INFILTRATION ANALYSIS

The Cottages at State College
Ferguson Township, Centre County, PA

CMT Laboratories File No. 1313801

Prepared for:

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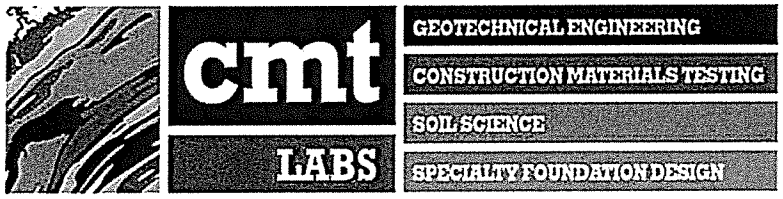
Prepared by:



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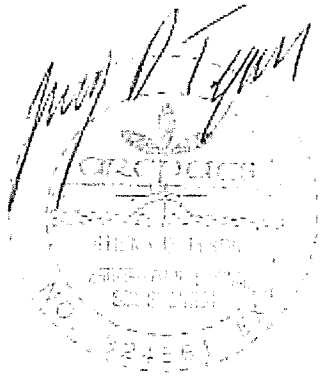
State College, PA 16801



December 22, 2014

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The Cottages at State College
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INTRODUCTION

Our scope of services included observing 8 test pits at locations identified by PennTerra Engineering, Inc., and conducting infiltration tests at each of the test pit locations; however, the presence of bedrock at depths shallower than the infiltration test depths specified by PennTerra, precluded conventional infiltration testing at several test pit locations. These conditions were discussed with PennTerra during the investigation and it was decided that general permeability observations were adequate at these locations, since non-conventional infiltration testing of the bedrock occurred at the site during an investigation CMT conducted in 2013 (i.e., CMT File No. 1313800, dated April 22, 2013). We understand the purpose of this investigation is to supplement and expand on information gathered during our 2013 investigation. The locations of the test pits are shown on a plan provided by PennTerra in Appendix A.

It should be noted that we have not considered any potential impact that an infiltration Best Management Practice (BMP) may have on adjacent structures (existing and/or proposed). These types of issues, if applicable, should be addressed by the appropriate professionals.

SOIL MAPPING

The Natural Resource Conservation Service (NRCS) soil mapping indicates that Hagerstown and Opequon-Hagerstown Complex series soils exist at the site.

In general, Opequon and Hagerstown series soils are similar. Both series consists of well-drained residual soils derived from limestone or dolomite bedrock; however, Opequon soils are shallow (20 inches or less to bedrock) and Hagerstown soils are deep or very deep (depth to bedrock of 40 inches or more). Typically, areas mapped as Opequon-Hagerstown have a depth to bedrock too variable to separate the two series.

GEOLOGIC INFORMATION

According to the NRCS mapping, the rock formation at the site is the Nittany Formation. The dominant rock type is dolomite.

Sinkhole Potential

No evidence of active sinkholes was observed during our investigation; however, the presence of carbonate bedrock in itself renders the site susceptible to sinkhole development during or after construction. In addition, altering a site's grading and drainage characteristics can result in sinkholes developing even when surface/subsurface observations reflect little or no potential. In other words, the risk of sinkholes developing in carbonate bedrock/karst areas as a result stormwater infiltration BMPs is inherent.

In terms of risk management, we do not believe there is an effective method for eliminating sinkholes in karst infiltration areas. Certain sources suggest that reducing the ponding depth within a recharge basin from 36 inches to 18 inches may reduce the likelihood that sinkholes will develop; however, our experience within the Centre Region does not support the theory that this hydraulic difference has a noticeable effect. We have observed sinkholes in basins that experience very little ponding depth, while other basins experiencing historically deeper depths remain sinkhole-free, suggesting that the repeated inundation of a recharge basin, and not its ponding depth, is a much more significant factor in sinkholes developing within sinkhole-prone areas. Further, enlarging a recharge basin's footprint within a karst area to accommodate the reduced ponding depth may effectively increase the potential for sinkhole development because the inundation area of influence is larger.

In summary, the risk of sinkhole development in karst infiltration areas is inherent, and the best management strategy, short of eliminating groundwater recharge, may be to preplan for repair of sinkholes, should they develop.

TEST PITS

General

A total of 8 test pits were excavated in the presence of a CMT representative, with a backhoe provided and operated by a subcontractor. With the exceptions of where excavation refusals occurred, the test pits were extended several feet below the specified infiltration test depths.

The soils observed in the test pits are consistent with the Hagerstown and Opequon series soils discussed in the soil mapping paragraph of this report. After our observations were recorded, the test pits were backfilled with the excavated materials.

Topsoil

The topsoil at the site consists of dark brown clayey silt with sand and organic matter. The topsoil exhibits excellent soil structure and macropore (i.e., root channels, earthworm burrows, etc) abundance, which is typically favorable for infiltration.

At test pit locations TP-14 and TP-15 several feet of topsoil was observed. The thickness of topsoil in this area is likely the result of topsoil that migrated from upslope areas.

Subsoils

The topsoil is underlain by residual silt and/or clay subsoils with variable amounts of sand and gravel. Soil structure and macropore abundance in the subsoil layers ranges from excellent at shallow depths to moderate in the deeper subsoils, which we consider exceptional for fine-grained (silt/clay) subsoils. We believe the soil structure at the site is greatly enhanced by the agricultural land uses and the earthworm population/activities. At test pit location TP-21, which was located in a wooded, non-agricultural area, the earthworm population appeared significantly lower.

Bedrock

Weathered dolomite bedrock was observed in all but one of the test pits (TP-21). The bedrock varies from weathered dolomite cobbles and boulders surrounded by soil (identified as BR-Horizons on the test pit logs) to hard dolomite bedrock with few visible fractures.

In four test pits, bedrock was encountered shallower than the proposed infiltration test depth. At two of these locations, excavation refusal occurred prior to reaching the proposed infiltration test depths; however, further excavation may be possible with larger equipment and/or a larger excavation. In general, the bedrock observed in the test pits did not appear more restrictive than the overlying subsoils.

Groundwater/Redoximorphic Features

No groundwater or redoximorphic features were observed through the excavation termination depths.

INFILTRATION TESTS

General

At the locations where soil was observed at/below the test depths specified by PennTerra, infiltration tests were conducted at/below those depths. At test pit locations TP-14 and TP-15, infiltration tests were conducted in topsoil several feet below the specified test depth. While topsoil is typically not the governing soil layer, we believe its thickness in this area warranted testing and was appropriate, given that testing of subsoils in the general area already occurred in 2013.

No infiltration tests were conducted where bedrock was encountered significantly shallower than the specified test depths; however, infiltration tests were conducted at test pit location TP-18, where bedrock was encountered slightly shallower than the specified test depth.

The presence of bedrock shallower than the specified test depths at some of the test pit locations was discussed with PennTerra during our investigation. It was decided that since the rock was tested extensively in 2013, additional non-conventional infiltration tests were not needed during this investigation if CMT felt the rock was similar to that tested in 2013. To estimate general permeability, water was poured from 5-gallon jugs onto exposed bedrock at the bottoms of test pits where rock was encountered shallower than the specified test depth. At all locations the water drained relatively freely into the rock. Consequently, we believe it is reasonable to assume the rock encountered during this investigation is capable of providing apparent infiltration rates similar to the higher test results on the rock from 2013 (i.e., ranging from approximately 10 to 110 in/hr).

Infiltration Test Methods

A total of 10 infiltration tests, including 6 double-ring infiltrometer and 4 uncased-hole tests, were conducted. The uncased-hole tests were conducted in general accordance with the Percolation Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual. The double-ring infiltrometer tests were also conducted in accordance with the BMP manual. The uncased-hole tests were conducted in materials containing too much gravel for seating an infiltrometer.

The infiltration rate obtained using the uncased-hole method is calculated using the Reduction Factor specified in the BMP Manual for use with percolation tests. The reduction factor accounts for the exfiltration occurring through the sides of the percolation hole and assumes that the infiltration rate is affected by the depth of the water in the hole.

The infiltration rate obtained using the double-ring infiltrometer method is generally taken to be either the average rate of all measurements or the final measurement reported in in/hr. We recommend the use of the lower of the two rates.

The maximum design infiltration rates shown in this report were calculated using what we believe are reasonable minimum safety factors. The design engineer should determine if higher safety factors are appropriate.

After the infiltration tests were completed, the holes were backfilled with excavated materials.

TEST RESULTS

The following table summarizes the infiltration test results:

Location	Test Type	Test Depth (ft)	Materials Tested	Apparent Infiltration Rate (in/hr)	Min. Safety Factor	Maximum Design Infiltration Rate (in/hr)
			Topsoil (2 ft below specified test depth))			
IT14A	Infiltrometer	2.0	Dark Brown Clayey Silt with Sand	2.16	2	1.08
IT14B	Infiltrometer	2.0	Dark Brown Clayey Silt with Sand	1.92	2	0.96
IT15A	Infiltrometer	2.0	Dark Brown Clayey Silt with Sand	2.40	2	1.20
IT15B	Infiltrometer	2.0	Dark Brown Clayey Silt with Sand	2.88	2	1.44
			Subsoils			
IT18A	Infiltrometer	1.5	Yellowish Red Silty Clay with Sand	1.20	2	0.60
IT18B	Infiltrometer	1.5	Yellowish Red Silty Clay with Sand	3.12	2	1.56
IT20A	Uncased-Hole	2.5	Strong Brown Silty Clay with Sand and Gravel	1.35	3	0.45
IT20B	Uncased-Hole	2.5	Strong Brown Silty Clay with Sand and Gravel	0.91	3	0.30
IT21A	Uncased-Hole	2.0	Yellowish Red Silty Clay with Sand and Gravel	0.19	3	0.06
IT21B	Uncased-Hole	2.0	Yellowish Red Silty Clay with Sand and Gravel	1.24	3	0.41

CONCLUSIONS

With the exception of the test result obtained at IT21 (0.06 in/hr), where fewer macropores were observed, the test results shown in the table above are considered reasonable for design purposes, assuming that the existing soil structure and macropore abundance is able to be maintained during and after construction. **Particular attention is called to the discussions regarding compaction during construction, sediment accumulation and soil restoration, which are included in the "Recommendations" section of this report.**

As discussed in our previous report, the governing municipality may require stormwater to pass through a filtration medium (i.e., a topsoil layer or other suitable medium) prior to entering weathered rock/bedrock. A separation fabric may be needed to minimize loss of the filtration medium into the weathered rock; however, separation fabrics are prone to clogging over time, and may require long term maintenance. In addition, since permeable soils are underlain by permeable bedrock throughout the site, the potential for erodible materials to enter rock fractures and result in settlement/sinkholes exists. These issues should be discussed with appropriate municipal officials.

RECOMMENDATIONS

It is recommended that the civil engineer apply an appropriate factor of safety when establishing the design infiltration rates to account for inconsistencies in the test results, non-homogeneity of the soils, and long-term variations in the soils' infiltration characteristics due to seasonal changes and other factors. We believe that minimum safety factors ranging from 2 to 3 (dependent on soil texture) should be applied to the infiltrometer and uncased-hole test results, respectively, for this purpose, and have applied these safety factors to the results shown in the table.

Materials within planned infiltration areas must not be compacted during construction since it is believed that even minimal compaction will result in a loss of infiltration capability. All heavy equipment should be prohibited from operating and traveling over the infiltration areas, and all other traffic should be minimized. It is also recommended that planned infiltration areas be clearly marked on the site prior to the commencement of earthwork activities, and construction traffic be prohibited from entering the infiltration areas.

The infiltration capacity of an area may decrease over time due to sediment accumulation. We believe infiltration areas that are protected from sediment accumulation will maintain their infiltration capacity longer than those which are not protected. We recommend that infiltration areas not be used as temporary sediment traps during site construction. If the use of an infiltration area as a temporary sediment trap is unavoidable, measures to prevent sediment from reaching the planned infiltration surface may be effective in preserving the infiltration capacity. In our experience, these measures typically involve leaving some thickness of soil above the infiltration surface for the sediment trap, and then removing it when the sediment trap is converted to an infiltration area. Soils at the infiltration elevation are extremely susceptible to compaction or smearing during the conversion process, even from small tracked equipment. Any compaction or smearing would result in a loss of infiltration capacity.

Construction of the proposed BMP(s) may involve the removal or disturbance of the existing topsoil layer. Although the topsoil may be replaced after construction, the new topsoil will likely exhibit soil structure and organism habitat that are less conducive to infiltration until natural processes enhance it. The loss/reduction of soil organisms will likely affect infiltration rates in the tested subsoil layers as well. If the topsoil at the site is to be removed and replaced, the designer should consider applying a higher safety factor to the test results in this report, and/or include provisions to improve the new topsoil, as outlined below:

1. Adding gypsum, lime, sand and/or organic matter to the topsoil may help maintain soil structure and improve soil fertility and infiltration rates while natural soil structure develops and vegetation is established. Sources of these materials vary in suitability and availability, and should be evaluated prior to placement. The addition of organic matter that is not "stabilized compost" typically results in a nitrogen deficiency caused by microbial activity during decomposition. Therefore, the addition of a lawn fertilizer high in nitrogen content may be necessary for adequate plant growth.

2. Creating a natural topsoil to subsoil interface is typically beneficial. This can be accomplished by carefully blending several inches of the new topsoil with the in-situ subgrade soil, being careful not to compact the soils. Alternatively, a similar effect could be accomplished by scarifying the in-situ subgrade soil just prior to the topsoil's placement.

3. Select vegetation that is moisture tolerant and does not require frequent mowing. Frequent mowing typically results in shallow root penetration and compaction, both of which reduce infiltration performance. The designer can select vegetation that is best adapted to their design and the anticipated moisture conditions by contacting seed companies, one such seed company is Ernst Seed, which can be viewed online at http://www.ernstseed.com.

4. Allow the new vegetation to fully establish itself throughout the BMP prior to the introduction of stormwater. Vegetation will stabilize the surface soils making them more resistant to particle separation when the BMP is inundated with water. If inundation prior to vegetation occurs, particle separation may result in the development of a restrictive layer. Once vegetation is established, it will help create soil structure and habitat for soil organisms, both of which typically increase infiltration rates. If inundation of the BMP is unavoidable prior to a stable vegetative surface being established, the BMP should be monitored and maintenance performed as needed (i.e., reseeding and/or removal of any restrictive layers created).

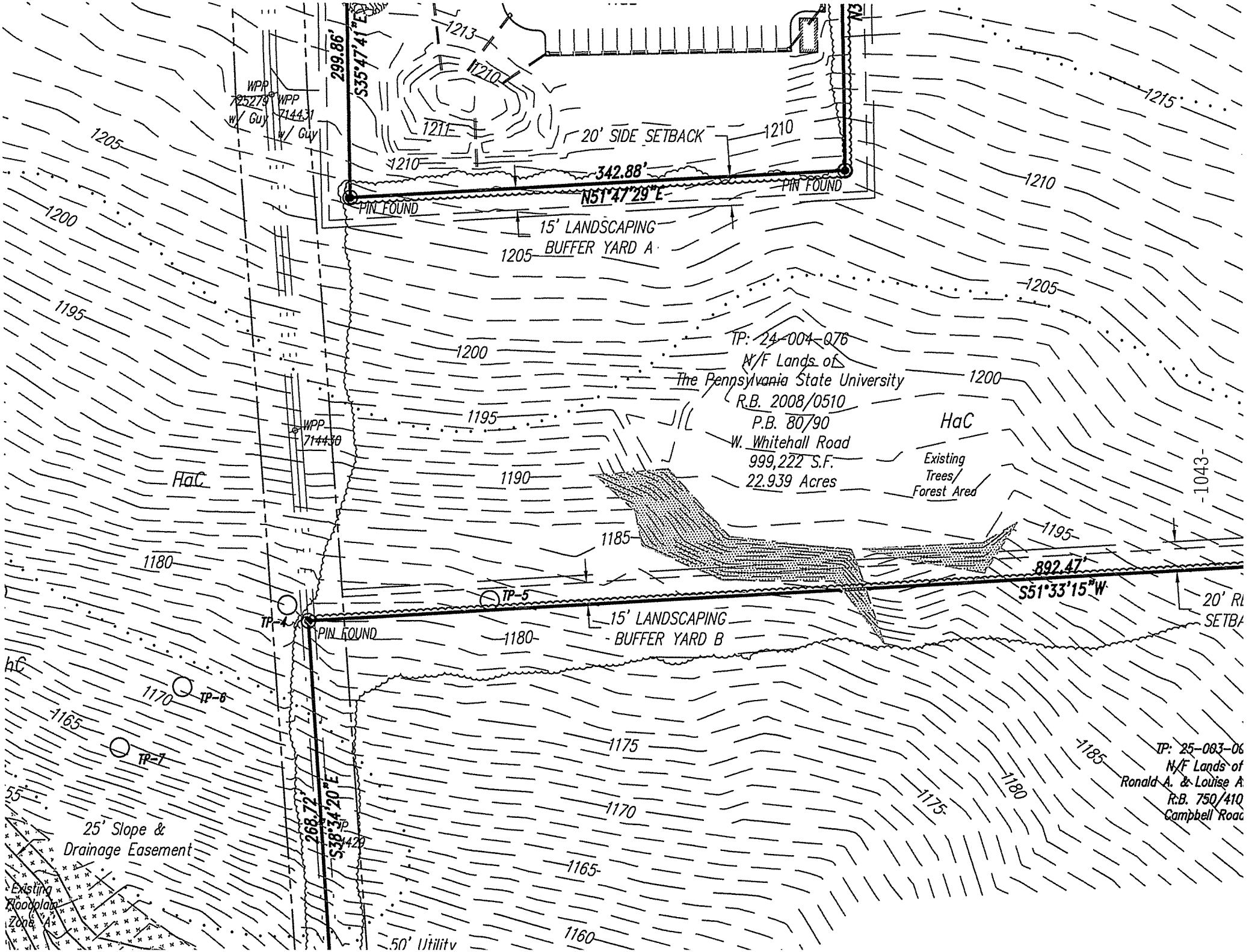
It is recommended that construction oversight (quality assurance) during construction be provided by the designer or owner. Oversight should include observation during earthwork activities and evaluation of proposed fill materials (including topsoil and topsoil mixtures).

COMMENTS

We request that this office be consulted if, during design or construction, conditions are encountered which differ from those contained herein, thereby warranting a review of our recommendations. This report has been prepared for the exclusive use of Landmark Collegiate Acquisitions, LLC and PennTerra Engineering, Inc.

APPENDIX A

Test Pit Location Plan


299.86'
S35°47'41"E
1213
1210
WPP 725279 w/ Guy
WPP 714431 w/ Guy
1215
1205
1210
1210
20' SIDE SETBACK
342.88'
N51°47'29"E
PIN FOUND
PIN FOUND
1200
15' LANDSCAPING
BUFFER YARD A
1205
1205
1195
TP: 24-004-076
N/F Lands of
The Pennsylvania State University
R.B. 2008/0510
P.B. 80/90
W. Whitehall Road
999,222 S.F.
22.939 Acres
1200
1200
1195
WPP 714430
HaC
HaC
Existing Trees/ Forest Area
1190
1185
1195
1180
892.47'
S51°33'15"W
TP-5
TP-4
PIN FOUND
15' LANDSCAPING
- BUFFER YARD B
1180
hC
1170
TP-6
1165
TP-7
1175
1185
1180
1175
1170
268.72'
S38°34'20"E
IP
1420
25' Slope &
Drainage Easement
Existing
Floodplain
Zone 'A'
1165
1160
50' Utility
-1043-
20' RU
SETBA
TP: 25-063-06
N/F Lands of
Ronald A. & Louise A
R.B. 750/410
Campbell Road

APPENDIX B

Test Pit Logs

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIALS TESTING
SOIL SCIENCE

The groundwork for success.

Test Pit Log

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date Performed: 12/15/2014
CMT File Number: 1313801

Location: TP-14
Excavation Equipment: Backhoe

Description	Depth (Feet)	Remarks
Ap - (0 to 12") TOPSOIL: Dark Brown Clayey SILT with Sand and Organic Matter; Granular Structure, Many Macropores, Damp	1	
A - (12" to 3.0') TOPSOIL: Dark Brown Clayey SILT with Sand and Organic Matter; Fine Sub-Angular Blocky Structure, Common Macropores, Damp	2	2.0': Infiltration Tests IT14A & IT14B
Bt_1 - (3.0' to 4.0') Yellowish Brown Clayey SILT with Sand and Gravel; Fine Sub-Angular Blocky Structure, Common Manganese Coatings, Common Macropores, Damp	3	
Bt_2 - (4.0' to 6.0') Strong Brown Sandy CLAY with Gravel; Medium Sub-Angular Blocky Structure, Few Manganese Coatings, Few Macropores, Damp	4	
	5	
BR - (6.0') Strong Brown Sandy CLAY and Weathered DOLOMITE	6	
Bottom of Pit - 6.0'	7	Groundwater Not Encountered
	8	
	9	

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GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIALS TESTING
SOIL SCIENCE
SUBSURFACE EXPLORATION & DESIGN

The groundwork for success.

Test Pit Log

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date Performed: 12/15/2014
CMT File Number: 1313801

Location: TP-15
Excavation Equipment: Backhoe

Description	Depth (Feet)	Remarks
Ap - (0 to 12") TOPSOIL: Dark Brown Clayey SILT with Sand and Organic Matter; Granular Structure, Many Macropores, Damp		
A - (12" to 3.5') TOPSOIL: Dark Brown Clayey SILT with Sand and Organic Matter; Fine Sub-Angular Blocky Structure, Common Macropores, Damp	1	
	2	2.0': Infiltration Tests IT15A & IT15B
	3	
Bt_1 - (3.5' to 4.8') Yellowish Brown Clayey SILT with Sand and Gravel; Fine Sub-Angular Blocky Structure, Common Manganese Coatings, Common Macropores, Damp	4	
Bt_2 - (4.8' to 6.5') Strong Brown Sandy CLAY with Gravel; Medium Sub-Angular Blocky Structure, Few Manganese Coatings, Few Macropores, Damp	5	
	6	
BR - (6.5') Strong Brown CLAY and Weathered DOLOMITE		
Bottom of Pit - 6.5'	7	Groundwater Not Encountered
	8	
	9	

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GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIALS TESTING
SOIL SCIENCE
SUB-SURFACE FOUNDATION DESIGN

The groundwork for success.

Test Pit Log

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date Performed: 12/15/2014
CMT File Number: 1313801

Location: TP-16
Excavation Equipment: Backhoe

Description	Depth (Feet)	Remarks
Ap - (0 to 5") TOPSOIL: Dark Brown Clayey SILT with Sand and Organic Matter; Granular Structure, Many Macropores, Damp		
Bt - (5" to 2.0') Yellowish Red Sandy CLAY; Medium Sub-Angular Blocky Structure, Few Macropores, Damp	1	
	2	
R - (2.0' to 8.5') Gray Weathered DOLOMITE with Silt; Very Broken, Damp		No infiltration tests conducted.
	3	
	4	
	5	
	6	
	7	
	8	Water added to pit bottom drained almost as quickly as it could be poured into the pit from a 5 gallon water container.
Bottom of Pit - 8.5'	9	Groundwater Not Encountered

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GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIALS TESTING
SOIL SCIENCE
SUBSURFACE EXPLORATION

The groundwork for success.

Test Pit Log

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date Performed: 12/15/2014
CMT File Number: 1313801

Location: TP-17
Excavation Equipment: Backhoe

Description	Depth (Feet)	Remarks
Ap - (0 to 3") TOPSOIL: Dark Brown Clayey SILT with Sand and Organic Matter; Granular Structure, Many Macropores, Damp		
Bt - (3" to 1.5') Yellowish Red Sandy CLAY; Medium Sub-Angular Blocky Structure, Few Macropores, Damp	1	
R_1 - (1.5' to 4.0') Gray Weathered DOLOMITE with Silt; Very Broken, Damp	2	
	3	
	4	
R_2 - (4.0' to 8.5') Gray Weathered DOLOMITE, Trace Silt; Hard, Broken, Damp		No infiltration tests conducted.
	5	
	6	
	7	
	8	Water added to pit bottom drained almost as quickly as it could be poured into the pit from a 5 gallon water container.
R_3 - (8.5') Gray DOLOMITE; Hard, Few Fractures, Damp		8.5': Excavation Refusal
Bottom of Pit - 8.5'	9	Groundwater Not Encountered

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GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIALS TESTING
SOIL SCIENCE
SPECIALTY SOLUTIONS & DESIGN

The groundwork for success.

Test Pit Log

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date Performed: 12/15/2014
CMT File Number: 1313801

Location: TP-18
Excavation Equipment: Backhoe

Description	Depth (Feet)	Remarks
Ap - (0 to 6") TOPSOIL: Dark Brown Clayey SILT with Sand and Organic Matter; Granular Structure, Many Macropores, Damp		
Bt - (6" to 2.5') Yellowish Red Silty CLAY with Sand; Fine Sub-Angular Blocky Structure, Common Macropores, Damp	1	
		1.5': Infiltration Tests IT18A & IT18B
	2	
BR - (2.5' to 7.0') Gray Weathered DOLOMITE (Cobbles & Boulders) with Clay; Damp	3	
	4	
	5	
	6	Water added to pit bottom drained almost as quickly as it could be poured into the pit from a 5 gallon water container.
	7	
Bottom of Pit - 7.0'	8	
	9	

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GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIALS TESTING
SOIL SCIENCE
SPECIALTY FOUNDATION DESIGN

The groundwork for success.

Test Pit Log

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date Performed: 12/15/2014
CMT File Number: 1313801

Location: TP-19
Excavation Equipment: Backhoe

Description	Depth (Feet)	Remarks
Ap - (0 to 7") TOPSOIL: Dark Brown Clayey SILT with Sand and Organic Matter; Granular Structure, Many Macropores, Damp		
Bt_1 - (7" to 1.0) Yellowish Brown Clayey SILT with Sand and Gravel; Fine Sub-Angular Blocky Structure, Common Macropores, Damp	1	
Bt_2 - (1.0' to 2.5') Yellowish Red Silty CLAY with Sand; Medium Sub-Angular Blocky Structure, Common Macropores, Damp	2	
BR - (2.5' to 5.5') Gray Weathered DOLOMITE (Cobbles & Boulders) with Clay; Damp	3	No infiltration tests conducted.
	4	
	5	Water added to pit bottom drained almost as quickly as it could be poured into the pit from a 5 gallon water container.
R - (5.5' to 6.0') Gray DOLOMITE; Hard, Few Fractures, Damp	6	6.0': Excavation Refusal
Bottom of Pit - 6.0'	7	Groundwater Not Encountered
	8	
	9	

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GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIALS TESTING
SOIL SCIENCE

The groundwork for success.

Test Pit Log

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date Performed: 12/15/2014
CMT File Number: 1313801

Location: TP-20
Excavation Equipment: Backhoe

Description	Depth (Feet)	Remarks
Ap - (0 to 12") TOPSOIL: Dark Brown Clayey SILT with Sand and Organic Matter; Granular Structure, Many Macropores, Damp		
Bt_1 - (12" to 2.0') Strong Brown Silty Clay with Sand; Fine Sub-Angular Blocky Structure, Common Macropores, Damp	1	
Bt_2 - (2.0' to 4.0') Strong Brown Silty Clay with Sand and Gravel; Stiff, Medium to Coarse Sub-Angular Blocky Structure, Common Manganese Coatings, Few Macropores, Damp	2	2.5': Infiltration Tests IT20A & IT20B
	3	
Bt_3 - (4.0' to 6.5') Yellowish Red Silty Clay with Sand and Gravel; Stiff, Medium to Coarse Sub-Angular Blocky Structure, Common Manganese Coatings, Few Macropores, Damp	4	
	5	
	6	
BR - (6.5') Yellowish Red CLAY and Weathered DOLOMITE; Damp		
Bottom of Pit - 6.5'	7	Groundwater Not Encountered
	8	
	9	

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GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIALS TESTING
SOIL SCIENCE
LABS

The groundwork for success.

Test Pit Log

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date Performed: 12/15/2014
CMT File Number: 1313801

Location: TP-21
Excavation Equipment: Backhoe

Description	Depth (Feet)	Remarks
Ap - (0 to 8") TOPSOIL: Dark Brown Clayey SILT with Sand and Organic Matter; Granular Structure, Many Macropores, Damp		
Bt_1 - (8" to 1.5') Yellowish Brown Silty Clay with Sand; Fine Sub-Angular Blocky Structure, Many Macropores, Damp	1	
Bt_2 - (1.5' to 3.0') Yellowish Red Silty CLAY with Sand and Gravel; Stiff, Fine Sub-Angular Blocky Structure, Few Macropores, Damp	2	2.0': Infiltration Tests IT21A & IT21B
Bt_3 - (3.0' to 6.0') Yellowish Red/Yellowish Brown Silty CLAY with Sand and Gravel; Stiff, Fine Sub-Angular Blocky Structure, Few Macropores, Damp	3 4 5	
Bottom of Pit - 6.0'	6 7 8 9	Groundwater Not Encountered

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APPENDIX C

Infiltration Test Results

Infiltration Test (Double-Ring Infiltrometer)

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date: 12/15/2014
CMT File No.: 1313801

Test Location: IT14A (Test Pit TP-14)

Test Apparatus Data
Inner Ring Diameter: 6 in
Outer Ring Diameter: 12 in
Test Depth: 2.0 ft
Soil Tested: Dark Brown Clayey Silt with Sand (Topsoil)

Date	Time	Time Interval (min)	Initial Water Height (ft)	Measured Water Drop (ft)	Final Water Height (ft)	Infiltration Rate for Time Interval (in/hr)
12/15/2014	1:03 PM	Start				
	1:33 PM	30	0.35	0.14	0.21	3.36
	2:03 PM	30	0.35	0.10	0.25	2.40
	2:33 PM	30	0.35	0.08	0.27	1.92
	3:03 PM	30	0.35	0.08	0.27	1.92
	3:33 PM	30	0.35	0.09	0.26	2.16
				Average:		2.35
				Minimum Safety Factor:		2
				Recommended Maximum Design Infiltration Rate (in/hr):		**1.08**

Note: Test was conducted in accordance with the Double-Ring Infiltrometer Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual.

Infiltration Test (Double-Ring Infiltrometer)

Project:	The Cottages at State College	**Date:**	12/15/2014
Location:	Ferguson Township, Centre County, PA	**CMT File No.:**	1313801
Client:	Landmark Collegiate Acquisitions, LLC		

Test Location: IT14B (Test Pit TP-14)

Test Apparatus Data
Inner Ring Diameter: 6 in
Outer Ring Diameter: 12 in
Test Depth: 2.0 ft
Soil Tested: Dark Brown Clayey Silt with Sand (Topsoil)

Date	Time	Time Interval (min)	Initial Water Height (ft)	Measured Water Drop (ft)	Final Water Height (ft)	Infiltration Rate for Time Interval (in/hr)
12/15/2014	1:04 PM	Start				
	1:34 PM	30	0.36	0.11	0.25	2.64
	2:04 PM	30	0.36	0.10	0.26	2.40
	2:34 PM	30	0.36	0.09	0.27	2.16
	3:04 PM	30	0.36	0.08	0.28	1.92
	3:34 PM	30	0.36	0.08	0.28	1.92
				Average:		2.21
				Minimum Safety Factor:		2
				Recommended Maximum Design Infiltration Rate (in/hr):		**0.96**

Note: Test was conducted in accordance with the Double-Ring Infiltrometer Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual.

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Infiltration Test (Double-Ring Infiltrometer)

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date: 12/15/2014
CMT File No.: 1313801

Test Location: IT15A (Test Pit TP-15)

Test Apparatus Data
Inner Ring Diameter: 6 in
Outer Ring Diameter: 12 in
Test Depth: 2.0 ft
Soil Tested: Dark Brown Clayey Silt with Sand (Topsoil)

Date	Time	Time Interval (min)	Initial Water Height (ft)	Measured Water Drop (ft)	Final Water Height (ft)	Infiltration Rate for Time Interval (in/hr)
12/15/2014	1:00 PM	Start				
	1:30 PM	30	0.37	0.16	0.21	3.84
	2:00 PM	30	0.37	0.12	0.25	2.88
	2:30 PM	30	0.37	0.12	0.25	2.88
	3:00 PM	30	0.37	0.11	0.26	2.64
	3:30 PM	30	0.37	0.10	0.27	2.40
				Average:		2.93
				Minimum Safety Factor:		2
				Recommended Maximum Design Infiltration Rate (in/hr):		**1.20**

Note: Test was conducted in accordance with the Double-Ring Infiltrometer Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual.

Infiltration Test (Double-Ring Infiltrometer)

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date: 12/15/2014
CMT File No.: 1313801

Test Location: IT15B (Test Pit TP-15)

Test Apparatus Data
Inner Ring Diameter: 6 in
Outer Ring Diameter: 12 in
Test Depth: 2.0 ft
Soil Tested: Dark Brown Clayey Silt with Sand (Topsoil)

Date	Time	Time Interval (min)	Initial Water Height (ft)	Measured Water Drop (ft)	Final Water Height (ft)	Infiltration Rate for Time Interval (in/hr)
12/15/2014	1:01 PM	Start				
	1:31 PM	30	0.37	0.21	0.16	5.04
	2:01 PM	30	0.37	0.12	0.25	2.88
	2:31 PM	30	0.37	0.14	0.23	3.36
	3:01 PM	30	0.37	0.13	0.24	3.12
	3:31 PM	30	0.37	0.12	0.25	2.88
				Average:		3.46
				Minimum Safety Factor:		2
				Recommended Maximum Design Infiltration Rate (in/hr):		1.44

Note: Test was conducted in accordance with the Double-Ring Infiltrometer Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual.

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Infiltration Test (Double-Ring Infiltrometer)

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date: 12/15/2014
CMT File No.: 1313801

Test Location: IT18A (Test Pit TP-18)

Test Apparatus Data
Inner Ring Diameter: 6 in
Outer Ring Diameter: 12 in
Test Depth: 1.5 ft
Soil Tested: Yellowish Red Silty Clay with Sand

Date	Time	Time Interval (min)	Initial Water Height (ft)	Measured Water Drop (ft)	Final Water Height (ft)	Infiltration Rate for Time Interval (in/hr)
12/15/2014	1:06 PM	Start				
	1:36 PM	30	0.42	0.10	0.32	2.40
	2:06 PM	30	0.42	0.07	0.35	1.68
	2:36 PM	30	0.42	0.07	0.35	1.68
	3:06 PM	30	0.42	0.05	0.37	1.20
	3:36 PM	30	0.42	0.05	0.37	1.20
				Average:		1.63
				Minimum Safety Factor:		2
				Recommended Maximum Design Infiltration Rate (in/hr):		**0.60**

Note: Test was conducted in accordance with the Double-Ring Infiltrometer Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual.

CMT Laboratories, Inc.
2701 Carolean Industrial Drive, State College PA 16801 Phone: (814) 231-8845 Fax: (814) 231-8846
www.cmtlabs.com

Infiltration Test (Double-Ring Infiltrometer)

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date: 12/15/2014
CMT File No.: 1313801

Test Location: IT18B (Test Pit TP-18)

Test Apparatus Data
Inner Ring Diameter: 6 in
Outer Ring Diameter: 12 in
Test Depth: 1.5 ft
Soil Tested: Yellowish Red Silty Clay with Sand

Date	Time	Time Interval (min)	Initial Water Height (ft)	Measured Water Drop (ft)	Final Water Height (ft)	Infiltration Rate for Time Interval (in/hr)
12/15/2014	1:07 PM	Start				
	1:37 PM	30	0.40	0.25	0.15	6.00
	2:07 PM	30	0.40	0.15	0.25	3.60
	2:37 PM	30	0.40	0.14	0.26	3.36
	3:07 PM	30	0.40	0.13	0.27	3.12
	3:37 PM	30	0.40	0.13	0.27	3.12
				Average:		3.84
				Minimum Safety Factor:		2
				Recommended Maximum Design Infiltration Rate (in/hr):		**1.56**

Note: Test was conducted in accordance with the Double-Ring Infiltrometer Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual.

Infiltration Test (Uncased Hole)

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date: 12/15/2014
CMT File No.: 1313801

Test Location: IT20A (Test Pit TP-20)

Test Apparatus Data
Avg. Hole Diameter (in): 8.0
Test Depth: 2.5 ft
Soil Tested: Strong Brown Silty Clay with Sand and Gravel

Date	Time	Time Interval (min)	Initial Water Height (ft)	Measured Water Drop (ft)	Percolation Rate (in/hr)	Reduction Factor	Infiltration Rate (in/hr)	Min. Safety Factor	Recommended Max. Design Infiltration Rate (in/hr)
12/15/2014	1:09 PM	Start							
	1:39 PM	30	0.50	0.14					
	2:09 PM	30	0.50	0.14					
	2:39 PM	30	0.50	0.12					
	3:09 PM	30	0.50	0.13	3.12	2.31	1.35	3	0.45

Note: Test was conducted, and reduction factor/infiltration rate were calculated in accordance with the Percolation Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual.

Infiltration Test (Uncased Hole)

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date: 12/15/2014
CMT File No.: 1313801

Test Location: IT20B (Test Pit TP-20)

Test Apparatus Data
Avg. Hole Diameter (in): 8.0
Test Depth: 2.5 ft
Soil Tested: Strong Brown Silty Clay with Sand and Gravel

Date	Time	Time Interval (min)	Initial Water Height (ft)	Measured Water Drop (ft)	Percolation Rate (in/hr)	Reduction Factor	Infiltration Rate (in/hr)	Min. Safety Factor	Recommended Max. Design Infiltration Rate (in/hr)
12/15/2014	1:10 PM	Start							
	1:40 PM	30	0.50	0.11					
	2:10 PM	30	0.50	0.10					
	2:40 PM	30	0.50	0.09					
	3:10 PM	30	0.50	0.09	2.16	2.37	0.91	3	0.30

Note: Test was conducted, and reduction factor/infiltration rate were calculated in accordance with the Percolation Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual.

Infiltration Test (Uncased Hole)

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date: 12/15/2014
CMT File No.: 1313801

Test Location: IT21A (Test Pit TP-21)

Test Apparatus Data
Avg. Hole Diameter (in): 8.0
Test Depth: 2.0 ft
Soil Tested: Yellowish Red Silty Clay with Sand and Gravel

Date	Time	Time Interval (min)	Initial Water Height (ft)	Measured Water Drop (ft)	Percolation Rate (in/hr)	Reduction Factor	Infiltration Rate (in/hr)	Min. Safety Factor	Recommended Max. Design Infiltration Rate (in/hr)
12/15/2014	1:15 PM	Start							
	1:45 PM	30	0.50	0.02					
	2:15 PM	30	0.50	0.02					
	2:45 PM	30	0.50	0.02					
	3:15 PM	30	0.50	0.02	0.48	2.47	0.19	3	0.06

Note: Test was conducted, and reduction factor/infiltration rate were calculated in accordance with the Percolation Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual.

Infiltration Test (Uncased Hole)

Project: The Cottages at State College
Location: Ferguson Township, Centre County, PA
Client: Landmark Collegiate Acquisitions, LLC

Date: 12/15/2014
CMT File No.: 1313801

Test Location: IT21B (Test Pit TP-21)

Test Apparatus Data
Avg. Hole Diameter (in): 8.0
Test Depth: 2.0 ft
Soil Tested: Yellowish Red Silty Clay with Sand and Gravel

Date	Time	Time Interval (min)	Initial Water Height (ft)	Measured Water Drop (ft)	Percolation Rate (in/hr)	Reduction Factor	Infiltration Rate (in/hr)	Min. Safety Factor	Recommended Max. Design Infiltration Rate (in/hr)
12/15/2014	1:16 PM	Start							
	1:46 PM	30	0.50	0.12					
	2:16 PM	30	0.50	0.12					
	2:46 PM	30	0.50	0.11					
	3:16 PM	30	0.50	0.12	2.88	2.32	1.24	3	0.41

Note: Test was conducted, and reduction factor/infiltration rate were calculated in accordance with the Percolation Test procedures outlined in the December 2006 PADEP Stormwater BMP Manual.