GEOTECHNICAL ENGINEERING
PERCOLATION / INFILTRATION
TEST REPORT

FULLERTON COLLEGE
M&O BUILDING

LOCATED AT

321 E. CHAPMAN AVENUE
FULLERTON, CALIFORNIA

FOR

NORTH ORANGE COUNTY
COMMUNITY COLLEGE DISTRICT
1830-B WEST ROMNEYA DRIVE
ANAHEIM, CA 92801

PROJECT SF-5809-08

JANUARY 6, 2021

GEOTECHNICAL SOLUTIONS, INC.
GEOTECHNICAL AND ENVIRONMENTAL
ENGINEERING

Geotechnical Solutions, Inc.
Geotechnical, Structural & Environmental Engineering

AASHTO ACCREDITED

January 6, 2021

Project No.: SF-5809-08

North Orange County Community College District
c/o Campus Capital Projects
Fullerton College
321 East Chapman Avenue
Fullerton, CA 92832-2095

Attention: Mr. Oscar Saghieh
Project Manager, Campus Capital Projects

Re: **Percolation / Infiltration Tests**
Fullerton College – M&O Building
321 East Chapman Avenue
Fullerton, California

Gentlemen:

As requested and authorized, we performed geotechnical engineering field percolation tests at the designated areas on the existing staff Parking Lot 3 where the new M&O Building has been proposed to be constructed just north of Central Plant Expansion Building inside Fullerton College Campus, Fullerton, California.

The accompanying Engineering Report presents the results of our subsurface exploration, field percolation tests, performing laboratory tests, analyzing field and laboratory data and our conclusions and recommendations for geotechnical engineering aspects of the project design.

Our services were performed using the standard of care ordinarily exercised in this locality, at the time when the report was prepared.

The investigation revealed that the top 10-feet of subgrade soil consists of permeable silty sandy layers followed by silty and clayey less permeable or non-permeable soil layers.

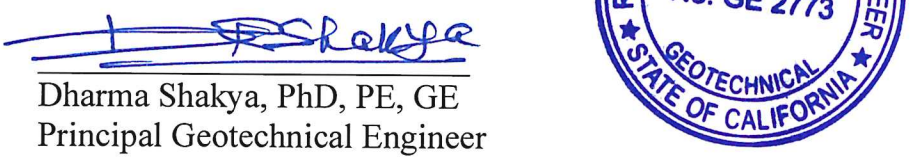
The field testing and analysis was made in accordance with generally accepted geotechnical engineering principles and procedures and included such field and laboratory tests considered necessary under the circumstances.

In the opinion of the undersigned, the accompanying report has been substantiated by mathematical and other data and presents fairly the design information requested by your organization.

This completes our scope of services for the initial design phase of the project. We appreciate this opportunity to be of service to you on this project.

Respectfully Submitted,

Geotechnical Solutions, Inc.



Dharma Shakya, PhD, PE, GE
Principal Geotechnical Engineer

Abraham S. Baha, PE, M. ASCE
Sr. Principal

Distribution: (pdf) Campus Capital Projects

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Introduction

Geotechnical Solutions, Inc. (GSI) has performed field percolation tests at the designated areas inside the Fullerton College Campus facility for the proposed development project namely construction of M&O Building inside Fullerton College Campus in the City of Fullerton, California.

The main purpose of this study is to provide infiltration rate of the subgrade material based on field percolation tests so that an appropriate system incorporating Storm Water permanent best management practice (BMP). For example, CONSPAN retention system or dry well or any other approved system may be designed and existing drainage be improved.

Site Conditions

The site of the proposed development is inside the Fullerton College campus, at staff Parking Lot 3, just north of the Central Plant Expansion Building, northeast of the baseball field in Fullerton High School, southwest of the intersection of North Berkeley Avenue and Nutwood Place. The project site is in a level, developed paved parking area.

Proposed Construction

The proposed development consists of constructing a new single-story Maintenance and Operation (M&O) building (plan for 2nd Story in future), 14,000 square feet in area at this time and various drainage improvements which are not detailed at this time. We understand, the extent of drainage facilities will, in part depend on the amount of drainage and percolation available at the project site.

Field Investigation

During our field investigation for the proposed M&O Building, we drilled five (5) hollow stem auger borings, B-1 through B-3 varying on depths from 21'6" to 36.5-feet below the ground surface including P-1 and P-2 which are specially drilled for percolation tests.

Soil borings were performed using a truck-mounted hollow-stem auger drill rig. Supply truck provided a water tank. Borings were drilled at the site, by means of an 8" hollow-stem drill rig. Records of the materials encountered during drilling were made by our field representative and logs of the borings at the percolation test locations are presented on Plates C and D, Log of Test Holes. Other borings were presented in our Geotechnical Engineering report dated January 6, 2021. For conveniences, we have presented the logs in Appendix B.

Field permeability testings were performed using falling head permeability test, where water was added into the borehole and the rate of drop was measured.

Subsurface Conditions

1. The area drilled was parking lot called staff Parking Lot 3 with paved areas with asphalt concrete and base in the surface zone.
2. The underlying materials to about 10-feet below surface were predominantly sandy and silty/clayey sand alluvium materials which are permeable.
3. Beyond 10-feet, the materials were generally mixtures layers of fine sand, silt, and clayey materials which are less permeable.

Laboratory Testing

Laboratory testing was programmed following a review of the field investigation data to be evaluated. Tests included physical testing to determine soil characteristics and selective tests. Test results are presented in Appendix A.

A. Mechanical Analysis

Mechanical analyses by the hydrometer test method were performed to confirm field classifications. Test results are as follows:

Test Hole No.	Sample Depth (ft)	Sand Percent	Silt Percent	Clay Percent
P-1	10'	62	11	27
P-2	10'	65	16	19

Field Percolation Test

Based on the soil profile realized at the time of drilling, we performed two field percolation tests, P-1 and P-2 at the depths of 10- feet below the existing ground surface. Because of the sandy and silty sandy materials, two consecutive measurements showed more than 6 inches seeping away in less than 25 minutes on both percolation test locations. Initial Pre-Percolation data are tabulated on Plates 1 and 3 in Appendix C.

Since the tests are fast, further 6 readings every 10 minutes at both locations were obtained to complete percolation tests in accordance with the Technical Guidance.

The percolation test procedure was performed in accordance with the current acceptable method for shallow (less than 10 feet) percolation test by qualified personnel under the supervision of registered geotechnical engineer as per Technical Guidance Document, Orange County Public Works, Table VII.1 Recommended Infiltration Investigation Method: Percolation Test Procedure (Riverside County Department of Environmental Health) and is described as follows:

Percolation Tests at each P-1 and P-2 Locations (at 10' depth):

- Borehole diameter was 8 inches.
- Test is performed at 10- feet in depth below the ground surface.
- Bottom elevation of test hole should correspond to bottom elevation of proposed dry well or any other system.
- The bottom of the test hole was covered with 2 inches of gravel prior to testing.

- Sides of the hole were not smeared after drilling and there was no caving.
- Hole was filled with clear water to 5-feet depth from the ground surface (appropriate depths at least 5 x radius of the hole (5 x 4" = 20 inches) from the bottom).
- Measurements showed that more than 6 inches of water seeped away in two - 25 minutes intervals. Thus, the tests were run for at least six 10-minutes interval with measurements.
- Measurements were taken with a precision of 0.25 inches or better.
- All the field percolation tests are tabulated and are presented in Appendix C.
- The holes were backfilled with soil cuttings after the tests.

Percolation Rate Evaluation

To evaluate the percolation rates, testing was performed by filling the borehole with water and observing the rate of water drop from the fixed reference point on the ground surface. The depths of water drop for every 10 minutes intervals (for both P-1 and P-2) were noted and tabulated and plotted as shown on Plates 2 and 4 in Appendix C.

Percolation rate, k can be correlated with the data in the form of the straightline equation as shown below:

$$t/R = b + kt$$

Where, t = average time in minutes

$$R = \Delta t / d$$

Δt = Time Interval, minutes

d = drop in inch = R1 – R2

R1 = Initial Readings, inch

R2 = Final Readings, inch

k = Percolation Rate inch/minute

R = 1/k at equilibrium rate

t/R is plotted against t as shown on the plots on Plates 2 and 4 in Appendix C and the regression analyses were performed to interpolate the data obtained in the field. The straightline interpolation gives the slope as a percolation rate, k.

Results and Conclusions

The results obtained from the analyses are as follows:

1. Near surface material up to 10-feet is fine to coarse grained sand, silty and clayey sand materials which are permeable for percolation tests, whereas at the deeper depths, sandy silt and silty clay materials having low permeability or even impermeable clayey materials will be encountered.

2. Where the subgrade materials consist of sand, silty/clayey sand materials above 10 feet depth, over-all percolation rate is relatively fast and need to be designed by an acceptable system which drain water to the desired extent. Similarly, the subgrade soil beyond 10-feet depth may encounter very low percolation values and infiltration basin below 10 feet is not suggested.

3. Field Percolation tests shows the following results:

Location	Coefficient of Permeability, k			
	Inch/minute	cm/sec	**Inch/hour Average**	**Inch/hr** based on **Last Reading**
P-1 @ 10'	0.2004	8.5 x E-03	12.02	**13.8**

P-2 @ 10'	0.2643	1.12 x E-02	15.86	**18.0**
Average	**0.2324**	**9.9 x E-03**	**13.94**	**15.90**
		Average:	**14.92 inch/hour**	
			1.05 x E-02 cm/sec	

4. Based on the data presented in this report and the testing information accumulated, it is our judgment that the percolation rate is an average of **14.92 inch per hour** and it takes approximately **4.02 minutes to percolate 1 inch.**

5. This conclusion regarding percolation rate is based on the results of our field exploration and testing.

6. General range of permeability for some of the subgrade soils are as follows:

Type of Soil	Permeability (cm/sec)
Medium to coarse gravel	$> 10^{-1}$
Coarse sand to fine sand	between $1x10^{-1}$ to $1x10^{-3}$
Fine sand and silty sand	between $1x10^{-3}$ to $1x10^{-5}$
Silt, clayey silt or silty clay	between $1x10^{-4}$ to $1x10^{-6}$
Clays	$1x10^{-7}$ or less

Since the percolation rate average is **1.05 x E-02 cm/Sec**, it falls into coarse sand to fine sand category as tabulated above and we conclude that percolation is fairly well at the project location for upper 10 feet region.

Infiltration Rate

As per Technical Guidance Document, Infiltration rate, I_t is calculated based on

Percolation Rate Conversion using Porchet Method, aka Inverse Borehole Method as tabulated on Infiltration Rate for P-1 and P-2.

Percolation tests were performed with the depth of the test hole set at the infiltration surface level (bottom of basin). The data collected at the final interval was used to calculate infiltration rates and are tabulated in the Table below:

The detailed calculations and the results are tabulated and presented on Plates 5 and 6 in Appendix D.

TABLE for P-1

PERCOLATION – INFILTRATION (Porchet method)

Location	Percolation Rate inch/hour Based on average Readings	Infiltration Rate Inch/hour Based on Porchet Method aka Inverse Borehole Method
P-1	**12.02**	**0.607**
With Factor of Safety = 2.0		**0.304**
> 0.3 inch/hour		

Since the infiltration rate is **0.304 inch per hour** (> than **0.3 inch per hour**), it satisfies the requirement of minimum 0.3 inch per hour criteria in accordance with **TGD VII.2.**

TABLE for P-2

PERCOLATION – INFILTRATION (Porchet method)

Location	Percolation Rate inch/hour Based on average Readings	Infiltration Rate Inch/hour Based on Porchet Method aka Inverse Borehole Method
P-2	**15.86**	**0.889**

With Factor of Safety = 2.0	0.444
> 0.3 inch/hour	

Since the infiltration rate average is **0.444 inch per hour** (> than **0.3 inch per hour**), it does satisfy the requirement of minimum 0.3 inch per hour criteria in accordance with **TGD VII.2.**

Reduction Factor (R_f) Method

Also, Reduction Factor Formula (Rf) Method (County of Los Angeles) has been used and tabulated for both P-1 and P-2. The percolation rate must be reduced to account for the discharge of water from both the sides and bottom of the boring (i.e., non-vertical flow). The following formula has been used to determine the infiltration rate:

Reduction Factor $(R_f) = (2d_1 - \Delta d)/ (DIA) + 1$

Where, d_1 = Initial Water Depth (in)

Δd = Water Level Drop of Final Period of Stabilized Rate (in.)

DIA = Equivalent diameter of the boring (in)

Infiltration rate is then calculated as pre-adjusted Percolation rate divided by Reduction factor.

Infiltration Rates as calculated by this method have been tabulated on Plates 7 and 8 respectively for P-1 and P-2 in Appendix E.

The results are as follows:

Location	I_f Using (Reduction Factor Method) (inch/hour)
P-1	0.7359
P-2	0.9212
AVERAGE:	**0.8286**
With FOS = 2	**0.414**
	➢ **0.3 inch/hour**

Note: It does satisfy the requirement.

Conclusions

The subgrade soils consist of sand and clayey/silty sand up to the depths of about 10 feet and generally silty clay or sandy clay beyond this depth. Thus, we recommend that the bottom of the shallow infiltration system should be within top 10 feet in depth. Historical high ground water in accordance with California Geologic Survey (CGS, La Habra Quadrangle. Released April 15, 1998) is around 35 feet deep.

Based on our other borings inside the Fullerton College, the groundwater was not encountered within 50 feet depth, however, historical high groundwater was found to be around 35 feet in depth. Hence the groundwater is not of any concern

Additional Services

This office will be available for further consultation and review of as built and proposed plans. Our additional services include, but are not necessarily limited to the following:

(a) Review of Infiltration System plans.

(b) Consultation with other consultants as required during this study.

(c) Observation and testing during construction, as needed.

Closure

Based on the data presented in this report and the testing information accumulated, it is the judgment of the undersigned that appropriate BMP infiltration system like Infiltration Basin, Dry-Well, Cudo System or other available systems may be chosen by the project civil engineer. The conclusions presented in this report are based on the results of our field exploration and testing.

This report has been compiled for the exclusive use on the above referenced site, for the purpose stated above. It should not be transferred to or used by another party, or applied to any other project on this site, other than as described herein, without consent and/or thorough review by this office.

Geotechnical Solutions, Inc.

References

California Building Standards Commission, California Building Code, 2019, California Code of Regulations, Title 24, Volume 2 of Part 2.

California Department of Water Resources groundwater well data

http://wdl.water.ca.gov.

Geotechnical Solutions, Inc., 2021, "Geotechnical Engineering Report for NOCCCD M&O Building, Fullerton College Located at 321 East Chapman Avenue, Fullerton, California", Project Number SF-5809-06 dated January 6.

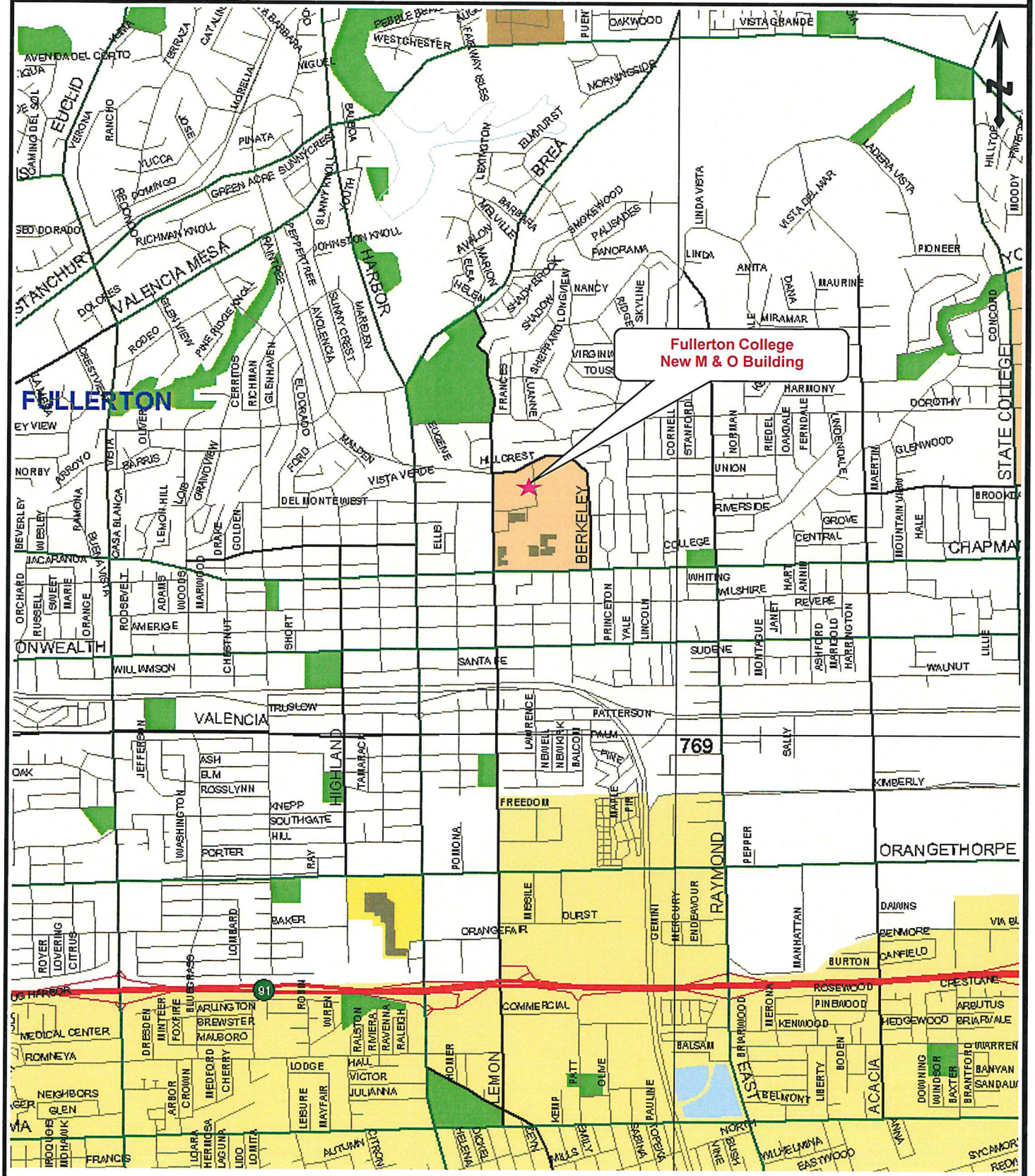
Santa Ana Regional Water Quality Control Board (SARWQCB) – North of El Toro Road, "Exhibit 7.III - Technical Guidance Document for the Preparation of Conceptual/ Preliminary and/or Project Water Quality Management Plans (WQMP's) - Updated December 2013.

Appendix A

Plates:

- Vicinity Map
- Plot Plan & Percolation Tests Location Map
- Boring Log P-1
- Boring Log P-2

VICINITY MAP



Fullerton College- New M&O Building	Project No.	SF-5809-08
321 E. Chapman Avenue, Fullerton, California	Plate:	A

Geotechnical Solutions, Inc.

SITE PLAN & PERCOLATION TEST LOCATION MAP

Fullerton College- New M&O Building	Project No.	SF-5809-08
321 E. Chapman Avenue, Fullerton, California	Plate:	B
Geotechnical Solutions, Inc.		

Project : **Fullerton College- New M&O Building**			Borehole No. P-1
Project Location : **321 E. Chapman Avenue, Fullerton, California**		**LOG OF TEST HOLE**	Plate No. C
Project Number : **SF-5809-08**			Page 1 of 1

Date(s) Drilled :	December 22, 2020	Logged By :	BA	Checked By :	Abraham Baha
Drilling Method :	Hollow-Stem Auger	Drill Bit Size / Type :	8-inch-OD rock bit	Total Depth of Borehole, feet :	10
Drill Rig Type :	CME-75	Drilling Contractor :	Whitcomb	Approx. Surface Elevation, feet :	170 feet MSL
Groundwater Level and Date Measured:	No Groundwater encountered	Sampling Method :	SPT, California (ring), bulk	Hammer Data :	Downhole wire 140 lbs / 30-inch drop
Borehole Backfill :	Drill cuttings	Comments :	Refer to site plan for location		

Elevation, feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Penetration Resistance, Blows / 6"	SAMPLES: No Recovery (NR)	Blows / 12"	MATERIAL DESCRIPTION	Moisture Content, %	Dry Unit Weight, pcf	Percent Passing No. 200 Sieve (%)	OTHER TESTS AND REMARKS
170	0						4" AC over 6" AB				
							Brown clayey Sand, medium dense, slightly moist				
	2						@2': Brown SILTY SAND (SM), slightly moist, medium dense, fine to coarse grained,				
165	5										
160	10						@10': Same as above				
							Drilled for Percolation test to 10'				
							Add 2" of gravel at the bottom				
							Backfilled w/cuttings after percolation test.				
							No Ground Water Encountered				
155	15										
150	20										
145	25										
140	30										
135	35										
130	40										
	45										

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Project :	**Fullerton College- New M&O Building**	**LOG OF TEST HOLE**	Borehole No. P-2
Project Location :	**321 E. Chapman Avenue, Fullerton, California**		Plate No. D
Project Number :	**SF-5809-08**		Page 1 of 1

Date(s) Drilled :	December 22, 2020	Logged By :	BA	Checked By :	Abraham Baha
Drilling Method :	Hollow-Stem Auger	Drill Bit Size / Type :	8-inch-OD rock bit	Total Depth of Borehole, feet :	10
Drill Rig Type :	CME-75	Drilling Contractor :	Whitcomb	Approx. Surface Elevation, feet :	170 feet MSL
Groundwater Level and Date Measured:	No Groundwater encountered	Sampling Method :	SPT, California (ring), bulk	Hammer Data :	Downhole wire 140 lbs / 30-inch drop
Borehole Backfill :	Drill cuttings	Comments :	Refer to site plan for location		

Elevation, feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Penetration Resistance, Blows / 6"	SAMPLES: No Recovery (NR)	Blows / 12"	MATERIAL DESCRIPTION	Moisture Content, %	Dry Unit Weight, pcf	Percent Passing No. 200 Sieve (%)	OTHER TESTS AND REMARKS
170	0						4" AC over 6" AB				
							Brown clayey Sand, medium dense, slightly moist				
	2						@2': Brown SILTY SAND (SM), slightly moist, medium dense, fine to coarse grained,				
165	5										
160	10						@10': Same as above				
							Drilled for Percolation test to 10'				
							Add 2" of gravel at the bottom				
							Backfilled w/cuttings after percolation test.				
							No Ground Water Encountered				
155	15										
150	20										
145	25										
140	30										
135	35										
130	40										
	45										

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Appendix B

Boring Logs

- B-1
- B-2
- B-3

Project : **Fullerton College - M & O Building**		**LOG OF TEST HOLE**	Borehole No. B-1
Project Location : **321 E. Chapman Avenue, Fullerton, California**			Plate No. K-1
Project Number : **SF-5809-06**			Page 1 of 1

Date(s) Drilled :	December 22, 2020	Logged By :	BA	Checked By :	Abraham Baha
Drilling Method :	Hollow-Stem Auger	Drill Bit Size / Type :	8-inch-OD rock bit	Total Depth of Borehole, feet :	36.5
Drill Rig Type :	CME-75	Drilling Contractor :	Whitcomb	Approx. Surface Elevation, feet :	170 feet MSL
Groundwater Level and Date Measured:	No Groundwater encountered	Sampling Method :	SPT, California (ring), bulk	Hammer Data :	Downhole wire 140 lbs / 30-inch drop
Borehole Backfill :	Drill cuttings	Comments :	Refer to site plan for location		

Elevation, feet	Depth, feet	SAMPLES Type	Number	Penetration Resistance, Blows / 6"	No Recovery (NR)	Blows / 12"	MATERIAL DESCRIPTION	Moisture Content, %	Dry Unit Weight, pcf	Percent Passing No. 200 Sieve (%)	OTHER TESTS AND REMARKS
170	0						4" AC over 4" AB				
	2		Bag #1				Brown Clayey SAND (SC), medium dense, slightly moist			22	HD: 78%-7%-15%
			C-1	6-9-8		17	@2': Brown SILTY SAND (SM), very moist, medium dense, fine to coarse grained,	17	93		
165	5		C-2	7-8-10		18	@5': Light Brown Clayey Sand (SC), very moist, fine grained, medium dense	14	79		
160	10		C-3	2-4-5		9	@10': Top one foot clayey sand followed by Brown Sandy Silt (ML), very moist, medium stiff, medium plasticity	27	90		
155	15		S-1	3-5-7		12	@15': Brown Sandy Clay (CL), moist, stiff, fine to medium grained, medium plasticity	8	-		
150	20		S-2	3-5-6		11	@20': Silty Clay to fine Sandy Clay (CL), stiff, brown, Sl. Moist	4	-		
145	25						Total Depth = 21.5 feet No Groundwater encountered during drilling Backfilled w/Cuttings				
140	30										
135	35										
130	40										
	45										

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Project : **Fullerton College - M & O Building**			Borehole No. B-2
Project Location : **321 E. Chapman Avenue, Fullerton, California**		**LOG OF TEST HOLE**	Plate No. K-2
Project Number : **SF-5809-06**			Page 1 of 1

Date(s) Drilled :	December 22, 2020	Logged By :	BA	Checked By :	Abraham Baha
Drilling Method :	Hollow-Stem Auger	Drill Bit Size / Type :	8-inch-OD rock bit	Total Depth of Borehole, feet :	36.5
Drill Rig Type :	CME-75	Drilling Contractor :	Whitcomb	Approx. Surface Elevation, feet :	170 feet MSL
Groundwater Level and Date Measured:	No Groundwater encountered	Sampling Method :	SPT, California (ring), bulk	Hammer Data :	Downhole wire 140 lbs / 30-inch drop
Borehole Backfill :	Drill cuttings	Comments :	Refer to site plan for location		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Penetration Resistance, Blows / 6"	SAMPLES No Recovery (NR)	Blows / 12"	MATERIAL DESCRIPTION	Moisture Content, %	Dry Unit Weight, pcf	Percent Passing No. 200 Sieve (%)	OTHER TESTS AND REMARKS
170	0						4" AC over 4" AB				
	2		Bag #1				Brown Sand, medium dense, slightly moist, little clay			15	HD:85%-5%-10%
			C-1	4-7-10		17	@2': Brown Silty fine sand (SM), very moist, medium dense, fine grained	17	98		DS: P=Peak / Ult=Ultimate $\phi = 32^0$, c = 300 psf (P) $\phi = 31^0$, c = 250 psf (Ult)
165	5		C-2	5-5-11		16	@5': Light Brown Clayey Sand (SC), moist, very fine to fine, medium dense	15	86		$\phi = 30^0$, c = 400 psf (P) $\phi = 29^0$, c = 350 psf (Ult)
160	10		C-3	3-3-5		8	@10': Top one foot clayey Sand followed by Sandy Silt (ML), very moist, medium stiff, light brown in color	23	94		
155	15		S-1	3-4-5		9	@15': Brown Sandy Clay (CL), stiff, moist, fine grained, low plasticity	9	-		
150	20		S-2	4-4-4		8	@20': Same as above	13	-		
145	25		S-3	4-5-9		14	@25': Brown Sandy Clay/Clayey Sand (CL/SC), moist, stiff, fine grained, medium plasticity	7	-		
140	30		S-4	4-4-8		12	@30': Brown SILTY SAND, moist, medium dense, fine grained	8	-		
135	35		S-5	5-5-9		14	@35': Brown Silty Sand (SM), moist, medium dense, fine to medium grained	11	-		
130	40						Total Depth = 36.5 feet No Groundwater encountered during drilling Backfilled w/Cuttings				
	45										

GEOTECHNICAL SOLUTIONS, INC.

Project : **Fullerton College - M & O Building**			Borehole No. B-3
Project Location : **321 E. Chapman Avenue, Fullerton, California**		**LOG OF TEST HOLE**	Plate No. K-3
Project Number : **SF-5809-06**			Page 1 of 1

Date(s) Drilled :	December 22, 2020	Logged By :	BA	Checked By :	Abraham Baha
Drilling Method :	Hollow-Stem Auger	Drill Bit Size / Type :	8-inch-OD rock bit	Total Depth of Borehole, feet :	36.5
Drill Rig Type :	CME-75	Drilling Contractor :	Whitcomb	Approx. Surface Elevation, feet :	170 feet MSL
Groundwater Level and Date Measured:	No Groundwater encountered	Sampling Method :	SPT, California (ring), bulk	Hammer Data :	Downhole wire 140 lbs / 30-inch drop
Borehole Backfill :	Drill cuttings	Comments :	Refer to site plan for location		

Elevation, feet	Depth, feet	SAMPLES Type	Number	Penetration Resistance, Blows / 6"	No Recovery (NR)	Blows / 12"	MATERIAL DESCRIPTION	Moisture Content, %	Dry Unit Weight, pcf	Percent Passing No. 200 Sieve (%)	OTHER TESTS AND REMARKS
170	0						4" AC over 6" AB				
	2		Bag #1				Brown Clayey SAND (SC), medium dense, slightly moist			13	HD:87%-3%-10%
			C-1	7-11-14		25	@2': Brown Silty SAND (SP/SM), moist, medium dense, fine to medium grained,	6	96		
165	5		C-2	7-8-9		17	@5': Brown Clayey Sand (SC), moist, very fine grained medium dense,	4	95		
160	10		C-3	3-4-6		10	@10': Top one foot clayey sand followed by Brown Silt (ML), clayey/sandy, very moist, medium stiff, medium plasticity	17	99		
155	15		S-1	2-3-5		8	@15':Brown Silty/Sandy Clay (CL), moist, stiff, low plasticity	11	-		
150	20		S-2	4-5-8		13	@20':Same as above	8	-		
145	25						Total Depth = 21.5 feet No Groundwater encountered during drilling Backfilled w/Cuttings				
140	30										
135	35										
130	40										
	45										

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Appendix C – Percolation Test Results

- Pre-Test at Location P-1
- Percolation Test at Location P-1
- Pre-Test at Location P-2
- Percolation Test at Location P-2

PRE-TEST

PERCOLATION TEST DATA SHEET

Project:	Fullerton College	Project No.:	SF-5809-08	Date:	12/22/2020
Test Hole Number:	P-1	Tested By:	AB & BA		
Depth of Test Hole, DT	10'	USCS Soil Classification:	Sand (SP)		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if Round) =	8"	Sides (if Rectangular) =			

Sandy Soil Criteria Test *

Trial No.	Start Time	Stop Time	Time Interval (Min)	Initial Depth to Water (in)	Final Depth to Water (in)	Change in Water Level (in)	Greater than or Equal to 6"? y/n
1	8:35 AM	9:00 AM	25	60	84	24	> 6"
2	9:00 AM	9:25 AM	25	84	94.5	10.5	> 6"

* If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute Intervals) with a precision of at least 0.25".

PERCOLATION TEST

Borehole No. P-1 — Depth **120** inch

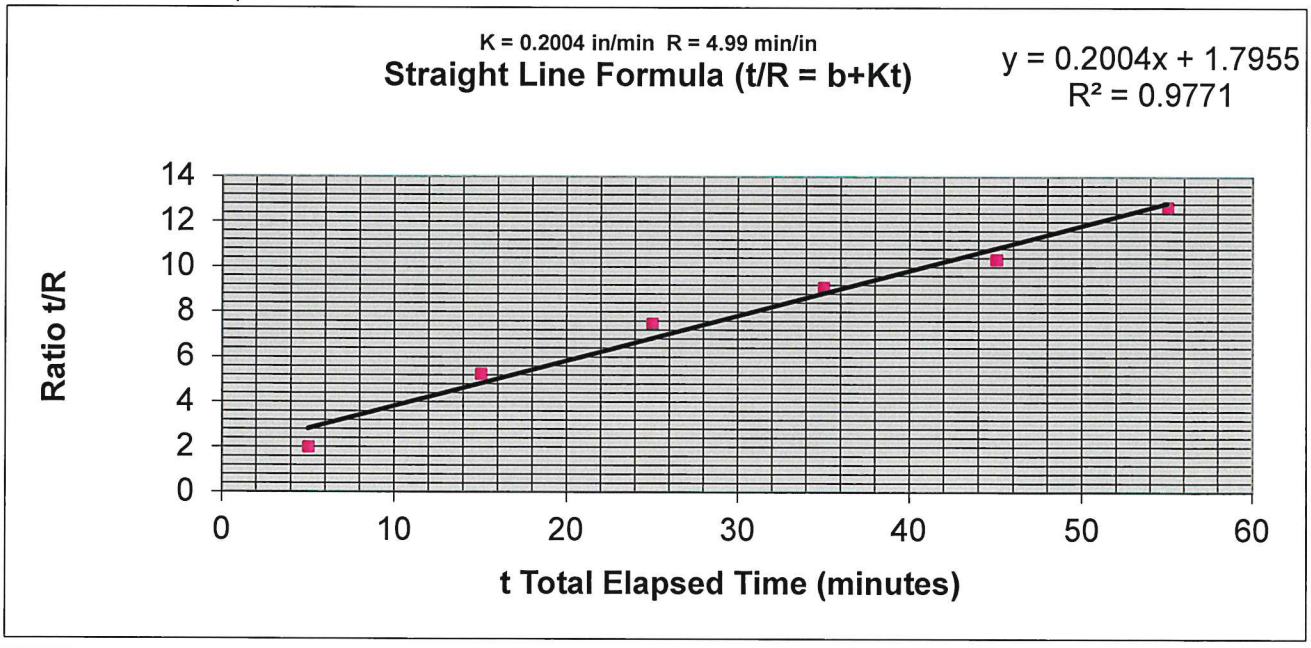
Date	Time of Reading	Δt (min.)	Total Elapsed Time (t)	Average t (minutes)	Reading R_1 (inches)	Reading R_2 (inches)	Drop d (inches)	R=Δt/d (min./in.)	t/R (in.)	k * 1000 (cm/s)
12/22/2020	9:30 AM	0	0							
	9:40 AM	10	10	5	60.00	64.00	4.00	2.50	2.00	16.9
	9:50 AM	10	20	15	64.00	67.50	3.50	2.86	5.25	14.8
	10;00 AM	10	30	25	67.50	70.50	3.00	3.33	7.50	12.7
	10:10 AM	10	40	35	70.50	73.10	2.60	3.85	9.10	11.0
	10:20 AM	10	50	45	73.10	75.40	2.30	4.35	10.35	9.7
	10:30 AM	10	60	55	75.40	77.70	2.30	4.35	12.65	9.7

Plot: t/R as ordinate vs. 't' as abscissa; tanOC = K.

R_1 = Vertical distance from reference point to water level after refilling at beginning of increment period.

R_2 = Vertical distance from reference point to water level at the end of increment period.

R = 1/K at equilibrium rate.



Fullerton College- New M&O Building	Project:	SF-5809-08
321 E. Chapman Avenue, Fullerton, California	Plate:	2

GEOTECHNICAL SOLUTIONS, INC.

INITIAL TEST

PERCOLATION TEST DATA SHEET							
Project:	Fullerton College		Project No.:	SF-5809-08		Date:	12/22/2020
Test Hole Number:	P-2		Tested By:	AB & BA			
Depth of Test Hole, DT	10'		USCS Soil Classification:	Sand (SP)			
Test Hole Dimensions (inches)				Length		Width	
Diameter (if Round) =	8"		Sides (if Rectangular) =				
Sandy Soil Criteria Test *							
Trial No.	Start Time	Stop Time	Time Interval (Min)	Initial Depth to Water (in)	Final Depth to Water (in)	Change in Water Level (in)	Greater than or Equal to 6"? y/n
1	10:40 AM	11:05 AM	25	60	90	30	> 6"
2	11:05 AM	11:30 AM	25	90	105	15	> 6"

* If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute Intervals) with a precision of at least 0.25".

PERCOLATION TEST

Borehole No. P-2 — Depth **120** inch

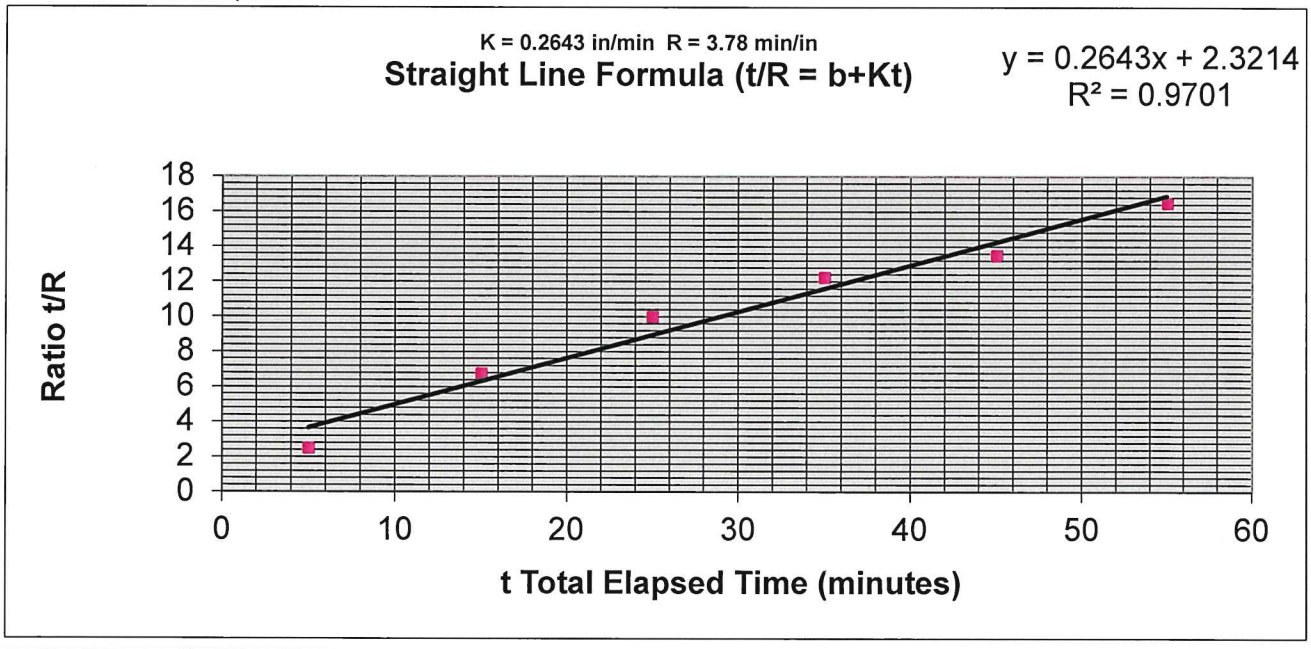
Date	Time of Reading	Δt (min.)	Total Elapsed Time (t)	Average t (minutes)	Reading R_1 (inches)	Reading R_2 (inches)	Drop d (inches)	R=Δt/d (min./in.)	t/R (in.)	k * 1000 (cm/s)
12/22/2020	11:40 AM	0	0							
	11:50 AM	10	10	5	60.00	65.00	5.00	2.00	2.50	21.2
	12:00 PM	10	20	15	65.00	69.50	4.50	2.22	6.75	19.1
	12:10 PM	10	30	25	69.50	73.50	4.00	2.50	10.00	16.9
	12:20 PM	10	40	35	73.50	77.00	3.50	2.86	12.25	14.8
	12:30 PM	10	50	45	77.00	80.00	3.00	3.33	13.50	12.7
	12:40 PM	10	60	55	80.00	83.00	3.00	3.33	16.50	12.7

Plot: t/R as ordinate vs. 't' as abscissa; tanOC = K.

R_1 = Vertical distance from reference point to water level after refilling at beginning of increment period.

R_2 = Vertical distance from reference point to water level at the end of increment period.

R = 1/K at equilibrium rate.



Fullerton College- New M&O Building	Project:	SF-5809-08
321 E. Chapman Avenue, Fullerton, California	Plate:	4
GEOTECHNICAL SOLUTIONS, INC.		

Appendix D – Infiltration Rates

Infiltration Rate I_f Calculations

- P-1
- P-2

Percolation Rate Conversion
Infiltration Rate, I_t
Porchet Method, aka Inverse Borehole Method

Fullerton College - M & O Building
Project No: SF-5809-08

Data collected at the Final Interval analysed:

Percolation Test P-1

As per Test Result, Percolation Rate = 0.2004 inch/Min = 12.02 inch/hour

Time Interval, Δ t	=	10	Minutes	Initial Depth to Water, D_0	=	75.4 Inches
Total Depth of Test Hole, D_t	=	120	Inches	Final Depth to Water, D_f	=	77.7 Inches
Test Hole Radius, r	=	4	Inches			

Initial Height of Water at the selected time interval, H_0	=	44.6	Inches	$(D_t - D_0)$
Final Height of Water at the Selected time interval, H_f	=	42.3	Inches	$(D_t - D_f)$
Change in Height over the time interval, Δ H	=	2.3	Inches	$(H_0 - H_f)$
Average Head Height over the time interval, H_{avg}	=	43.45	Inches	$(H_0 + H_f)/2$

Tested Infiltration Rate, $I_t = \Delta H\ (60\ r)\ /((\Delta t)(r + 2\ H_{avg}))$ **in/hr**

Therefore, I_t = **0.607 inch/hour**

I_t = **0.304 inch/hour**

w/ FOS = 2.0

Percolation Rate Conversion
Infiltration Rate, I_t
Porchet Method, aka Inverse Borehole Method

Fullerton College - M & O Building
Project No: SF-5809-08

Data collected at the Final Interval analysed:

Percolation Test P-2

As per Test Result, Percolation Rate = 0.2643 inch/Min =15.86 inch/hour

Time Interval, Δ t	=	10 Minutes	Initial Depth to Water, D_0	=	80 Inches
Total Depth of Test Hole, D_t	=	120 Inches	Final Depth to Water, D_f	=	83 Inches
Test Hole Radius, r	=	4 Inches			

Initial Height of Water at the selected time interval, H_0	=	40 Inches	$(D_t - D_0)$
Final Height of Water at the Selected time interval, H_f	=	37 Inches	$(D_t - D_f)$
Change in Height over the time interval, Δ H	=	3 Inches	$(H_0 - H_f)$
Average Head Height over the time interval, H_{avg}	=	38.5 Inches	$(H_0 + H_f)/2$

Tested Infiltration Rate, $I_t = \Delta H\ (60\ r)\ /((\Delta t)(r + 2\ H_{avg}))$ **in/hr**

Therefore, I_t = **0.889 inch/hour**

I_t = **0.444 inch/hour**

w/ FOS = 2.0

Appendix E

Infiltration Rates Using Reduction Factor Method R_f

- P-1
- P-2

REDUCTION FACTOR, R_f

Project:	FC - M&O Building	Project No.:	SF-5809-08	Date:	12/30/2020
Test Hole Number:	**P-1**	Tested By:	BA/		
Depth of Test Hole, DT	10'	Initial Water Depth (Inches)	73		
Test Hole Dimensions (inches)				Length	Width
Diameter (if Round), Dia =	8	Sides (if Rectangular)	=		

Percolation Test	Pre-Adjusted Percolation Rate, in/hr	Initial Depth to Water, **d1** (in)	Water level Drop, Δ**d** (in)	R_f	I_f
P-1	14.4	75.4	2.25	19.57	0.7359

The average drop of the stabilized rate over the last three consecutive readings is the pre-adjusted percolation rate at the test location in inches per hour.

The pre-adjusted percolation rate must be reduced to account for the discharge of water from both the sides and bottom of the boring (non-vertical flow).

Use the Formula: Reduction Factor, $R_f = [(2d1 - \Delta d) / Dia] + 1$ where d_1 = Initial water Depth, in

Δ d = Water level drop of Final Period or Stabilized Rate (in)

REDUCTION FACTOR, R_f

Project:	FC - M&O Building	Project No.:	SF-5809-08	Date:	12/30/2020
Test Hole Number:	**P-2**	Tested By:	BA/		
Depth of Test Hole, DT	10'	Initial Water Depth (Inches)	80		
Test Hole Dimensions (inches)				Length	Width
Diameter (if Round), Dia =	8	Sides (if Rectangular)	=		

Percolation Test	Pre-Adjusted Percolation Rate, in/hr	Initial Depth to Water, **d1** (in)	Water level Drop, Δ**d** (in)	R_f	I_f
P-2	19	80	3	20.63	0.9212

The average drop of the stabilized rate over the last three consecutive readings is the pre-adjusted percolation rate at the test location in inches per hour.

The pre-adjusted percolation rate must be reduced to account for the discharge of water from both the sides and bottom of the boring (non-vertical flow).

Use the Formula: Reduction Factor, $R_f = [(2d1 - \Delta d) / Dia] + 1$ where d_1 = Initial water Depth, in

Δ d = Water level drop of Final Period or Stabilized Rate (in)