Soil Borings and Permeability Investigation

1115 Main Street
Bradley Beach, NJ

By:

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1. SUMMARY

Two soil borings (for permeability purposes) and Standard Penetration Tests to a depth of 12 ft were performed on 18 January 2025 at 1115 Main St. in Bradley Beach NJ. Soil sampling was performed per the International Building Code and in accordance with ASTM D1586, Specification for Penetration Test and Split Barrel Sampling of Soils. Samples were classified in accordance with ASTM D2487, Classification of Soils for Engineering Purposes, USCS.

Soil Boring 1 (SB-1) found loose to medium dense fill (sand, silt, clay and gravel) with construction debris (concrete and wood) to a depth of 4 ft below grade. From 4 to 6 ft, loose to medium dense poorly graded sand (SP), with a layer of clay at 4.5 ft, was found. From 6 to 8 ft, medium dense poorly graded sand (SP), with a layer of clay at 7.75 ft, was found. From 8 to 9 ft, loose poorly graded sand (SP) was found. From 9 to 10 ft, stiff clay (CH) was found. From 10 to 11 ft, loose poorly graded sand (SP) was found. From 11 to 12 ft, stiff clay (CH) was found. Water was encountered at 11 ft 3 in. below grade and the past seasonal high is estimated at 7 ft 6 in. with a standard deviation on 6 in.

Soil Boring 2 (SB-2) found loose poorly graded sand with some clay (SP-SC and SP) to a depth of 5 ft below grade. From 5 to 5.5 ft, medium clay (CH) was found. From 5.5 to 9 ft, loose poorly graded sand (SP) was found. From 9 to 12 ft, medium to stiff clay (CH) was found. Water was encountered at 10 ft 9 in. below grade and the past seasonal high is estimated at 7 ft 6 in. with a standard deviation of 6 in.

Permeability Results

Soil permeability was performed at two locations, next to each soil boring. Boreholes were machine drilled, using 2.25 in. hollow stem augers, to 12 in. above test level. The last 12 in. of the borehole was excavated using a 4 in. diameter hand auger.

The tests were conducted in accordance with the Well Permeameter Method published by the US Department of Interior (Earth Manual Part 2, Third Edition, Pp. 1234-5). Test Results are summarized in the following table. The computational method and permeability worksheet is provided in the appendix.

Item	SB 1	SB 2	Comment
First Impervious Layer	4.5 ft	5.0 ft	Permeability test was taken below this layer. Design should allow water passage through the layer.
Borehole Depth	5.0 ft	5.4 ft	The variable H in calculations.
USCS Classification	SP	SP	Yellow sand.
Seasonal High Estimate	7 ft 6 in.	7 ft 6 in.	The variable s in calculations.
Second Impervious Layer	7 ft 9 in.	8 ft 0 in.	Removal of layer not required.
Water Level	11 ft 3 in.	10 ft 9 in.	Encountered during SPT test.
Q	4.7 in^3/min	5.0 in^3/min	Steady state water flow in borehole. Measured in field.
Ksat	0.393 in/hr	0.419 in/hr	Saturated Hydraulic Conductivity. Computed value.
Soil Classification	K1	K1	Per NJAC 7:9A (pp. 57)

Water Level Probabilities

When considering the past seasonal high estimate and standard deviation, the probability of the water level rising to an elevation above the seasonal high estimate is tabulated below. Further information is provided in the Estimated Seasonal High Water Supplement found in the appendix.

Estimated Seasonal High Water Level:	See boring log(s)
Standard Deviation:	0.5 ft

Probability of the Water Level Rising to an Elevation above the Seasonal High Estimate

Elevation above Seasonal High (ft)	Probability
2.50	0.00003%
2.00	0.00317%
1.50	0.13499%
1.00	2.27501%
0.50	15.86553%

Slab on Grade Recommendations

Slabs on grades, may be used with proper subgrade preparation and placement of compacted fill. Provide joints between structures supported by footings (or grade beams) and those not supported by footings. The following recommendations are related to slabs on grade:

1. Strip debris and any topsoil from the ground prior to placing slab on grade. A minimum of 18 in. is recommended for removal.
2. Excavate loose soil and proof roll or compact existing ground to remove any soft spots that may be present.
3. Provide compacted fill to the appropriate grade in accordance with the compacted fill recommendations.
4. Any site preparation and earthwork should be done during favorable weather conditions.
5. Slabs on grade should be isolated from columns, walls and foundations.
6. Slabs on grade should not be constructed on frozen ground.
7. Use a modulus of subgrade reaction (k) of 110 pci for slab thickness and reinforcement design.
8. A 6 mil. vapor barrier should be provided between the ground surface and the bottom of slab to prevent water transmission.

Site Preparation and Compacted Fill Recommendations

The following recommendations are related to site preparation and compacted fill, in the event compacted fill is used in the project:

1. As per the state Uniform Construction Code, Subchapter 5 and IBC Section 1705.6, it is necessary to engage a Special Inspector certified in soils or a registered design professional to perform special inspections for site soil conditions, fill placement and to verify load bearing requirements during construction.
2. Prior to the start of site work, the special inspector must be able to verify that proper materials and placement methods are appropriate. Samples of fill material and written procedures should be submitted to the special inspector for approval. Fill samples will be used to determine the maximum dry density and optimum moisture content using ASTM D1557 (Modified Proctor). Fill shall be clean and not contain any clay or organic material. Fines shall be limited to 5% or less passing a No. 200 sieve. Note any onsite soil containing organic or clay material as well as more than 5% fines is not suitable to be used as fill. If borrow fill is needed, DGA, No. 57 stone or NJDOT I-8 soil aggregate is recommended.
3. Any fill staged onsite should be protected from excessive moisture. If fill is found too moist, it may require drying before placement.
4. In general, site clearing should be one of the first stages of site work. Clear any asphalt or concrete surfacing that may interfere with the proposed work. Clear and grub organic material from the ground. Ensure the site is clear of any debris and organic material prior to placing compacted fill or reconfiguring detention basin.
5. Excavate any poorly compacted soil on-site to the proper bearing elevation.
6. Compact the existing ground using a vibratory roller or compactor to remove any soft spots that may be present in the soil. (A sheepsfoot roller may be required for clay soil.) Compacting should occur at the appropriate moisture content and not on saturated soil.
7. Prior to placement of approved fill, subgrade must be observed and verified by the special inspector or registered design professional to confirm that it was properly prepared.
8. Place fill, having the proper moisture content, in 8 in. lifts under continuous inspector supervision. Fill shall be compacted using a vibratory compactor or roller. Note that smaller lifts may be required to meet density requirements.
9. Any site preparation and earthwork should be done during favorable weather conditions.
10. Density testing shall be performed in accordance with ASTM D6938, ASTM D7698 or ASTM D8167. The density achieved shall be at least 92% of the Modified Proctor value for foundations and over-built areas. Other areas are recommended to be compacted to a minimum of 85% of the Modified Proctor Value.
11. Backfill at walls shall be provided a method of draining water away from the wall such as a perforated pipe leading to a recharge chamber or other location.

2. BACKGROUND ON GEOTECHNICAL SOIL BORINGS

Soil borings consist of two parts, excavation and sampling. During excavation a 3 in. diameter open hole is made to the elevation of where sampling is to begin. For this work the method of excavation is indicated on the boring log. Sampling was performed in accordance with ASTM D1586. This sampling method is known as the Standard Penetration Test (SPT) and is a standardized procedure for driving a split barrel sampler to obtain a representative soil sample and measure the resistance of the soil to the penetration of the sampler. The sampler is driven with a 140 lb. hammer dropped from a height of 30 in. The measure of resistance is designated as “N” and is also known as the “blow counts”. The number of blows on the sampler is recorded in four 6 in. increments for a total penetration depth of 24 in. The sum of blows for the middle 12 in. is the blow count. Soil samples were classified in accordance with the Unified Soil classification System (USCS) using ASTM D2487.

Seasonal High Water

Excluding extreme weather events, the water elevation varies (during extreme events the elevation may vary even more). The past seasonal high water level estimate is based on soil colors, staining and mottling, and is an estimate of the past high water level during the season. For additional information refer to the Estimated Seasonal High Water Level Supplement in the appendix.

General

The conclusions and recommendations in the report are based on data obtained from the soil boring(s). Although, as per IBC Section 1803.3.1, there shall be at least one soil boring per 2,500 sf of over-build, the possibility remains that unexpected conditions may be encountered during construction due to the nature of underground work. An allowance should be established to account for possible extra costs that may be required. Additional costs may be incurred for various reasons including uncovering unsuitable soils, in-ability to use onsite soils, variations of soil conditions, water runoff conditions, requirements for the support of excavation, etc. It is recommended that designs utilizing geotechnical data such as water levels and bearing capacity, consider the uncertainties of the data and use a reliability factor. Note that uncertainty is never zero. More information can be found in the references listed in the appendix.

3. APPENDIX

a. Photographs
b. Soil Boring Log(s)
c. ASTM D2487 Soil Classification Definitions
d. Soil Permeability Worksheet
e. Permeability Computation Method
f. Location Plan(s)
g. Estimated Seasonal High Water Supplement

Photographs

Photo 1: SB-1 Drill Rig Setup

Photo 2: SB-1 Samples (identified from top to bottom)
0 to 2 ft Sample, Fill w. construction debris – Loose then Med. Dense
2 to 4 ft Sample, Fill w. construction debris – Medium Dense
4 to 6 ft Sample, SP, CH then SP – Loose then Medium then Medium Dense
6 to 8 ft Sample, SP then CH – Medium Dense then Stiff

Photo 3: SB-1 Samples (identified from top to bottom)
8 to 10 ft Sample, SP then CH – Loose then Stiff
10 to 12 ft Sample, SP then CH – Loose then Stiff

Photo 4: SB-2 Drill Rig Setup

Photo 2: SB-1 Samples (identified from top to bottom)
0 to 2 ft Sample, SP-SC – Loose
2 to 4 ft Sample, SP – Loose
4 to 6 ft Sample, SP then CH – Loose then Medium
6 to 8 ft Sample, SP – Medium Dense

Photo 3: SB-1 Samples (identified from top to bottom)
8 to 10 ft Sample, SP then CH – Loose then Medium
10 to 12 ft Sample, CH – Stiff

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Soil Boring and Standard Penetration Test Log

Location:	1115 Main St.	Boring No:	SB-1
	Bradley Beach, NJ	Water Level:	11'3"
		Past Seasonal High Estimate:	7'6"
Drilling Date:	18-Jan-25		
Drilling Rig:	Diedrich D25 Track Rig	On Site:	R. Simon, PE
Drilling Method:	Driven Spoons		
Sampling Method:	ASTM D1586, 140 lb Auto-Hammer, 30 in. Drop, Split Spoon		

Depth ft.	Sample Depth	SPT Blow Counts (per 6 in.)				N Value	Photo No.	USCS Class	Remarks
0	0-2	3	3	5	14	8	2	Fill	Fill w. construction debris
									Loose then Med. Dense
2	2-4	10	17	12	9	29	2	Fill	Fill w. construction debris
									Med. Dense
4	4-6	4	5	5	9	10	2	SP/CH	Loose then Medium
								SP	then Med. Dense
6	6-8	9	9	7	7	16	2	SP	Med. Dense then Stiff
								CH	
8	8-10	5	4	4	5	8	3	SP	Loose then Stiff
								CH	
10	10-12	3	5	7	10	12	3	SP	Loose then Stiff
								CH	End Boring at 12 ft

"w" indicates that the sampler penetrated 6 in. under only the hammer weight, indicating weak soil.

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Soil Boring and Standard Penetration Test Log

Location:	1115 Main St.	Boring No:	SB-2
	Bradley Beach, NJ	Water Level:	10'9"
		Past Seasonal High Estimate:	7'6"
Drilling Date:	18-Jan-25		
Drilling Rig:	Diedrich D25 Track Rig	On Site:	R. Simon, PE
Drilling Method:	Driven Spoons		
Sampling Method:	ASTM D1586, 140 lb Auto-Hammer, 30 in. Drop, Split Spoon		

Depth ft.	Sample Depth	SPT Blow Counts (per 6 in.)				N Value	Photo No.	USCS Class	Remarks
0	0-2	1	2	4	5	6	5	SP-SC	Loose
2	2-4	2	2	3	2	5	5	SP	Loose
4	4-6	2	2	3	3	5	5	SP	Loose then Medium
								CH	
6	6-8	4	6	5	4	11	5	SP	Med. Dense
8	8-10	3	2	2	3	4	6	SP	Loose then Medium
								CH	
10	10-12	3	7	9	9	16	6	CH	Stiff
									End Boring at 12 ft

"w" indicates that the sampler penetrated 6 in. under only the hammer weight, indicating weak soil.

ATSM D 2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

This is a standard soil classification system referenced by the International Building Code (NJ Edition) which is the state adopted building code. It consists of two major categories of soils, Coarse Grained (retained on a No. 200 Sieve) and Fine Grained (passing a No.
200 Sieve). If a soil is more than 50% of either category it is classified in that category. Within the major categories, soil classifications are further refined. Below is a listing and descriptions of the soil classifications.

Coarse Grained Soils

Gravel		**Sand**	
GW	Well Graded Gravel	SW	Well Graded Sand
GP	Poorly Graded Gravel	SP	Poorly Graded Sand
GW-GM	Well Graded Gravel with Silt	SW-SM	Well Graded Sand with Silt
GW-GC	Well Graded Gravel with Clay	SW-SC	Well Graded Sand with Clay
GP-GM	Poorly Graded Gravel with Silt	SP-SM	Poorly Graded Sand with Silt
GP-GC	Poorly Graded Gravel with Clay	SP-SC	Poorly Graded Sand with Clay
GM	Silty Gravel	SM	Silty Sand
GC	Clayey Gravel	SC	Clayey Sand

Fine Grained Soils

ML	Silt
CL-ML	Silty Clay (Low Plasticity)
CL	Lean Clay (Low Plasticity)
CH	Fat Clay (High Plasticity)
OL	Organic Soil with Low Plasticity
OH	Organic Soil with High Plasticity

N-Values for Coarse Grained Soils		**N-Values for Fine Grained Soils**	
0-4	Very Loose	0-2	Very Soft
5-10	Loose	3-4	Soft
11-29	Medium Dense	5-8	Medium
30-49	Dense	9-15	Stiff
>50	Very Dense	16-30	Very Stiff
		>30	Hard

Other Soils

PT	Peat, Highly Organic

Note that OL, OH and PT are not suitable for use as a foundation subgrade.

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Soil Permeability Worhsheet

Location: 1115 Main St.
Bradley Beach

On Site: R. Simon, P.E.
Test Date: January 18, 2025
Boring Method: Hollow Stem Auger and Hand Auger
Boring Diameter: 4 in.
Testing Method: Well Permeameter Method published by the
US Department of Interior (Earth Manual Part 2, Third Edition, Pp. 1234-5)

Constants

s - Water Level Depth (ft)	7.50
r - Radius of Borehole (in)	2.00
h - Head of Water in Borehole (in)	5.25

Saturated Hydraulic Conductivity, Ksat Calculations

Sample	Borehole Depth, ft	Soil Type	L, ft	L/h Ratio	Use	Q in^3/min	Ksat in/hr	Soil Permeability Classification
SB-1	5.0	SP	2.94	6.7	Eq. 1	4.7	0.4	K1
SB-2	5.4	SP	2.54	5.8	Eq. 1	5.0	0.4	K1

Notes

L is the vertical distance between the constant water head, h, and the water table.

Q is the steady flow rate recorded in the field.

Ksat is the saturated hydraulic conductivity of the soil.

Soil Permeability Class as defined by NJAC 7:9A, pp. 57.

Calculating saturated hydraulic conductivity (K_{sat})

Saturated Hydraulic conductivity can be calculated using several methods. The following calculations are based on USBR 7300-89 procedure (Earth Manual Part2, Third Edition, and P. 1234-5. Denver, Colorado 1990).

Depending on the value of L/h ratio (L is the vertical distance between constant water head (h) and water table / impervious layer; see Fig. 6), K_{sat} can be calculated from different formulas:

Condition I: when L/h is greater than three ($L/h > 3$)

$$K_{sat} = \frac{Q}{2\pi h^2}\left\{\ln\left[h/r + \sqrt{\left(h/r\right)^2 + 1}\right] - \frac{\sqrt{1 + \left(h/r\right)^2}}{h/r} + \frac{1}{h/r}\right\}$$ Unit: cm/min Equation [1]

Condition II: when L/h is between one and three ($1 \leq L/h \leq 3$)

$$K_{sat} = \frac{Q}{2\pi h^2}\left[\frac{\ln\left(h/r\right)}{\frac{1}{6} + \frac{1}{3}\left(\frac{L}{h}\right)}\right]$$ Unit: cm/min Equation [2]

Condition III: when L/h is greater than three ($L/h < 1$)

$$K_{sat} = \frac{Q}{2\pi h^2}\left[\frac{\ln\left(h/r\right)}{\frac{L}{h} + \frac{1}{2}\left(\frac{L}{h}\right)^2}\right]$$ Unit: cm/min Equation [3]

Where K_{sat} is saturated hydraulic conductivity (cm/s), Q is steady flow rate (ml/s), h is height of constant water head in Borehole (cm), r is radius of Borehole (cm) and L is the vertical distance between water surface in Borehole and the water table (cm), *ln* is the symbol for natural logarithm and π is 3.14. Note: for converting K_{sat} unit from cm/s to inch/s, it has to be multiplied by 0.39.

Parameter L can be easily calculated:

$$L = s - H + h = 350 - 340 + 10.1 = 20.1$$ Unit: cm Equation [4]

Where H is borehole depth, h is constant water head height in borehole, s is water table depth and L is the vertical distance between constant water head and water table/impervious layer.

Since the L/h ratio in Table 1 is between 1 and 3, Equation [2] has to be used for calculating K_{sat}:

$$K_{sat} = \frac{10}{2\pi 10.1^2}\left[\frac{\ln\left(10.1/5.08\right)}{\frac{1}{6} + \frac{1}{3}\left(\frac{20.1}{10.1}\right)}\right] = 0.0010$$ Unit: cm/min Equation [5]

Google Maps 1115 Main St

 50 ft

Estimated Seasonal High Water Level Supplement

Excluding extreme weather events, the water elevation varies. During extreme weather events the elevation may vary even more. Extreme weather events are not considered here.

The past seasonal high water level estimate in the report is made from the geotechnical boring(s). It is based on soil colors, staining and mottling, and it is an estimate (a measurement) of the past high water level during the season. As with all measurements, "everything dealing with the collection, processing, analysis, and interpretation of data belongs to the domain of statistics." (Miller et al. 1990, Pp. 1). Depending on the soil and other factors, in some cases evidence of the seasonal high water level can be clearly seen. In other cases, it is not so clear. This uncertainty is quantified in the Standard Deviation, designated σ, using the procedure outlined in Duncan, 2000 (Ref. 2).

The geotechnical report complies with the International Building Code. The IBC does not define a method of estimating the seasonal high water level. For construction of single-family homes, additions and inground swimming pools in Monmouth and Ocean Couties, it is common practice and acceptable to many of the engineers, architects, builders and building departments to estimate seasonal high water level using soil borings. Other methods of estimating the past seasonal high water level are available that may provide a smaller standard deviation, i.e. less uncertainty. Each has advantages and disadvantages. The most common methods, in addition to soil borings, include test pits and monitoring wells and are described here:

- Test pits are larger holes, dug to the water table, where the side walls can be viewed for evidence of seasonal high water. These can provide less uncertainty than borings, but they disturb a large area and can affect the foundation bearing layers.
- Monitoring wells typically provide the lowest standard deviation and, sometimes, a more accurate seasonal high estimate. These can be installed at strategic locations on the site but take time to produce results. Time estimates can be in the order of one to three years. These can be installed on your property.

Note that Simon Engineering LLC does not design basements or inground swimming pools but provides some of the data so that interested parties can make informed decisions. There is always a risk when it comes to the water level and it being above a certain elevation. The risk is never zero, it can change over time, and it increases during extreme weather.

References

1. Miller, I.R. et al. (1990), *Probability and Statistics for Engineers, 4th Edition* (Englewood Cliffs, NJ: Prentice Hall)
2. Duncan, J.M. (2000), "Factors of Safety and Reliability in Geotechnical Engineering," Journal *of Geotechnical and Geoenvironmental Engineering*, Vol 126, No. 4, pp. 307-316