq plot
1,000
100
10
1
Corrected cone resistance, qt/pa
-0.60
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Pore pressure ratio, Bq
σ_{vo}
u_o
q_t
u
SBT legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

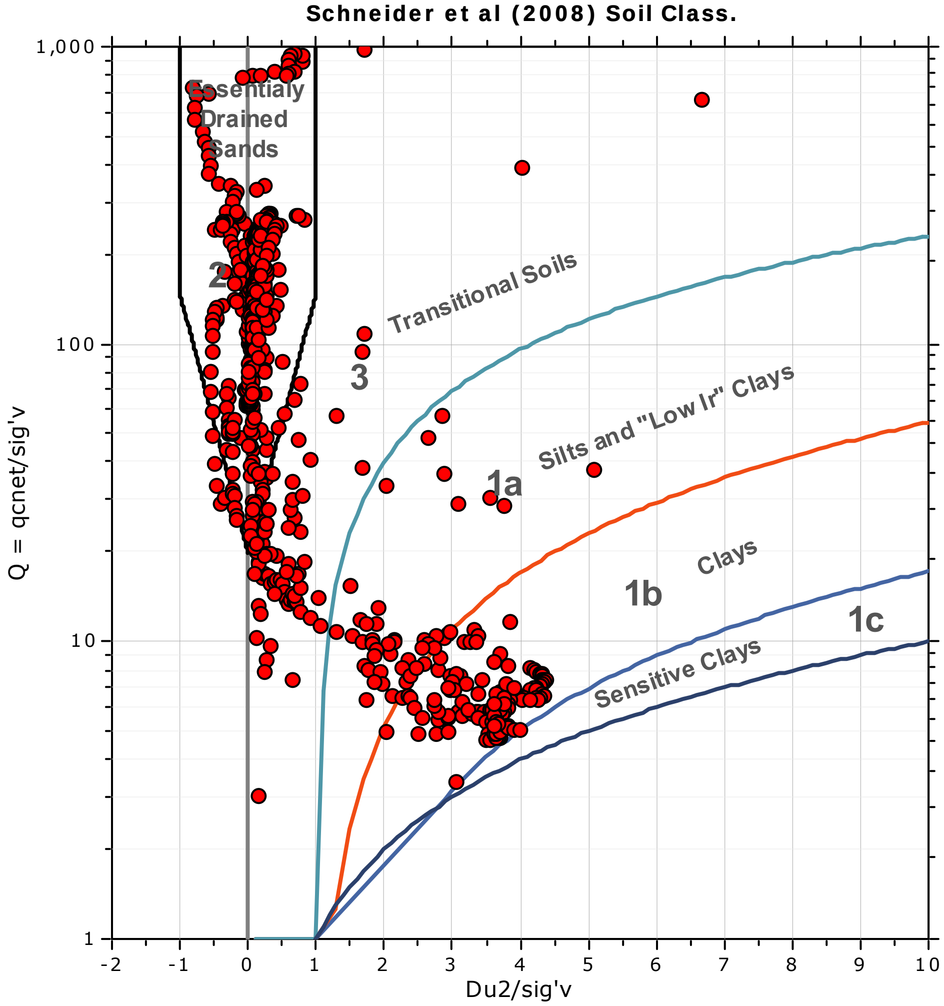
SBT - Bq plots (normalized)

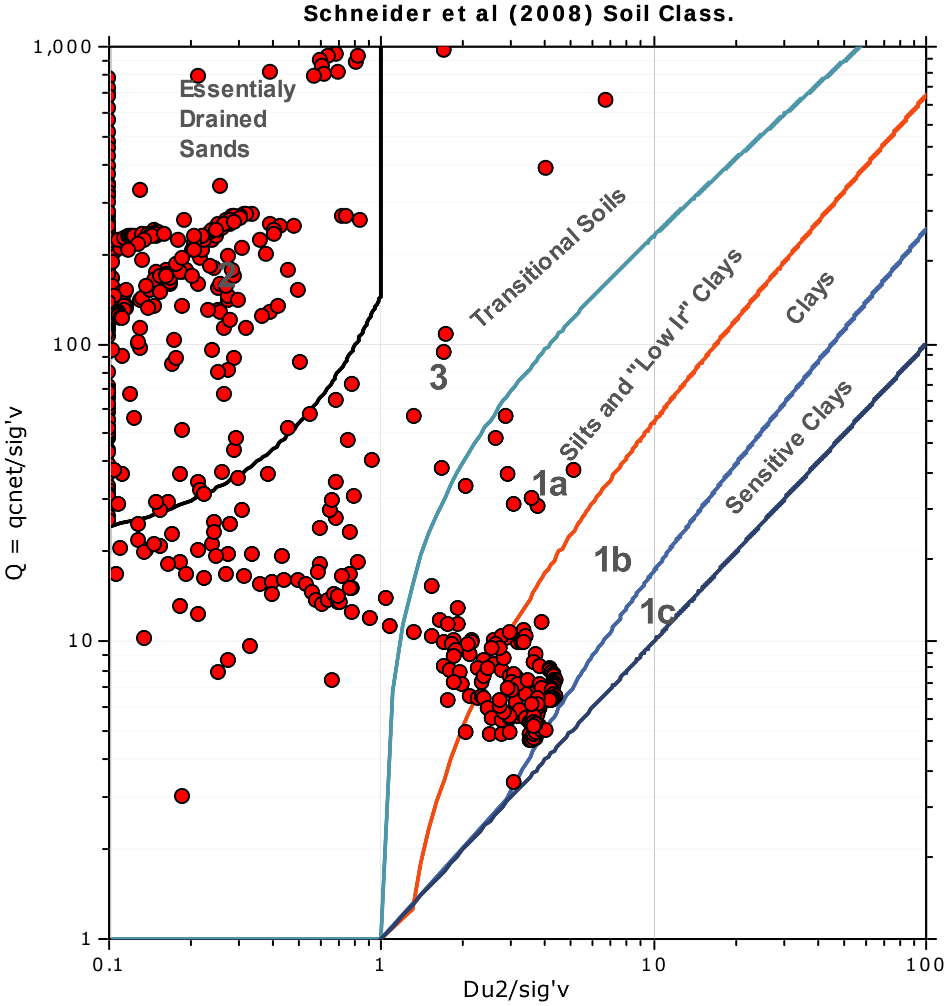


SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬜ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

Bq plots (Schneider)

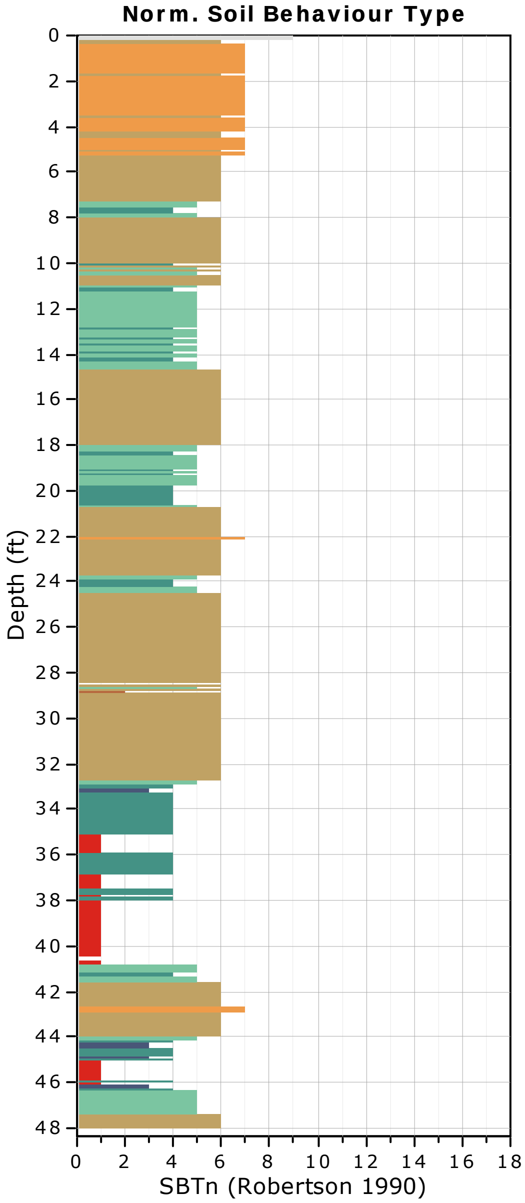


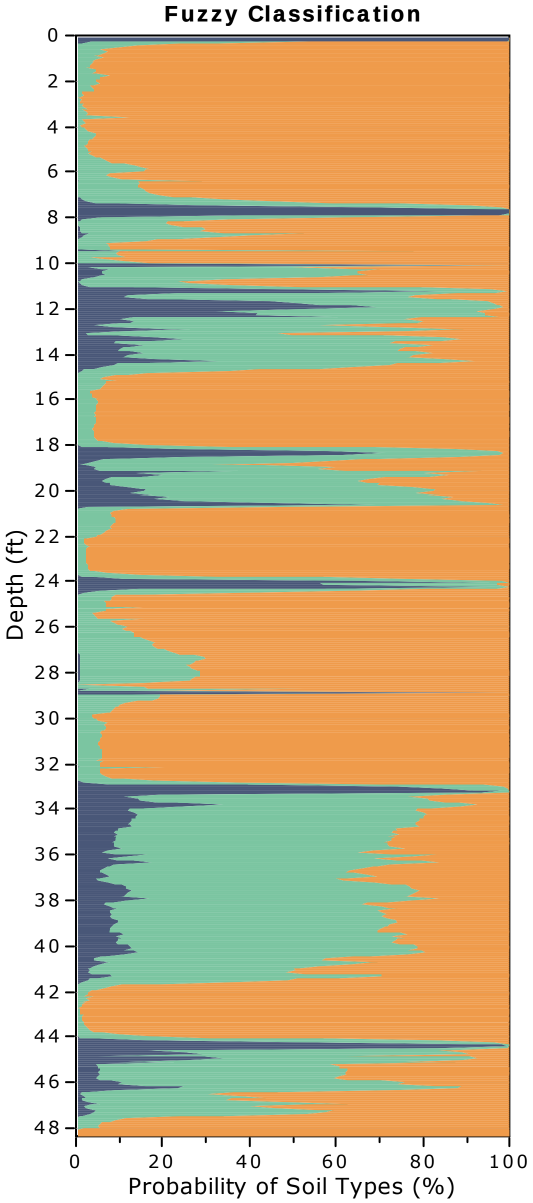


Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-1
Total depth: 48.36 ft





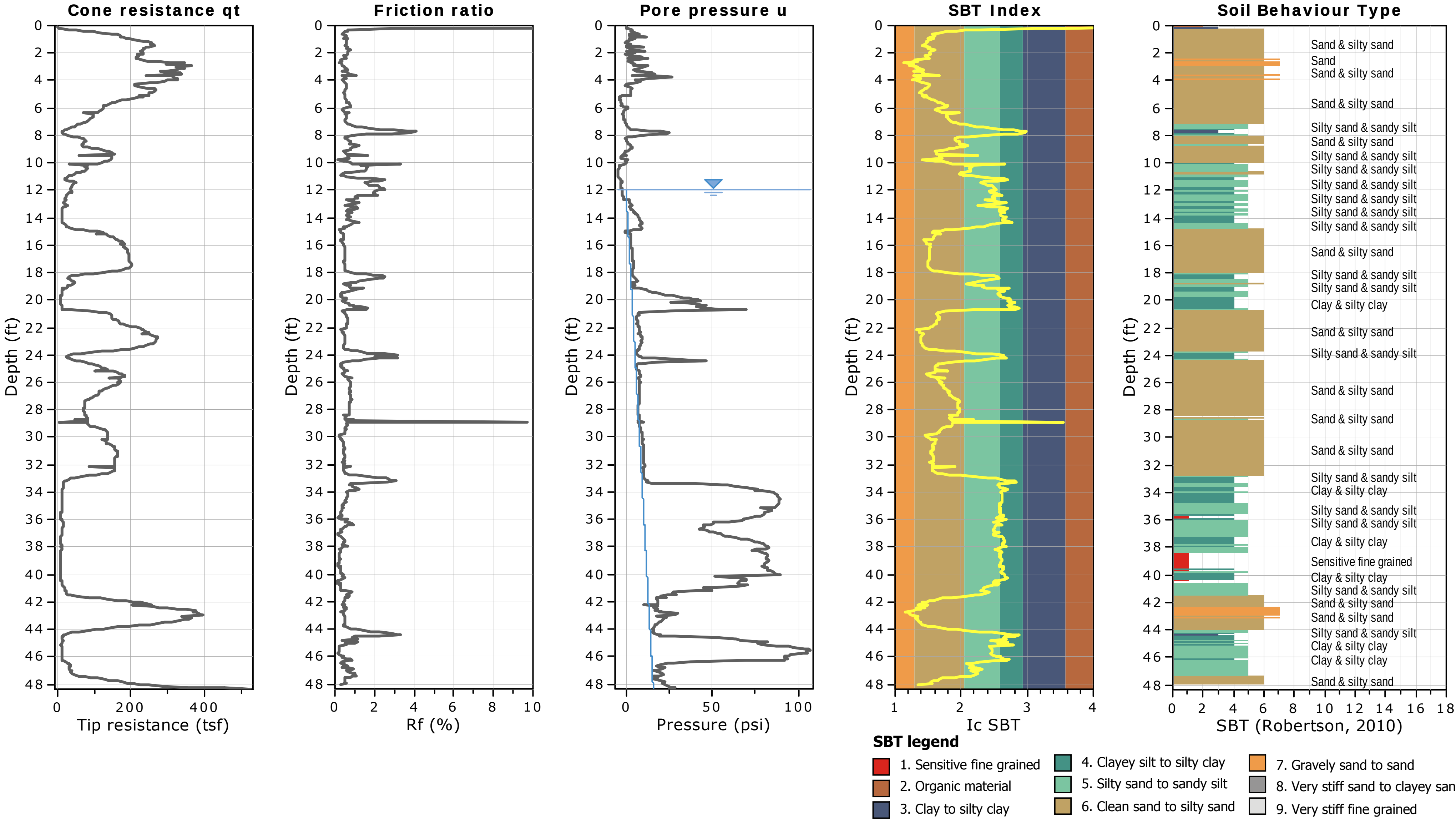
Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

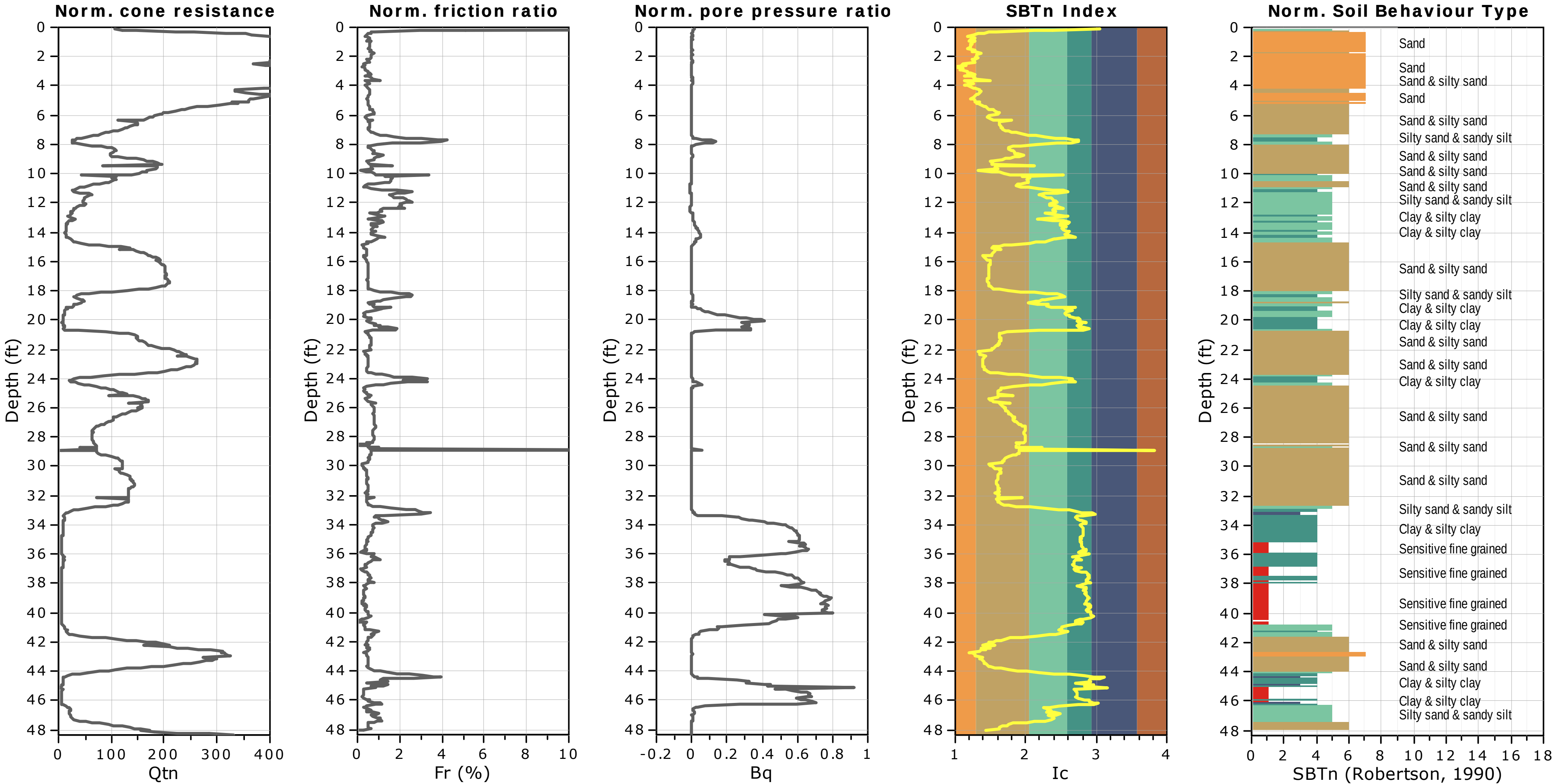
CPT: SCPT-1

Total depth: 48.36 ft



Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-1
Total depth: 48.36 ft



SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬜ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

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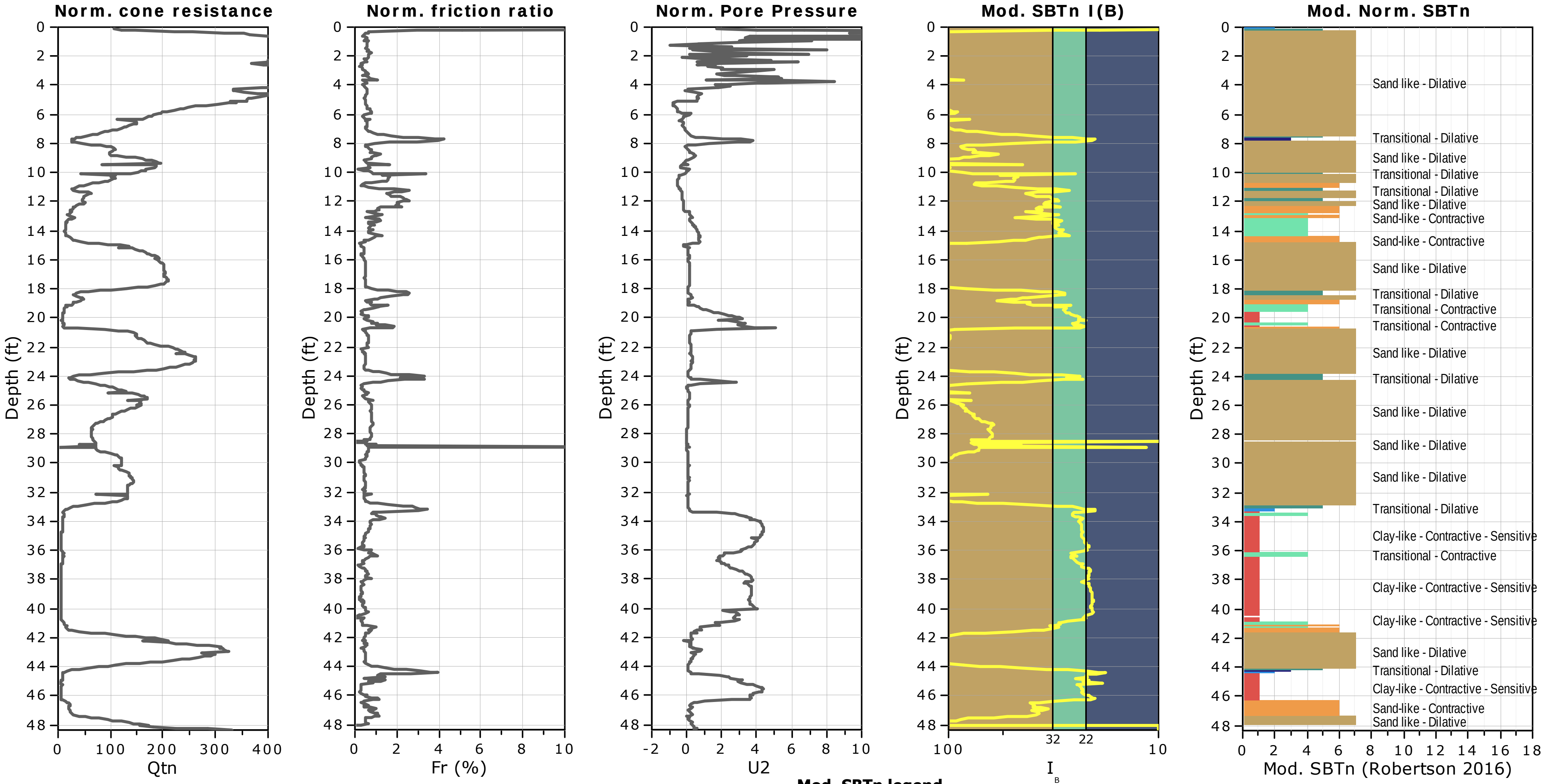
Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: SCPT-1

Total depth: 48.36 ft

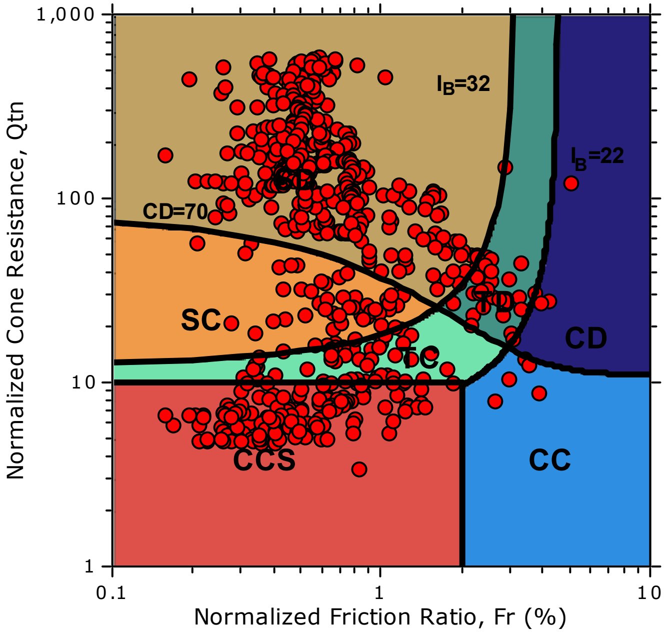


Mod. SBTn legend

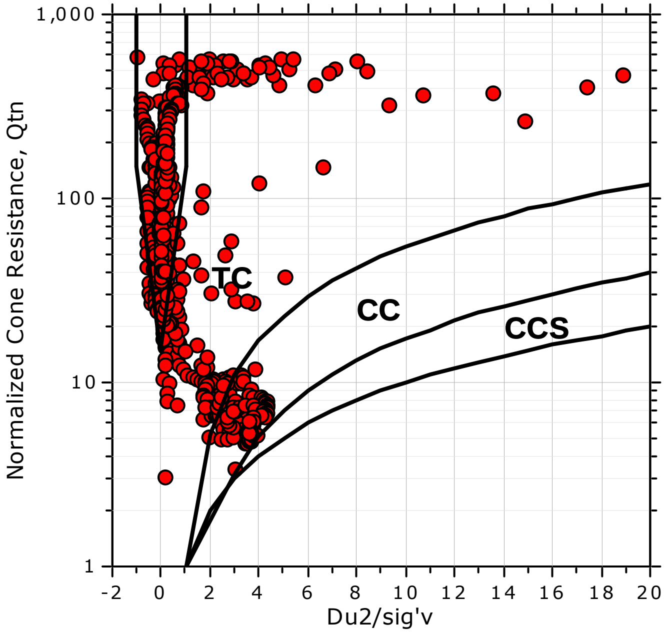
🟥 1. CCS: ClayLike - Contractive, Sensitive
🟦 2. CC: Clay-like - Contractive
🟦 3. CD: Clay-Like: Dilative
🟩 4. TC: Transitional - Contractive
🟩 5. TD: Transitional - Dilative
🟧 6. SC: Sand-like - Contractive
🟫 7. SD: Sand-like - Dilative

Updated SBTn plots

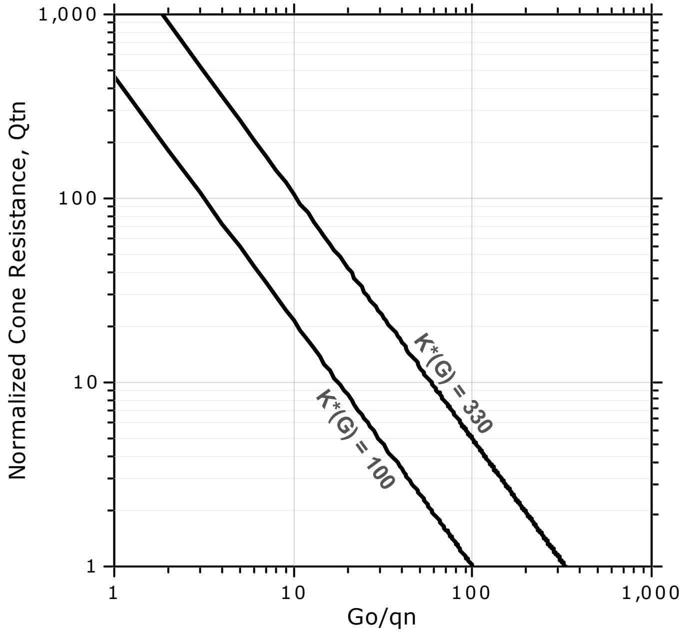
Modified Robertson (2016) SBTn



Modified Schneider et al (2008) SBTn



Normalized Rigidity Index



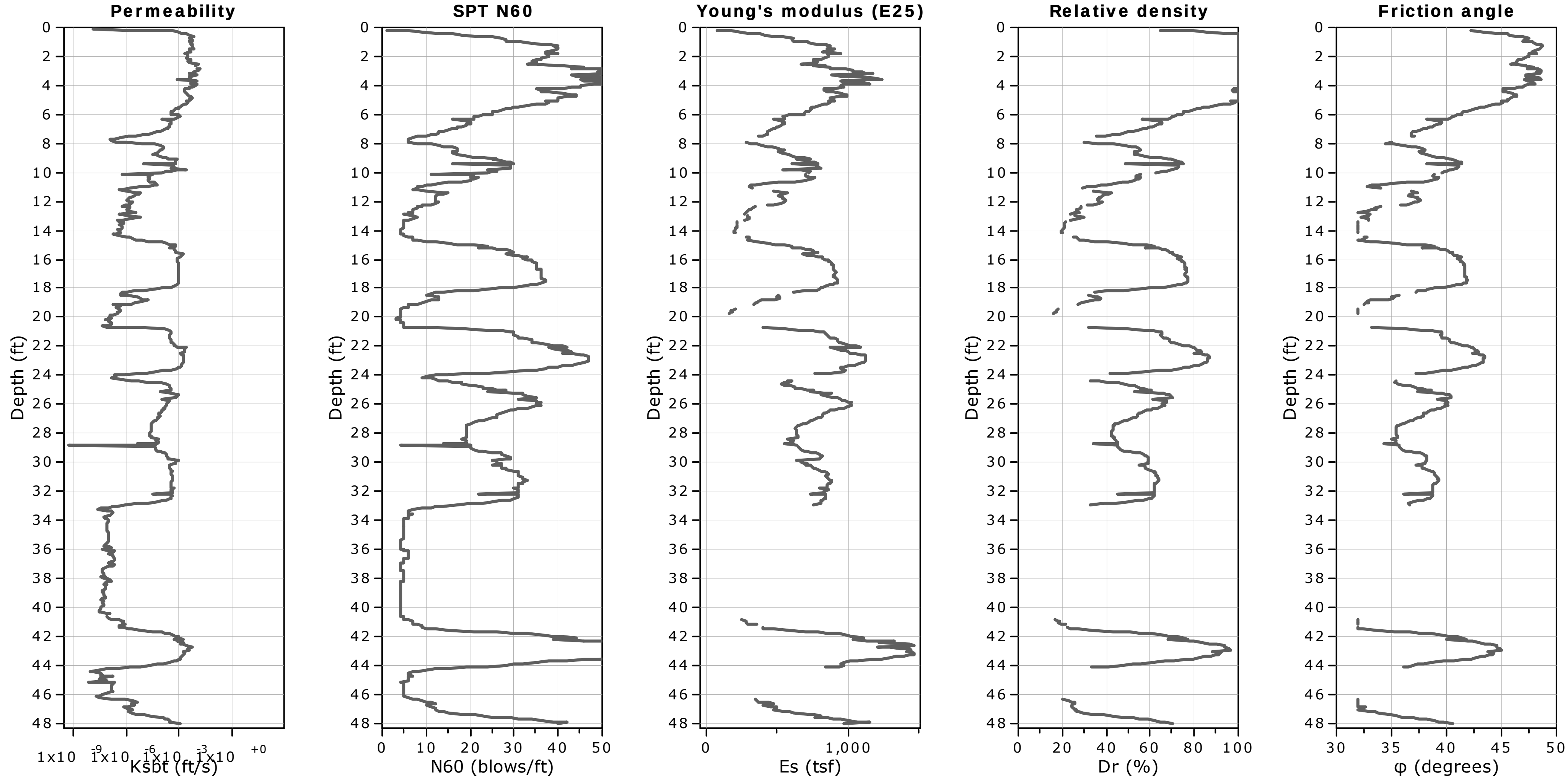
CCS:	Clay-like - Contractive - Sensitive
CC:	Clay-like - Contractive
CD:	Clay-like - Dilative
TC:	Transitional - Contractive
TD:	Transitional - Dilative
SC:	Sand-like - Contractive
SD:	Sand-like - Dilative

K(G) > 330: Soils with significant microstructure
(e.g. age/cementation)

Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-1
Total depth: 48.36 ft

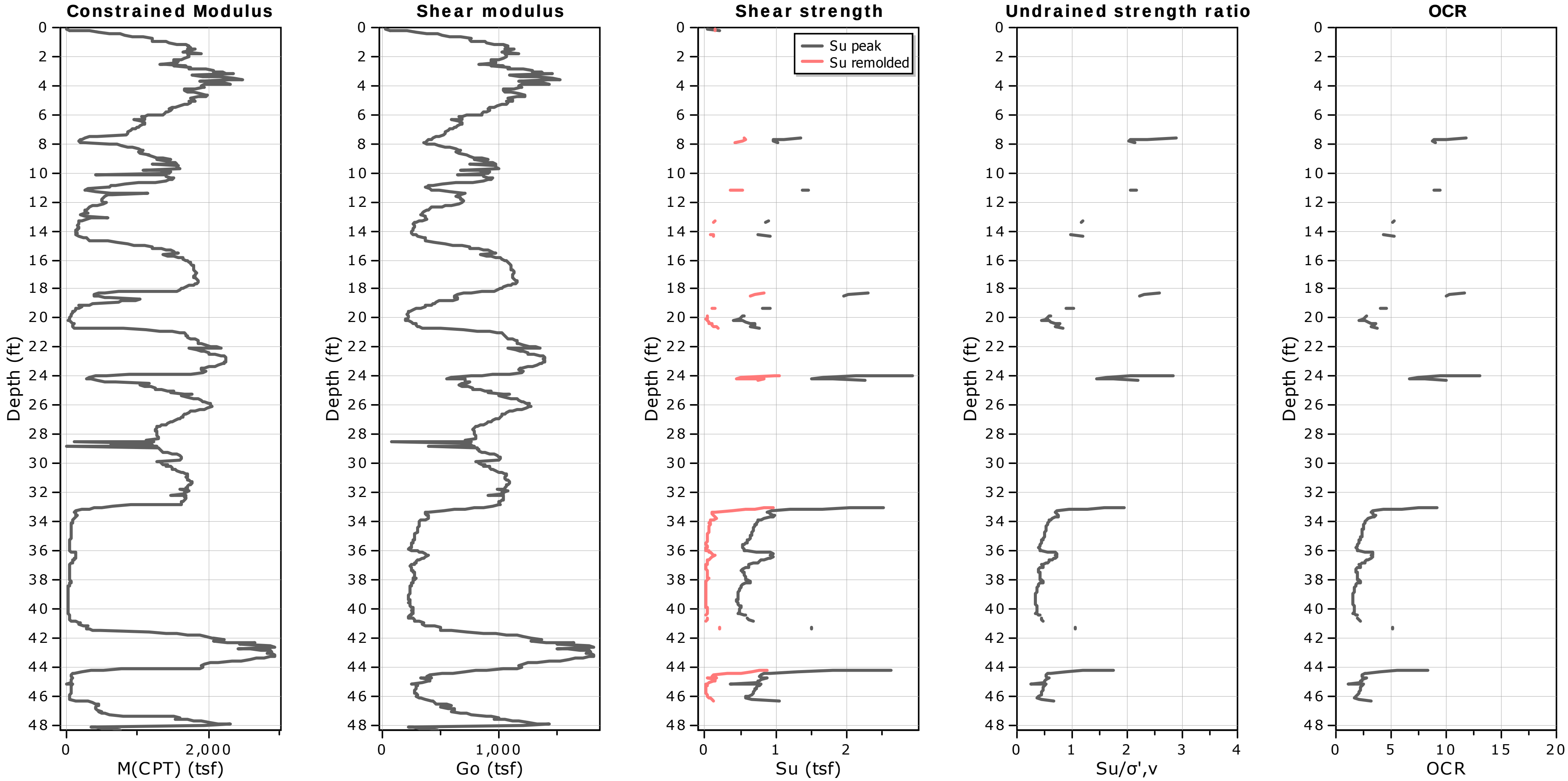


Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
●— User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-1
Total depth: 48.36 ft



Calculation parameters

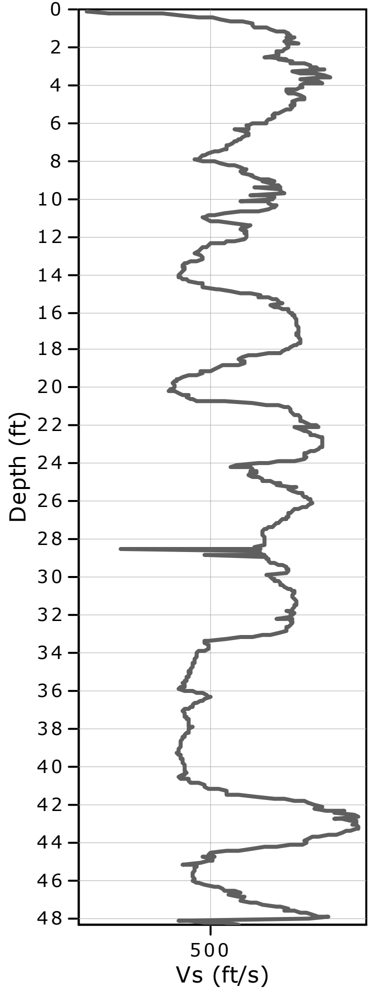
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

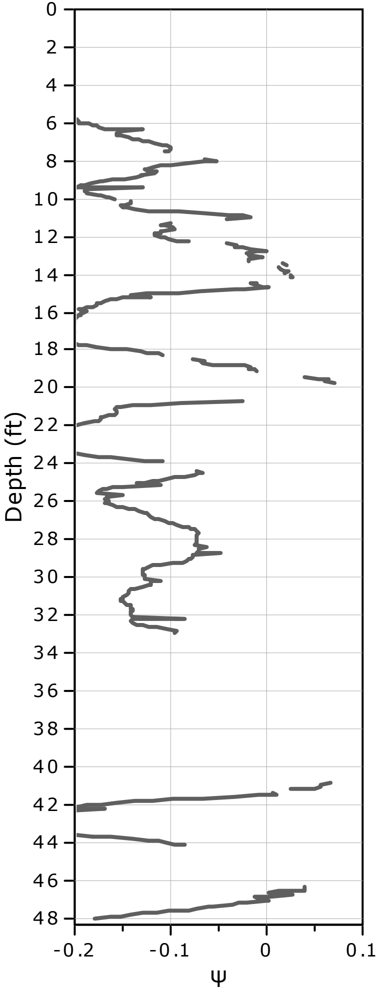
Project: Langan
Location: BL England Substation - Marmora NJ

CPT: SCPT-1
Total depth: 48.36 ft

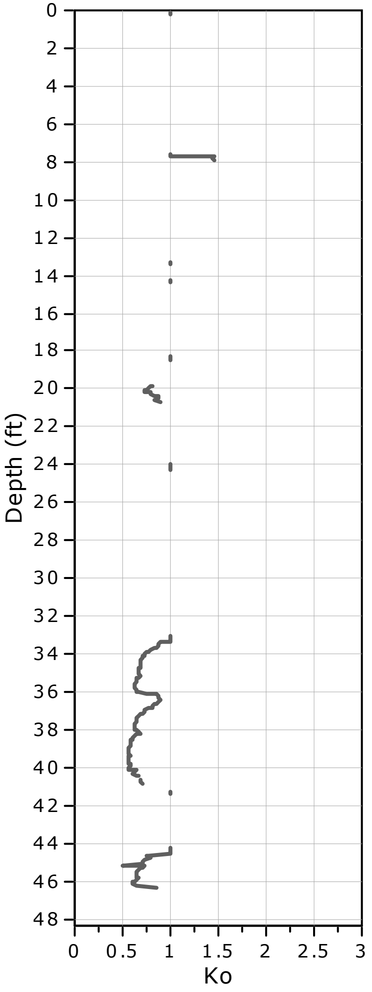
Shear Wave velocity



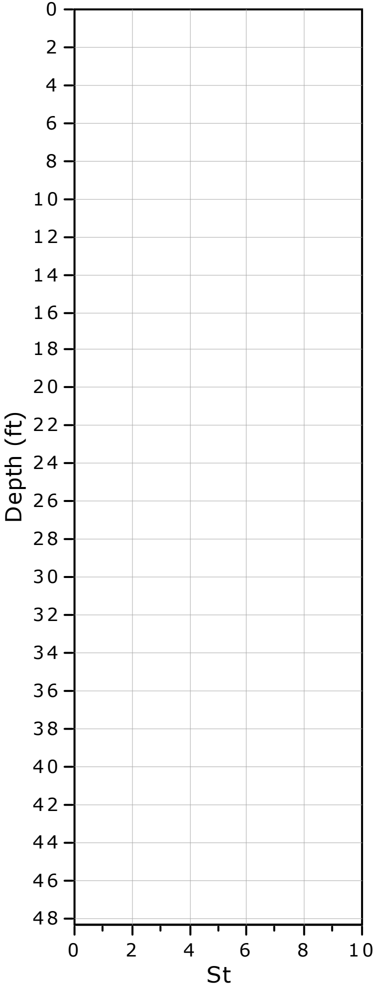
State parameter



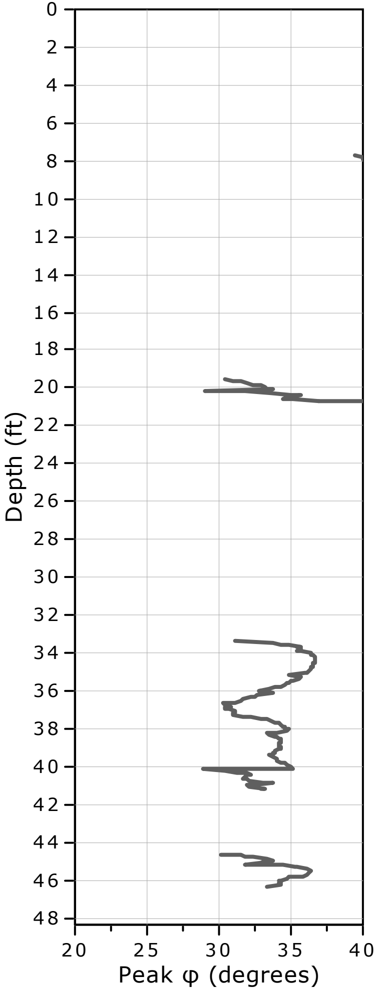
In-situ stress ratio



Soil sensitivity



Effective friction angle



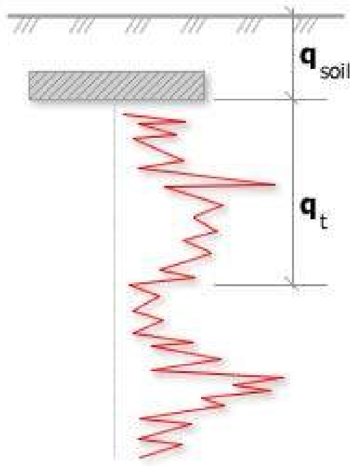
Calculation parameters

Soil Sensitivity factor, N_S: 350.00

● User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

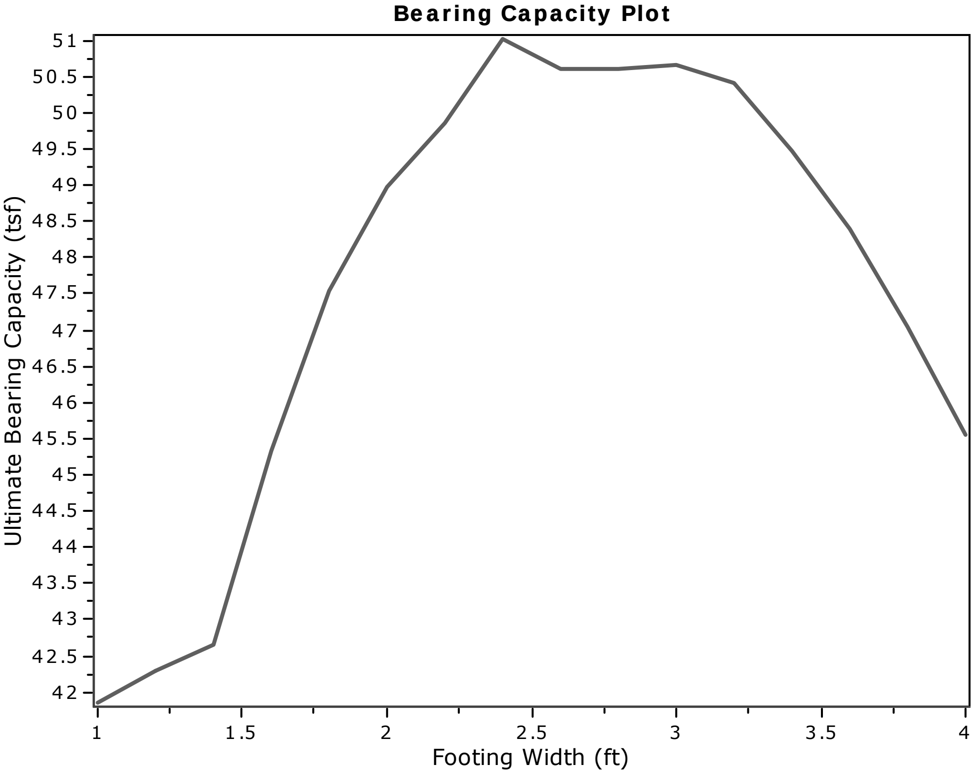
CPT: SCPT-1
Total depth: 48.36 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

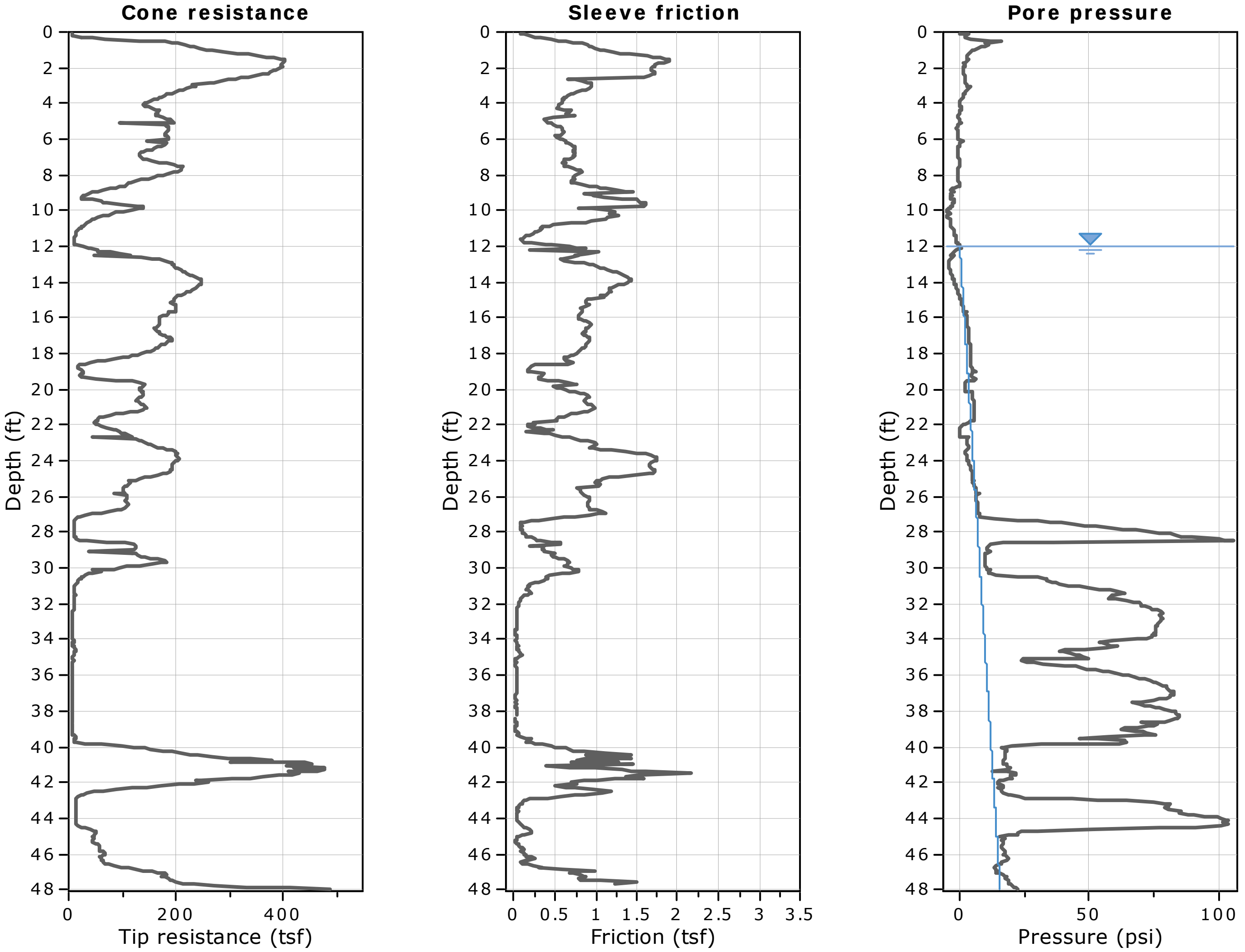


:: Tabular results ::

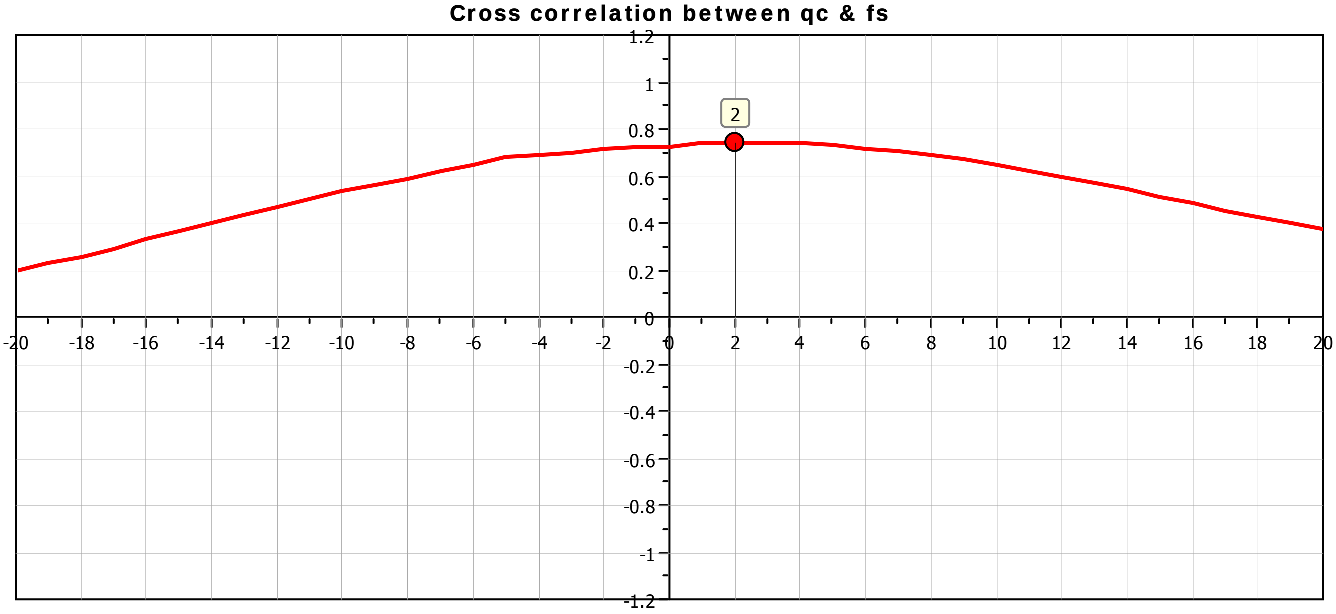
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	209.12	0.20	0.03	41.85
2	1.20	0.50	2.30	211.30	0.20	0.03	42.29
3	1.40	0.50	2.60	213.10	0.20	0.03	42.65
4	1.60	0.50	2.90	226.48	0.20	0.03	45.33
5	1.80	0.50	3.20	237.50	0.20	0.03	47.53
6	2.00	0.50	3.50	244.74	0.20	0.03	48.98
7	2.20	0.50	3.80	249.18	0.20	0.03	49.87
8	2.40	0.50	4.10	254.93	0.20	0.03	51.02
9	2.60	0.50	4.40	252.92	0.20	0.03	50.61
10	2.80	0.50	4.70	252.80	0.20	0.03	50.59
11	3.00	0.50	5.00	253.16	0.20	0.03	50.66
12	3.20	0.50	5.30	251.95	0.20	0.03	50.42
13	3.40	0.50	5.60	247.21	0.20	0.03	49.47
14	3.60	0.50	5.90	241.88	0.20	0.03	48.41
15	3.80	0.50	6.20	235.10	0.20	0.03	47.05
16	4.00	0.50	6.50	227.65	0.20	0.03	45.56

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-18
Total depth: 47.97 ft



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



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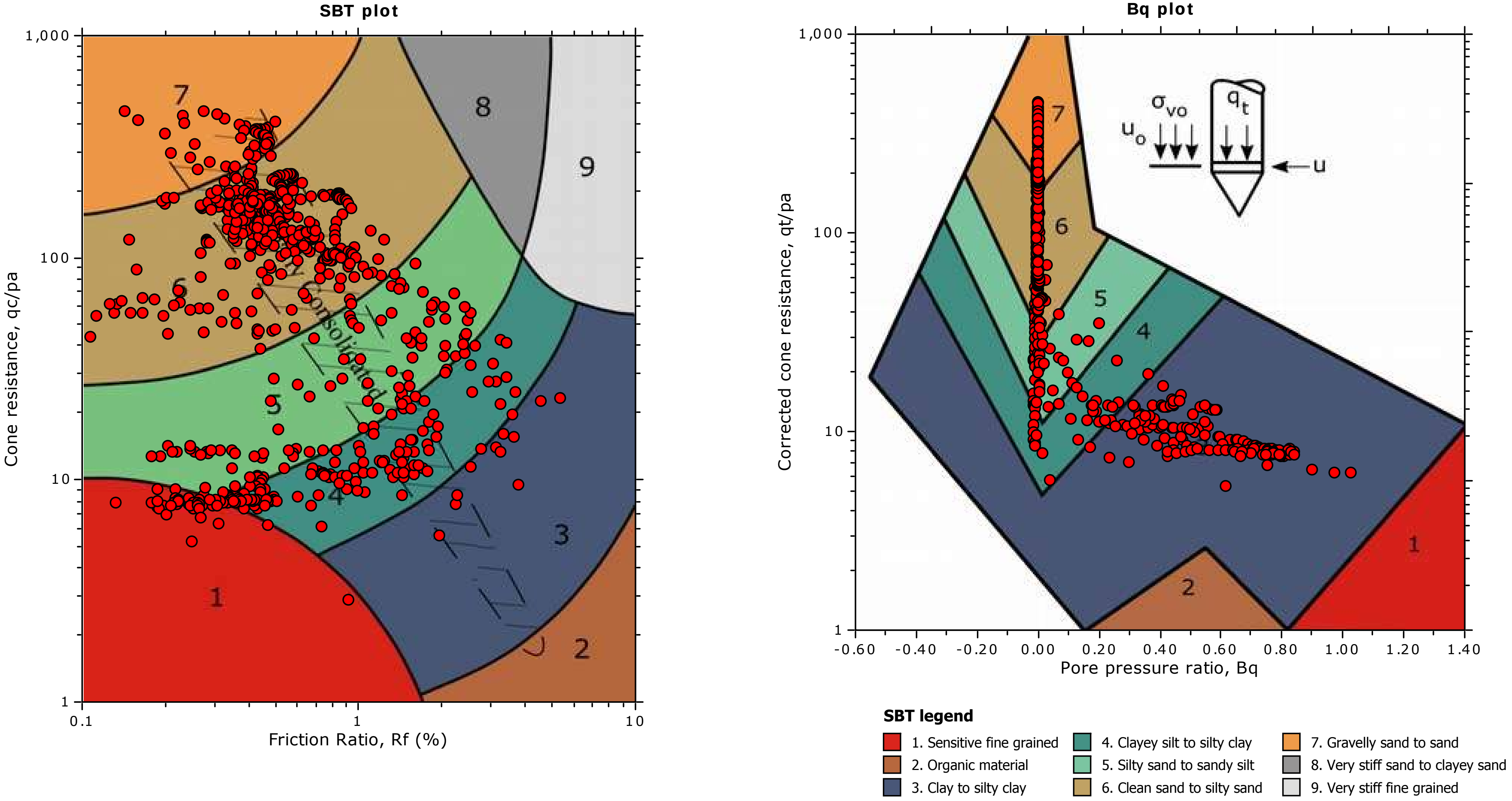
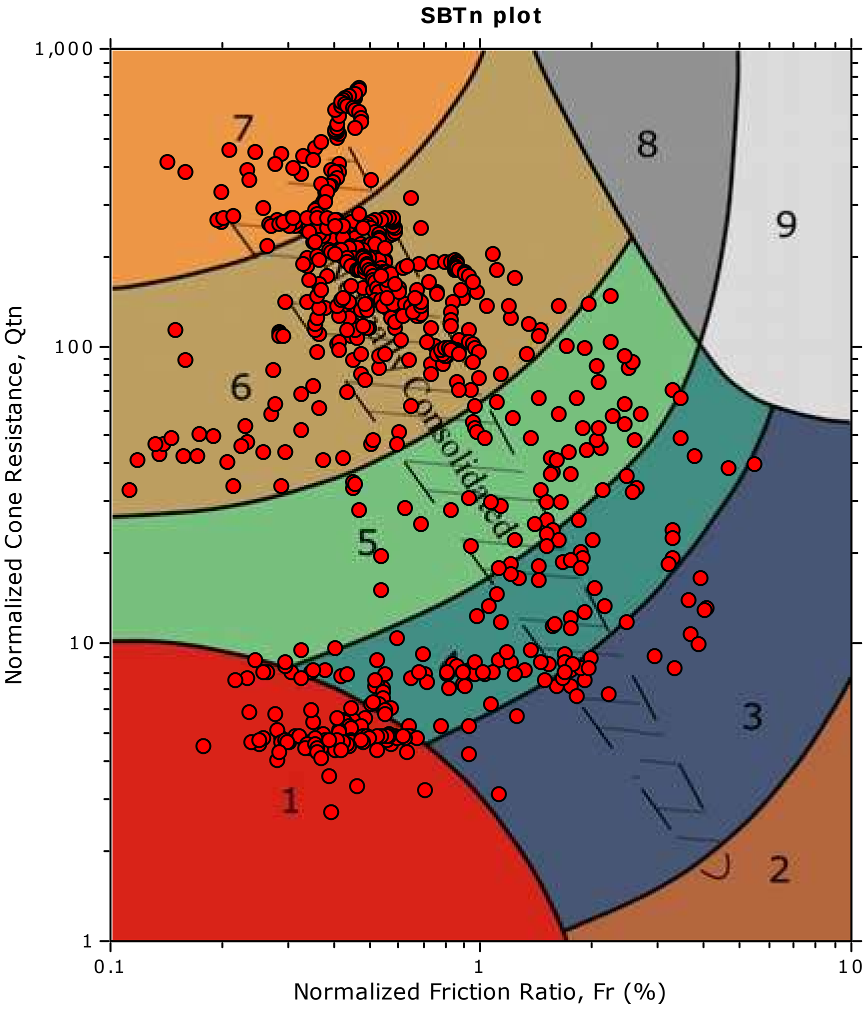
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

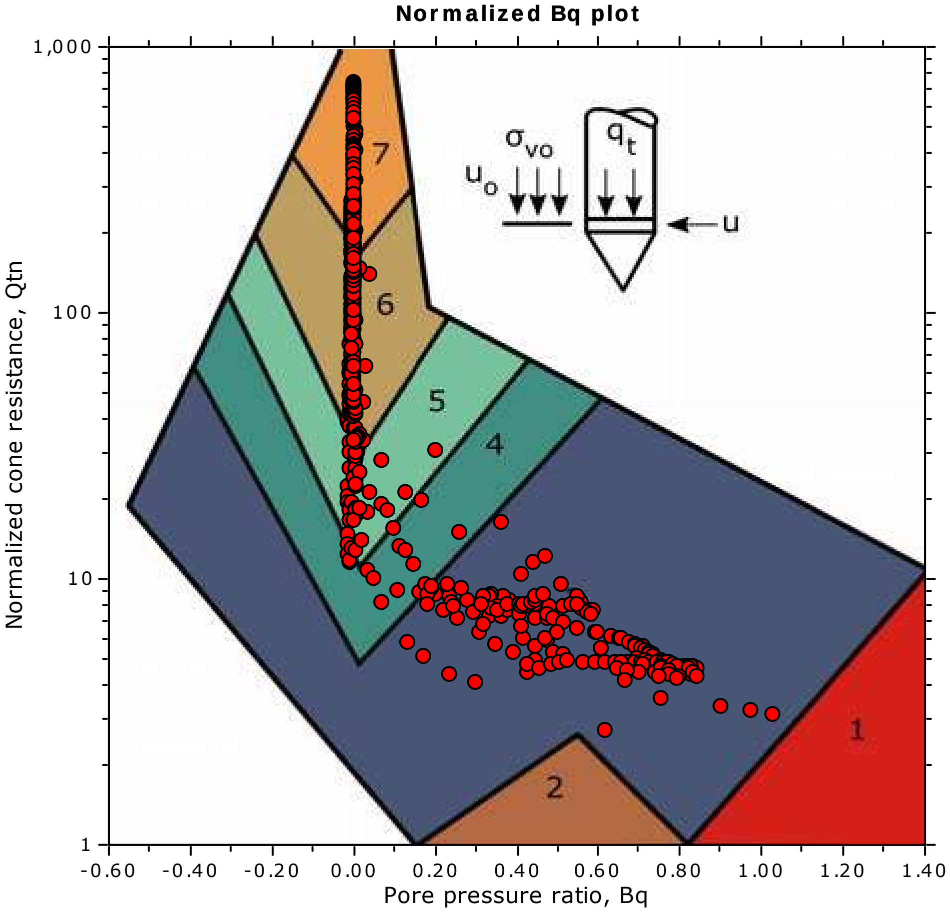
CPT: SCPT-18
Total depth: 47.97 ft

SBT - Bq plots



SBT - Bq plots (normalized)


SBTn plot

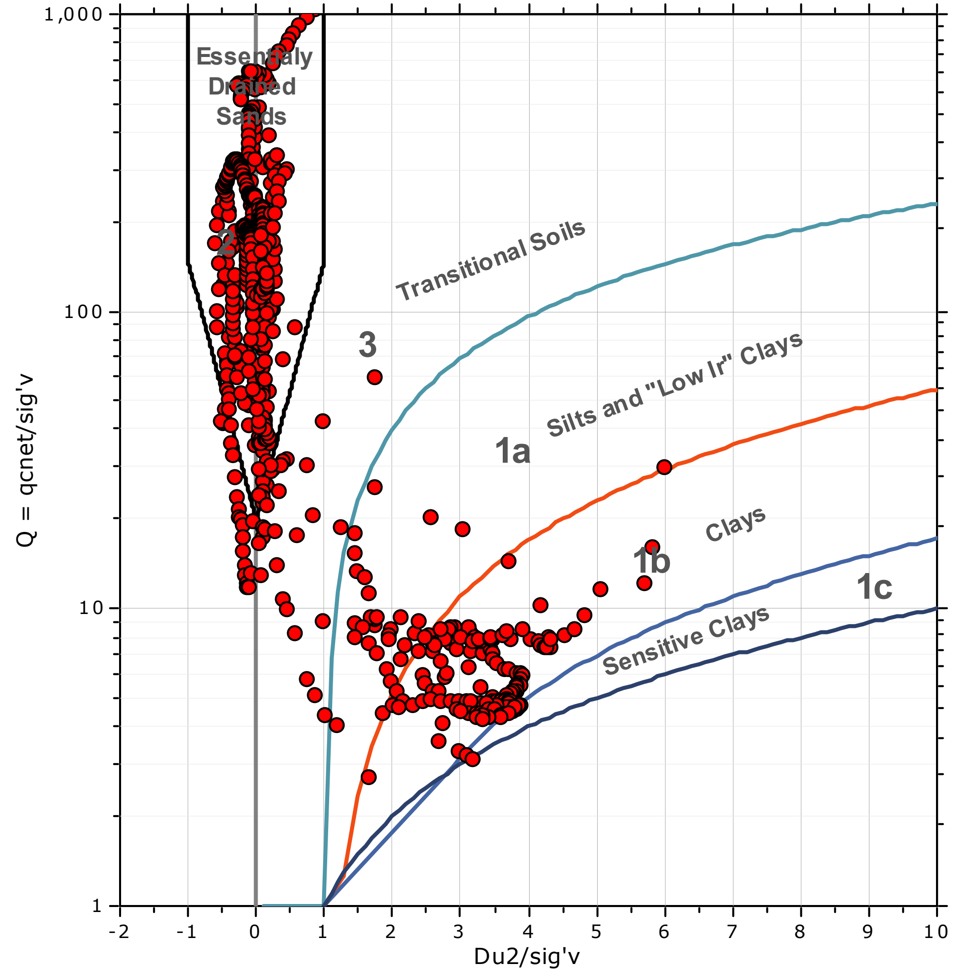

Normalized Bq plot

SBTn legend

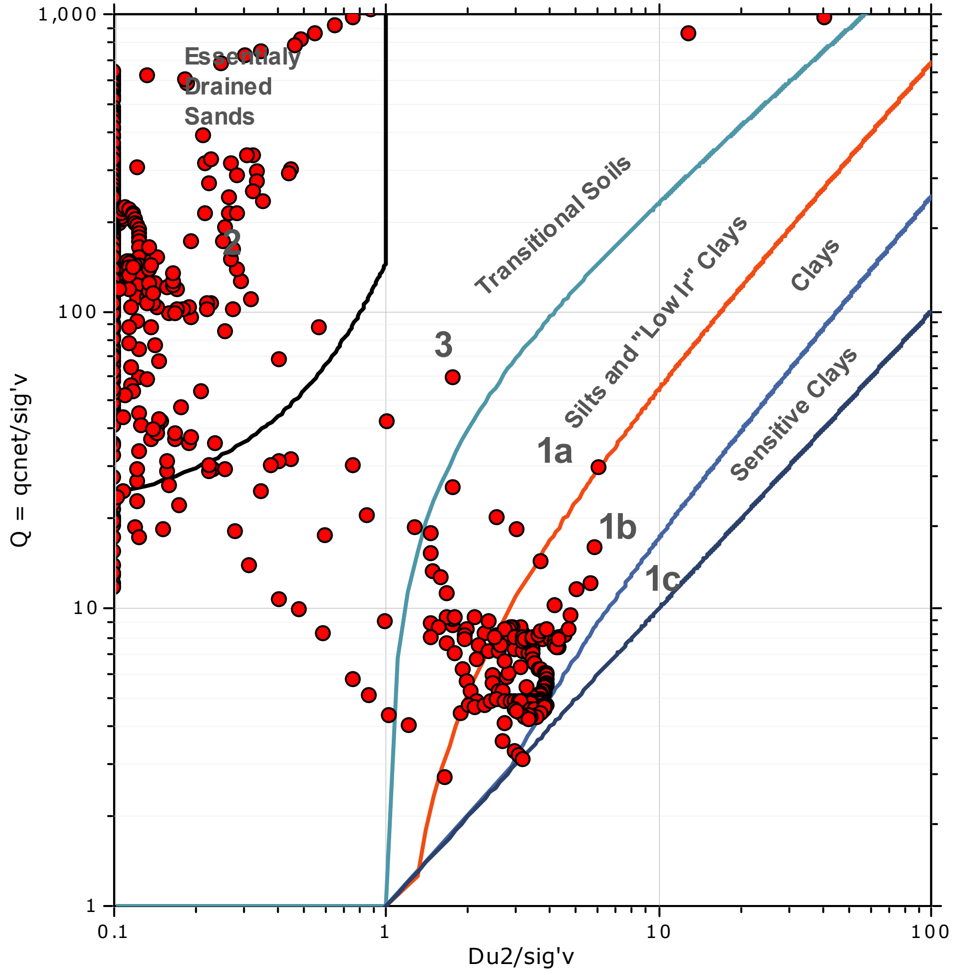
- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬜ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

Bq plots (Schneider)

Schneider et al (2008) Soil Class.

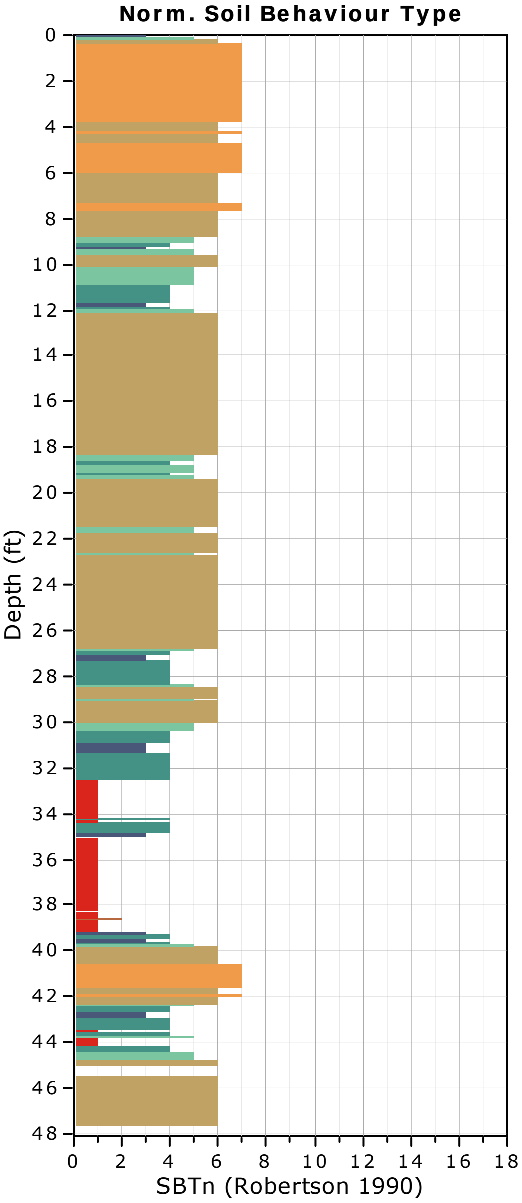


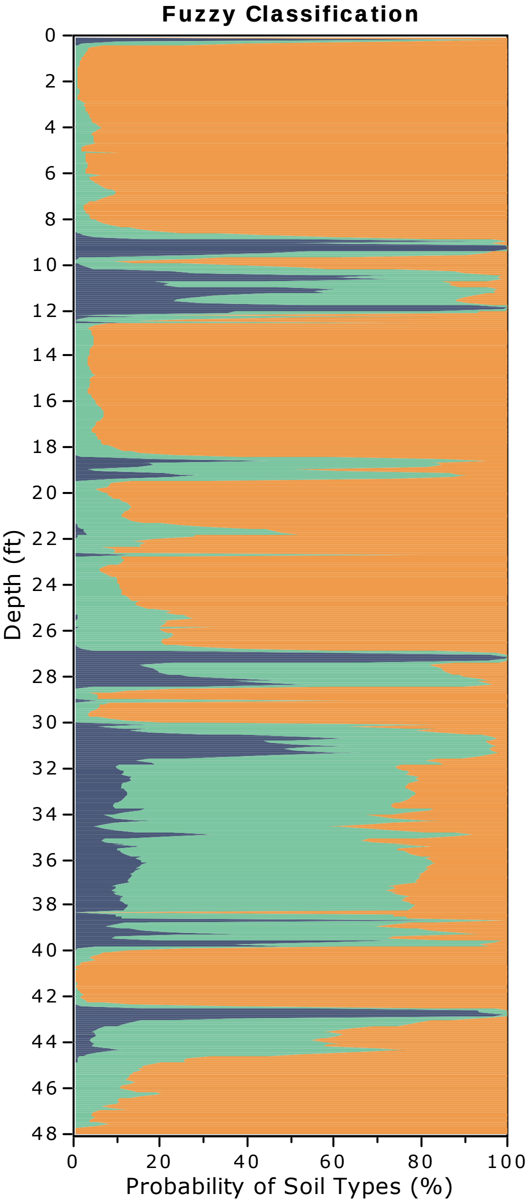
Schneider et al (2008) Soil Class.



Project: **Langan**
Location: **BL England Substation - Marmora NJ**

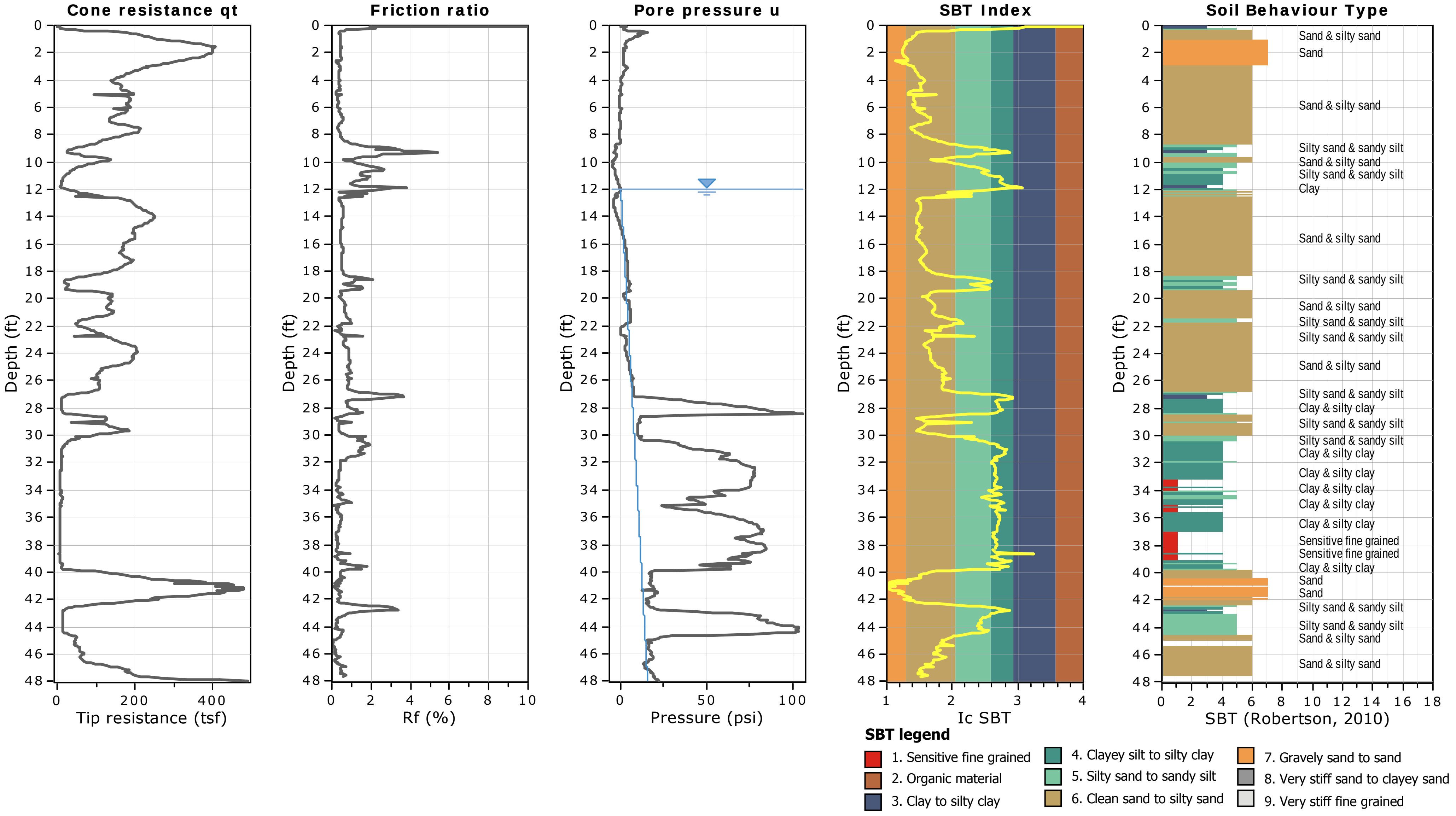
CPT: SCPT-18
Total depth: 47.97 ft





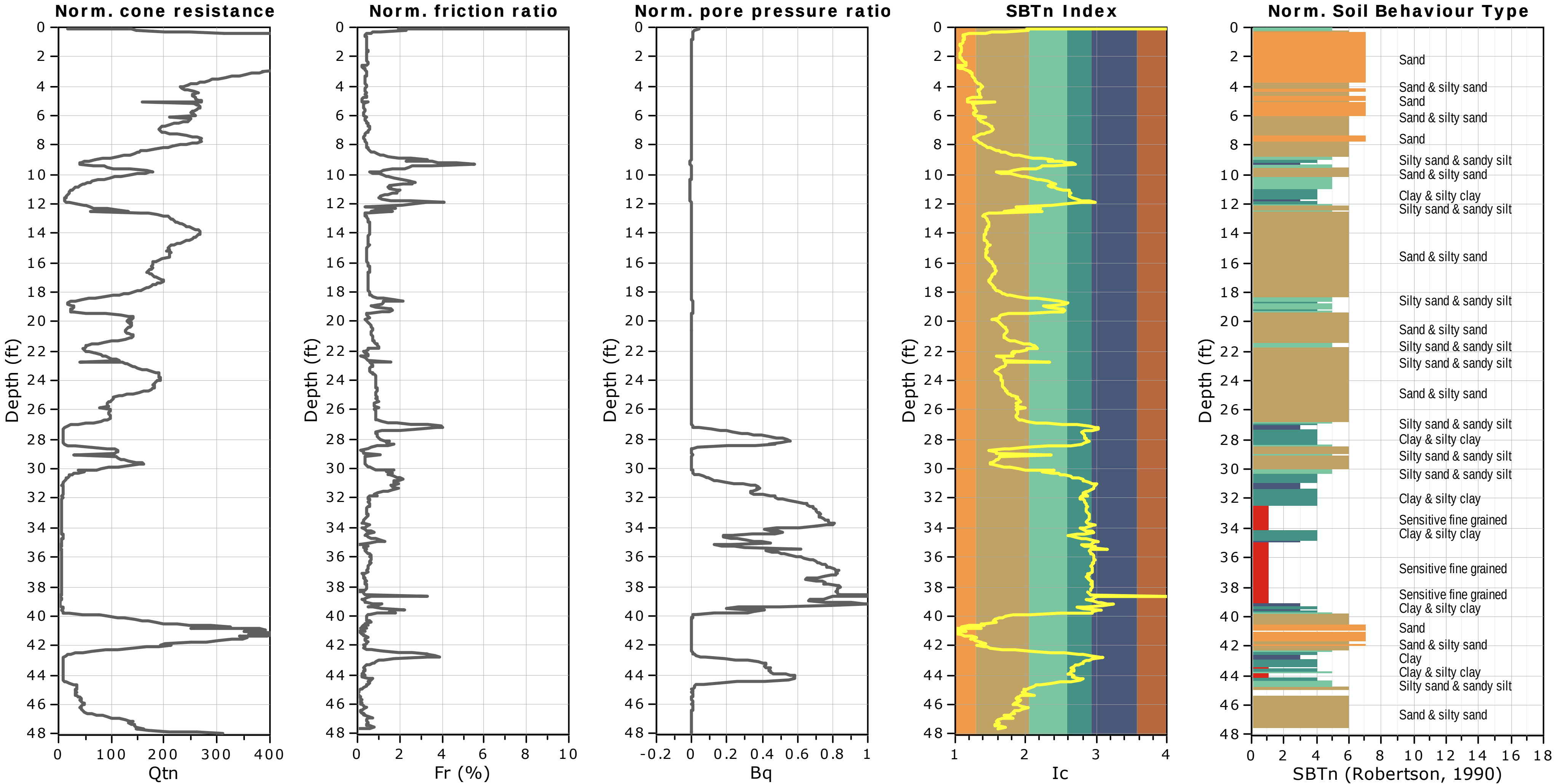
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-18
Total depth: 47.97 ft



Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-18
Total depth: 47.97 ft



SBTn legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
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⬛ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

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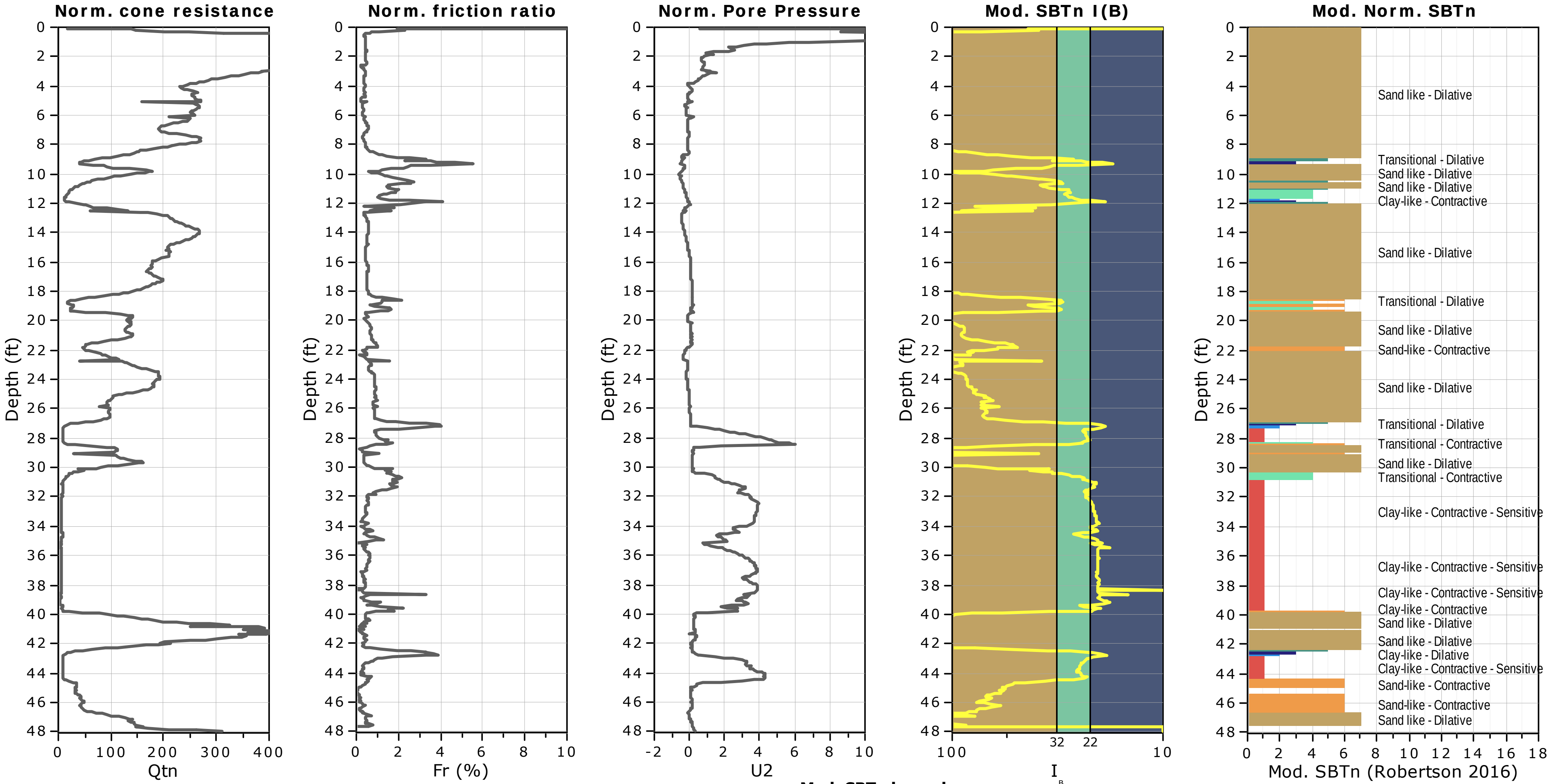
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

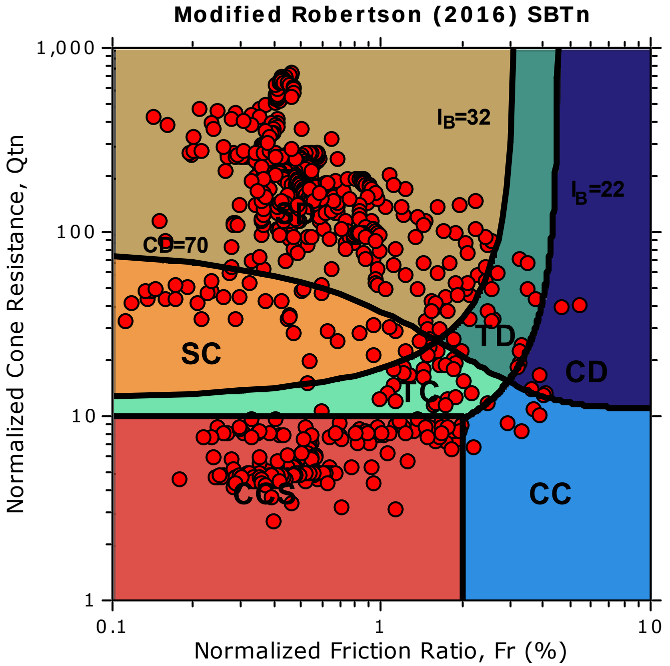
CPT: SCPT-18
Total depth: 47.97 ft

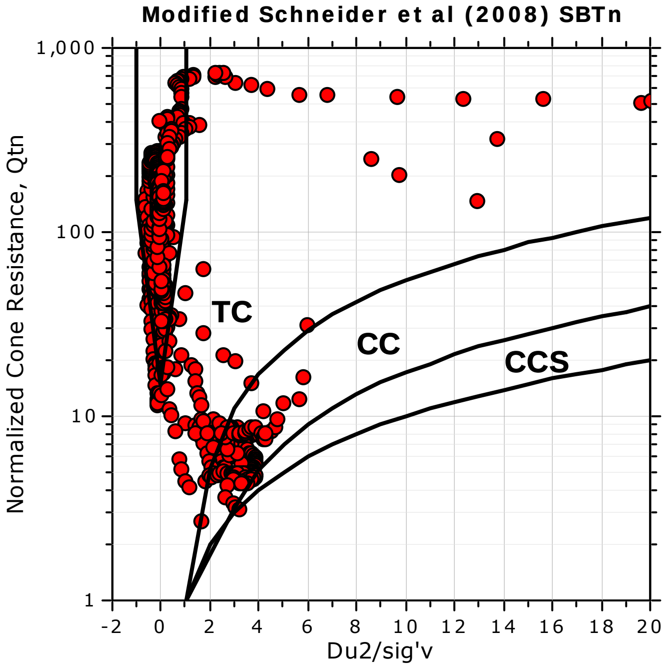


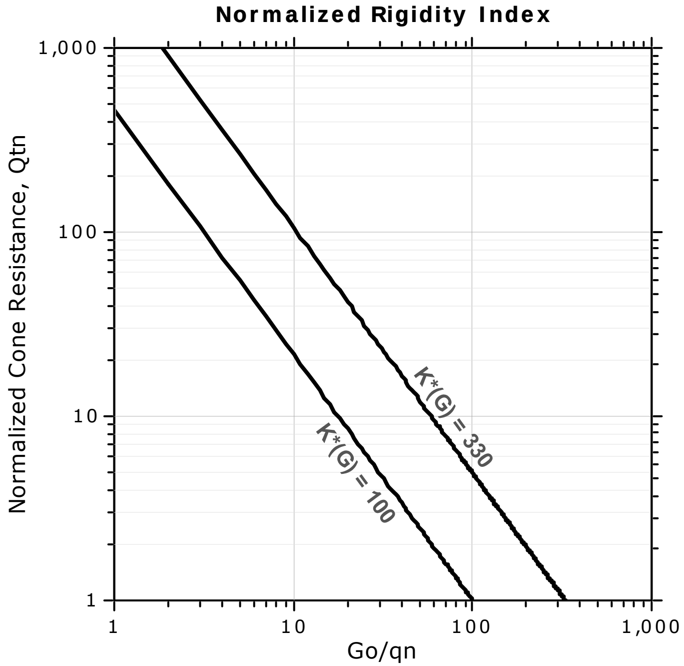
Mod. SBTn legend

- 🟥 1. CCS: ClayLike - Contractive, Sensitive
- 🟦 2. CC: Clay-like - Contractive
- 🟦 3. CD: Clay-Like: Dilative
- 🟩 4. TC: Transitional - Contractive
- 🟩 5. TD: Transitional - Dilative
- 🟧 6. SC: Sand-like - Contractive
- 🟫 7. SD: Sand-like - Dilative

Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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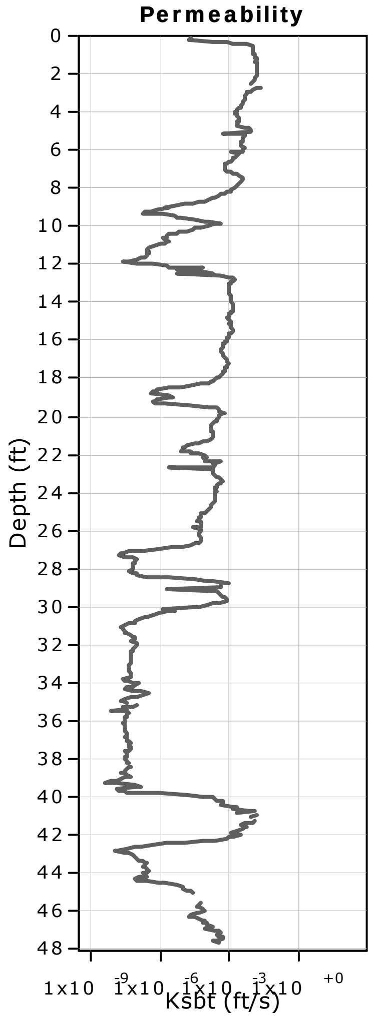
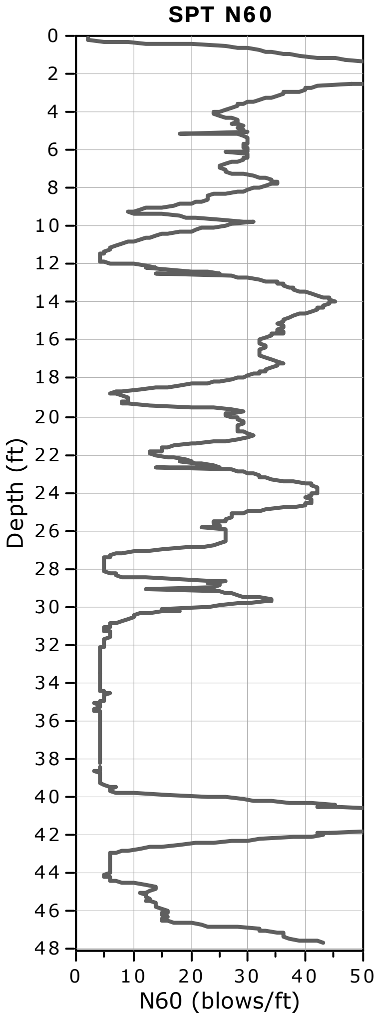
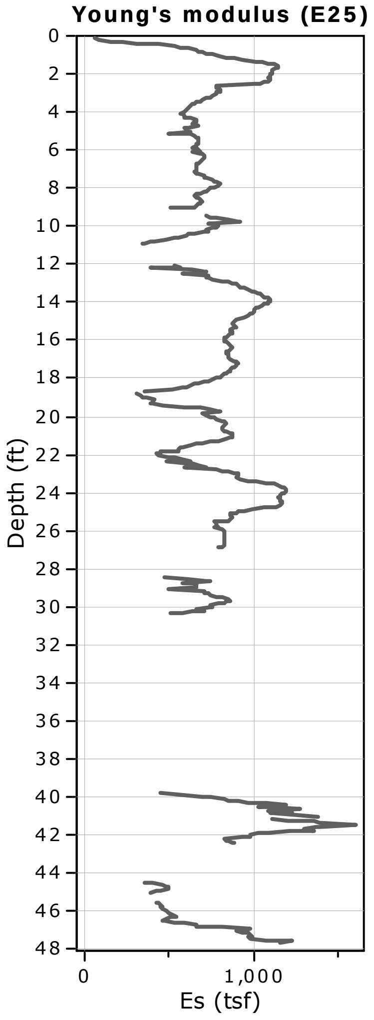
5230 Atlantic Ave
Mays Landing, NJ

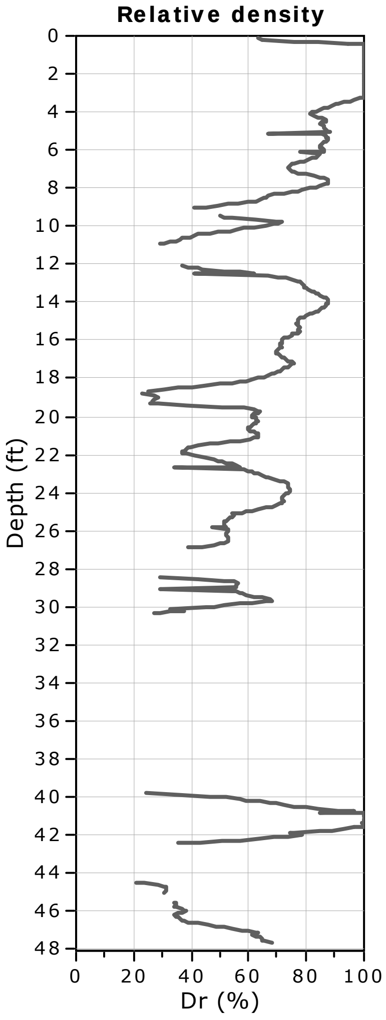
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

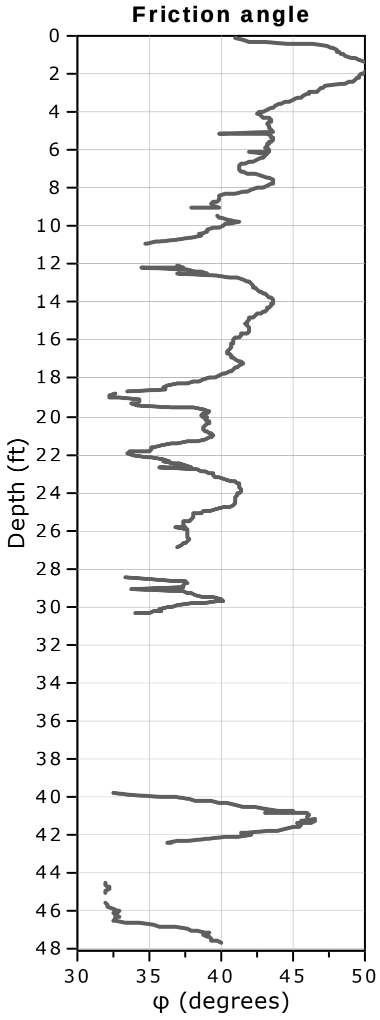
CPT: SCPT-18
Total depth: 47.97 ft











Calculation parameters

Permeability: Based on SBT_n

SPT N_{60}: Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0

Phi: Based on Kulhawy & Mayne (1990)

—●— User defined estimation data

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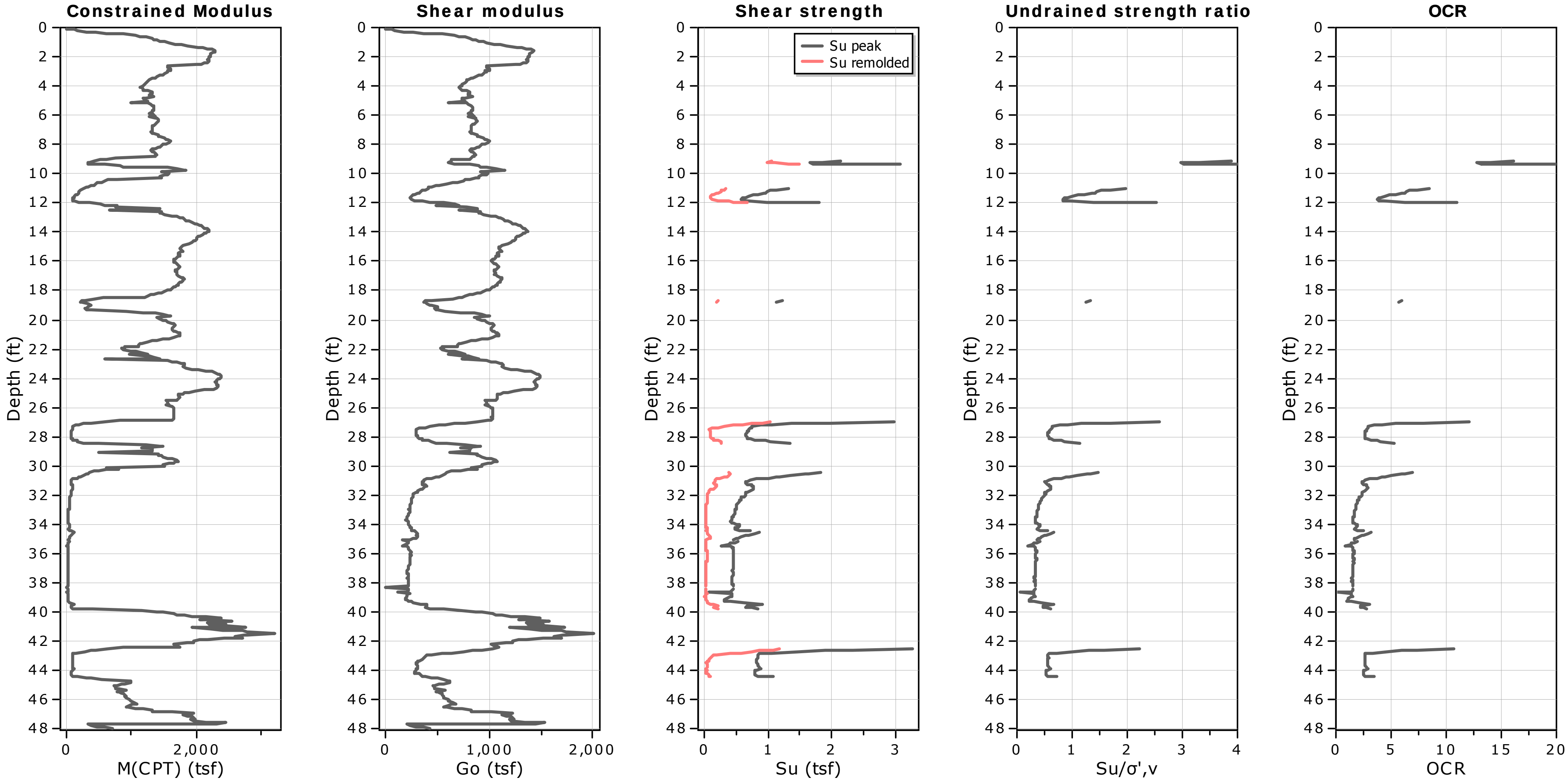
Mays Landing, NJ

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: SCPT-18

Total depth: 47.97 ft



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)

Go: Based on variable *alpha* using I_c (Robertson, 2009)

Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33

● User defined estimation data

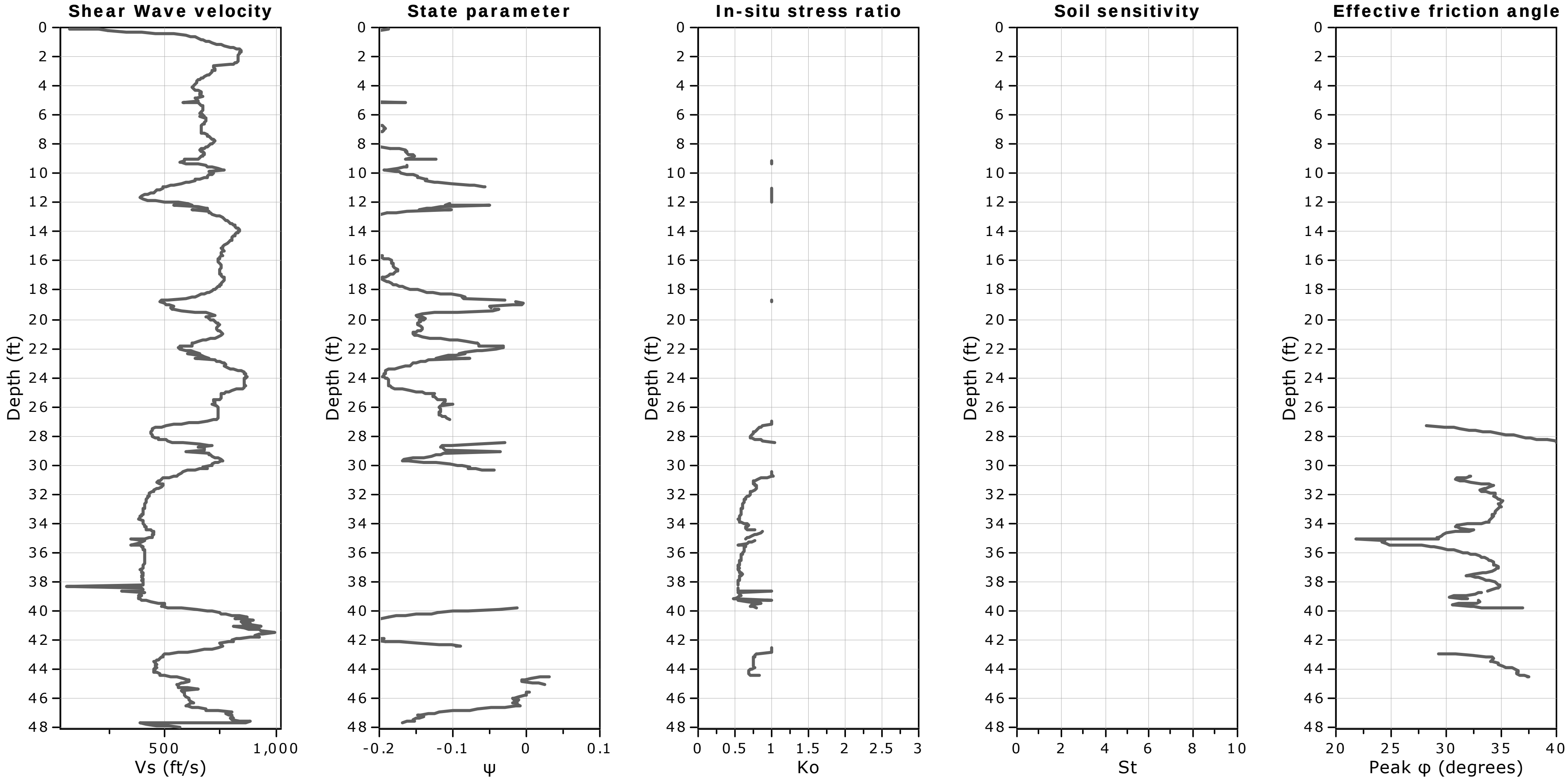
● Flat Dilatometer Test data

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: SCPT-18

Total depth: 47.97 ft



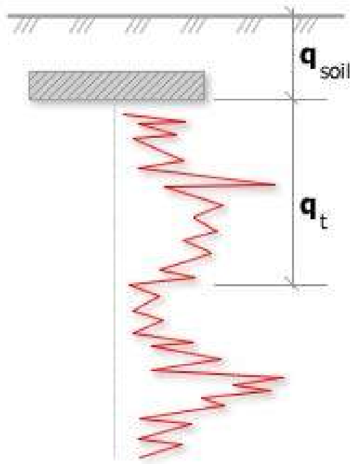
Calculation parameters

Soil Sensitivity factor, N_S: 350.00

—●— User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

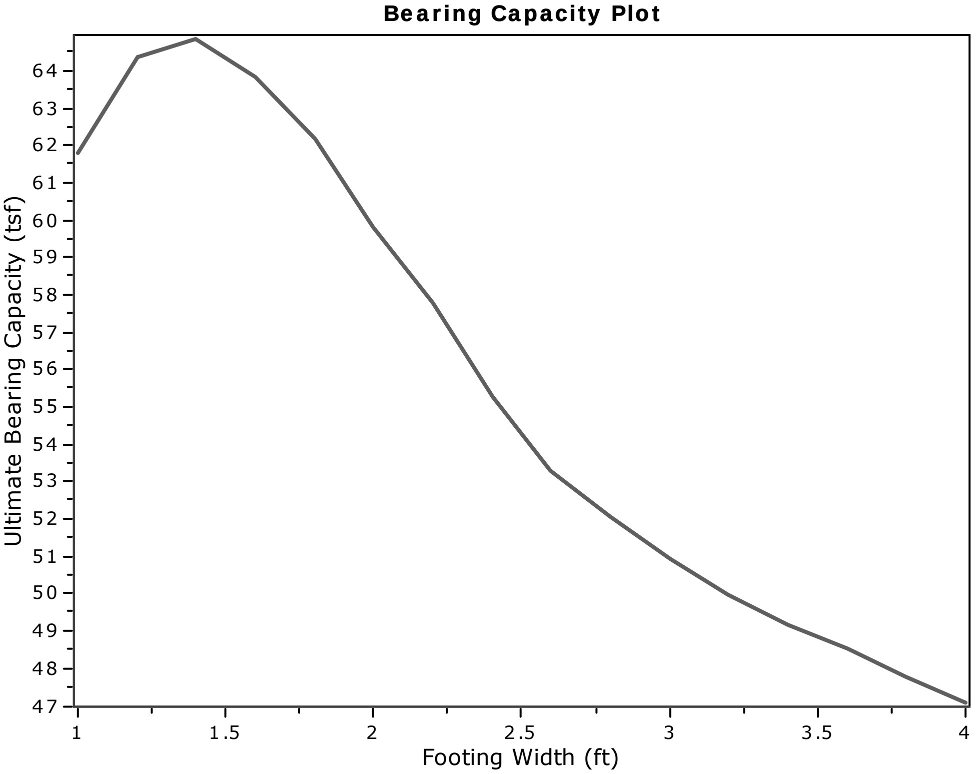
CPT: SCPT-18
Total depth: 47.97 ft



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

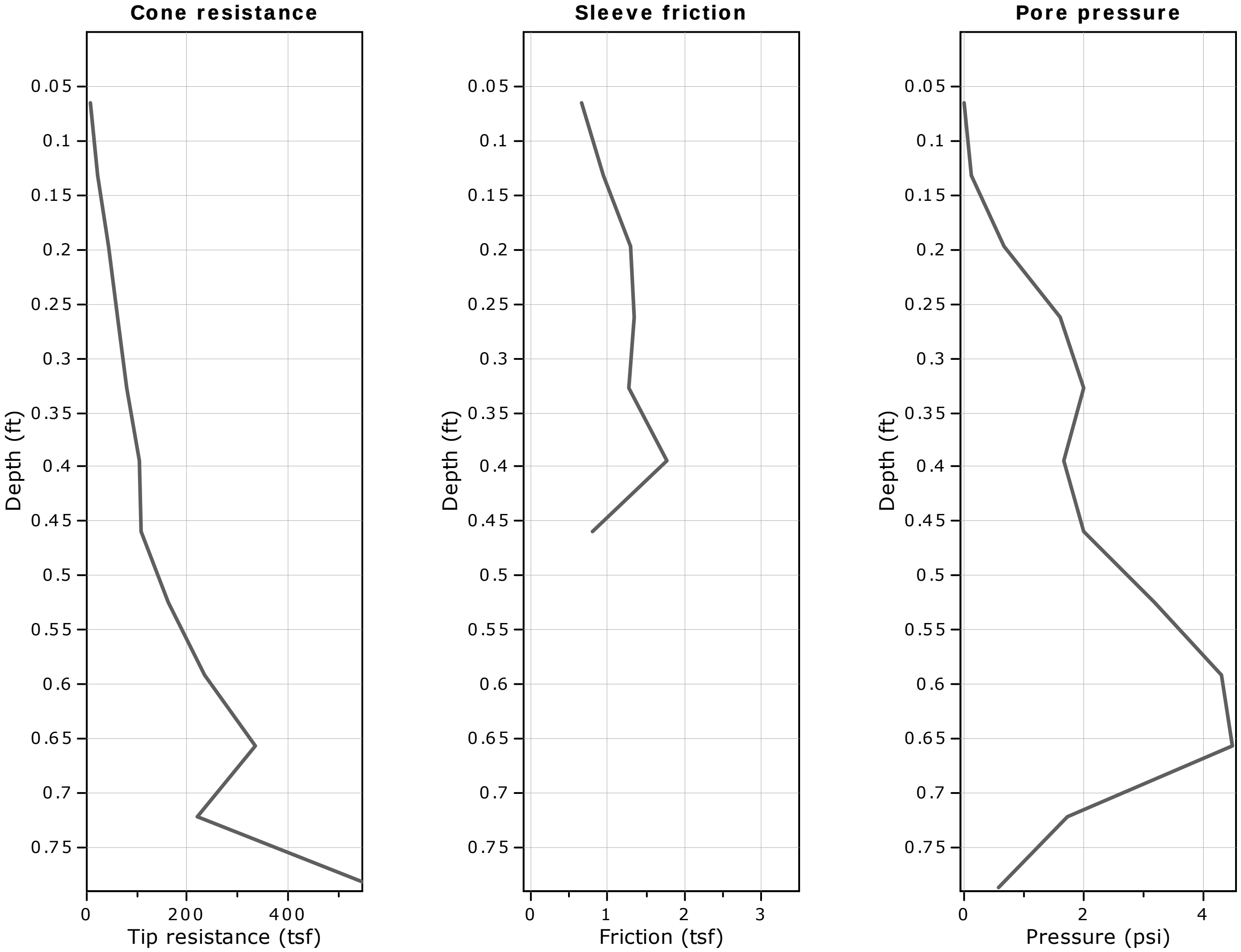


:: Tabular results ::

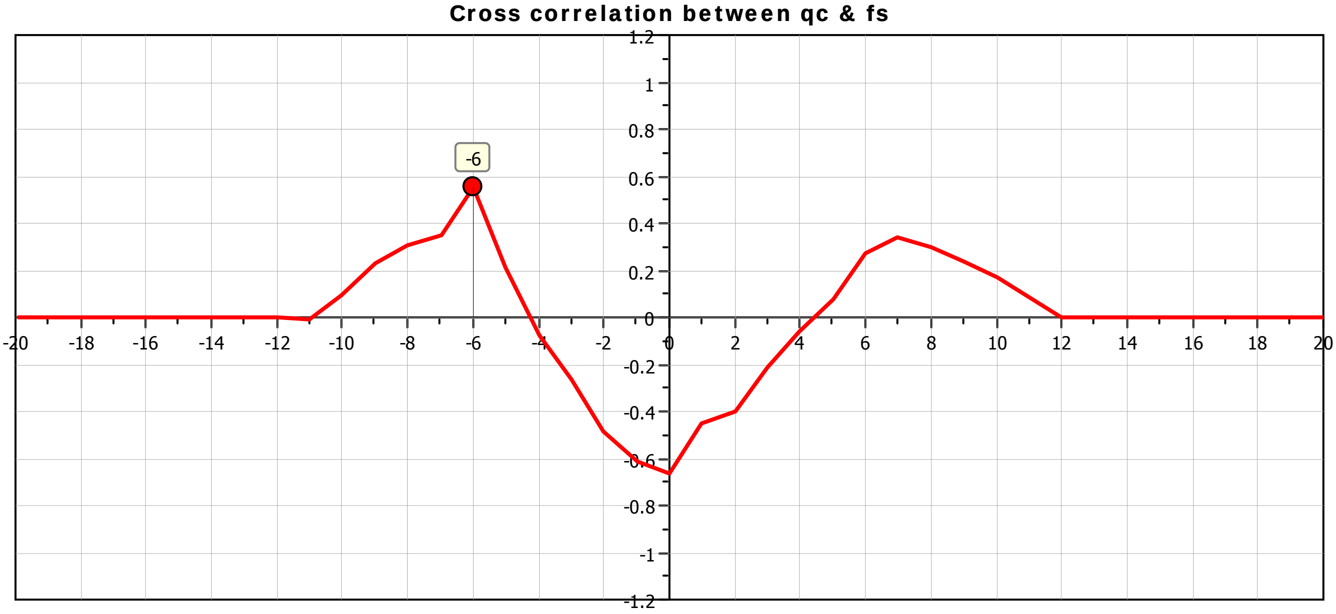
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	308.77	0.20	0.03	61.78
2	1.20	0.50	2.30	321.59	0.20	0.03	64.35
3	1.40	0.50	2.60	324.14	0.20	0.03	64.86
4	1.60	0.50	2.90	319.12	0.20	0.03	63.85
5	1.80	0.50	3.20	310.63	0.20	0.03	62.16
6	2.00	0.50	3.50	298.85	0.20	0.03	59.80
7	2.20	0.50	3.80	288.89	0.20	0.03	57.81
8	2.40	0.50	4.10	276.28	0.20	0.03	55.29
9	2.60	0.50	4.40	266.41	0.20	0.03	53.31
10	2.80	0.50	4.70	260.12	0.20	0.03	52.05
11	3.00	0.50	5.00	254.57	0.20	0.03	50.94
12	3.20	0.50	5.30	249.65	0.20	0.03	49.96
13	3.40	0.50	5.60	245.68	0.20	0.03	49.17
14	3.60	0.50	5.90	242.54	0.20	0.03	48.54
15	3.80	0.50	6.20	238.81	0.20	0.03	47.79
16	4.00	0.50	6.50	235.26	0.20	0.03	47.08

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

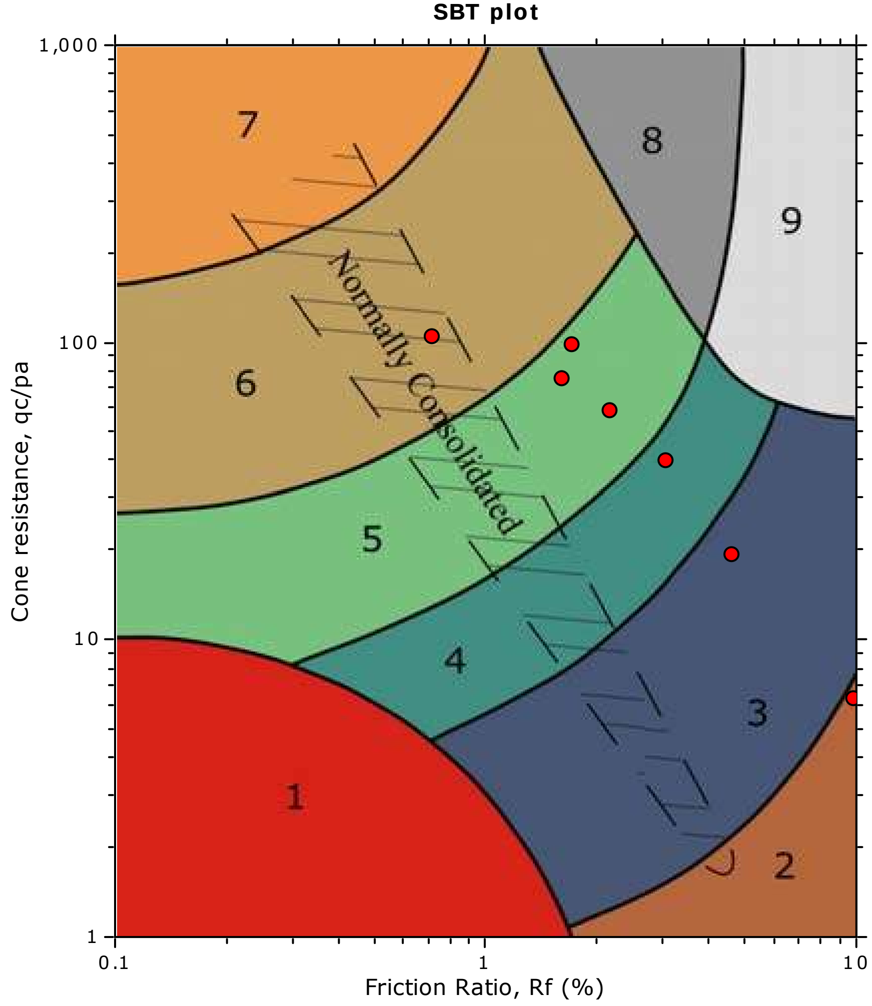
CPT: SCPT-19
Total depth: 0.79 ft

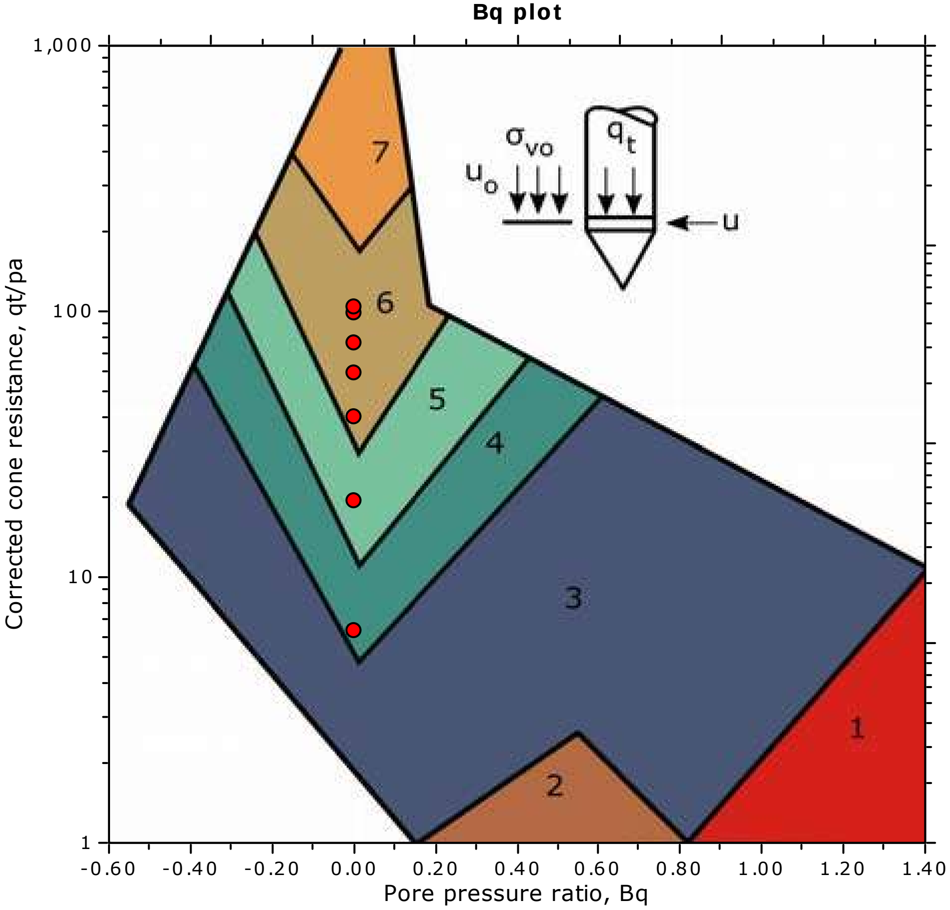


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

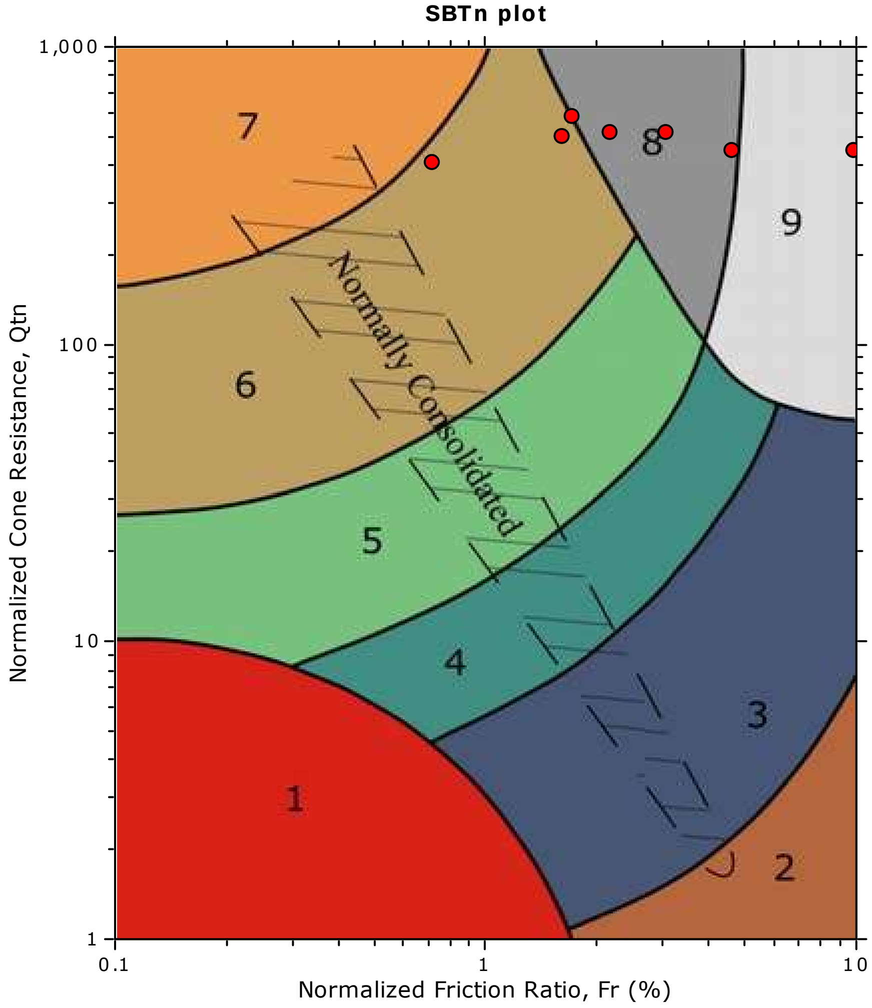


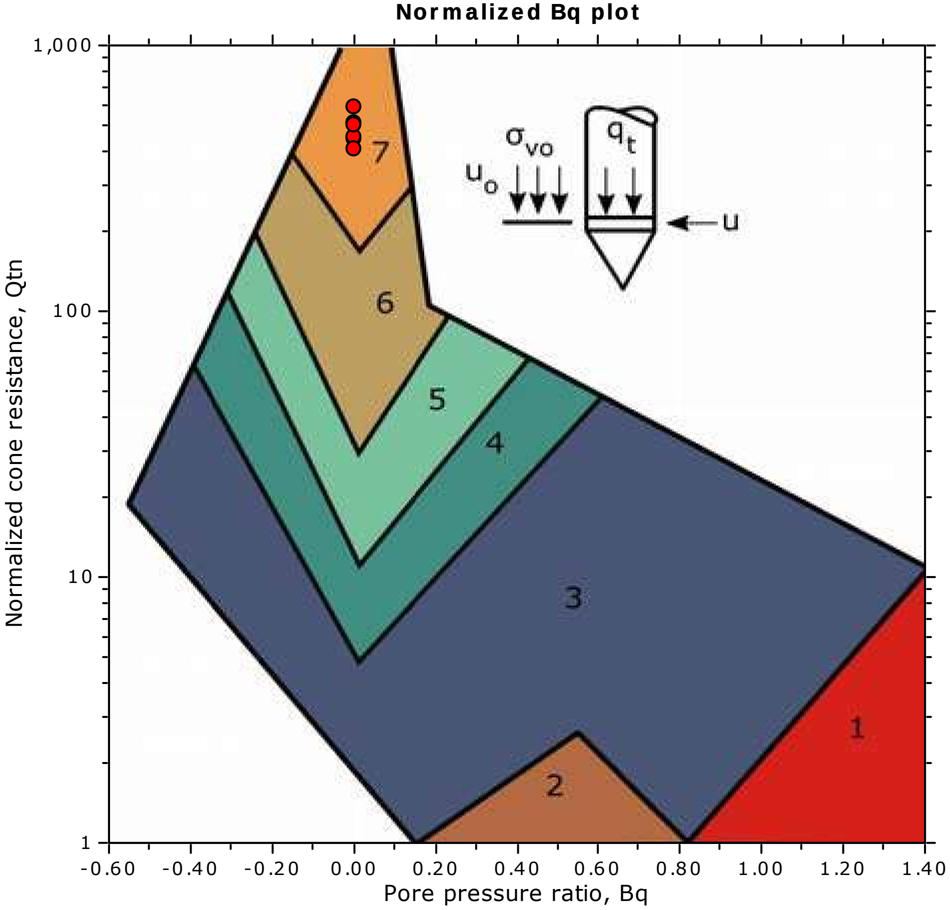


SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

SBT - Bq plots (normalized)

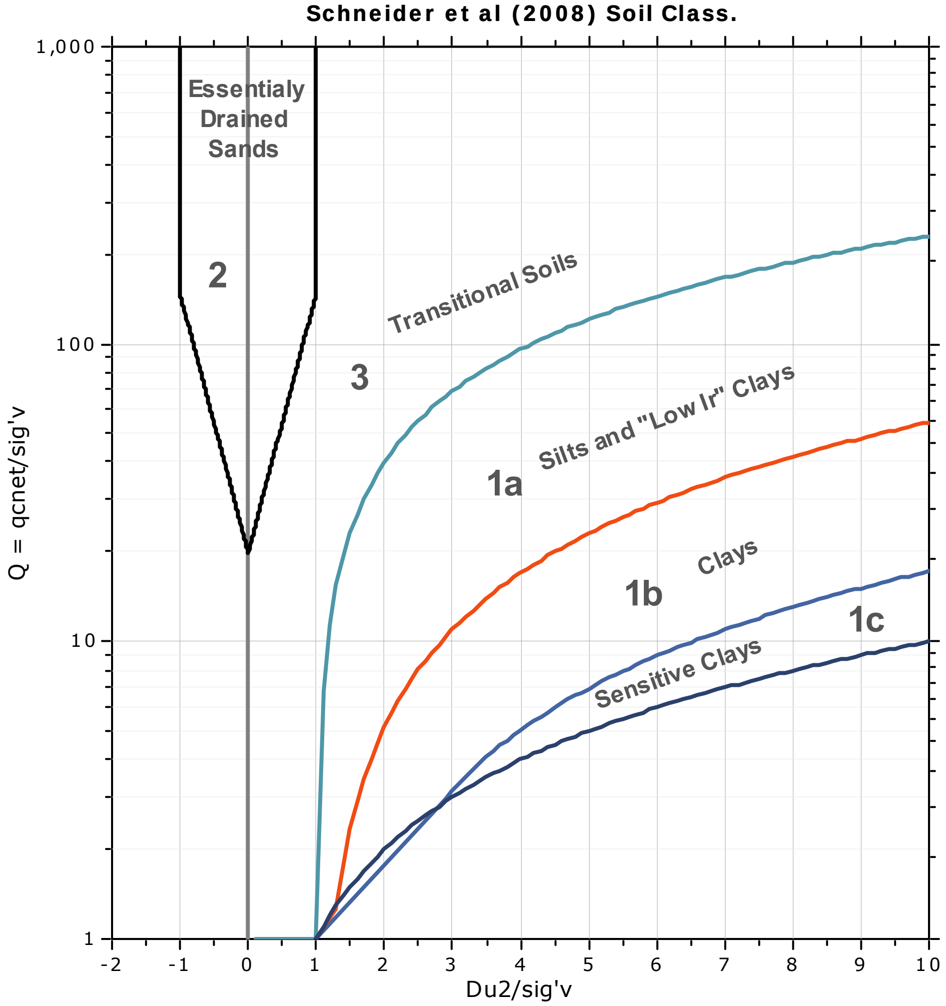


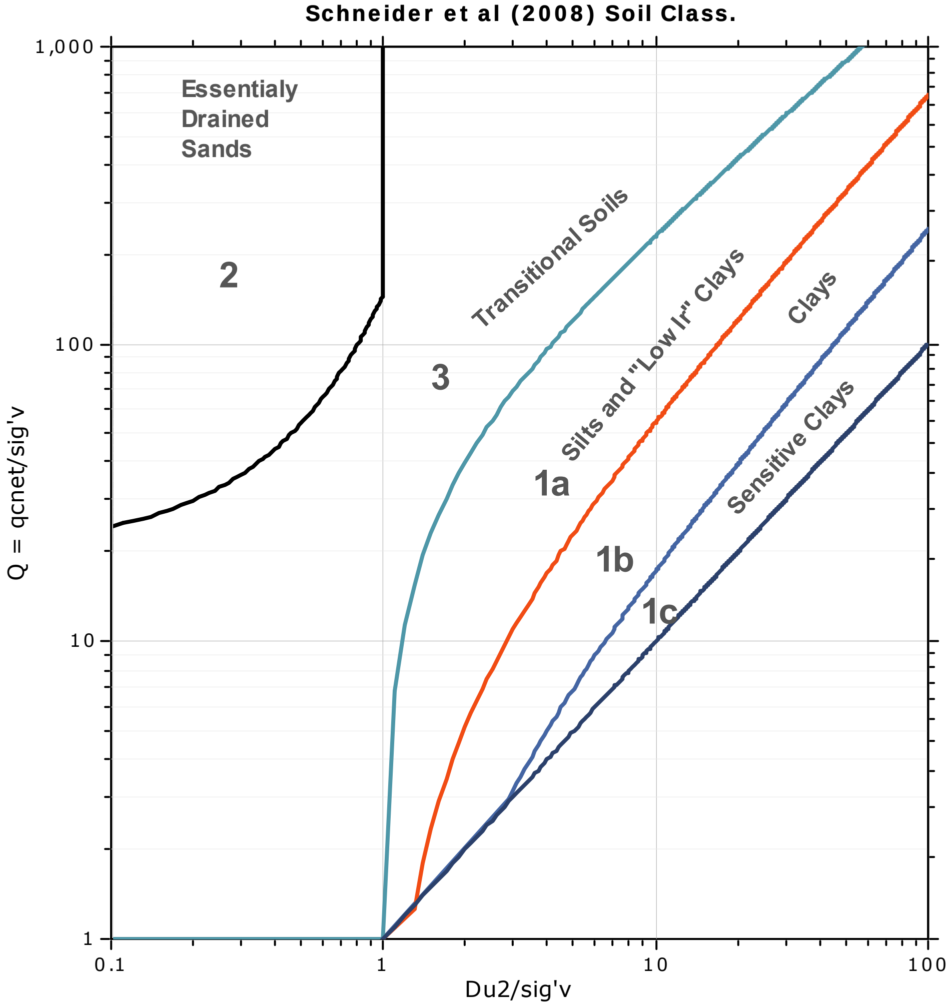


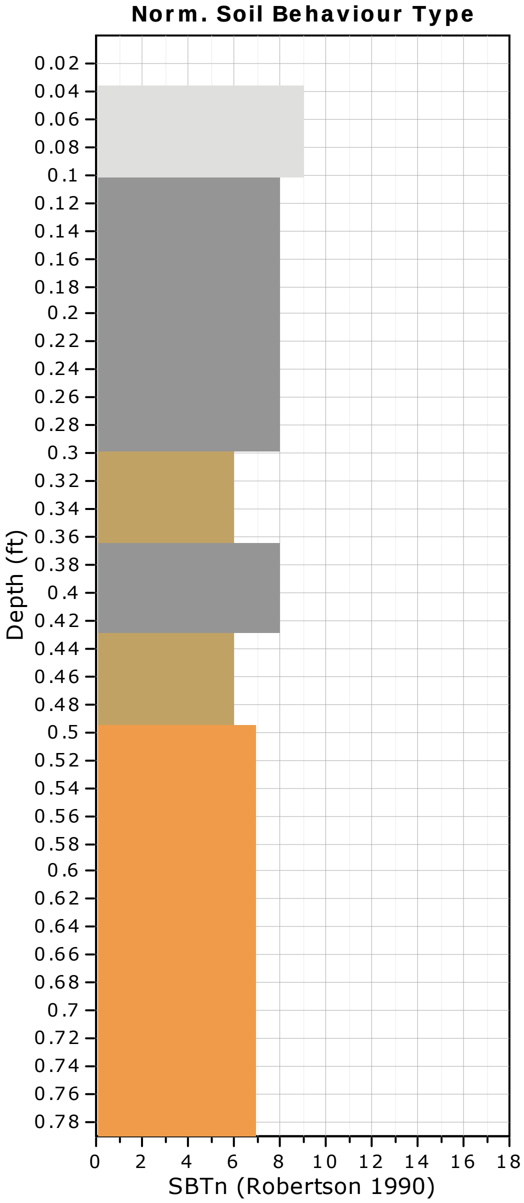
SBTn legend

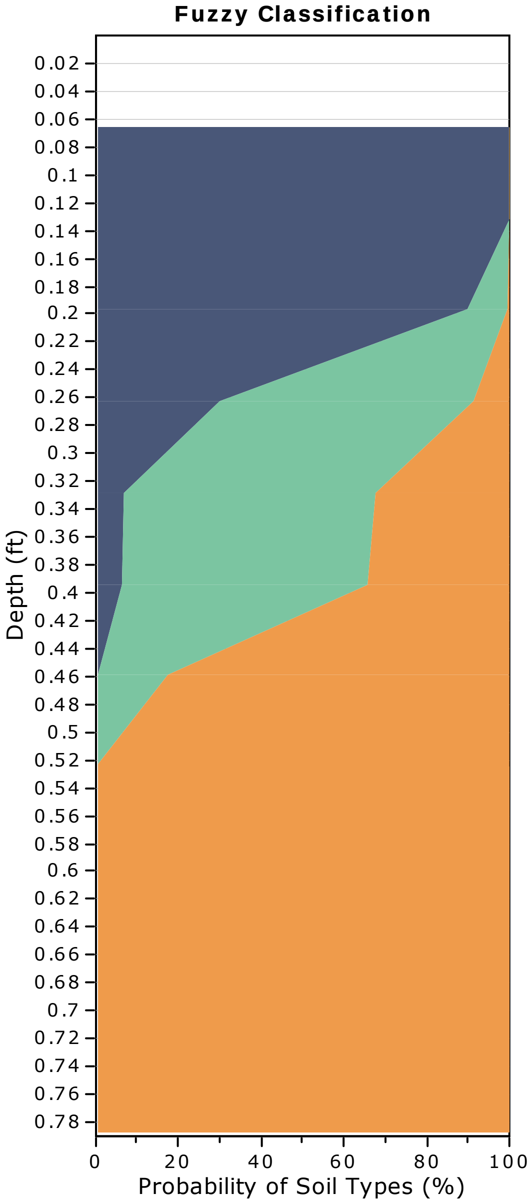
🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty clay	🟧 7. Gravelly sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬜ 8. Very stiff sand to clayey sand
🟦 3. Clay to silty clay	🟫 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

Bq plots (Schneider)



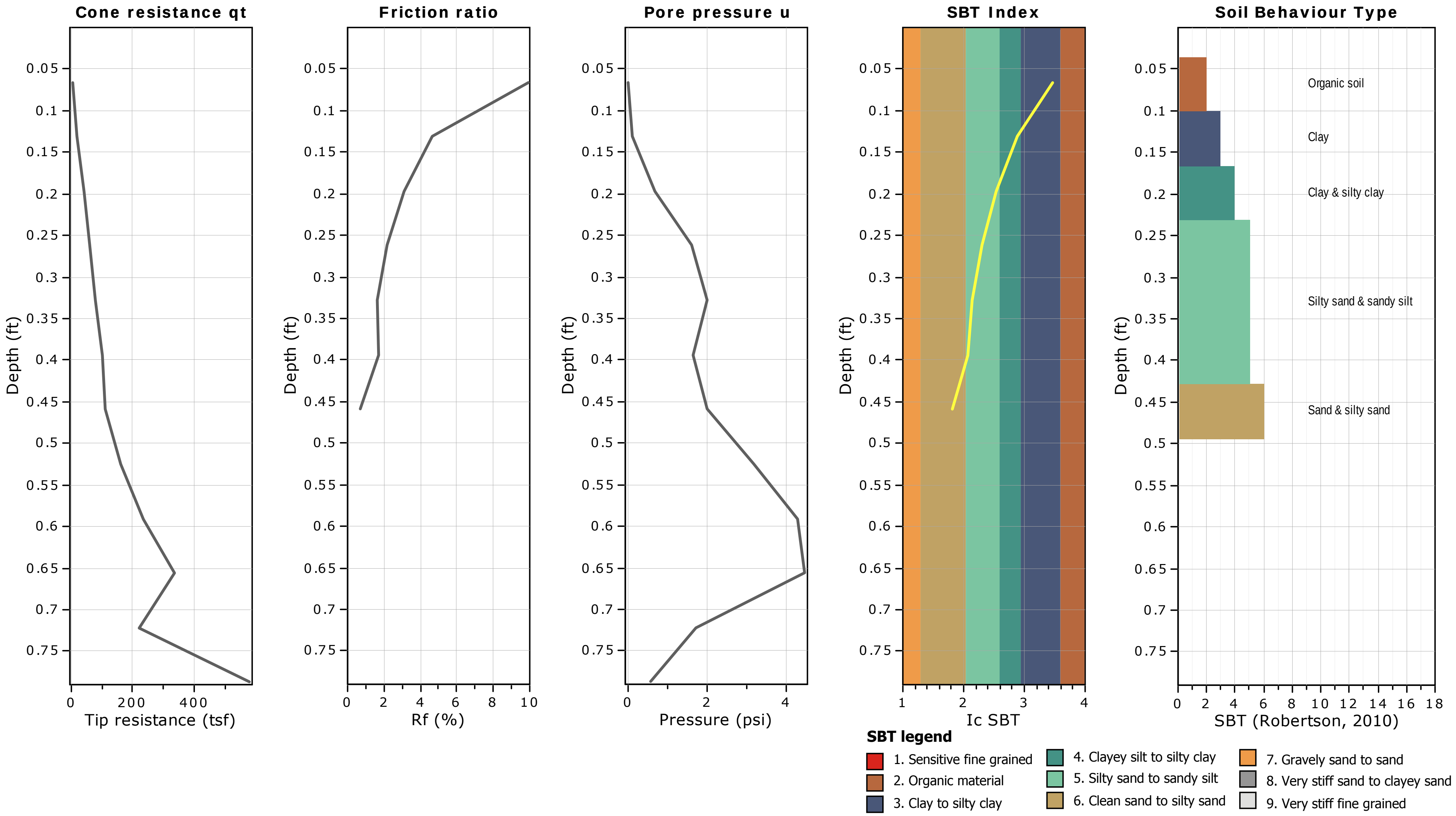



Norm. Soil Behaviour Type
Depth (ft)
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
0.24
0.26
0.28
0.3
0.32
0.34
0.36
0.38
0.4
0.42
0.44
0.46
0.48
0.5
0.52
0.54
0.56
0.58
0.6
0.62
0.64
0.66
0.68
0.7
0.72
0.74
0.76
0.78
0
2
4
6
8
10
12
14
16
18
SBTn (Robertson 1990)


Fuzzy Classification
Depth (ft)
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
0.24
0.26
0.28
0.3
0.32
0.34
0.36
0.38
0.4
0.42
0.44
0.46
0.48
0.5
0.52
0.54
0.56
0.58
0.6
0.62
0.64
0.66
0.68
0.7
0.72
0.74
0.76
0.78
0
20
40
60
80
100
Probability of Soil Types (%)

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19
Total depth: 0.79 ft



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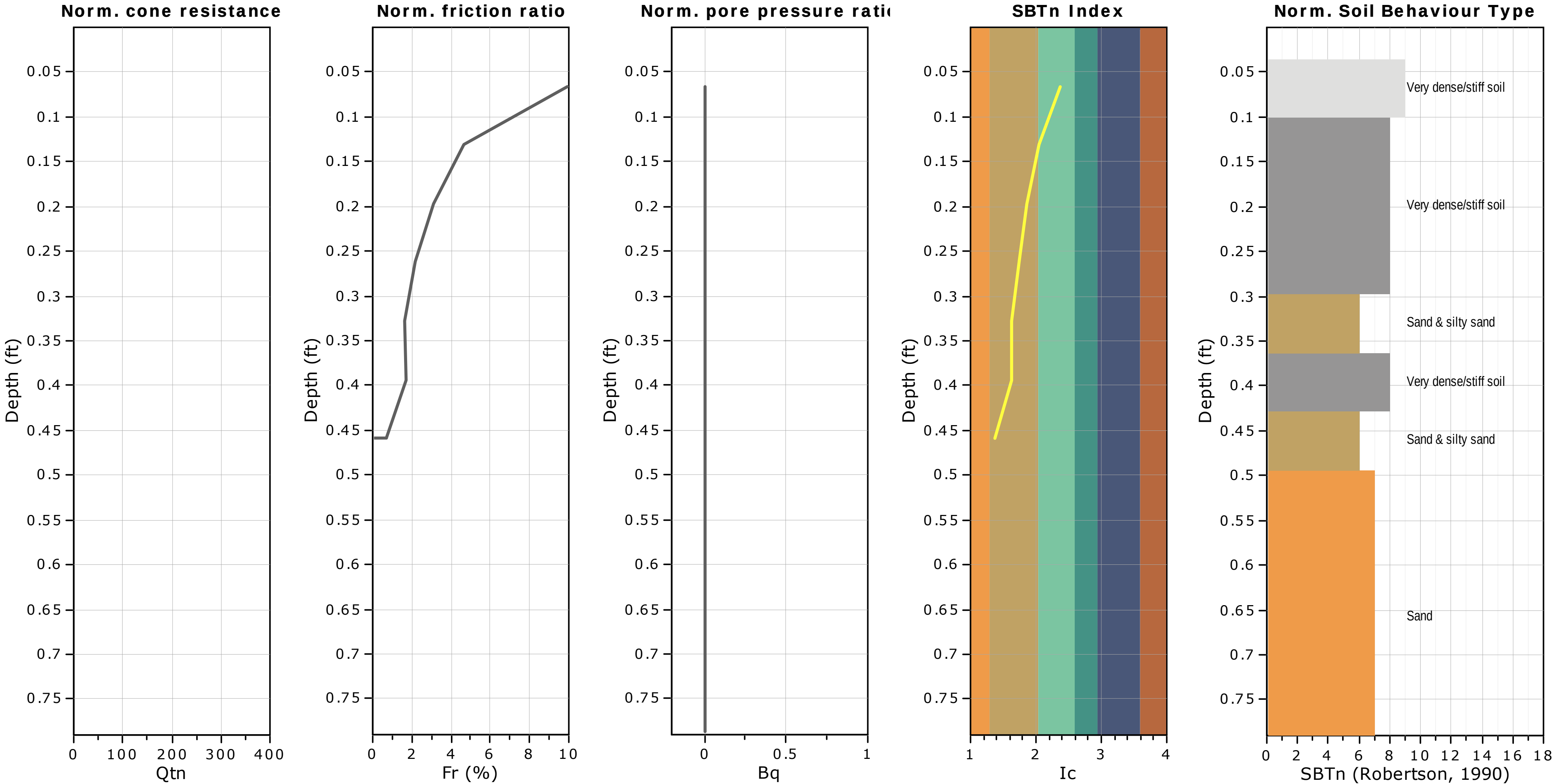
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19
Total depth: 0.79 ft



SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
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- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

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Mays Landing, NJ

Project: **Langan**
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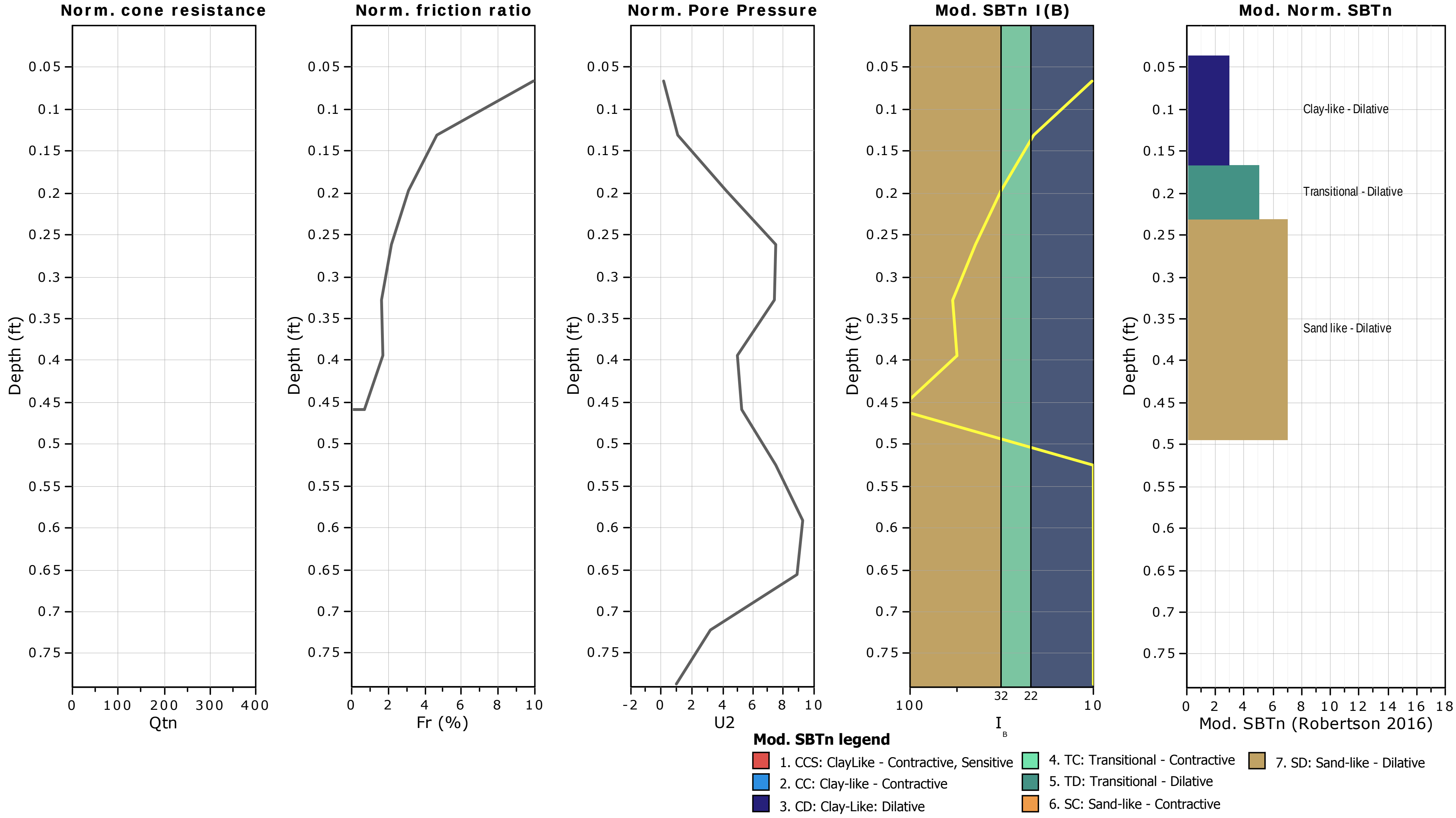
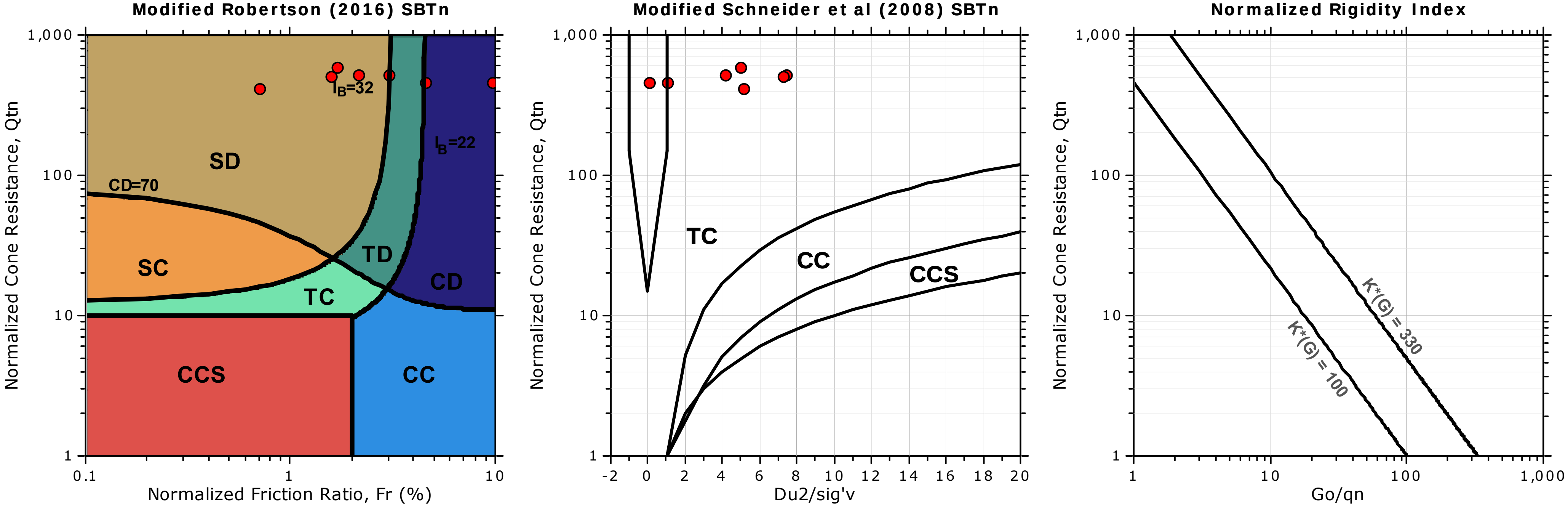
CPT: SCPT-19
Total depth: 0.79 ft



Updated SBTn plots

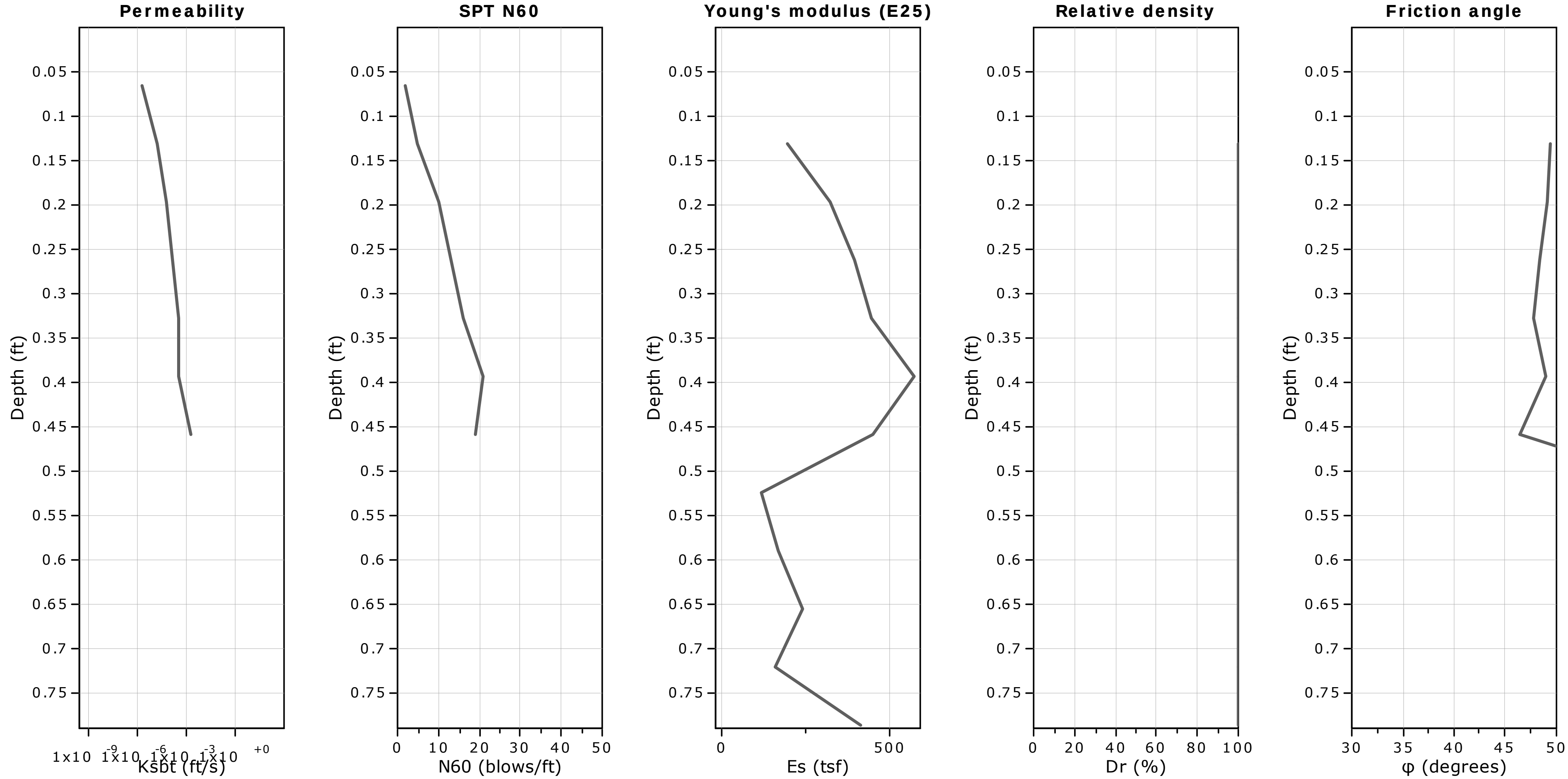


CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19
Total depth: 0.79 ft

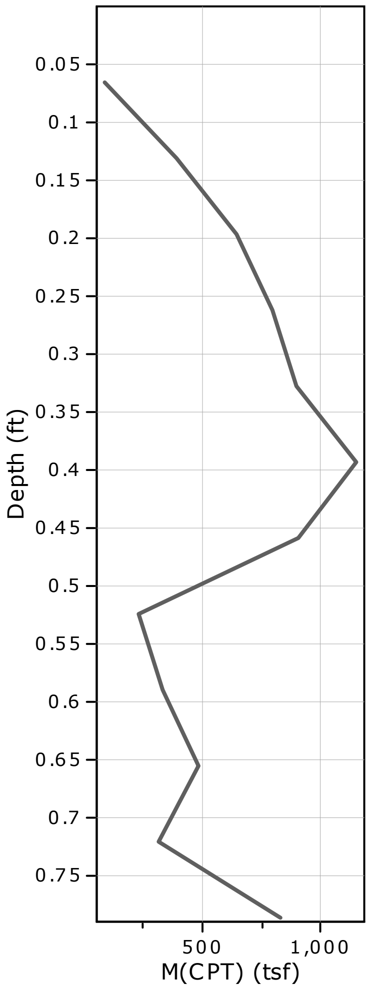


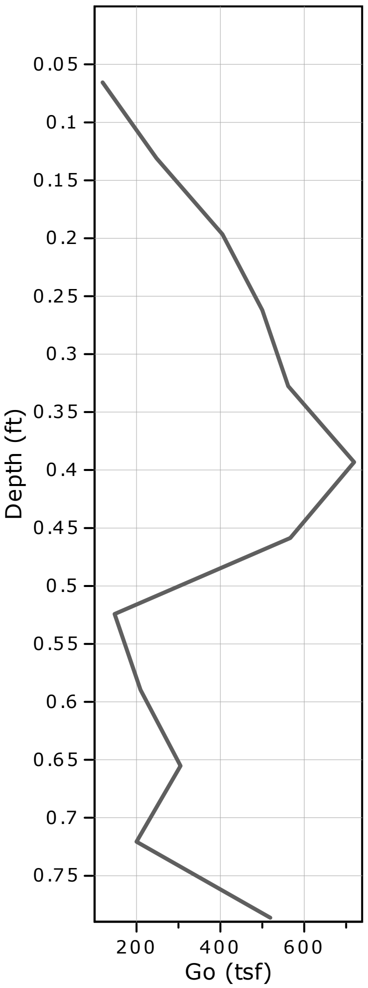
Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

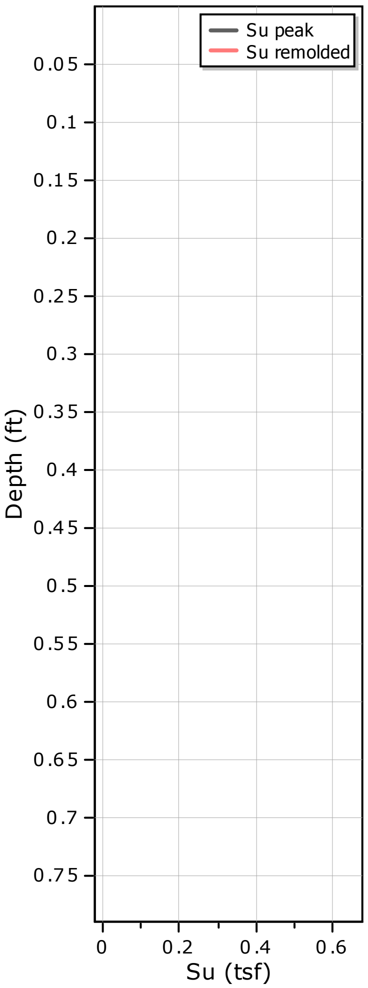
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
—●— User defined estimation data

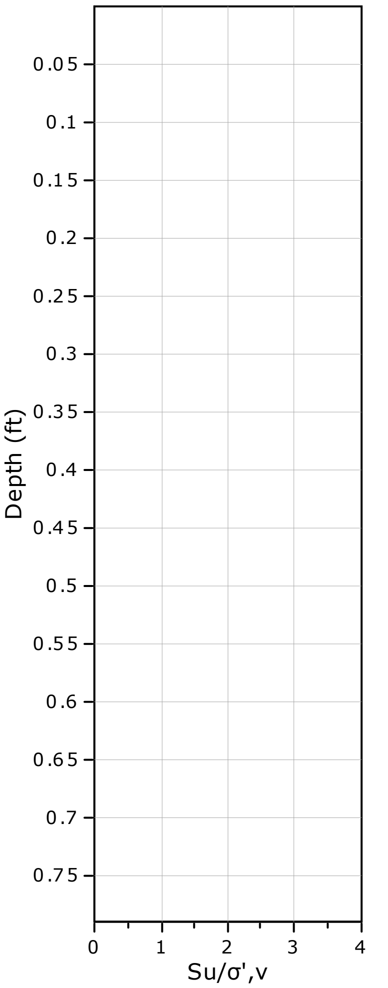
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

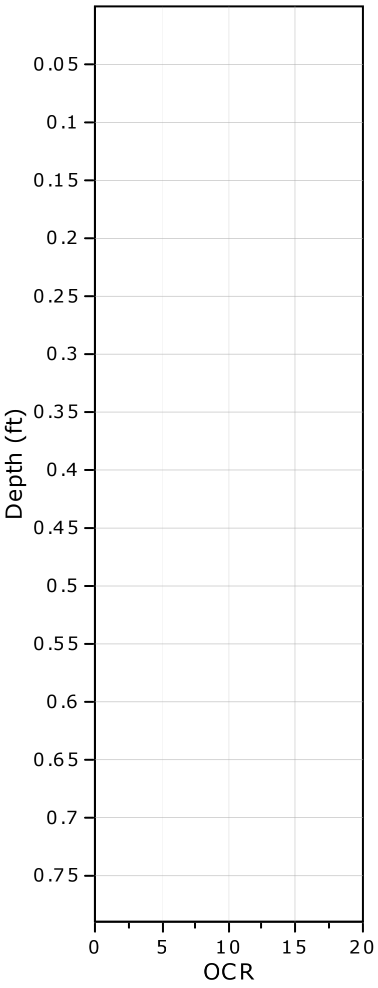
CPT: SCPT-19
Total depth: 0.79 ft


Constrained Modulus


Shear modulus


Shear strength


Undrained strength ratio


OCR

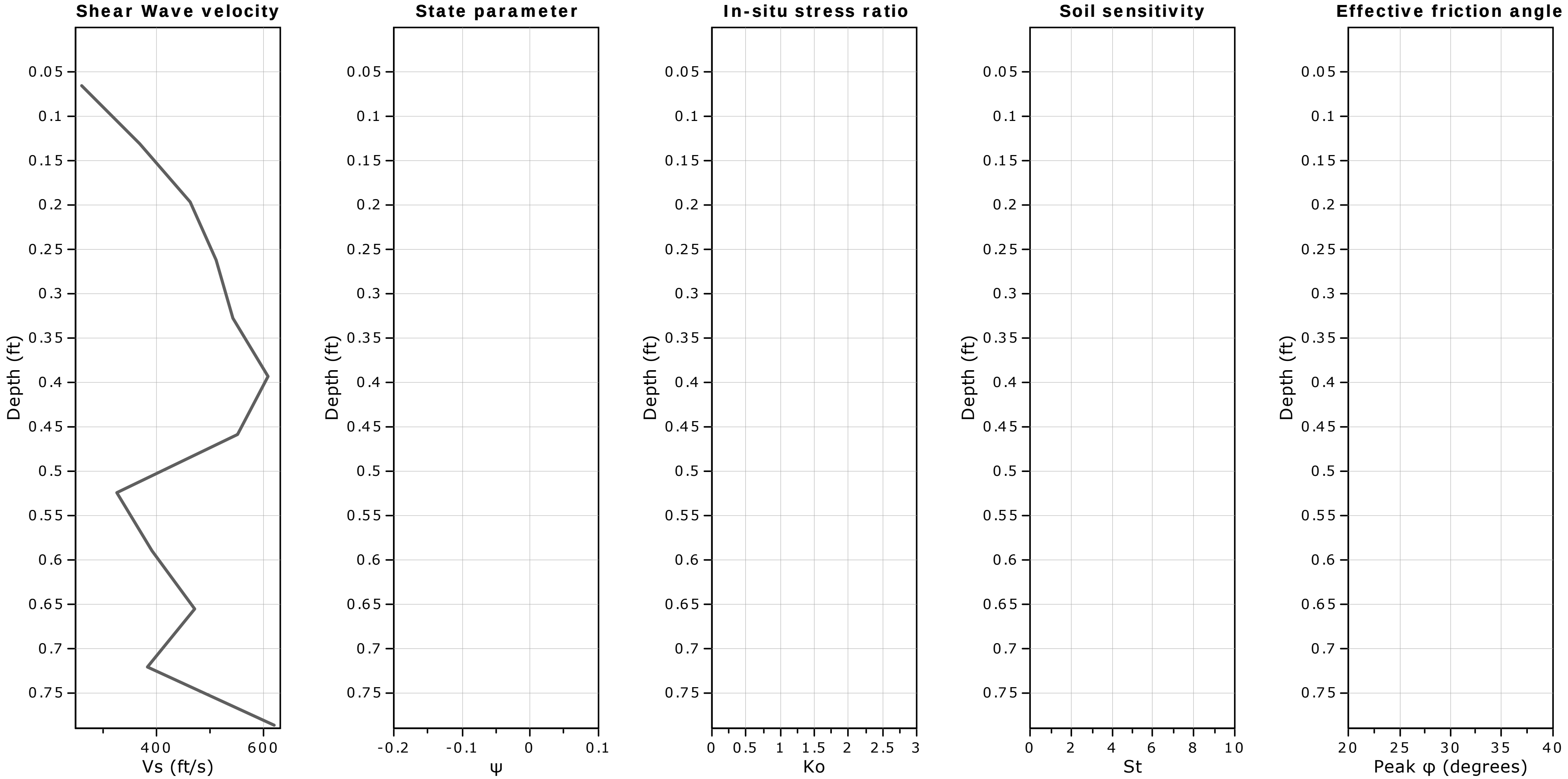
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

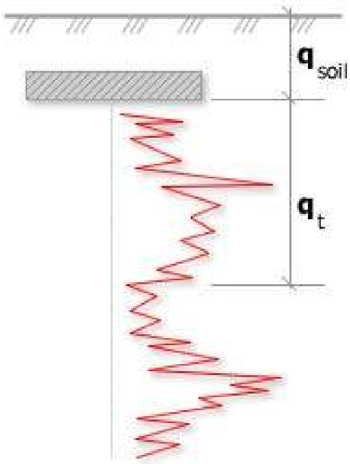
CPT: SCPT-19
Total depth: 0.79 ft



Calculation parameters

Soil Sensitivity factor, N_S: 350.00

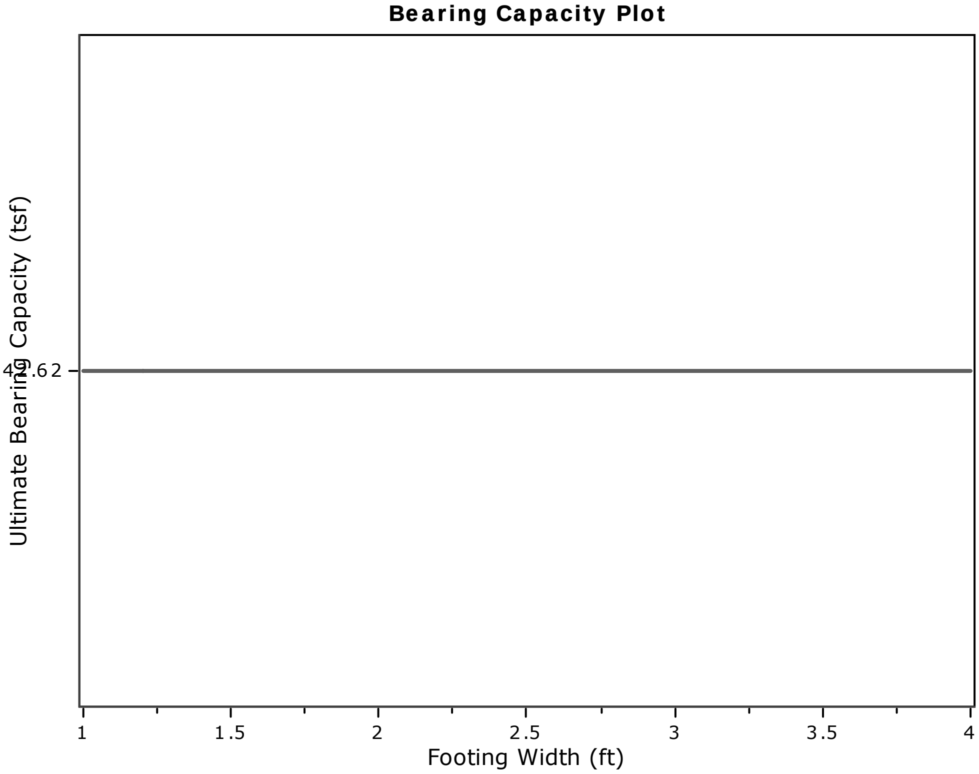
● User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

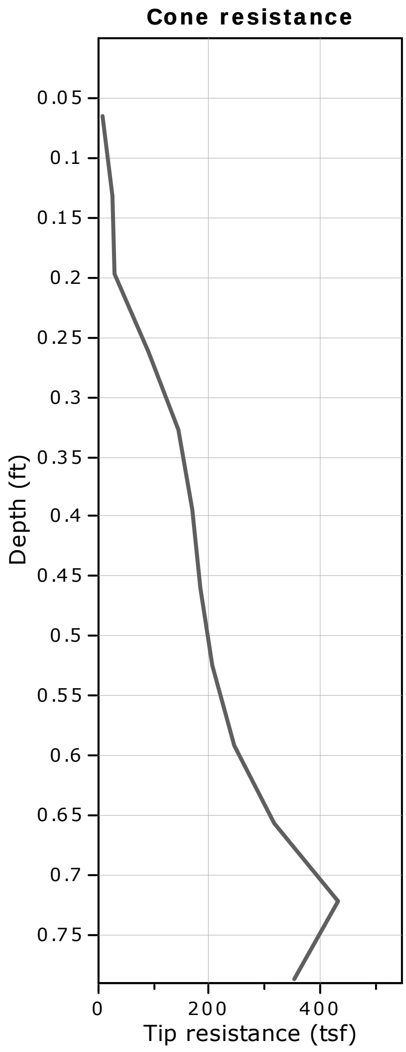


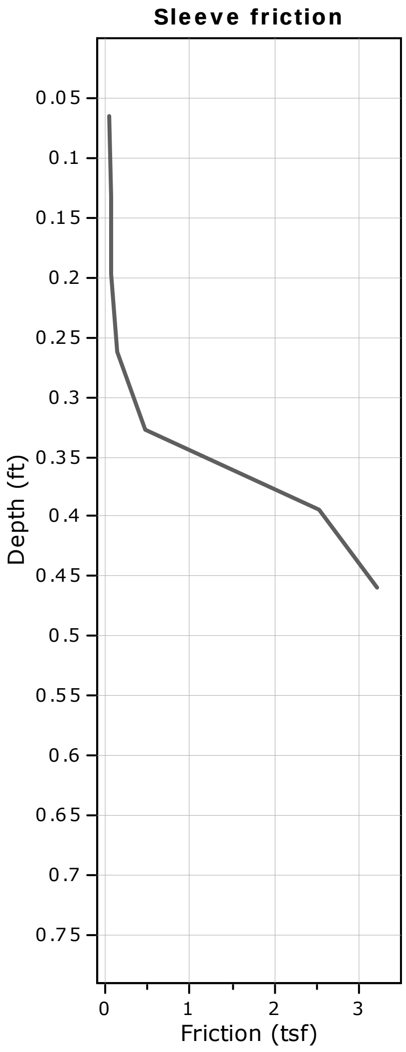
:: Tabular results ::

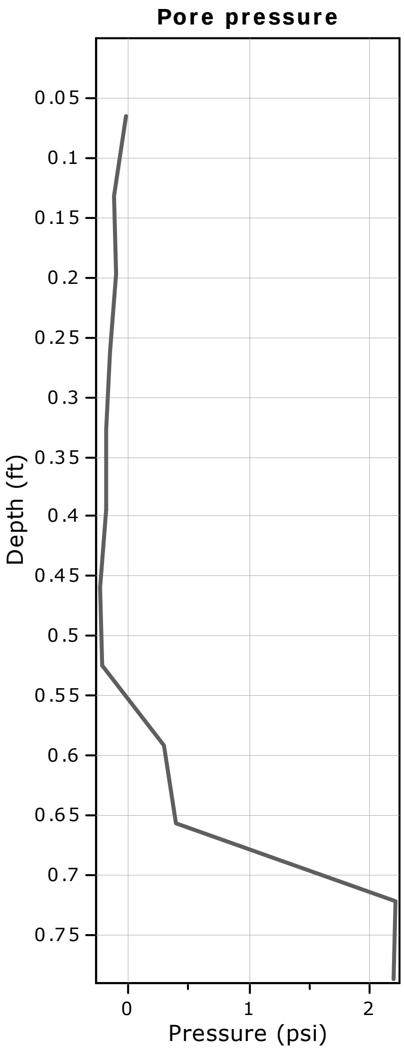
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	212.95	0.20	0.03	42.62
2	1.20	0.50	2.30	212.95	0.20	0.03	42.62
3	1.40	0.50	2.60	212.95	0.20	0.03	42.62
4	1.60	0.50	2.90	212.95	0.20	0.03	42.62
5	1.80	0.50	3.20	212.95	0.20	0.03	42.62
6	2.00	0.50	3.50	212.95	0.20	0.03	42.62
7	2.20	0.50	3.80	212.95	0.20	0.03	42.62
8	2.40	0.50	4.10	212.95	0.20	0.03	42.62
9	2.60	0.50	4.40	212.95	0.20	0.03	42.62
10	2.80	0.50	4.70	212.95	0.20	0.03	42.62
11	3.00	0.50	5.00	212.95	0.20	0.03	42.62
12	3.20	0.50	5.30	212.95	0.20	0.03	42.62
13	3.40	0.50	5.60	212.95	0.20	0.03	42.62
14	3.60	0.50	5.90	212.95	0.20	0.03	42.62
15	3.80	0.50	6.20	212.95	0.20	0.03	42.62
16	4.00	0.50	6.50	212.95	0.20	0.03	42.62

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

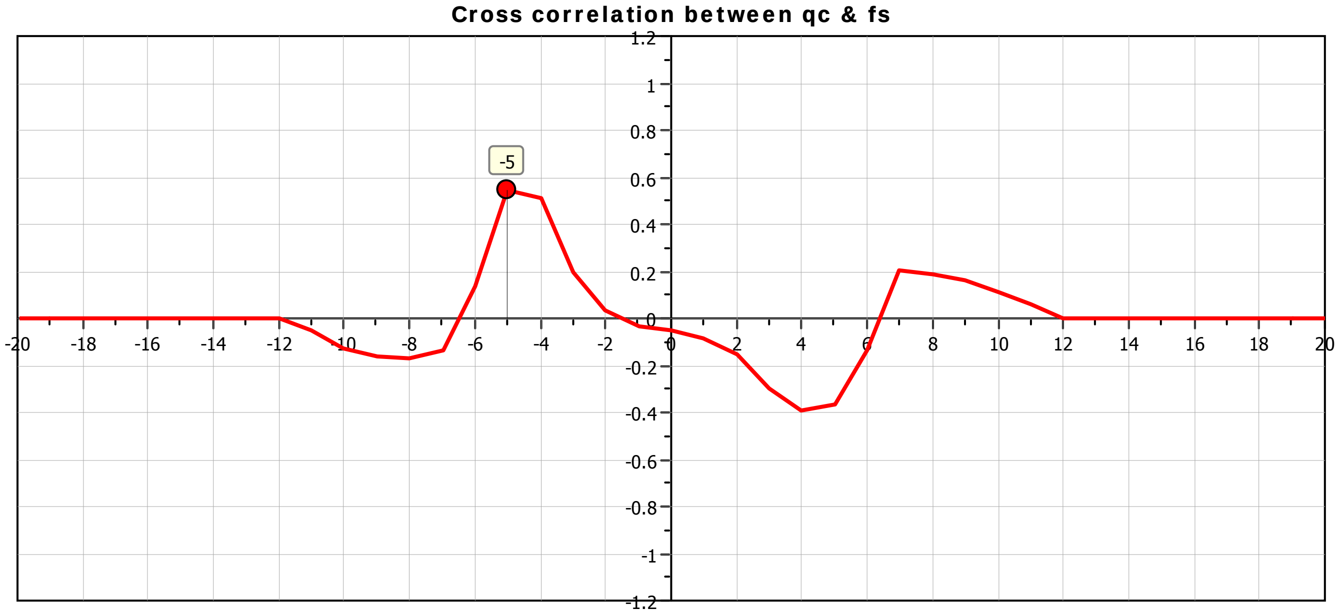
CPT: SCPT-19a
Total depth: 0.79 ft


Cone resistance

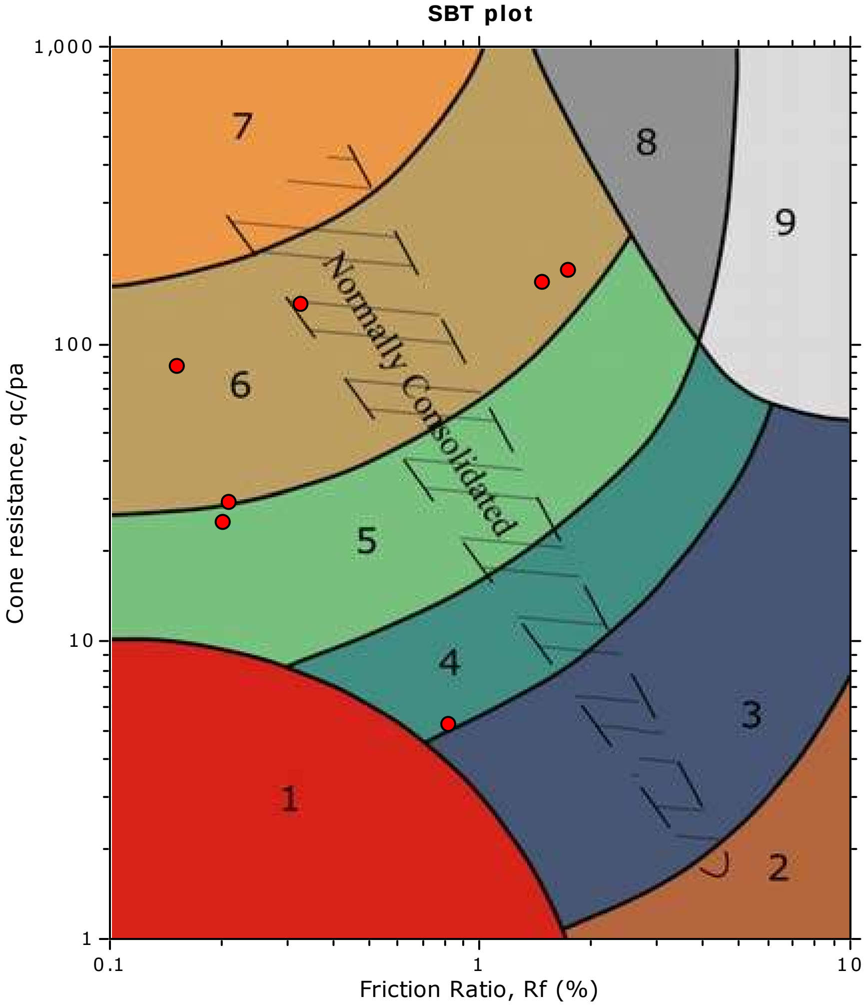

Sleeve friction

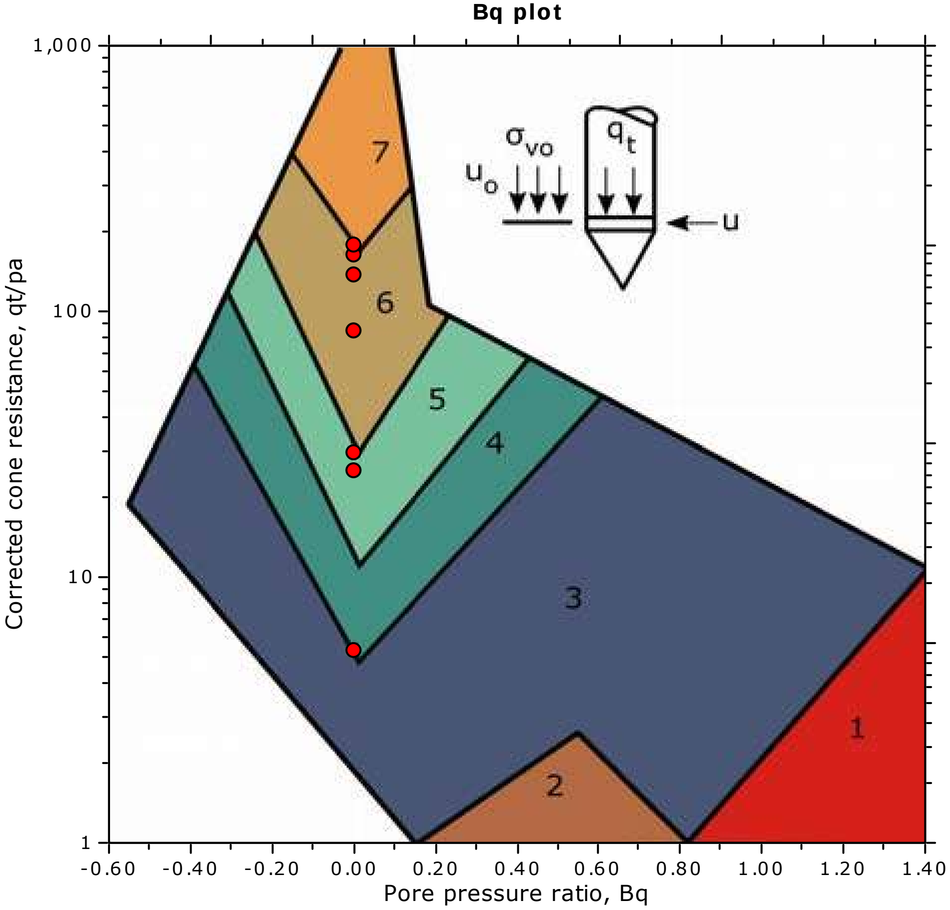

Pore pressure

The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).


Cross correlation between qc & fs

SBT - Bq plots

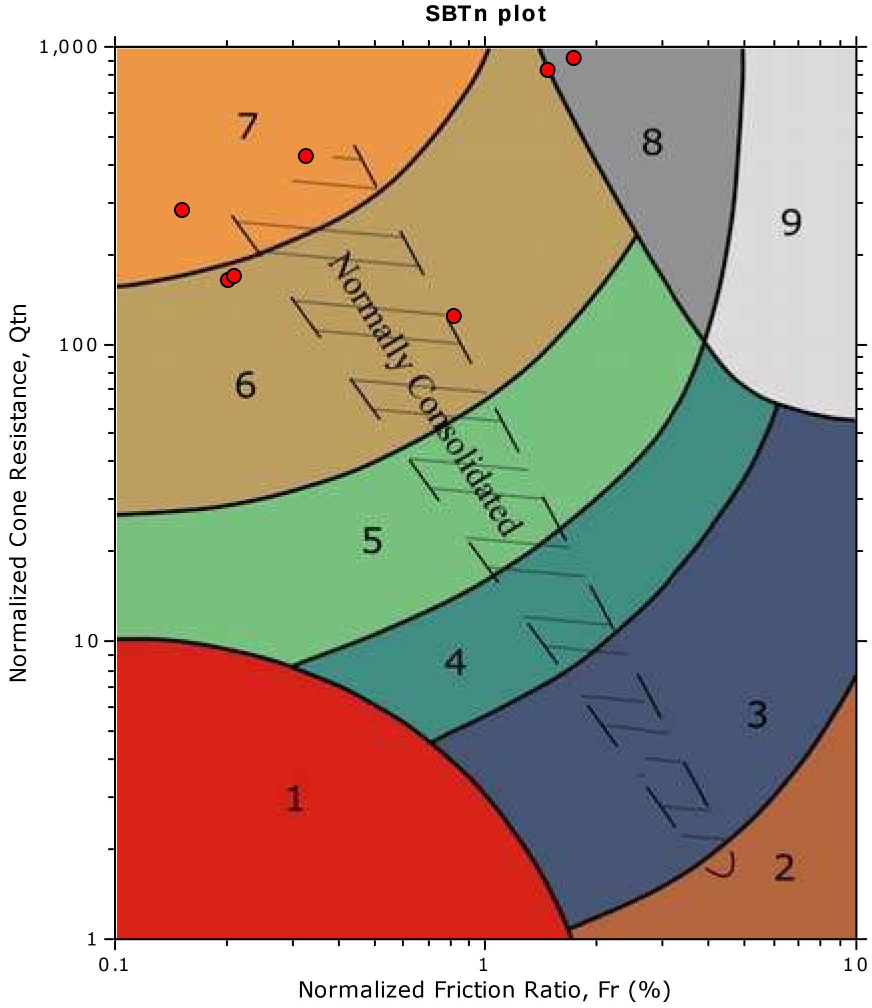


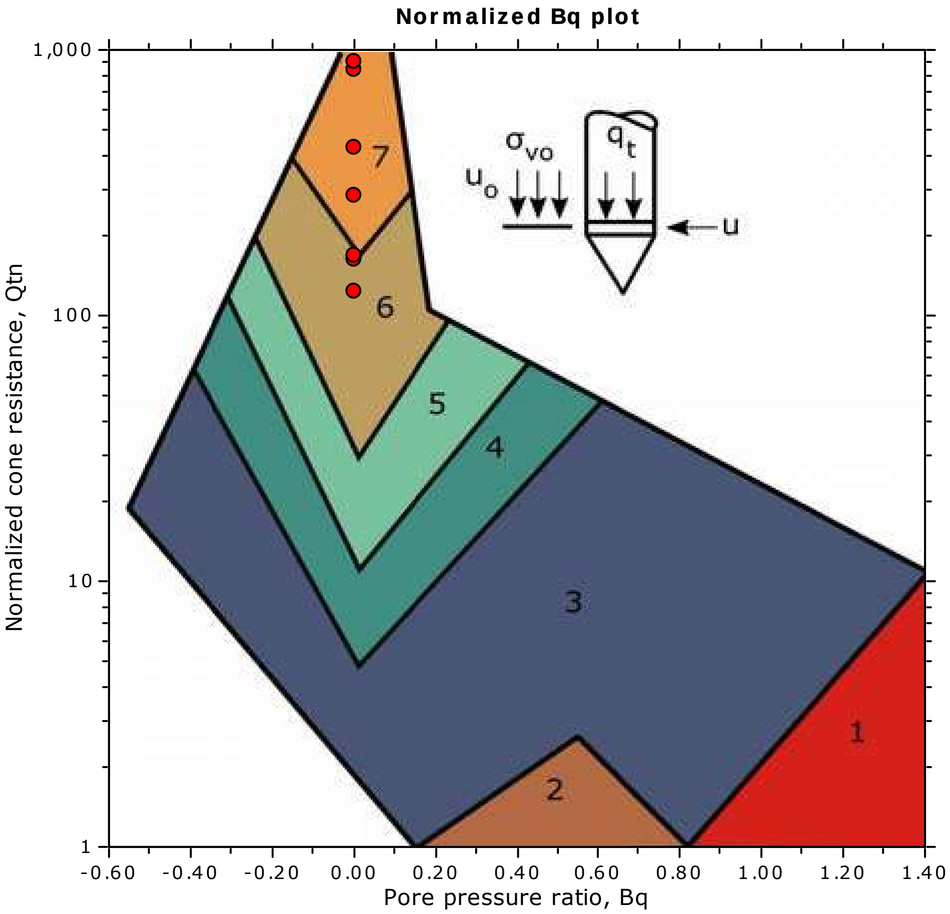


SBT legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟫 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬛ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

SBT - Bq plots (normalized)





SBTn legend

🟥 1. Sensitive fine grained
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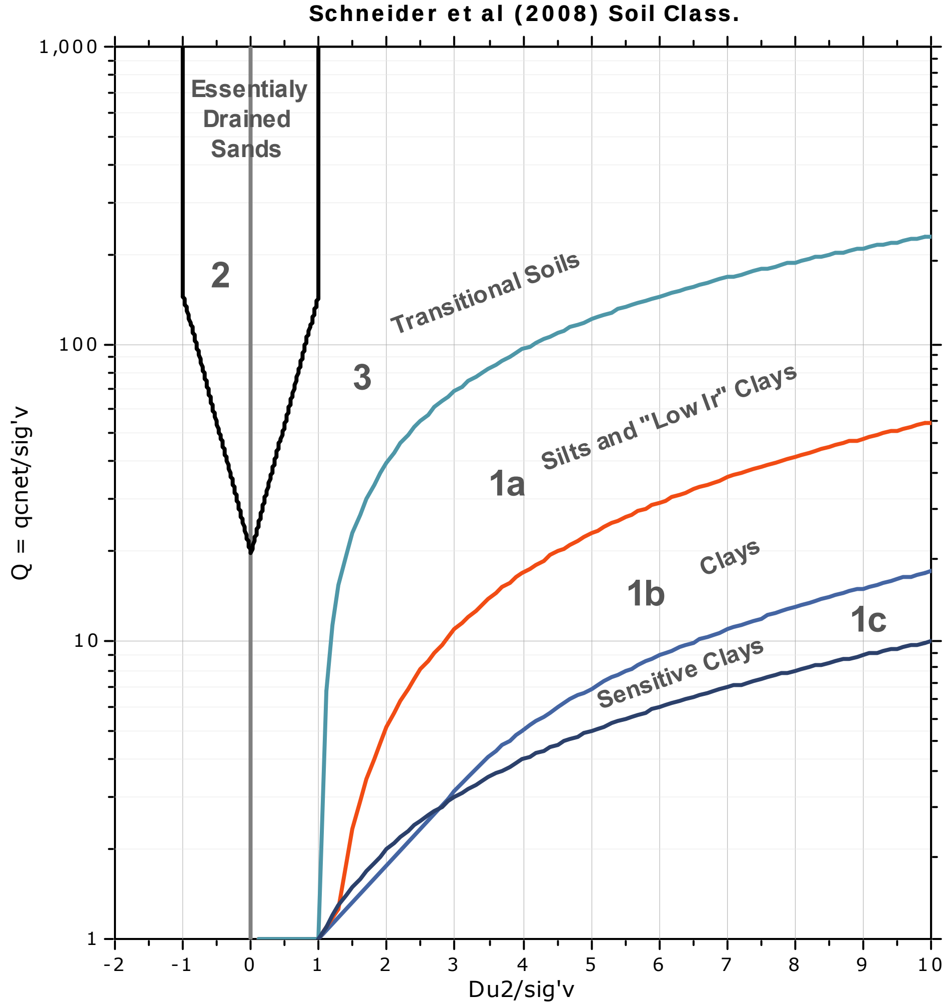
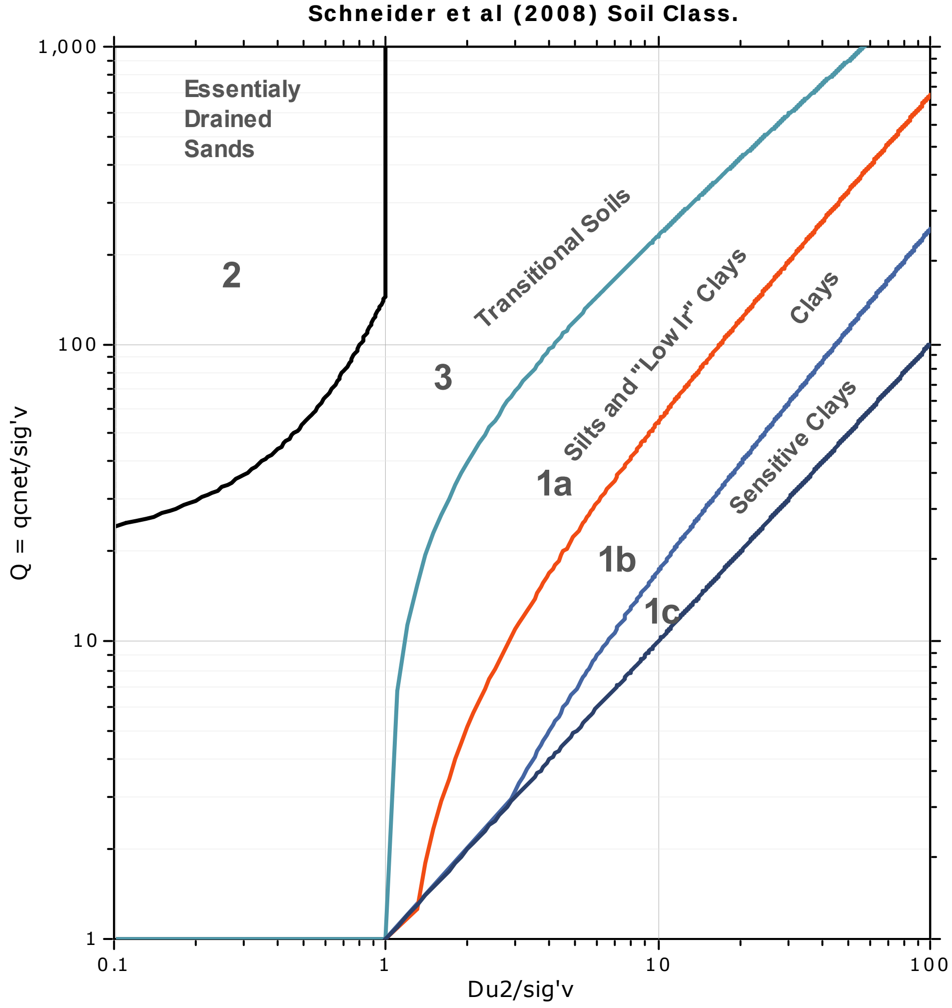
🟩 5. Silty sand to sandy silt
🟫 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬛ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

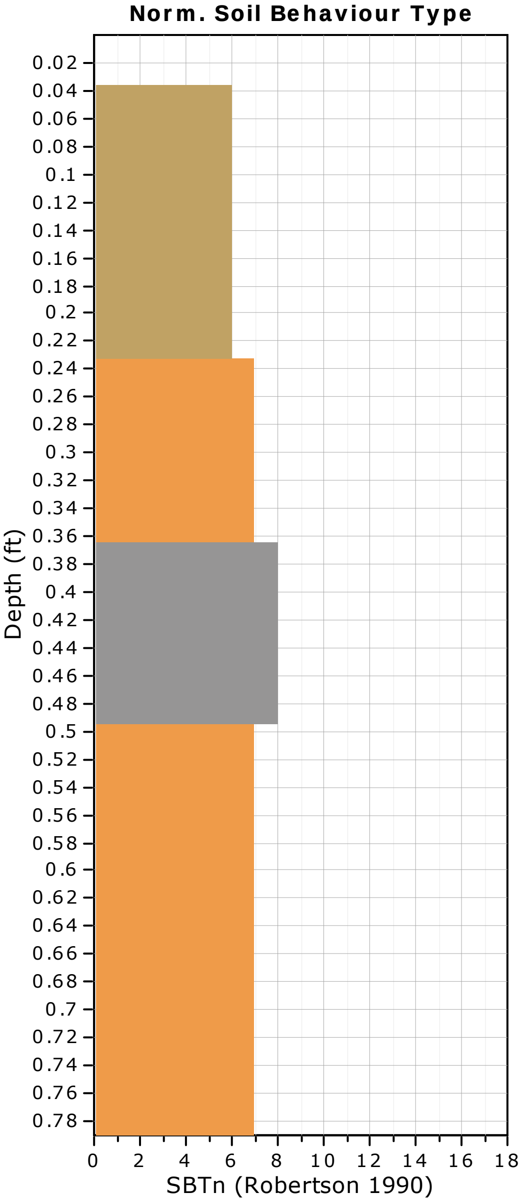
Bq plots (Schneider)

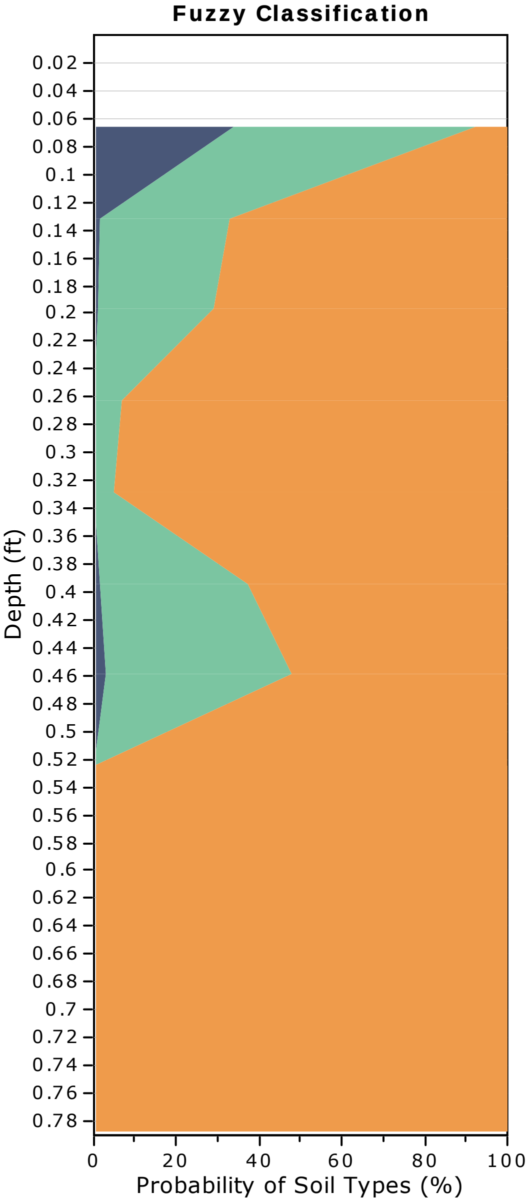




Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19a
Total depth: 0.79 ft





Craig Geotechnical Drilling
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Project: **Langan**
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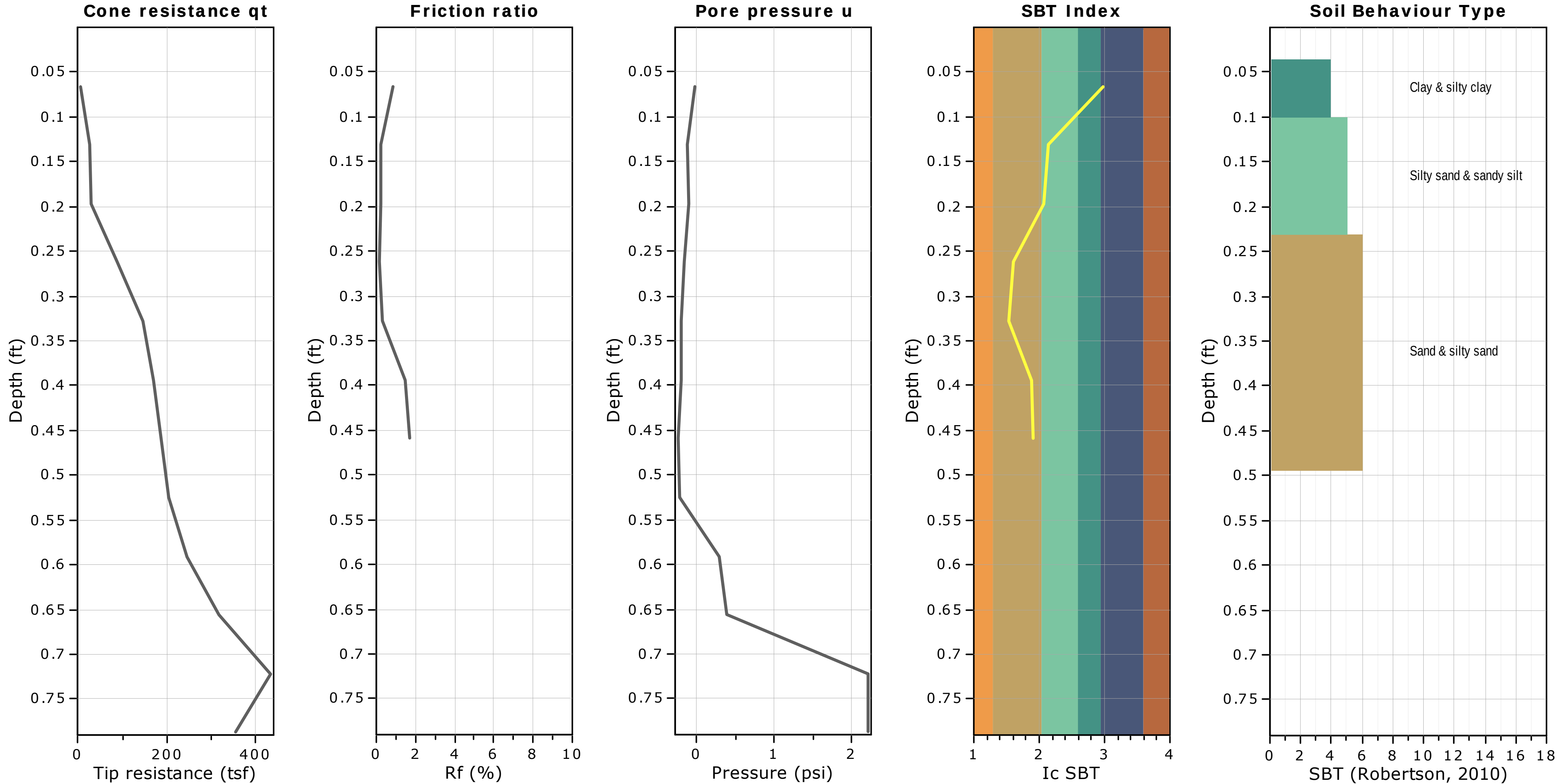
CPT: SCPT-19a
Total depth: 0.79 ft



SBT legend

🟥 1. Sensitive fine grained
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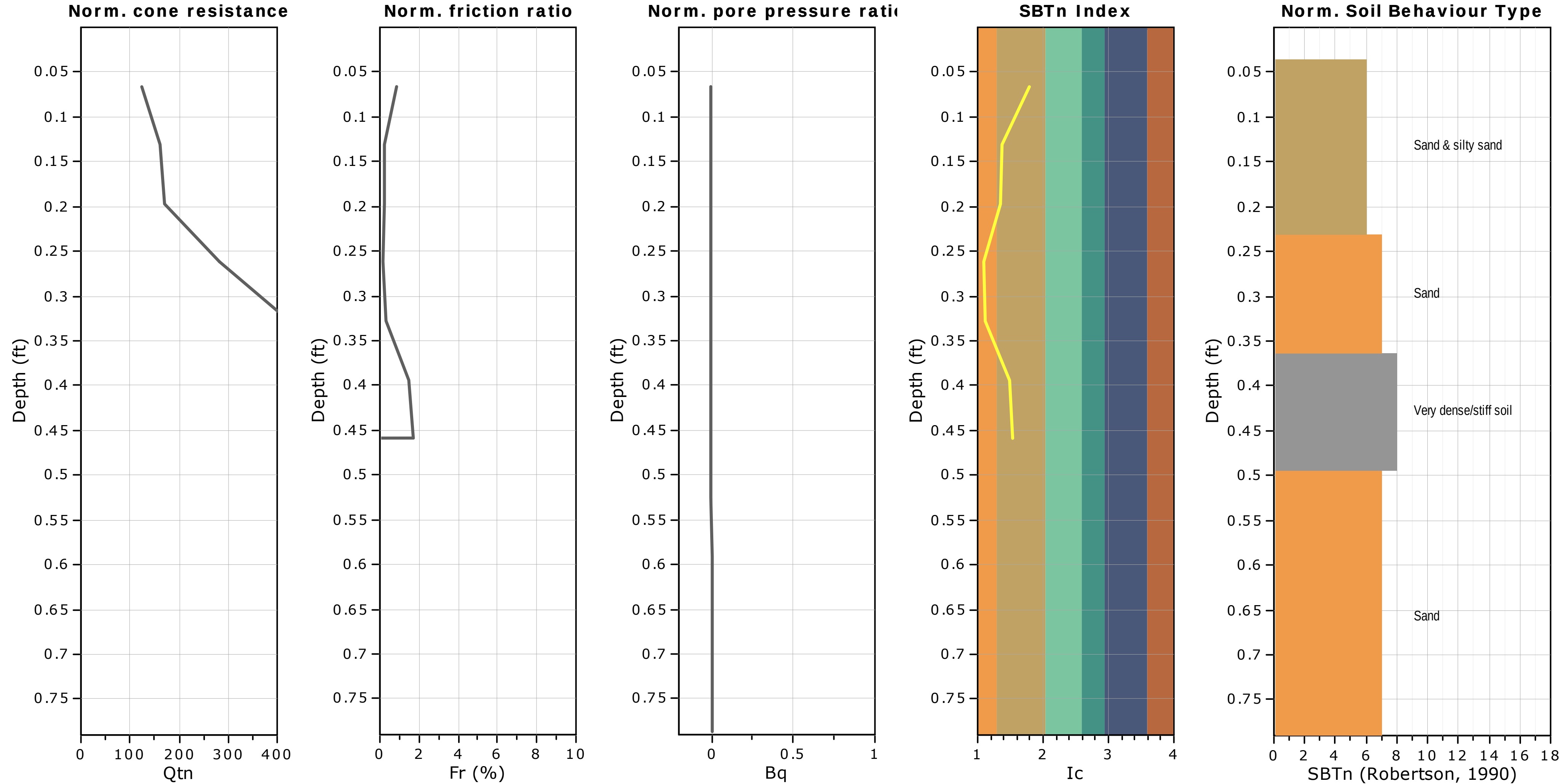

SBTn legend

- 🟥 1. Sensitive fine grained
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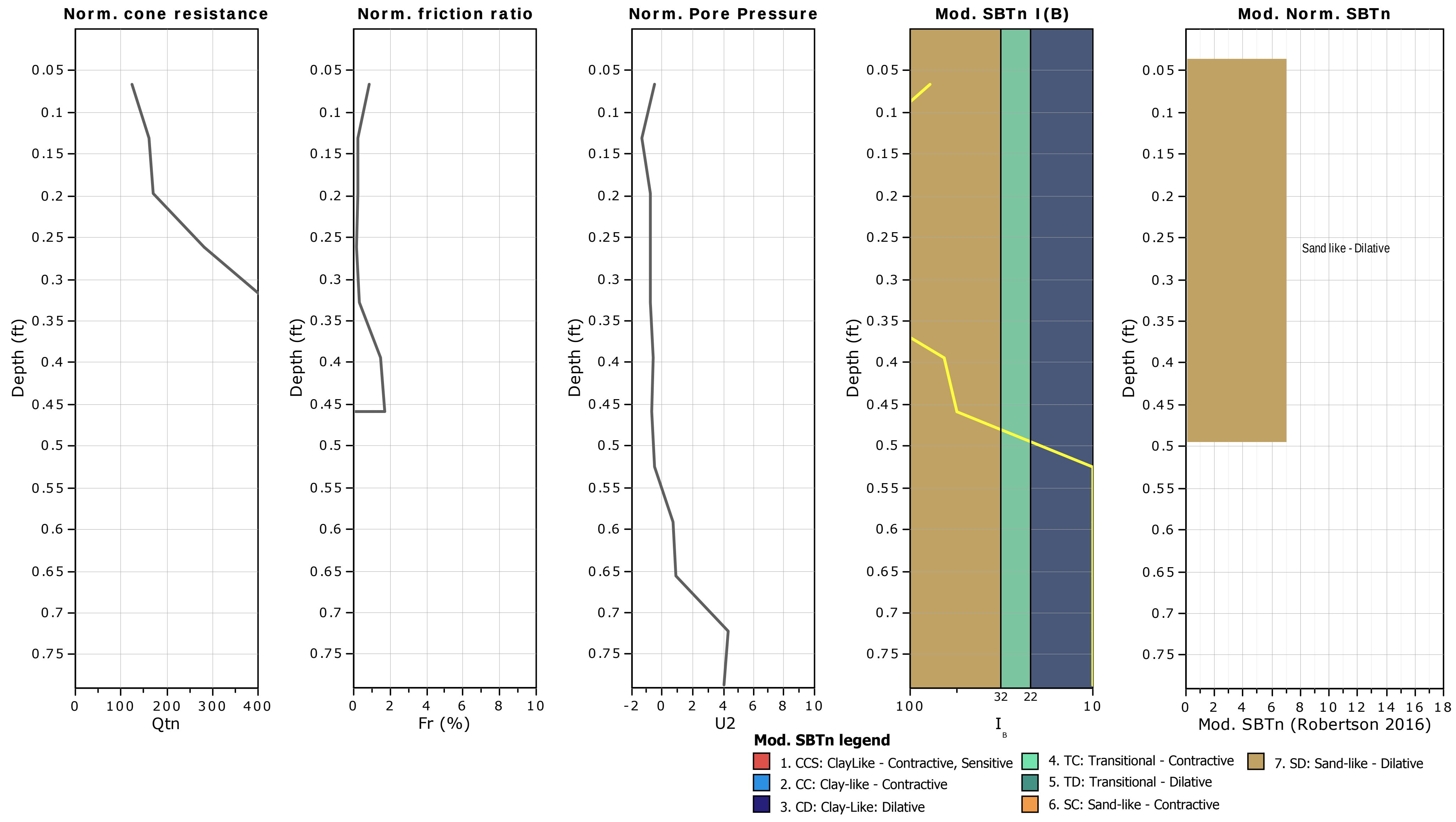
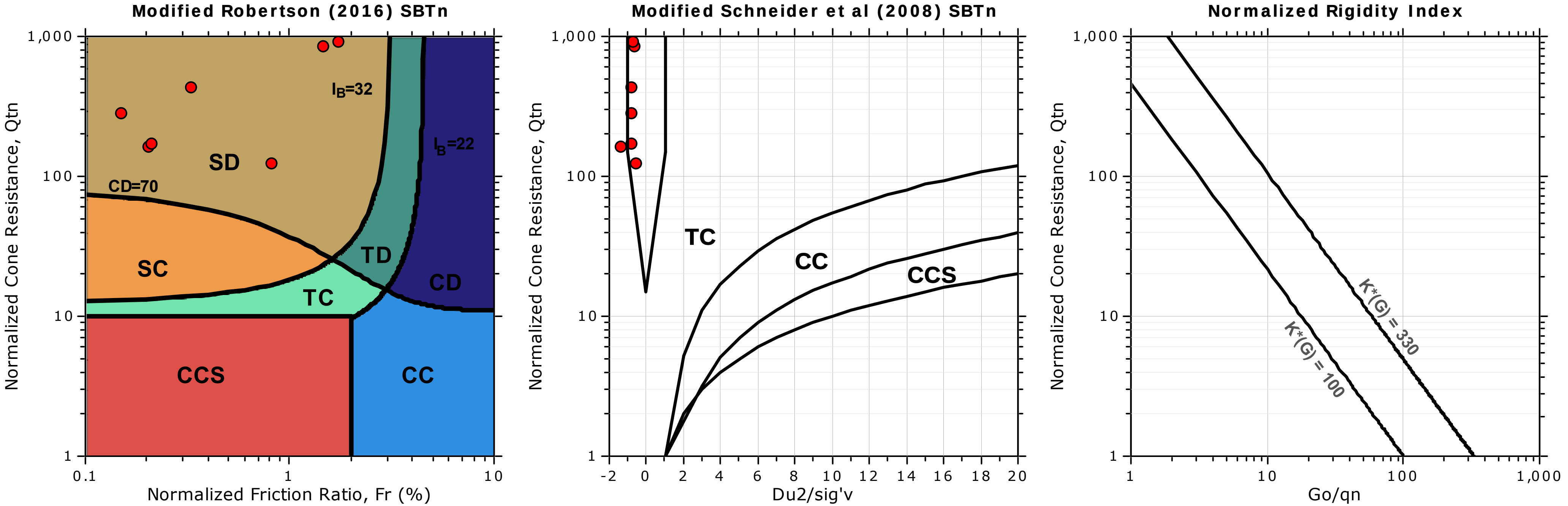


Updated SBTn plots

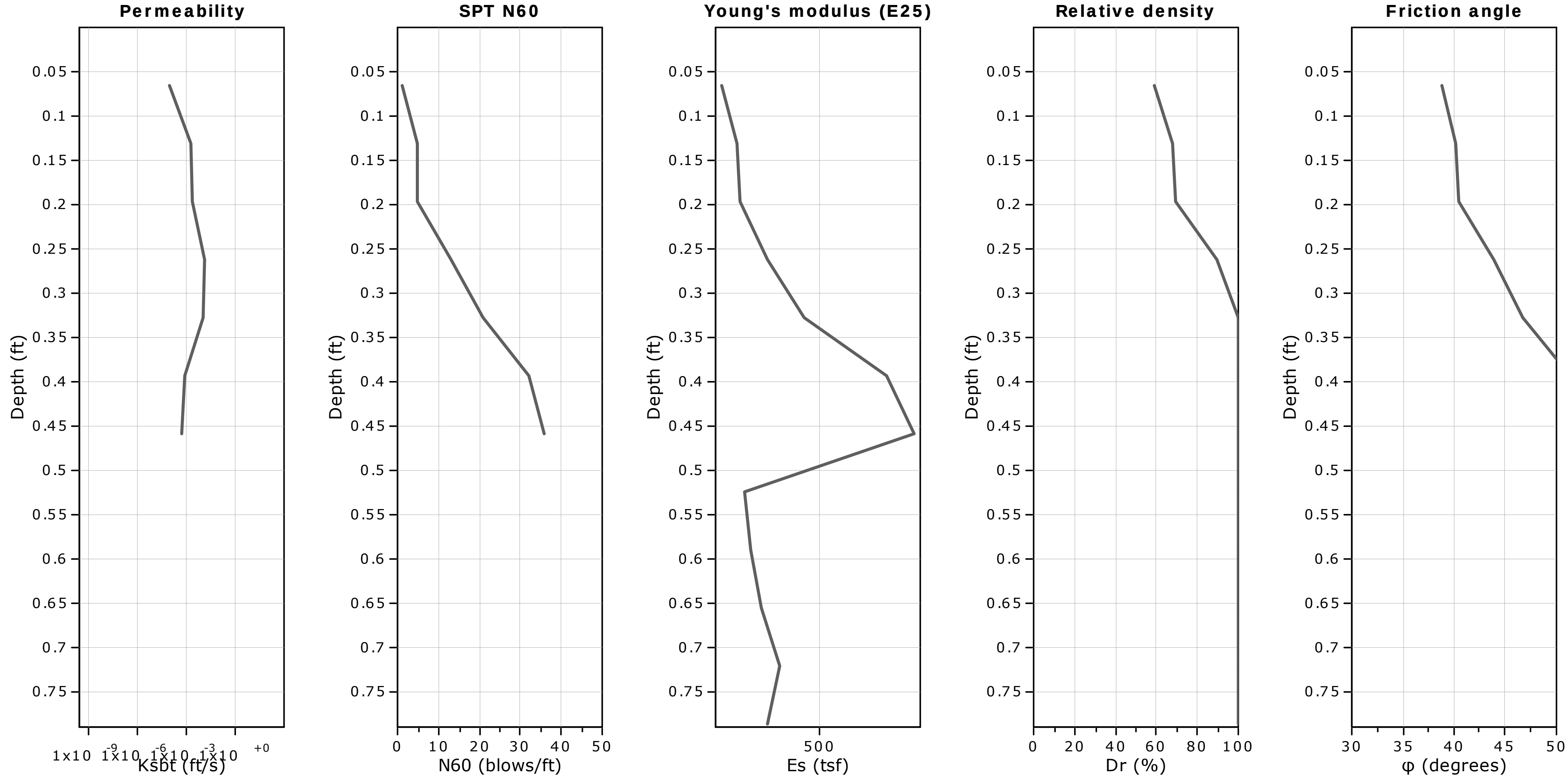


CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19a
Total depth: 0.79 ft



Calculation parameters

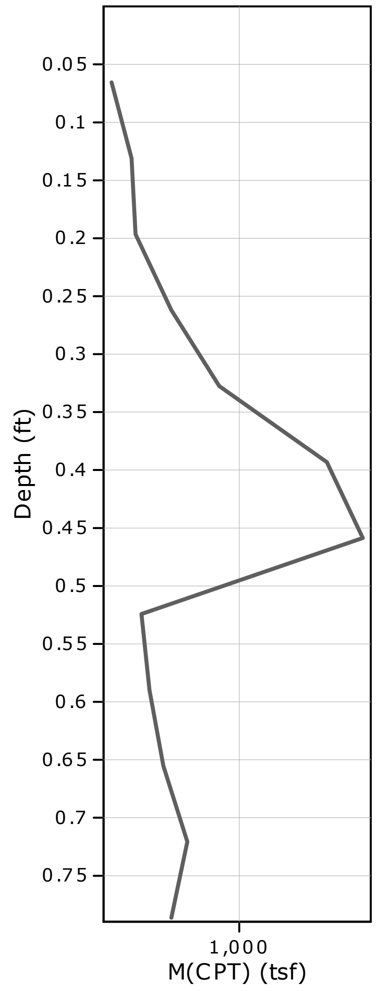
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
●— User defined estimation data

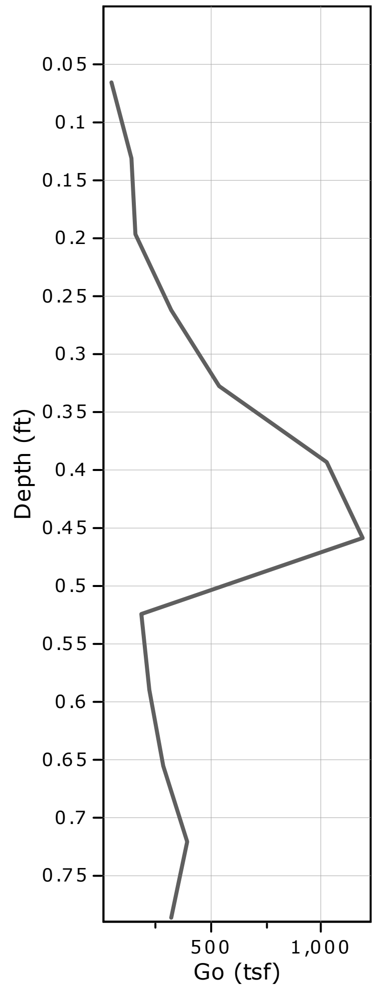
Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19a
Total depth: 0.79 ft

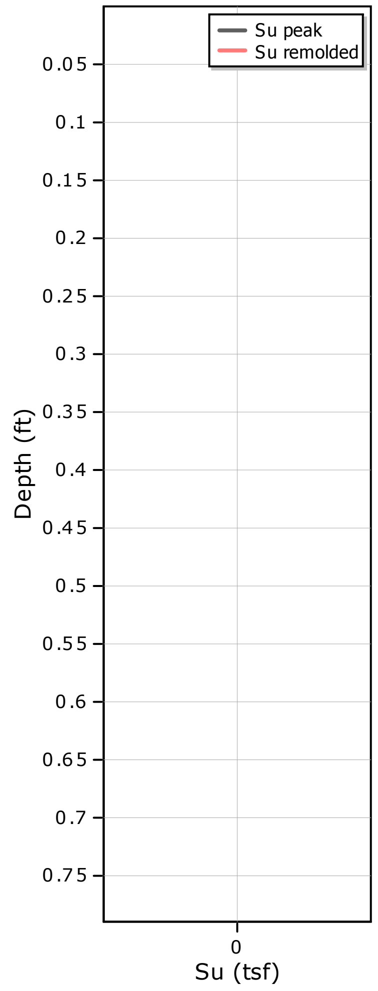
Constrained Modulus



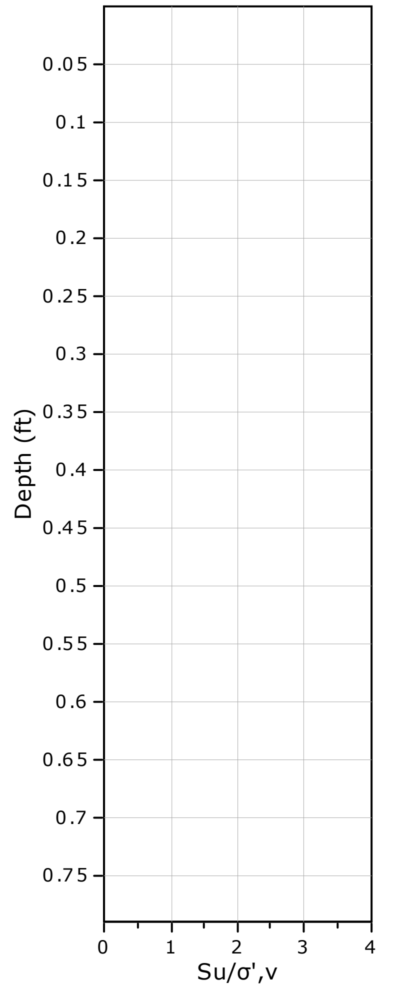
Shear modulus



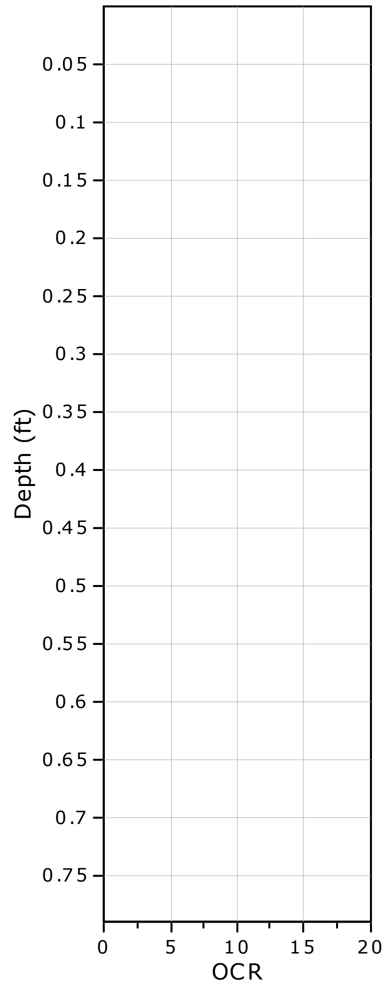
Shear strength



Undrained strength ratio



OCR



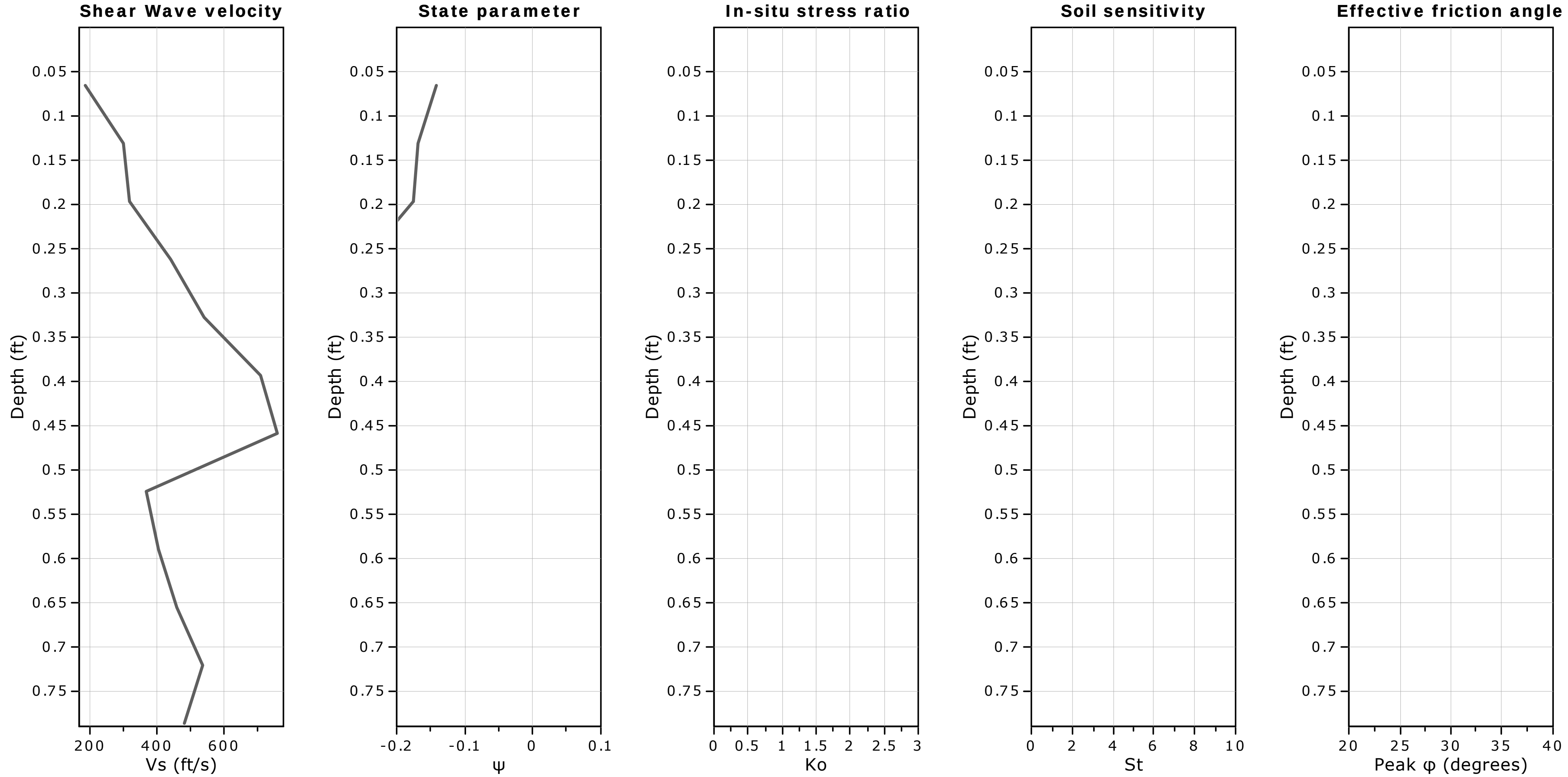
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
● User defined estimation data
● Flat Dilatometer Test data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19a
Total depth: 0.79 ft

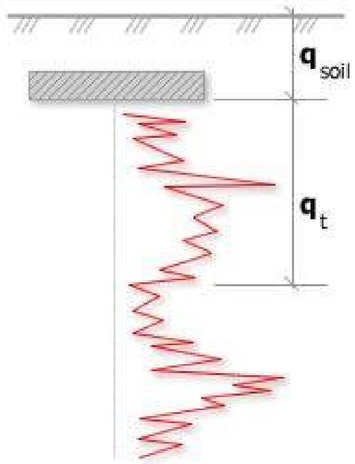


Calculation parameters

Soil Sensitivity factor, N_S: 350.00
—●— User defined estimation data

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19a
Total depth: 0.79 ft

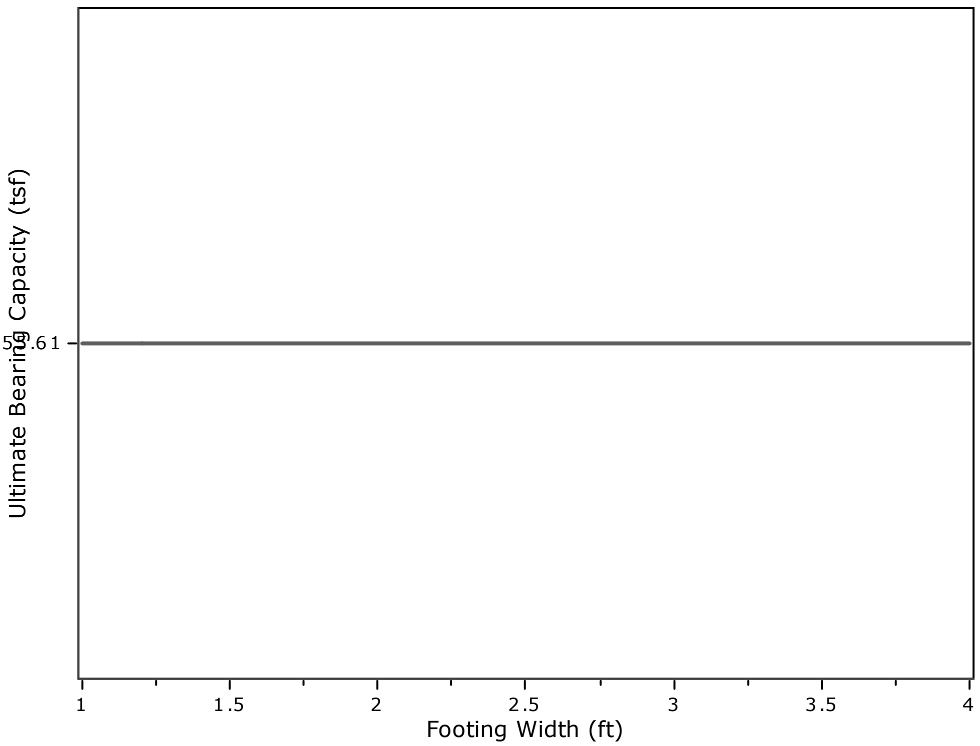


Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

Bearing Capacity Plot

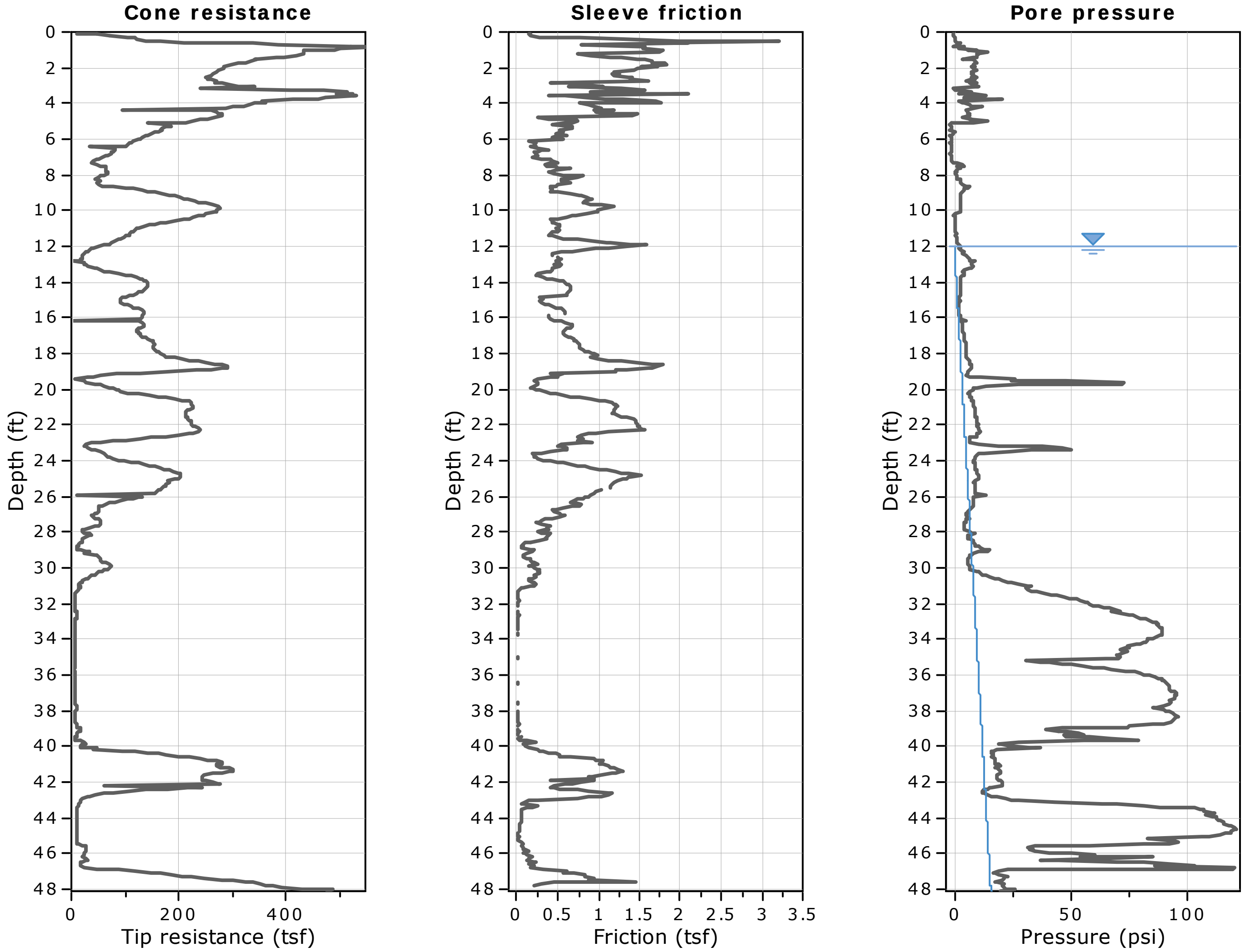


:: Tabular results ::

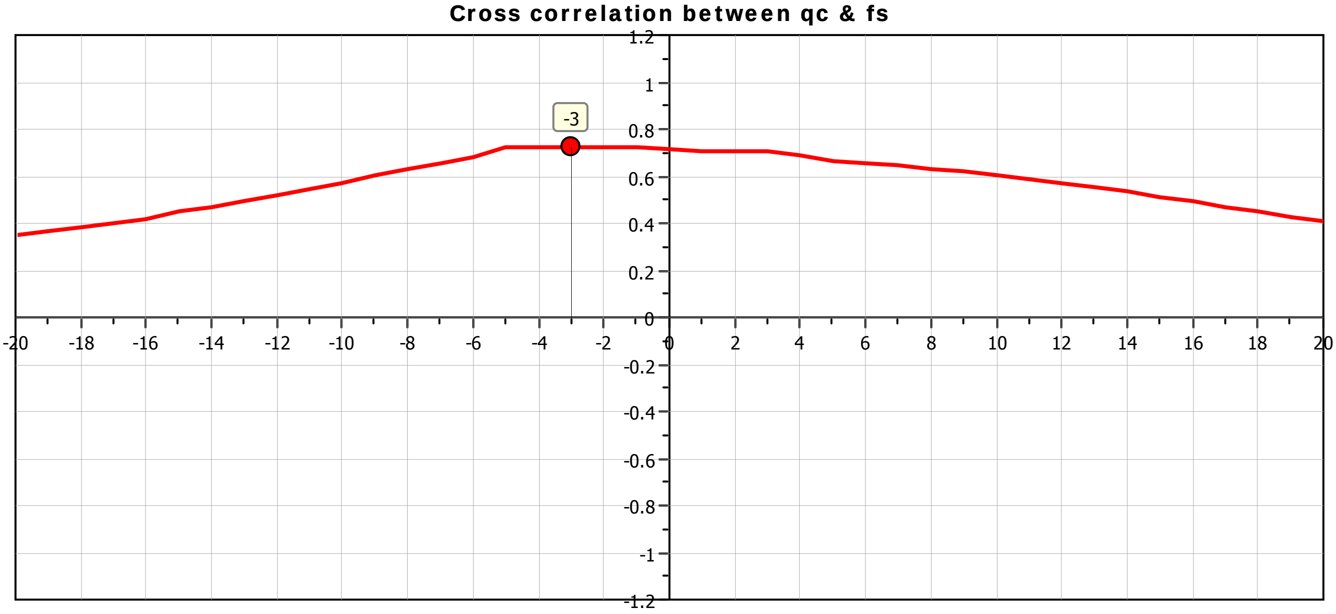
No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	277.90	0.20	0.03	55.61
2	1.20	0.50	2.30	277.90	0.20	0.03	55.61
3	1.40	0.50	2.60	277.90	0.20	0.03	55.61
4	1.60	0.50	2.90	277.90	0.20	0.03	55.61
5	1.80	0.50	3.20	277.90	0.20	0.03	55.61
6	2.00	0.50	3.50	277.90	0.20	0.03	55.61
7	2.20	0.50	3.80	277.90	0.20	0.03	55.61
8	2.40	0.50	4.10	277.90	0.20	0.03	55.61
9	2.60	0.50	4.40	277.90	0.20	0.03	55.61
10	2.80	0.50	4.70	277.90	0.20	0.03	55.61
11	3.00	0.50	5.00	277.90	0.20	0.03	55.61
12	3.20	0.50	5.30	277.90	0.20	0.03	55.61
13	3.40	0.50	5.60	277.90	0.20	0.03	55.61
14	3.60	0.50	5.90	277.90	0.20	0.03	55.61
15	3.80	0.50	6.20	277.90	0.20	0.03	55.61
16	4.00	0.50	6.50	277.90	0.20	0.03	55.61

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19b
Total depth: 48.10 ft



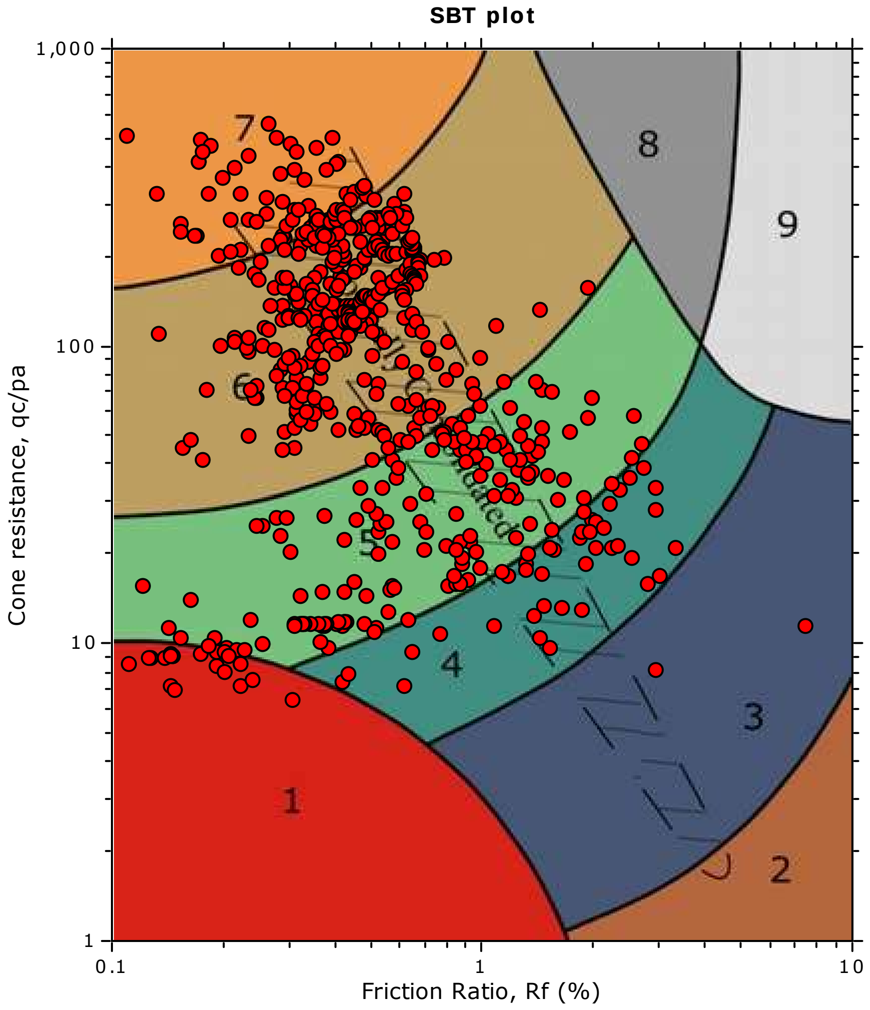
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

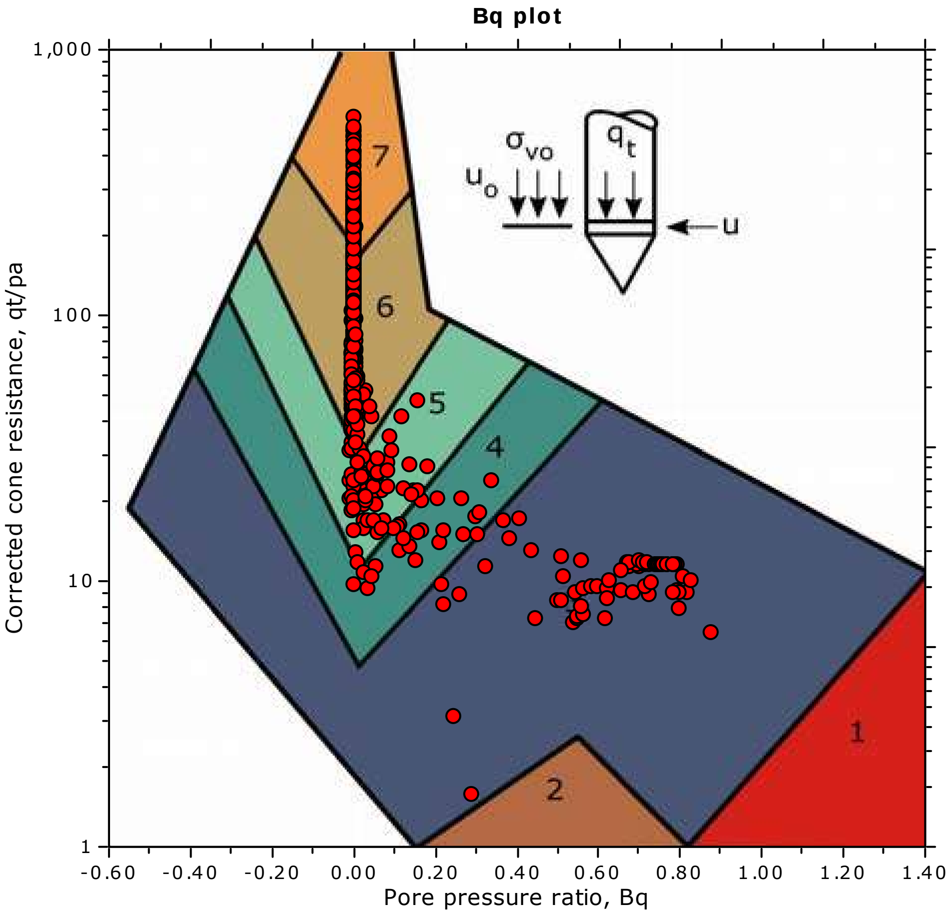


Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19b
Total depth: 48.10 ft

SBT - Bq plots

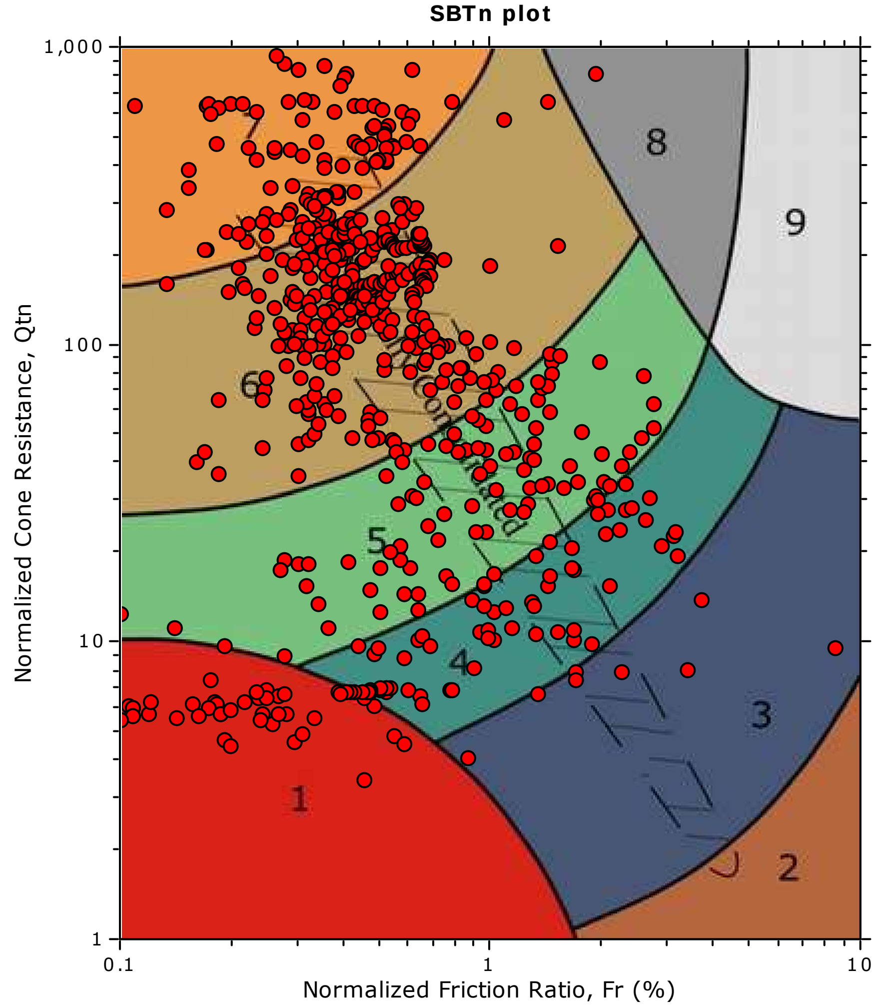


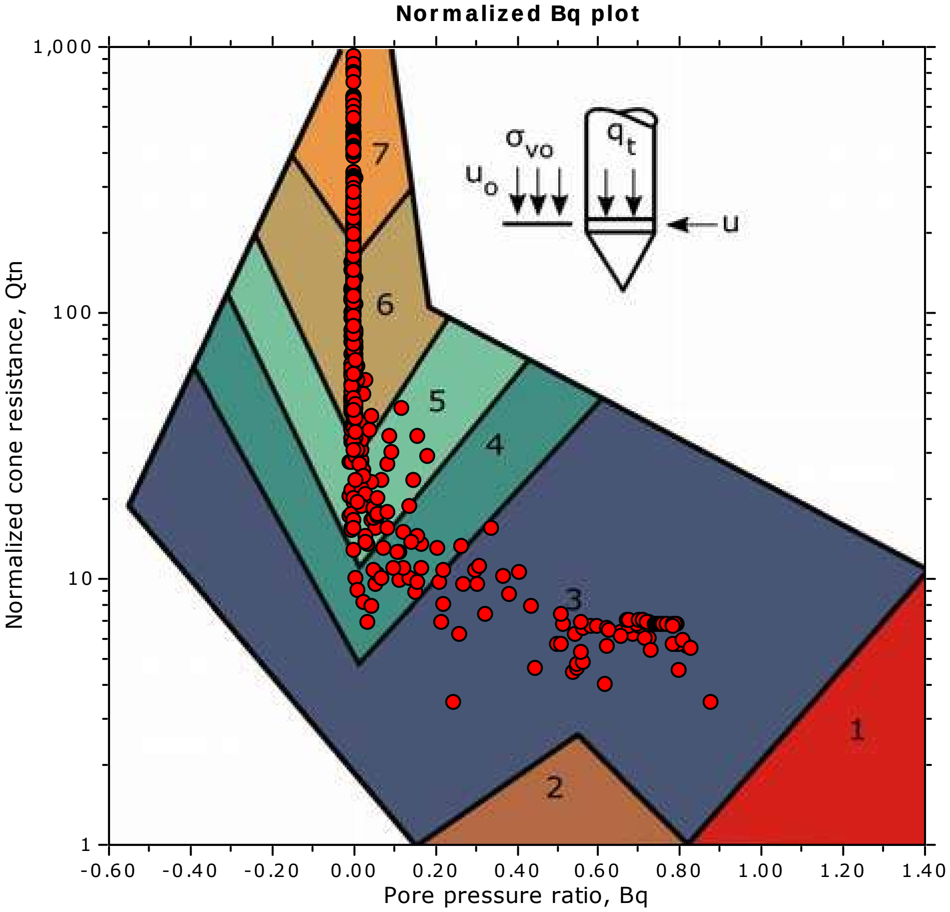


SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

SBT - Bq plots (normalized)

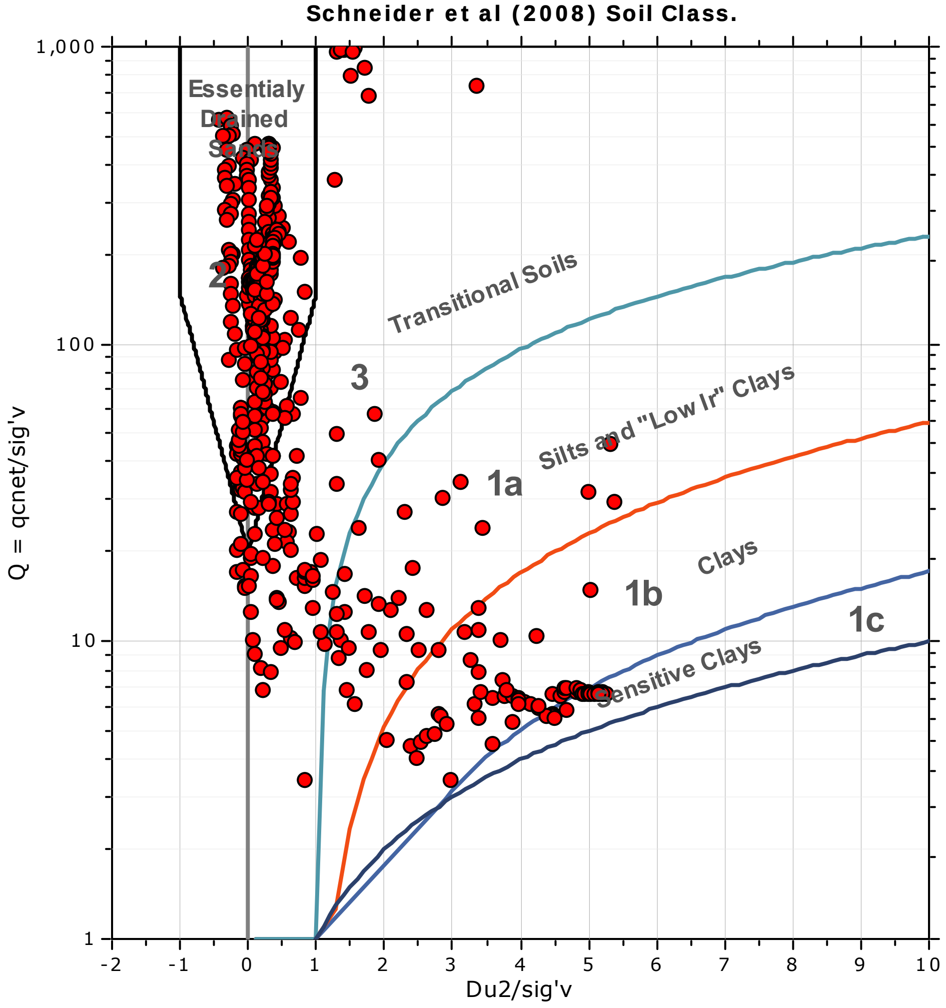


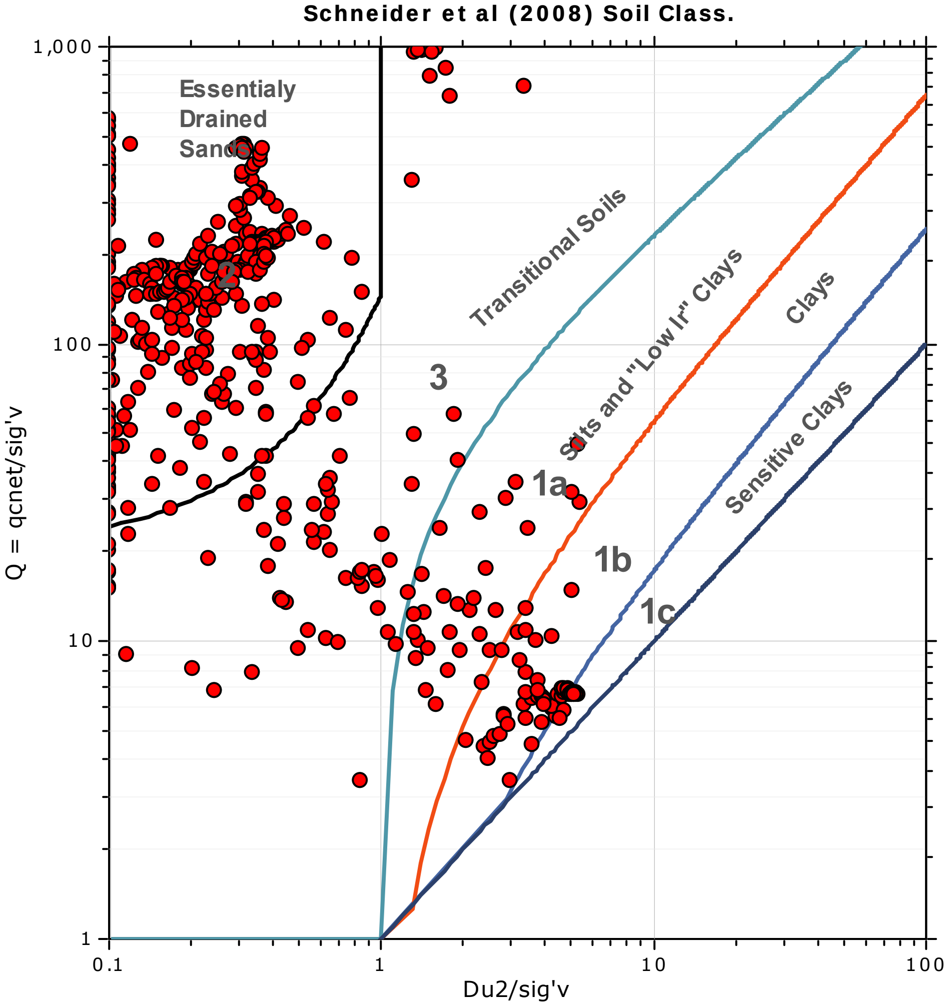


SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

Bq plots (Schneider)

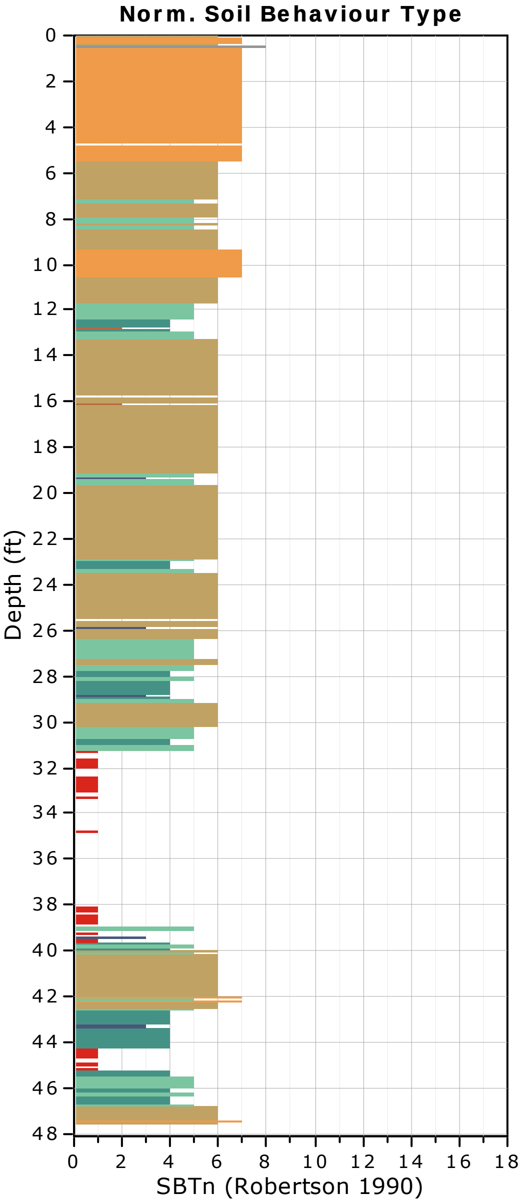


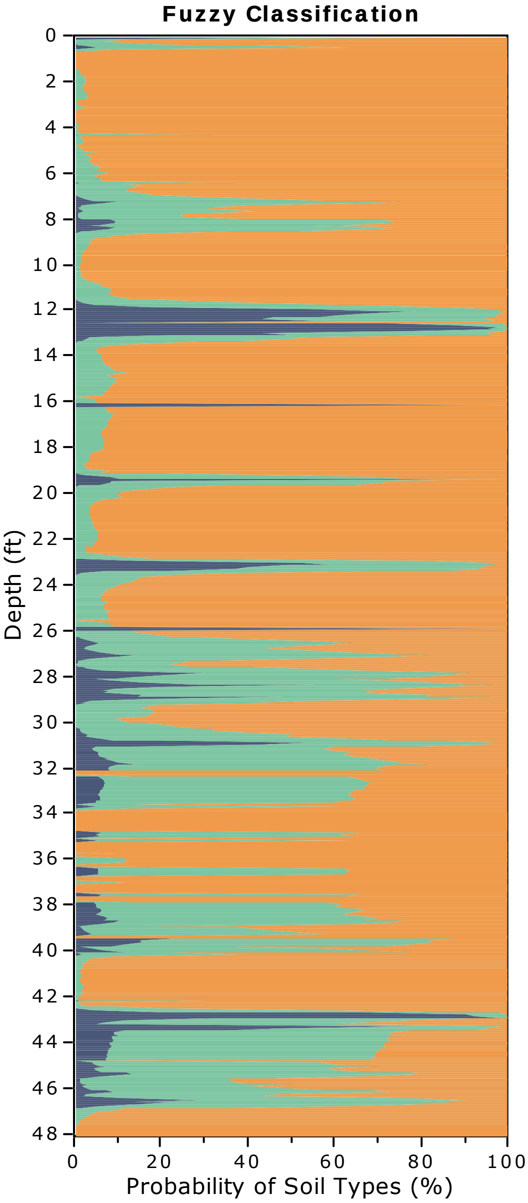


Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

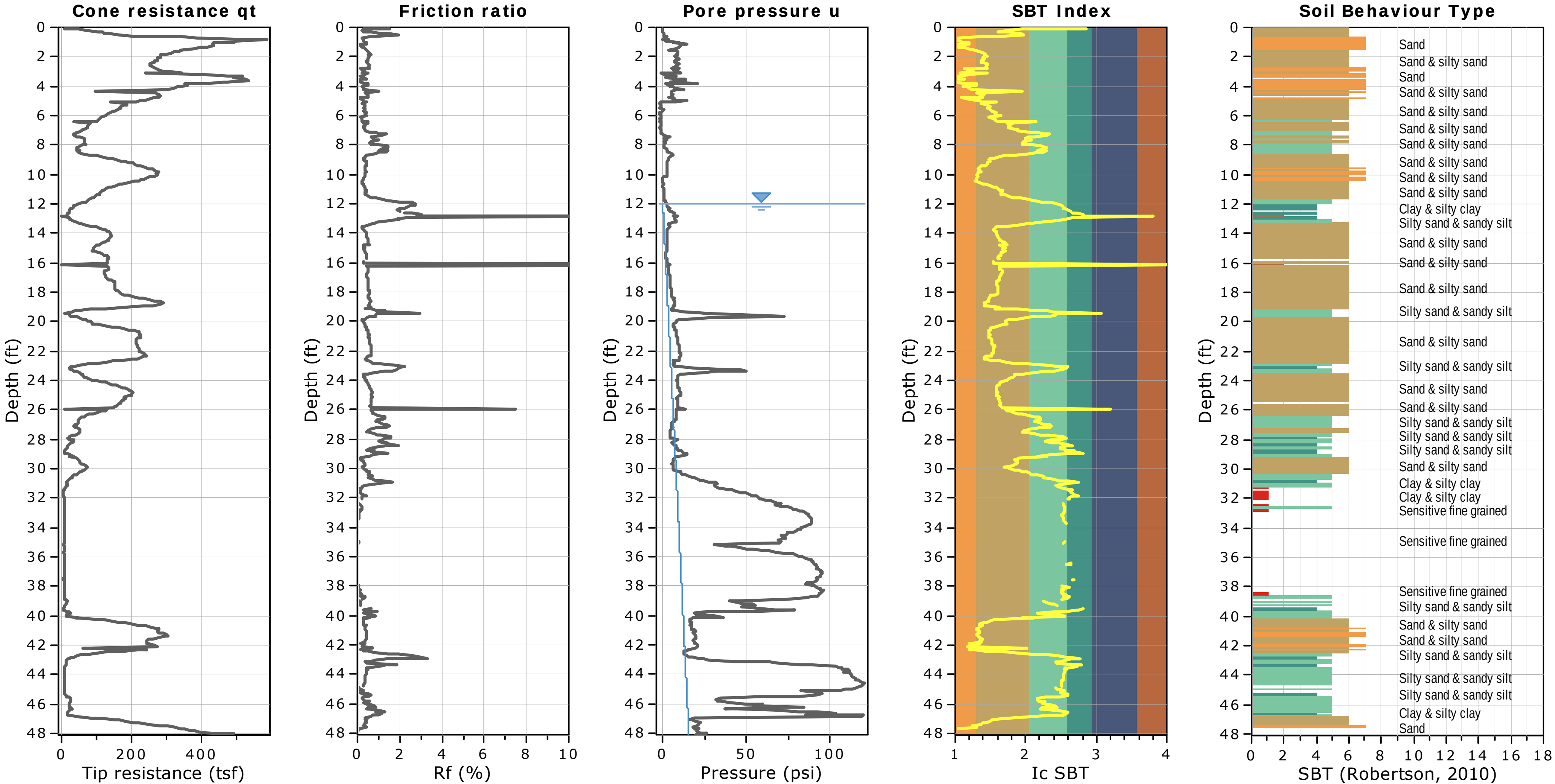
CPT: SCPT-19b
Total depth: 48.10 ft





Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19b
Total depth: 48.10 ft

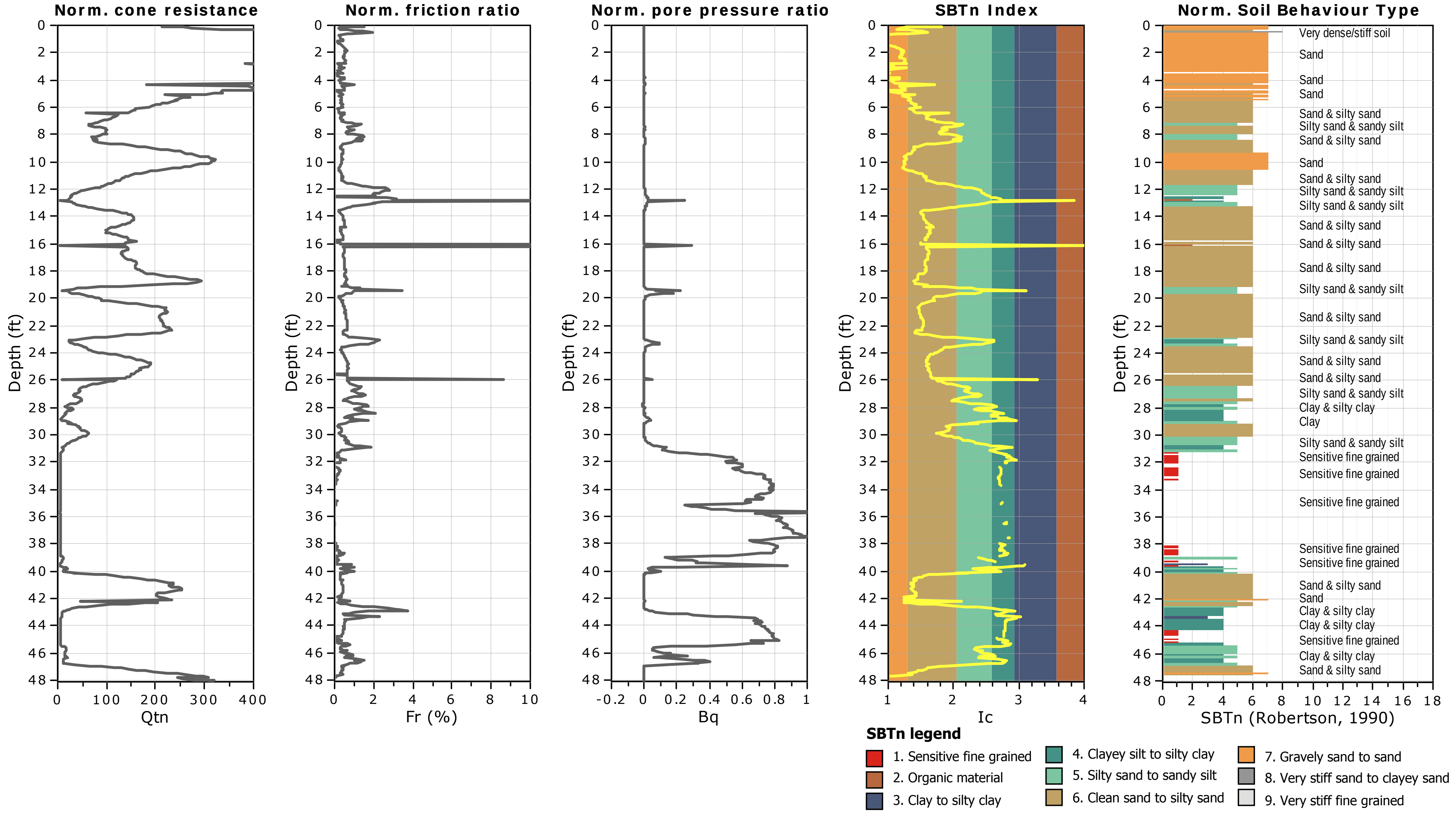


SBT legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty clay	🟧 7. Gravely sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬛ 8. Very stiff sand to clayey sand
🟦 3. Clay to silty clay	🟨 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

Project: Langan
Location: BL England Substation - Marmora NJ

CPT: SCPT-19b
Total depth: 48.10 ft

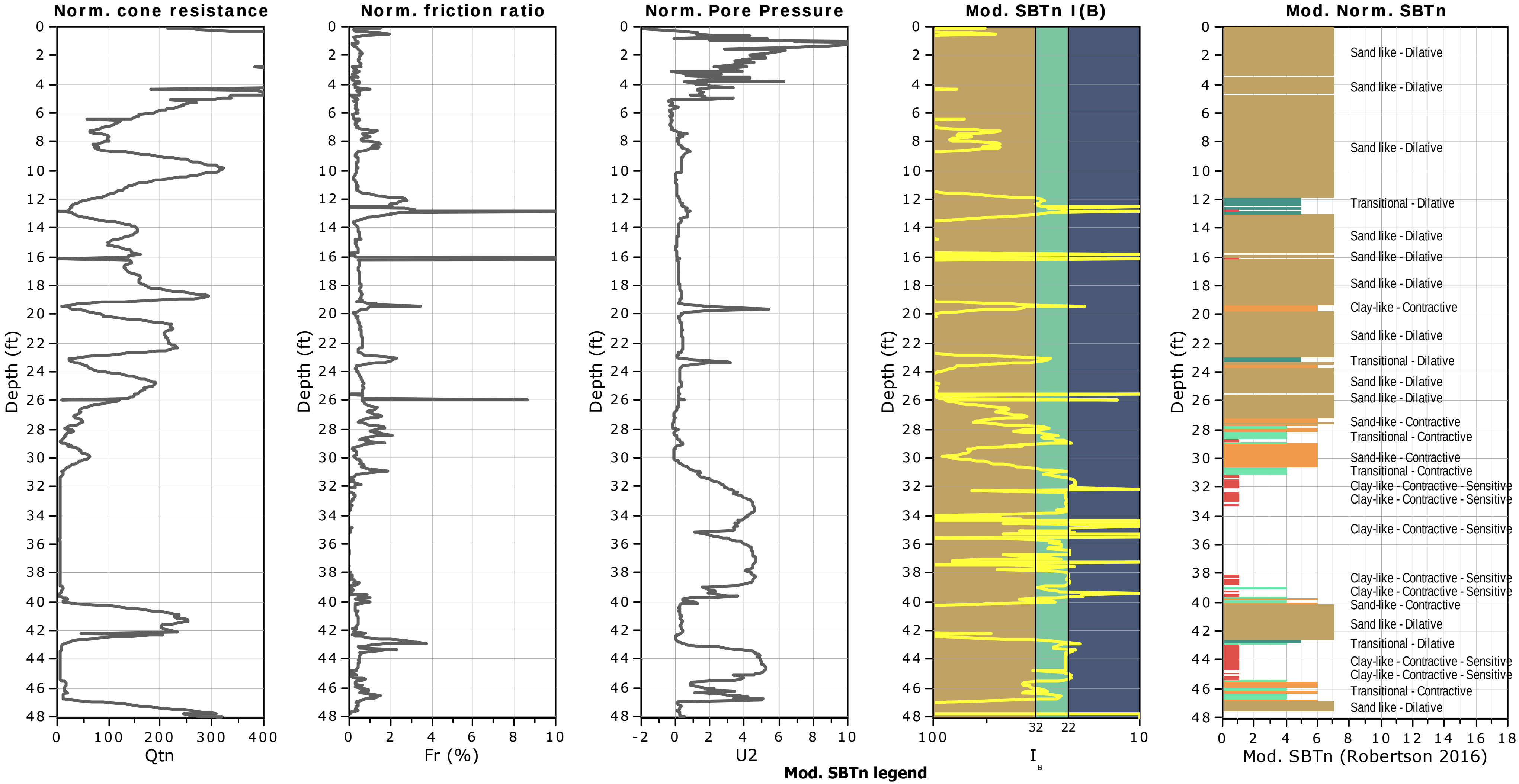


Project: Langan

Location: BL England Substation - Marmora NJ

CPT: SCPT-19b

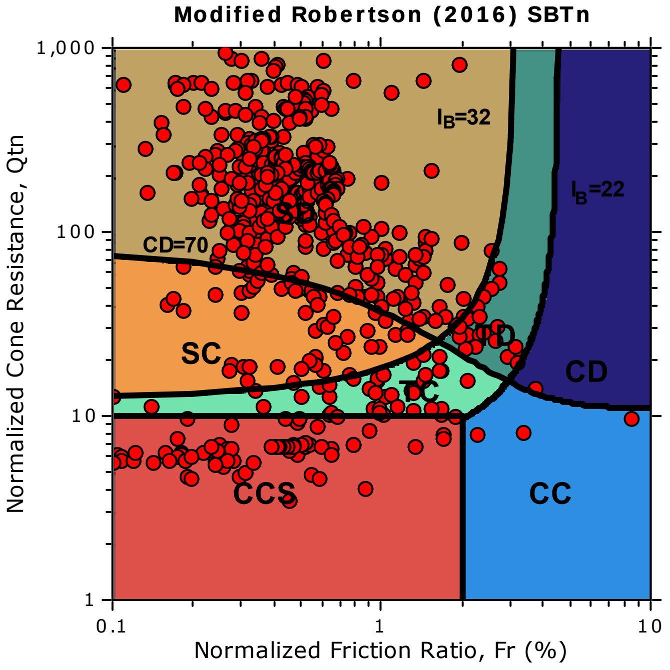
Total depth: 48.10 ft

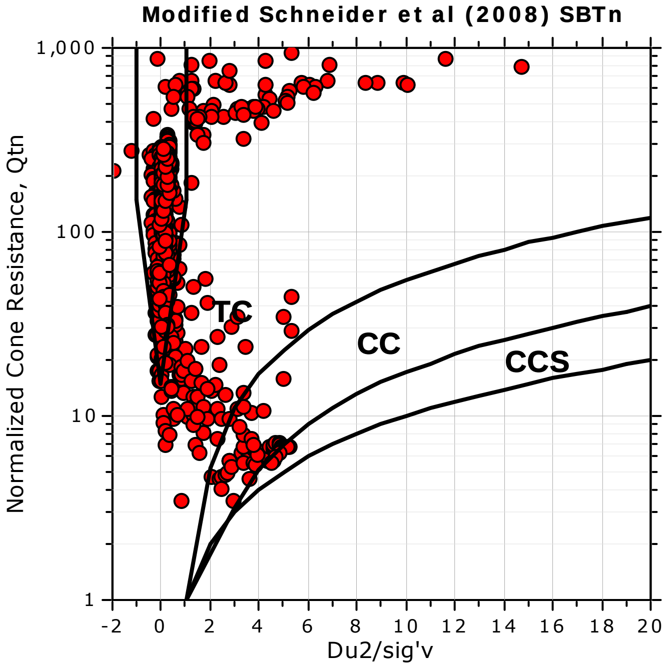


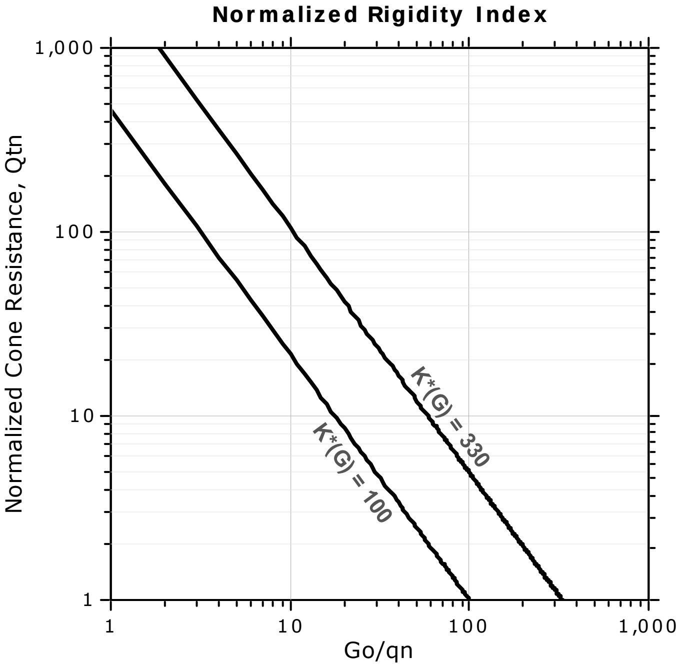
Mod. SBTn legend

- 🟥 1. CCS: ClayLike - Contractive, Sensitive
- 🟦 2. CC: Clay-like - Contractive
- ■ 3. CD: Clay-Like: Dilative
- 🟩 4. TC: Transitional - Contractive
- 🟩 5. TD: Transitional - Dilative
- 🟧 6. SC: Sand-like - Contractive
- 🟫 7. SD: Sand-like - Dilative

Updated SBTn plots





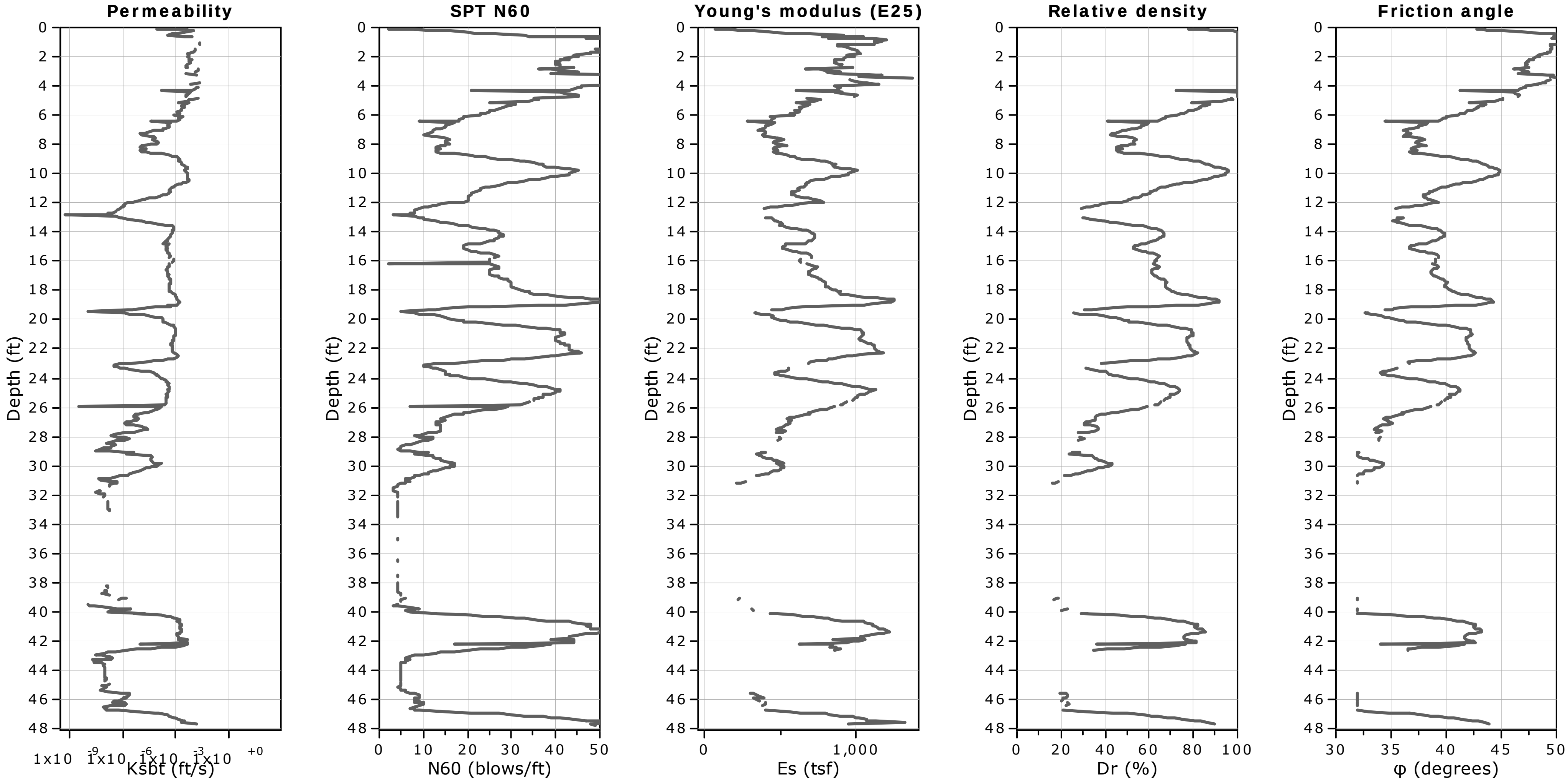


CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

Project: **Langan**
Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19b
Total depth: 48.10 ft



Calculation parameters

Permeability: Based on SBT_n

SPT N_{60}: Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0

Phi: Based on Kulhawy & Mayne (1990)

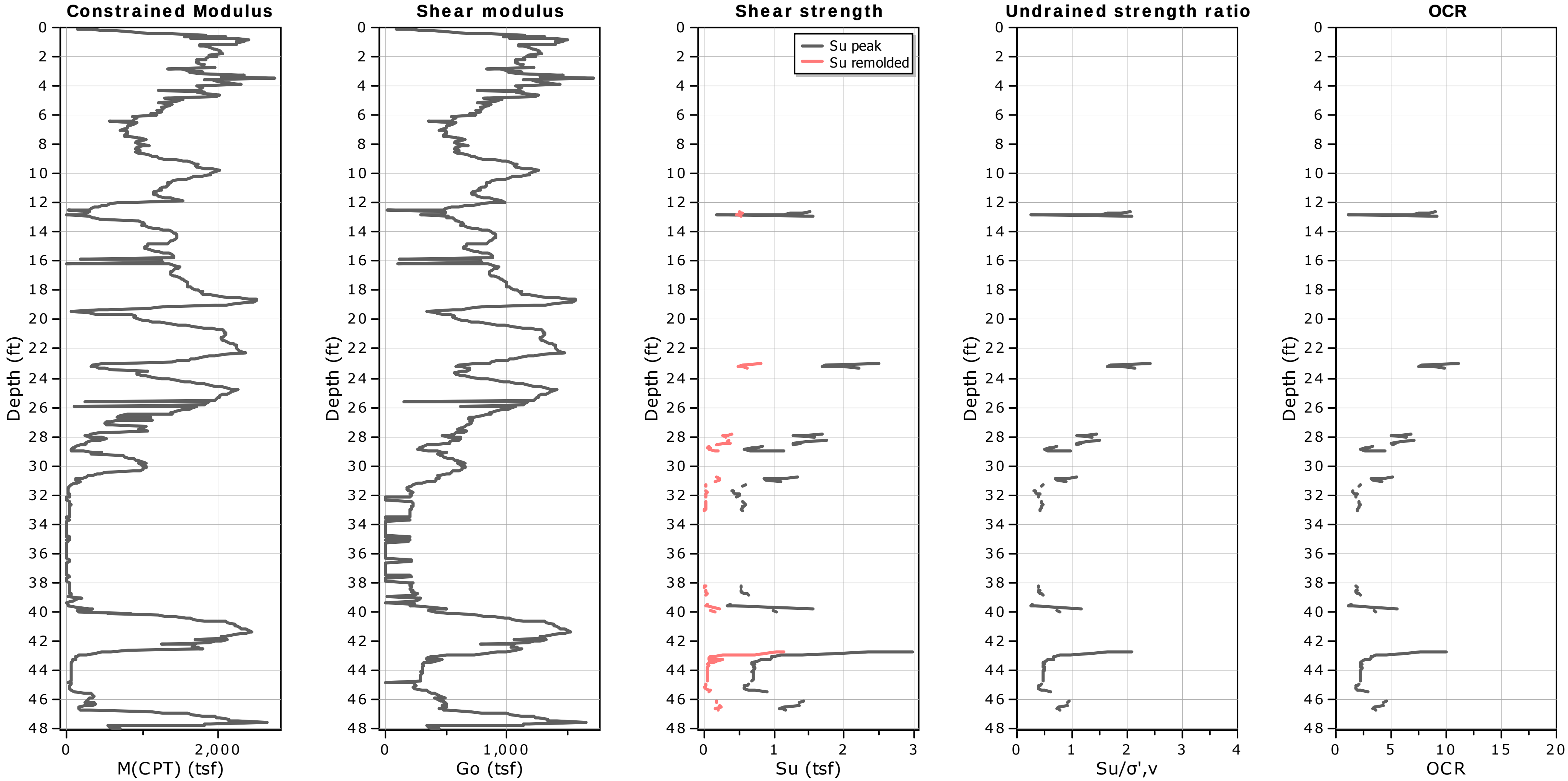
—●— User defined estimation data

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19b

Total depth: 48.10 ft



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)

Go: Based on variable *alpha* using I_c (Robertson, 2009)

Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33

● User defined estimation data

● Flat Dilatometer Test data

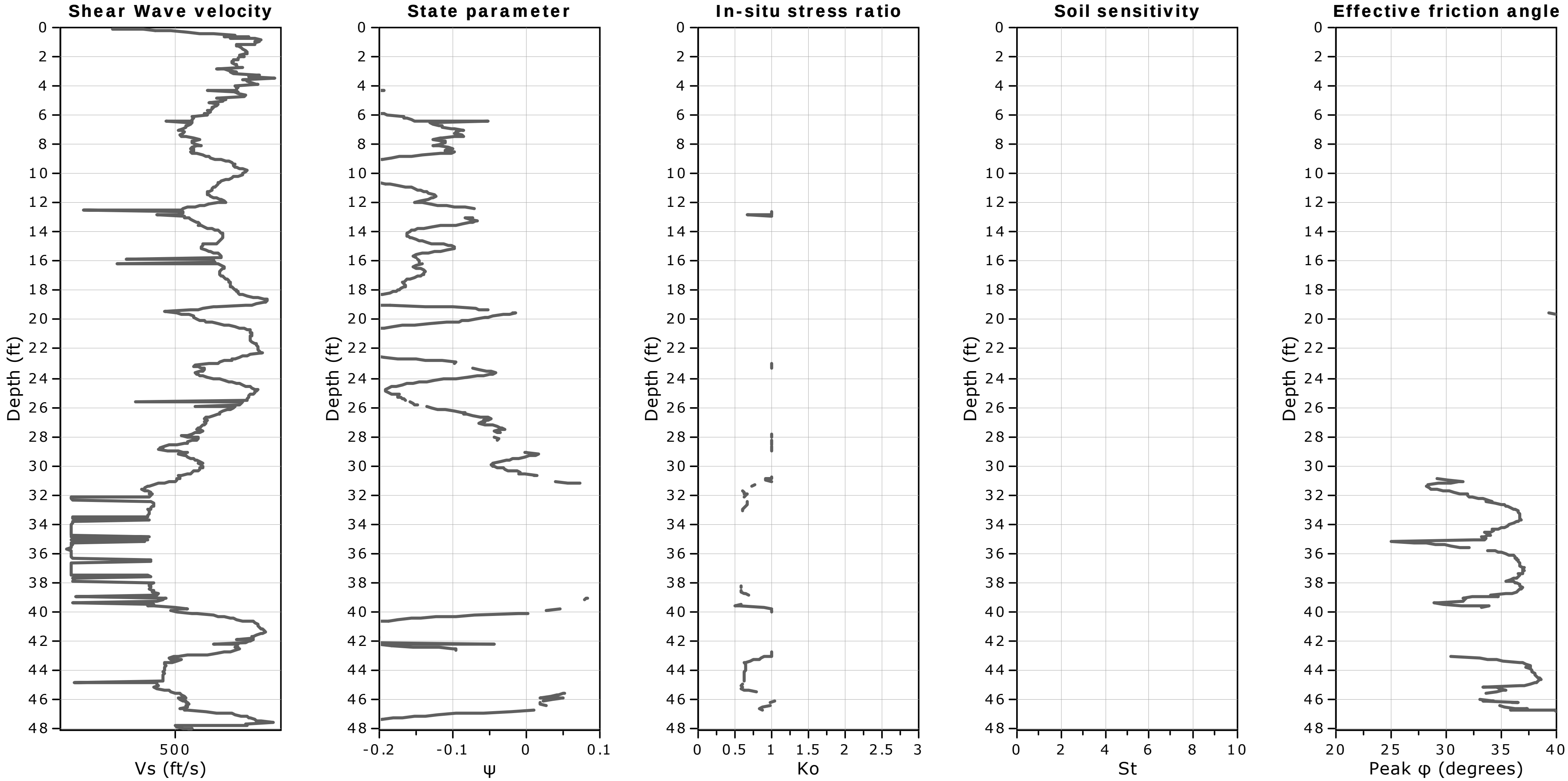
Craig Geotechnical Drilling
5230 Atlantic Ave
Mays Landing, NJ

Project: **Langan**

Location: **BL England Substation - Marmora NJ**

CPT: SCPT-19b

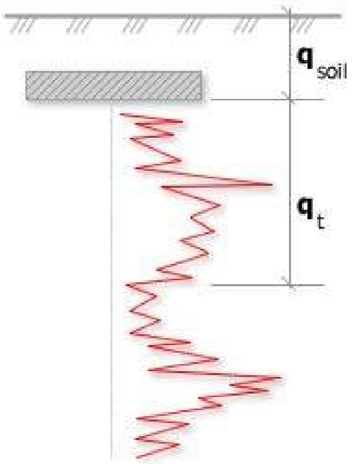
Total depth: 48.10 ft



Calculation parameters

Soil Sensitivity factor, N_S: 350.00

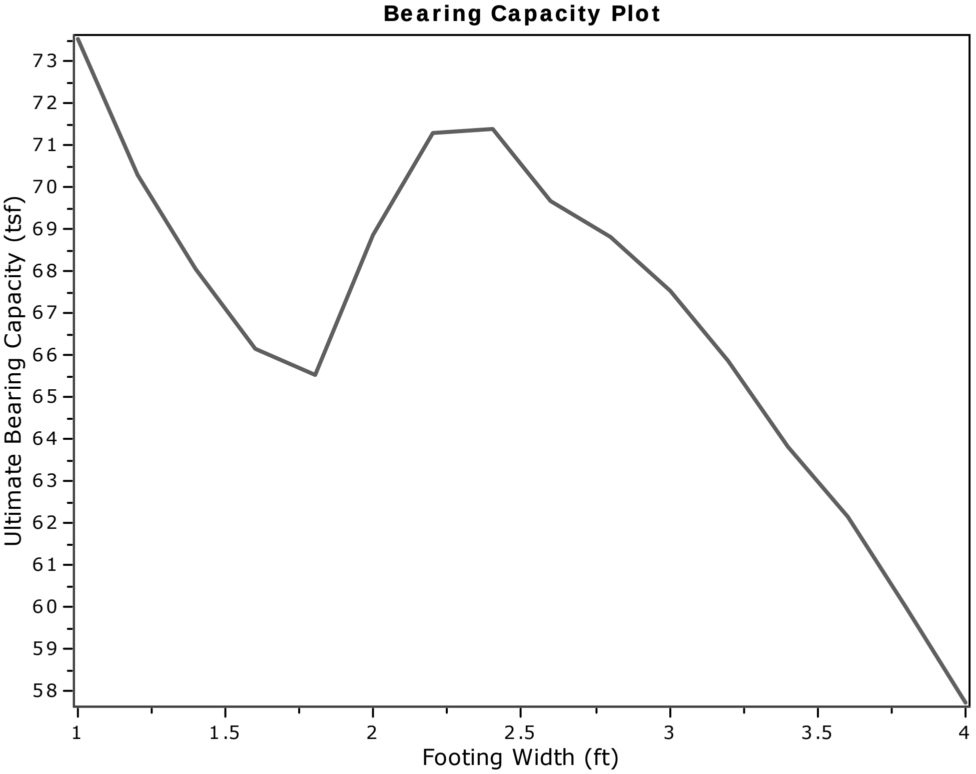
● User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (ft)	Start Depth (ft)	End Depth (ft)	Ave. q_t (tsf)	R_k	Soil Press. (tsf)	Ult. bearing cap. (tsf)
1	1.00	0.50	2.00	367.51	0.20	0.03	73.53
2	1.20	0.50	2.30	351.41	0.20	0.03	70.31
3	1.40	0.50	2.60	340.26	0.20	0.03	68.08
4	1.60	0.50	2.90	330.67	0.20	0.03	66.16
5	1.80	0.50	3.20	327.52	0.20	0.03	65.53
6	2.00	0.50	3.50	344.19	0.20	0.03	68.87
7	2.20	0.50	3.80	356.33	0.20	0.03	71.30
8	2.40	0.50	4.10	356.72	0.20	0.03	71.37
9	2.60	0.50	4.40	348.28	0.20	0.03	69.69
10	2.80	0.50	4.70	343.94	0.20	0.03	68.82
11	3.00	0.50	5.00	337.53	0.20	0.03	67.54
12	3.20	0.50	5.30	329.10	0.20	0.03	65.85
13	3.40	0.50	5.60	319.00	0.20	0.03	63.83
14	3.60	0.50	5.90	310.67	0.20	0.03	62.16
15	3.80	0.50	6.20	299.99	0.20	0.03	60.03
16	4.00	0.50	6.50	288.52	0.20	0.03	57.73

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236\right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952\text{-}3.04 \cdot I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52\text{-}1.37 \cdot I_c}$

:: N_{SPT} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a}\right) \cdot \frac{1}{10^{1.1268 - 0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268 - 0.2817 \cdot I_c}}$$

:: Young's Modulus, Es (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Drained Friction Angle, φ (°) ::

$$\varphi = \varphi'_{cv} + 15.94 \cdot \log(Q_{tn,cs}) - 26.88$$

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$

$\alpha = 14$ for $Q_{tn} > 14$

$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$

$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \geq 2.20$

$$M_{CPT} = 0.03 \cdot (q_t - \sigma_v) \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Small strain shear Modulus, Go (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho}\right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 \cdot + 7 \cdot \log(F_r))}\right]^{1.25}$$ or user defined

$$OCR = k_{OCR} \cdot Q_{tn}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Peak Friction Angle, φ' (°) ::

$$\varphi' = 29.5^\circ \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

References

- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

ATTACHMENT D

Field Resistivity Testing Report

HAGER-RICHTER
GEOSCIENCE, INC.

SOIL RESISTIVITY TESTING
OCEAN WIND LLC – BL ENGLAND SUBSTATION
MARMORA, NEW JERSEY

Prepared for:

LANGAN
300 Kimball Drive, 4th Floor
Parsippany, New Jersey 07054-2172

Prepared by:

Hager-Richter Geoscience, Inc.
846 Main Street
Fords, New Jersey 08863

File 22AM24
September 2022

HAGER-RICHTER
GEOSCIENCE, INC.

GEOPHYSICS FOR THE ENGINEERING COMMUNITY
SALEM, NEW HAMPSHIRE
Tel: 603.893.9944
FORDS, NEW JERSEY
Tel: 732.661.0555

September 16, 2022
File 20AM21

Victoria Rhodes
Senior Staff Engineer
LANGAN
300 Kimball Drive, 4th Floor
Parsippany, New Jersey 07054-2172

Tel: 973-560-4631
Cell: 732-850-3217
Email: vrhodes@langan.com

RE: Soil Resistivity Testing
Ocean Wind LLC – BL England Substation
Marmora, NJ

Dear Ms. Rhodes:

In this report, we summarize the results of a geophysical survey conducted in September 2022 by Hager-Richter Geoscience, Inc. (HRGS) at the above referenced site for LANGAN (Langan). The scope of the project and area of interest were specified by Langan.

INTRODUCTION

In support of work related to a proposed a new substation, identified as Ocean Wind LLC – BL England Substation, located at a site west of the north end of Clay Avenue, in Marmora, New Jersey, Langan required soil electrical resistivity testing in two areas identified as R1 and R2. Figure 1 shows the general location of the tests. Soil resistivity data were acquired along two arrays in area R1 and three arrays in area R2, identified as Lines R1-A/B and R2-A/B/C. Figure 2 shows the locations of the testing arrays.

Soil electrical resistivity testing was conducted in substantial accordance with IEEE Std 81 and ASTM G57 using the Wenner Four-Electrode Method. According to the scope of work, field resistivity testing was to be acquired using the following spacings (a-spacing): 0.5, 1, 1.5, 2, 3, 5, 7, 10, 15, 20, 30, 45, 100, 150, 200, 300, 450 feet, where space allows. The maximum a-spacing achieved on each of the lines varied from 100 feet to 350 feet.

OBJECTIVES

The objective of the soil resistivity survey was to determine the soil electrical resistivity of in-situ soils at two areas of interest using the Wenner Four-Electrode Method.

THE SURVEY

Amanda Fabian P.G. and Justin Covert, of HRGS conducted the field operations on September 12th and 13th, 2022. The project was coordinated with Ms. Rhodes of Langan. Mr. Lei Xu, also from Langan, was onsite during the survey. Soil resistivity data were acquired along five lines in the two proposed areas of interest. The test locations were identified as Lines R1-A/B (northern aera) and R2-A/B/C (southern area). Original data and field notes will be retained in the HRGS files for a minimum of three (3) years.

THE METHOD

The method as first described by Frank Wenner uses four equally spaced electrodes driven a short distance into the ground. Electric current (DC) is injected through the outer electrodes to produce a potential difference between the inner electrodes. Measurements of the electrode spacing, a, the current, I, and the potential difference, V, are sufficient to determine the resistivity, ρ_a, which is given by

$$\rho_a = 2 * \pi * a * (V/I) \qquad \text{EQ 1}$$

The resistivity ρ_a determined in this manner is called apparent resistivity because it is the theoretical resistivity of a semi-infinite earth. To determine more precise values of resistivity, measurements are made for several values of a, and the data are then inverted using methods of mathematical physics that are beyond the scope of this project.

Equipment. The testing was conducted using an Advanced Geosciences, Inc. (AGI) SuperSting R8 resistivity meter to determine the soils resistivity. This instrumentation consists of a Power Supply, Transmitter, and Receiver.

The SuperSting R8 provides for the following:

- automatically reversing polarity of the injected current
- measuring the electrode contact resistance, and, if too high in the judgment of the operator, the measurement of resistance can be discontinued and the contact resistance reduced to an acceptable level by pouring a small amount of salty water around the electrode
- repeating individual measurement for either an operator specified number of times or until the standard error of the accumulated data is equal to or less than an operator specified percentage.

Procedure. As stated above, HRGS measured soil resistivity at the subject site in substantial accordance with IEEE 81-1983 and ASTM G57 using the AGI SuperSting R8 resistivity meter. Soil resistivity data were acquired at two locations. Figure 2 shows the locations and center points of the resistivity testing lines. The locations of the arrays were surveyed by HRGS using a Trimble GeoX7 CM GPS receiver coupled with an external Zephyr-2 antenna. Measurements were taken using steel electrodes at the proposed a-spacings: .5, 1, 1.5, 2, 3, 5, 7, 10, 15, 20, 30, 45,100, 150, 200, 300, 350 feet, as access permitted. Photos 1 and 2 illustrate the site conditions and the equipment utilized in the survey.

Photo 1. Line R1-A. Overhead power lines in the area of R1 A/B

Photo 2. Line R2-C.

Standing water was not present in the area surveyed. A negligible amount of precipitation was recorded in the 48 hours prior to the survey, and no precipitation was recorded on site during the field work. The sky was partly cloudy, and the air temperature was near 80 ºF and the soil temperature varied by location and was around 77 ºF.

LIMITATIONS OF THE METHOD

As with any of the electrical geophysical methods, resistivity data are subject to interference from such cultural features as buildings, fencing, underground utilities that are electrically conducting, and overhead power lines. Thus, for certain applications, the use of the resistivity method in some settings might be inappropriate.

The subsurface is three dimensional in character, and although the resistivity data are acquired along a line, the data are affected by resistivity changes off-line. Therefore, unless there are parallel survey lines that are spaced appropriately, resistivity changes off-line may be interpreted as changes below the survey line. This limitation is particularly significant for single survey lines.

RESULTS

The soil resistivity testing was conducted in substantial accordance with IEEE standard 81-1983 and ASTM G57. Specifically, the survey was conducted using the four-point Wenner method. Soil resistivity data were acquired along two areas of interest, identified as Lines R1-A/B and R2-A/B/C. The locations of the test lines are shown in Figure 2. Data were acquired using the proposed a-spacings: .5, 1, 1.5, 2, 3, 5, 7, 10, 15, 20, 30, 45,100, 150, 200, 300, and 350 feet where accessible. It should be noted that Lines R1-A/B were located in the vicinity of overhead power lines.

The apparent resistivity values, calculated from Eq. 1, are provided in the attached Soil Resistivity Field Measurement Forms. Figure 3 is a graphic representation of the resistivity data for two arrays.

LIMITATIONS ON USE OF THE REPORT

This letter report was prepared for the exclusive use of LANGAN and its client (collectively, Client). No other party shall be entitled to rely on this Report, or any information, documents, records, data, interpretations, advice, or opinions given to the Client by Hager-Richter Geoscience, Inc. (HRGS) in the performance of its work. The Report relates solely to the specific project for which HRGS has been retained and shall not be used or relied upon by the Client or any third party for any variation or extension of this project, any other project or any other purpose without the express written permission of HRGS. Any unpermitted use by the Client or any third party shall be at the Client's or such third party's own risk and without any liability to HRGS.

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Except as expressly provided in this limitations section, HRGS makes no other representation or warranty of any kind whatsoever, oral or written, expressed or implied; and all implied warranties of merchantability and fitness for a particular purpose, are hereby disclaimed.

If you have any questions or comments on this letter report, please contact us at your convenience. It has been a pleasure to work with Langan on this project. We look forward to working with you again in the future.

Sincerely yours,
HAGER-RICHTER GEOSCIENCE, INC.

Amanda Fabian

Amanda Fabian, P.G.
Geophysicist

Attachments: Soil Resistivity Field Measurement Forms
Figures 1 – 3

Soil Resistivity Field Measurement Form

Location: Line R1-A			Project Name: BL England Substation, Cape May City, NJ
Lat: 39.286864	Long: -74.632474	Orientation: 146° True North	Air Temperature: 77°F
Soil Type: Sandy soil			Date of Test: 9/12/22
Soil Conditions (wet,dry): dry, 76.7°F			Weather Conditions: Cloudy
Test Completed By: Amanda Fabian and Justin Covert			Test Methods: Soil Resistivity Testing (Wenner Array)
Test Instrument: AGI Sting R8 Resistivity meter. S/N: SS0803209			Calibration Date: 12/11/2020

Electrode Spacing (ft)	Current Electrode Depth (in)	Potential Electrode Depth (in)	Injected Current (mA)	Measured Potential (mV)	Measured Resistance (ohm)	Apparent Resistivity (Ohm-ft)
0.5	1	1	5.67	2595.15	457.97	1438.73
1.0	1	1	6.00	1963.32	327.22	2055.95
1.5	1	1	5.00	915.25	183.05	1725.18
2.0	1	1	5.00	611.50	122.30	1536.86
3.0	3	3	51.67	3980.92	77.05	1452.34
5.0	3	3	52.00	1430.98	27.52	864.52
7.0	3	3	51.33	752.98	14.67	645.14
10.0	4	4	52.00	338.20	6.50	408.65
15.0	4	4	52.33	77.96	1.49	140.41
20.0	4	4	52.67	42.20	0.80	100.69
30.0	6	6	53.00	29.83	0.56	106.10
45.0	6	6	51.67	19.06	0.37	104.28
100.0	6	6	51.67	13.70	0.27	166.63
150.0	8	8	52.00	13.83	0.27	250.70
200.0	8	8	51.00	12.03	0.24	296.31
300.0	8	8	52.00	7.63	0.15	276.48

Field Notes:

Soil Resistivity Field Measurement Form

Location: Line R1-B			Project Name: BL England Substation, Cape May City, NJ
Lat: 39.286348°	Long: -74.632822°	Orientation: 31° True North	Air Temperature: 77°F
Soil Type: Sandy soil			Date of Test: 9/12/22
Soil Conditions (wet,dry): dry, 76.7°F			Weather Conditions: Cloudy
Test Completed By: Amanda Fabian and Justin Covert			Test Methods: Soil Resistivity Testing (Wenner Array)
Test Instrument: AGI Sting R8 Resistivity meter. S/N: SS0803209			Calibration Date: 12/11/2020

Electrode Spacing (ft)	Current Electrode Depth (in)	Potential Electrode Depth (in)	Injected Current (mA)	Measured Potential (mV)	Measured Resistance (ohm)	Apparent Resistivity (Ohm-ft)
0.50	1	1	5.00	1018.20	203.64	639.74
1.00	1	1	7.00	634.65	90.66	569.66
1.50	1	1	51.33	2683.15	52.27	492.62
2.00	1	1	52.00	1531.80	29.46	370.17
3.00	3	3	51.33	653.05	12.72	239.79
5.00	3	3	51.67	248.20	4.80	150.91
7.00	3	3	52.00	138.70	2.67	117.31
10.00	4	4	51.33	81.90	1.60	100.24
15.00	4	4	51.67	46.34	0.90	84.52
20.00	4	4	51.33	28.34	0.55	69.37
30.00	6	6	51.00	19.43	0.38	71.82
45.00	6	6	52.33	18.35	0.35	99.16
100.00	6	6	51.00	16.52	0.32	203.56
150.00	8	8	51.00	13.66	0.27	252.42

Field Notes:

Soil Resistivity Field Measurement Form

Location: Line R2-A			Project Name: BL England Substation, Cape May City, NJ
Lat: 39.281468°	Long: -74.634639°	Orientation: 54° True North	Air Temperature: 80°F
Soil Type: Sandy soil			Date of Test: 9/12/22
Soil Conditions (wet,dry): dry, 75.5°F			Weather Conditions: Sunny
Test Completed By: Amanda Fabian and Justin Covert			Test Methods: Soil Resistivity Testing (Wenner Array)
Test Instrument: AGI Sting R8 Resistivity meter. S/N: SS0803209			Calibration Date: 12/11/2020

Electrode Spacing (ft)	Current Electrode Depth (in)	Potential Electrode Depth (in)	Injected Current (mA)	Measured Potential (mV)	Measured Resistance (ohm)	Apparent Resistivity (Ohm-ft)
0.5	1	1	6.00	1877.90	312.98	983.25
1.0	1	1	5.00	897.77	179.55	1128.15
1.5	1	1	6.00	719.92	119.99	1130.83
2.0	1	1	6.00	503.95	83.99	1055.45
3.0	3	3	52.00	2676.41	51.47	970.16
5.0	3	3	51.67	1339.82	25.93	814.67
7.0	3	3	51.67	911.80	17.65	776.17
10.0	4	4	51.00	743.25	14.57	915.67
15.0	4	4	51.33	430.76	8.39	790.87
20.0	4	4	51.33	320.14	6.24	783.70
30.0	6	6	51.67	183.95	3.56	671.10
45.0	6	6	52.00	109.53	2.11	595.55
100.0	6	6	51.67	40.84	0.79	496.59

Field Notes:

Soil Resistivity Field Measurement Form

Location: Line R2-B			Project Name: BL England Substation, Cape May City, NJ
Lat: 39.281082°	Long: -74.634687°	Orientation: 151° True North	Air Temperature: 80°F
Soil Type: Sandy Soil			Date of Test: 9/13/22
Soil Conditions (wet,dry): dry, 77.6°F			Weather Conditions: Sunny
Test Completed By: Amanda Fabian and Justin Covert			Test Methods: Soil Resistivity Testing (Wenner Array)
Test Instrument: AGI Sting R8 Resistivity meter. S/N: SS0803209			Calibration Date: 12/11/2020

Electrode Spacing (ft)	Current Electrode Depth (in)	Potential Electrode Depth (in)	Injected Current (mA)	Measured Potential (mV)	Measured Resistance (ohm)	Apparent Resistivity (Ohm-ft)
0.5	1	1	6.00	835.60	139.27	437.51
1.0	1	1	6.00	864.70	144.12	905.50
1.5	1	1	6.67	688.29	103.24	973.03
2.0	1	1	5.00	474.99	95.00	1193.75
3.0	3	3	51.67	3492.85	67.60	1274.28
5.0	3	3	52.00	3328.02	64.00	2010.60
7.0	3	3	51.67	2173.80	42.07	1850.47
10.0	4	4	51.00	1390.40	27.26	1712.95
15.0	4	4	51.33	842.44	16.41	1546.69
20.0	4	4	51.67	544.12	10.53	1323.40
30.0	6	6	51.67	291.02	5.63	1061.71
45.0	6	6	51.67	150.59	2.91	824.07
100.0	6	6	52.33	40.78	0.78	489.63
150.0	8	8	51.67	25.29	0.49	461.40
200.0	8	8	52.00	20.57	0.40	497.02
300.0	8	8	51.00	12.95	0.25	478.76
350.0	8	8	52.00	11.55	0.22	488.48

Field Notes:

Soil Resistivity Field Measurement Form

Location: Line R2-C			Project Name: BL England Substation, Cape May City, NJ
Lat: 39.282156°	Long: -74.634650°	Orientation: 155° True North	Air Temperature: 80°F
Soil Type: Sandy Soil			Date of Test: 9/13/22
Soil Conditions (wet,dry): dry, 77.6°F			Weather Conditions: Sunny
Test Completed By: Amanda Fabian and Justin Covert			Test Methods: Soil Resistivity Testing (Wenner Array)
Test Instrument: AGI Sting R8 Resistivity meter. S/N: SS0803209			Calibration Date: 12/11/2020

Electrode Spacing (ft)	Current Electrode Depth (in)	Potential Electrode Depth (in)	Injected Current (mA)	Measured Potential (mV)	Measured Resistance (ohm)	Apparent Resistivity (Ohm-ft)
0.50	1	1	7.00	640.17	91.45	287.30
1.00	1	1	51.00	3759.50	73.72	463.16
1.50	1	1	51.33	2277.18	44.36	418.08
2.00	1	1	51.67	1768.16	34.22	430.05
3.00	3	3	51.00	1184.39	23.22	437.75
5.00	3	3	52.00	580.08	11.16	350.45
7.00	3	3	51.67	384.29	7.44	327.13
10.00	4	4	51.67	303.74	5.88	369.38
15.00	4	4	51.67	227.89	4.41	415.70
20.00	4	4	51.67	181.62	3.52	441.72
30.00	6	6	51.67	131.28	2.54	478.94
45.00	6	6	51.33	89.80	1.75	494.60
100.00	6	6	52.00	40.83	0.79	493.29
150.00	8	8	51.33	28.92	0.56	530.90
200.00	8	8	52.00	22.82	0.44	551.37
300.00	8	8	51.00	14.59	0.29	539.31
350.00	8	8	52.00	12.04	0.23	509.11

Field Notes:

LOCATION

NOTE:

Modified from Google Earth Pro aerial photograph.

Figure 1
General Site Location
Ocean Wind LLC
BL England Substation
Marmora, New Jersey

File 22AM24	September, 2022

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LEGEND

●—	SOIL RESISTIVITY TEST LINE WITH MIDPOINT

SCALE (feet)

0 500 1000

NOTE:

Modified from Google Earth Pro aerial photograph.

Figure 2
Soil Resistivity Testing
Ocean Wind LLC
BL England Substation
Marmora, New Jersey

File 22AM24	September, 2022

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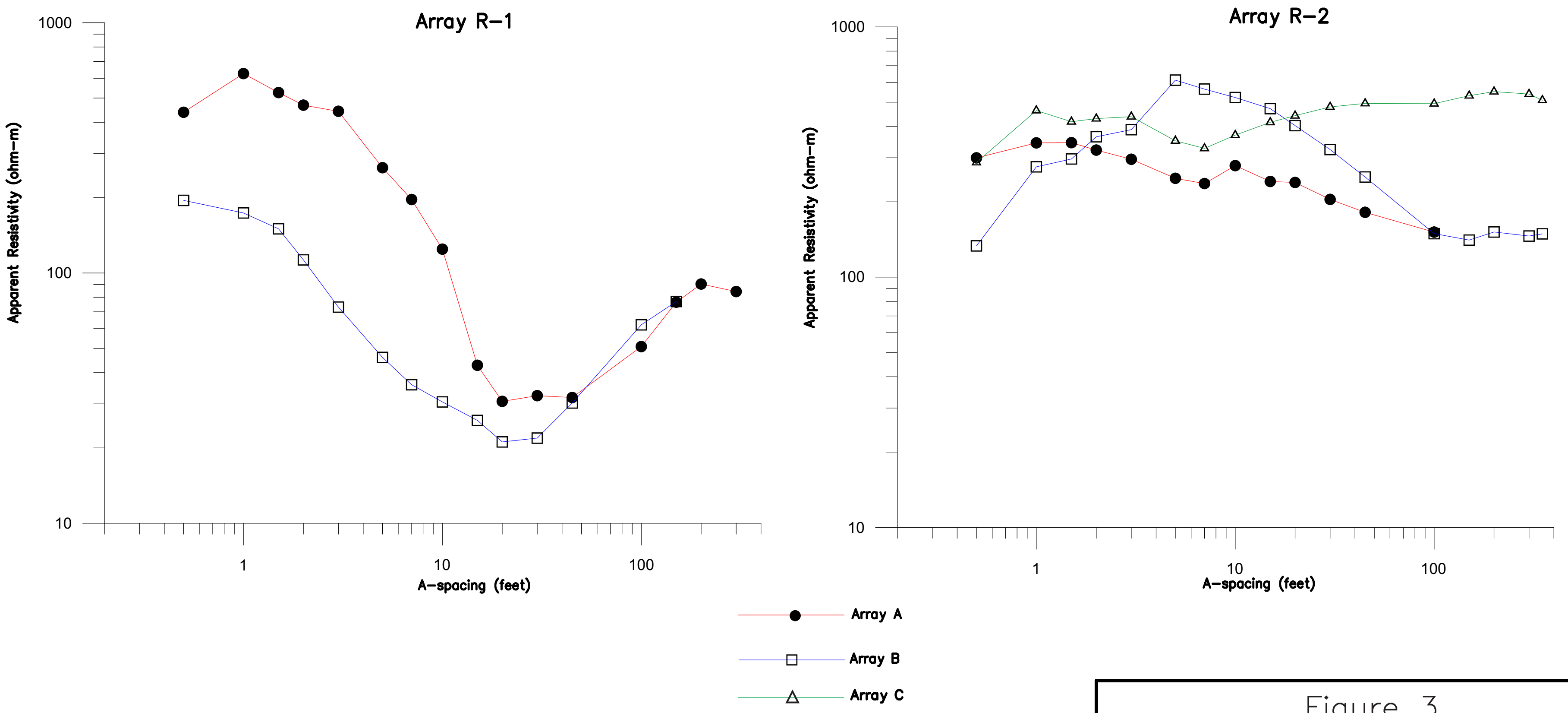

Figure 3
Soil Resistivity Testing Results
Ocean Wind LLC
BL England Substation
Marmora, New Jersey

File 22AM24	September, 2022

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Burns & McDonnell
10 North Park Place, Suite 330
Morristown, NJ 07960
O 973-884-8701
F 973-884-8751
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