FOR INFORMATION ONLY
NOT A PART OF THE CONTRACT DOCUMENTS

Geotechnical Engineering Report Terracon Consultants, Inc.

November 29, 2017

Geotechnical Engineering Report

Taxiway B Pavement and Subgrade Rehabilitation Project

Raleigh-Durham International Airport

Raleigh, North Carolina

November 29, 2017

Project No. 70175162

Prepared for:
WK Dickson & Co., Inc.
Raleigh, North Carolina

Prepared by:
Terracon Consultants, Inc.
Raleigh, North Carolina

November 29, 2017

Terracon

WK Dickson & Co., Inc.
720 Corporate Center Drive
Raleigh, North Carolina 27607

Attn: Mr. Paul D. Smith, P.E.
[P]: (919) 782-0495, x5610
[E]: psmith@wkdickson.com

Re: Geotechnical Engineering Report
Taxiway B Pavement and Subgrade Rehabilitation Project
Raleigh-Durham International Airport
Raleigh, North Carolina
Terracon Project No. 70175162

Dear Mr. Smith,

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal P70175162R dated September 5, 2017. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork for the proposed improvements.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.

Michael H. Frawley, P.E.
Project Geotechnical Engineer
Registered, NC 041528

Philip C. Lambe, P.E., ScD
Senior Geotechnical Engineer
Registered, NC 012412

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Terracon has completed the geotechnical engineering services for the Taxiway B Pavement and Subgrade Rehabilitation at Raleigh-Durham International Airport in Raleigh, North Carolina. Twelve (12) soil test borings were performed to depths of approximately 5 to 10 feet below the ground surface (bgs) within the existing taxiway area. The following geotechnical considerations were identified:

- Based on a review of historic topographic maps and our general knowledge of the airport, it appears that runway 5L / 23R and the associated taxiways, were built upon fill material placed in the mid-1980s. The fill material encountered in our borings appears to be locally sourced Triassic Basin soils with variable amounts of silt, clay, sand and gravel. Triassic Basin soils are known to be highly moisture sensitive and prone to significant loss of strength upon saturation.

- We do not possess any information regarding compaction or moisture content during placement of the fill material; however, the fill materials were generally free of debris and appeared to have been placed in a controlled manner.

- The existing concrete pavement ranged in thickness from about 15.5 inches to 17.25 inches. Steel reinforcement was not encountered in the core-holes performed for the project. The concrete pavement was typically underlain by 3 to 6 inches of asphalt pavement over a negligible thickness of aggregate base material. The concrete and asphalt pavement section was typically supported directly on fill materials consisting of sandy lean clay (CL) and lean clay with sand (CL). Boring B-11 was underlain by a shallow void approximately 2 to 3-inches deep.

- Apparent partially weathered rock (PWR) was encountered in borings B-1, B-5, B-7, and B-9 at depths ranging from 6.5 to 9 feet below existing site grades.

- Correlated California Bearing Ratio (CBR) values from the borings ranged from 20.3 to 63.9. These values represent in-situ conditions at the specific test locations, times tested, and depths tested; however, the fill materials appear to be Triassic Basin sandy clay soils which are known to be highly moisture sensitive. By comparison, the laboratory soaked CBR values of the same Triassic Basin fill materials ranged from 1.2 to 1.6 and swelled 7.9 to 8.4% when soaked.

- We understand that the pavement designer will use the data presented in this Geotechnical Engineering Report and other historical data to determine the CBR value(s) to be used in design of pavements.

- As a result of the high moisture sensitivity of the fill materials, maintaining proper moisture control measures during construction and over the design period of the taxiway is essential to the performance of the pavements. Since measured moisture contents of selected samples were 5 to 8% wet of modified optimum moisture content lime subgrade treatment should be considered as a design alternative, especially if construction is performed during wetter periods of the year.

- The geotechnical engineer should be retained to observe and to perform necessary tests during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills. A more complete discussion of these points and additional information is included in the following sections.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
TAXIWAY B PAVEMENT AND SUBGRADE REHABILITATION PROJECT
RALEIGH-DURHAM INTERNATIONAL AIRPORT
RALEIGH, NORTH CAROLINA

Project No. 70175162
November 29, 2017

1.0 INTRODUCTION

Terracon has completed geotechnical engineering services for the proposed improvements to the Raleigh-Durham International Airport in Raleigh, North Carolina. Twelve (12) soil test borings were performed to approximate depths of 5 to 10 feet below the surface.

The purpose of these services is to provide information and preliminary geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- existing pavement conditions
- site preparation / earthwork

2.0 PROJECT INFORMATION

2.1 Site Location and Description

ITEM	DESCRIPTION
Location	Raleigh-Durham International Airport is located at 2400 John Brantley Blvd in Morrisville, North Carolina. For further details regarding site location, refer to Exhibit A-1, Appendix A.
Existing improvements	Taxiway B runs parallel to runway 5L / 23R and is connected via various taxiways, aprons and service roads. Taxiway B is situated northeast of the existing Terminal 2 structure.
Current ground cover	Concrete pavement.
Existing topography	Relatively flat.

2.2 Project Description

We understand the existing pavements on Taxiway B at Raleigh-Durham International Airport (RDU) are being evaluated for rehabilitation. Rehabilitation is expected to consist of overlays, concrete milling and replacement, full depth reclamation or reconstruction.

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

According to the *1985 Geologic Map of North Carolina*, the site is located within the Durham Triassic Basin. The Durham Triassic Basin is part of the Piedmont Physiographic Province and was created through the accumulation of eroded sediments in a deep basin that was formed through rift faulting. Over time, these sediments were compressed and partially cemented to form soft to moderately hard sedimentary rock. The soils that form the subsurface profiles are residual materials derived from the in-place weathering of these rocks. In residual materials the transition from soil to rock occurs gradually over a vertical distance of a few feet to tens of feet. This transitional zone is termed "partially weathered rock (PWR)," which is defined for engineering purposes as residual material that can be drilled with soil drilling methods and exhibits standard penetration test values in excess of 100 blows per foot. Later, intrusions of magma created Diabase rock in dikes and sills across the Durham Triassic Basin. Diabase tends to be very hard and soil materials derived from its weathering in this area are generally highly plastic and moisture sensitive.

3.2 Typical Profile

3.2.1 Subsurface Soils

Based on the borings the site conditions can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency/Density
Pavement	15.5 to 17.25 inches	Concrete	N/A
	5.25 to 6.5 inches	Asphalt	
Stratum 1 – Existing Fill	5.5 feet to beyond the maximum depths of exploration, approximately 5 to 10 feet	Sandy Lean Clay (CL), Lean Clay with Sand (CL)	Stiff to Hard
Stratum 2 – Residual Soil [1]	6.5 feet to beyond the maximum depth of exploration, approximately 10 feet	Sandy Lean Clay (CL), Lean Clay with Sand (CL)	Medium Stiff to Very Stiff
Stratum 3 – PWR [2]	Extends beyond the maximum depth of exploration, approximately 10 feet	Partially Weathered Rock (PWR)	N/A

1. Residual soil encountered in Borings B-1, B-5, B-9, and B-11.
2. PWR encountered in Borings B-1, B-5, B-7, and B-9.

For a comprehensive description of the conditions encountered at the boring locations, refer to the boring logs in Appendix A. Stratification lines shown on the Boring Logs are intended to represent approximate depths of changes in soil types. Naturally, transitional changes in soil types are often gradual and cannot be defined at a particular depth. The boring depths are referenced from the ground surface at the time of exploration.

Laboratory tests were conducted on selected samples and the test results are presented on the boring logs in Appendix A and in the table below.

Boring Number	USCS	Sample Depth (feet)	Liquid Limit (%)	Plasticity Index (%)	#200 Wash (%)	Natural Moisture (%)
B-1	CL	3.5 – 5.0	34	19	71	14
B-3	CL	2.0 – 3.5	34	18	67	14
B-5	CL	2.0 – 3.5	34	17	60	13
B-6	CL	2.0 – 3.5	30	14	53	12
B-7	CL	2.0 – 3.5	33	16	51	11
B-9	CL	3.5 – 5.0	27	12	53	12
B-11	CL	2.0 – 3.5	30	14	53	11

3.2.2 Correlated CBR Values

Based on Kesler Dynamic Cone Penetrometer (DCP) tests performed on in-situ soils through the pavement core holes, the correlated CBR values are as follows:

Boring Location	Correlated CBR Value
B-2	20.3
B-4	27.6
B-6	25.6
B-8	43.7
B-10	41.4
B-12	63.9

Plots of correlated CBR values for each of these borings are displayed in Appendix A.

3.2.3 Laboratory California Bearing Ratio (CBR)

Three modified Procter compaction tests and California Bearing Ratio (CBR) tests were performed on bulk samples of the near surface soils to assist with pavement thickness design. Laboratory testing results are included in Exhibits B-3 through B-8. The Proctor and CBR laboratory test results are also summarized below.

Boring No.	Sample Depth (feet)	Optimum Moisture (%)	Maximum Dry Density (pcf) ASTM 1557D	CBR (0.1 inches penetration)	CBR (0.2 inches penetration)	Percent Swell (%)
B-3	2.5 bulk sample	7.1	132.1	1.2	1.5	8.4 [1]
B-11	8.0 bulk sample	5.9	135.0	1.6	1.9	7.9 [1]

1. 7.9% to 8.4% swell is high, even for Triassic Basin Soils. Special care and attention needs to be paid to the design of pavements supported on these soils.

Soaked California Bearing Ratio (CBR) testing resulted in CBR values between 1.2 and 1.9 percent for near surface soils obtained from Borings B-3 and B-11. The soil subgrade along the majority of the site consists of sandy clay within a few feet of the existing subgrade.

If drainage is not thoroughly addressed, the subgrade soils are at risk of significant softening as illustrated above by the laboratory soaked CBR values. Without effective drainage, subgrade CBR values may deteriorate to 1.0.

We understand that the pavement designer will use the data presented in this Geotechnical Engineering Report and other historical data to determine the CBR value(s) to be used in design of pavements.

3.3 Existing Pavement Structure

Based on the pavement cores taken, the existing pavement structures are as follows:

Boring Location	Concrete Thickness (inches)	Asphalt Thickness (inches)
B-1	16.75	5.5
B-2	17	5.25
B-3	16.75	5.25
B-4	15.5	6
B-5	17.25	5.25
B-6	17	5.5
B-7	15.5	6.5
B-8	16.5	6
B-9	16.5	5.5
B-10	16.5	5.5
B-11	16.5*	6*
B-12	15.75	6.25

Note: Negligible amounts of aggregate base course materials were encountered underlying the asphalt pavement in all of the borings.

*Boring B-11 encountered a 2 to 3 inch deep void below the exiting pavement section.

3.4 Groundwater

The borings were advanced using hollow stem auger and mud rotary drilling techniques. The open boreholes were observed for the presence and level of groundwater after the completion of drilling. Free water was not observed in any of the borings. However, the near surface soils are susceptible to perched water conditions. Perched conditions occur as water infiltrates the near-surface materials and becomes trapped over less permeable materials below.

While we do not anticipate that groundwater will be encountered during development of the project, the occurrence of groundwater can vary in both depth and location with seasonal and climatic variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, the presence and location of groundwater during construction or at other times in the life of the structure can be expected to vary.

4.0 RECOMMENDATIONS

4.1 Geotechnical Considerations

The pavement subgrade soils consist of sandy clay fill soils which are moisture sensitive and experience significant loss of strength with increasing moisture content. The existing fill soils underlying the existing taxiway B pavements were observed to be damp to moist, and generally in moderate to good condition indicating that surface water infiltration had not softened the subgrade soils at our specific borehole locations although measured moisture contents on selected samples had moisture contents that were 5% to 8% wet of the average Modified optimum moisture content (OMC) of 6.5%.

The laboratory measured CBR values on soaked compacted soil samples varied from 1.2 to 1.9 at test moisture contents following soaking that were 6 to 7% wet of OMC, while the measured CBR values on in-situ soils varied from approximately 20 to 64 at test moisture contents, which were wet of OMC.

Based on similar projects at RDU, we assume that one design option will incorporate a 12-inch-thick subbase layer of P219 recycled Portland Cement Concrete (PCC) from the existing pavement after being crushed and stockpiled for reuse. It is hoped that the subbase layer will reduce moisture changes in the subgrade and provide additional support corresponding to a higher design CBR. If this option is utilized, a nonwoven filter fabric such as Mirafi 140N or equivalent should be placed on the exposed subgrade soils before placement of P219 subbase.

The existing subgrade fill materials are moisture sensitive and currently wet of OMC. For pavement reconstruction it will be difficult to meet the recommended moisture content range of OMC$\pm$ 3% without significant moisture conditioning. A subgrade lime treatment can be considered as an option to using a P219 subbase layer.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; placement and compaction of controlled compacted fills; and just prior to paving.

A more complete discussion of these points and additional information is included in the following sections.

4.2 Earthwork Recommendations

After the removal of existing pavements, and grading to design subgrade elevation we recommend the exposed soil be compacted in-place with a heavy weight tamping foot roller. The roller should make at least six passes, with the second set of three passes perpendicular to the first set of three passes. The in place compaction should be performed during a period of dry weather to avoid degrading an otherwise suitable subgrade.

Engineered fill soil should meet the following requirements.

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Off Site Borrow Low Plasticity Soil	SM, SC, SP	All Locations and Elevations
On-site soils	CL	On-site soils generally appear suitable for use as fill [1]

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. A sample of each material type should be submitted to the geotechnical engineer for evaluation.

4.2.1 Compaction Requirements

ITEM	DESCRIPTION
Fill Lift Thickness	8-inches or less in loose thickness (4" to 6" lifts when hand-operated equipment is used)
Compaction Requirements [1]	98% of the materials Modified Proctor maximum dry density (ASTM D1557)
Moisture Content	Within the range of -3% to +3% of optimum moisture content as determined by the modified Proctor test at the time of placement and compaction.

1. Engineered fill should be tested for moisture content and compaction during placement. If in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the tests should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

If the contractor has difficulty moisture conditioning subgrade lime treatment should be considered as an option to speed construction.

4.2.2 Excavations

Groundwater was not encountered in any of the exploratory borings performed for the project. While we do not anticipate groundwater will impact the project, there may be perched water conditions during wet periods.

All excavations that may be required during construction should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards to provide stability and safe working conditions.

4.2.3 Construction Considerations

The site should be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills

5.0 GENERAL COMMENTS

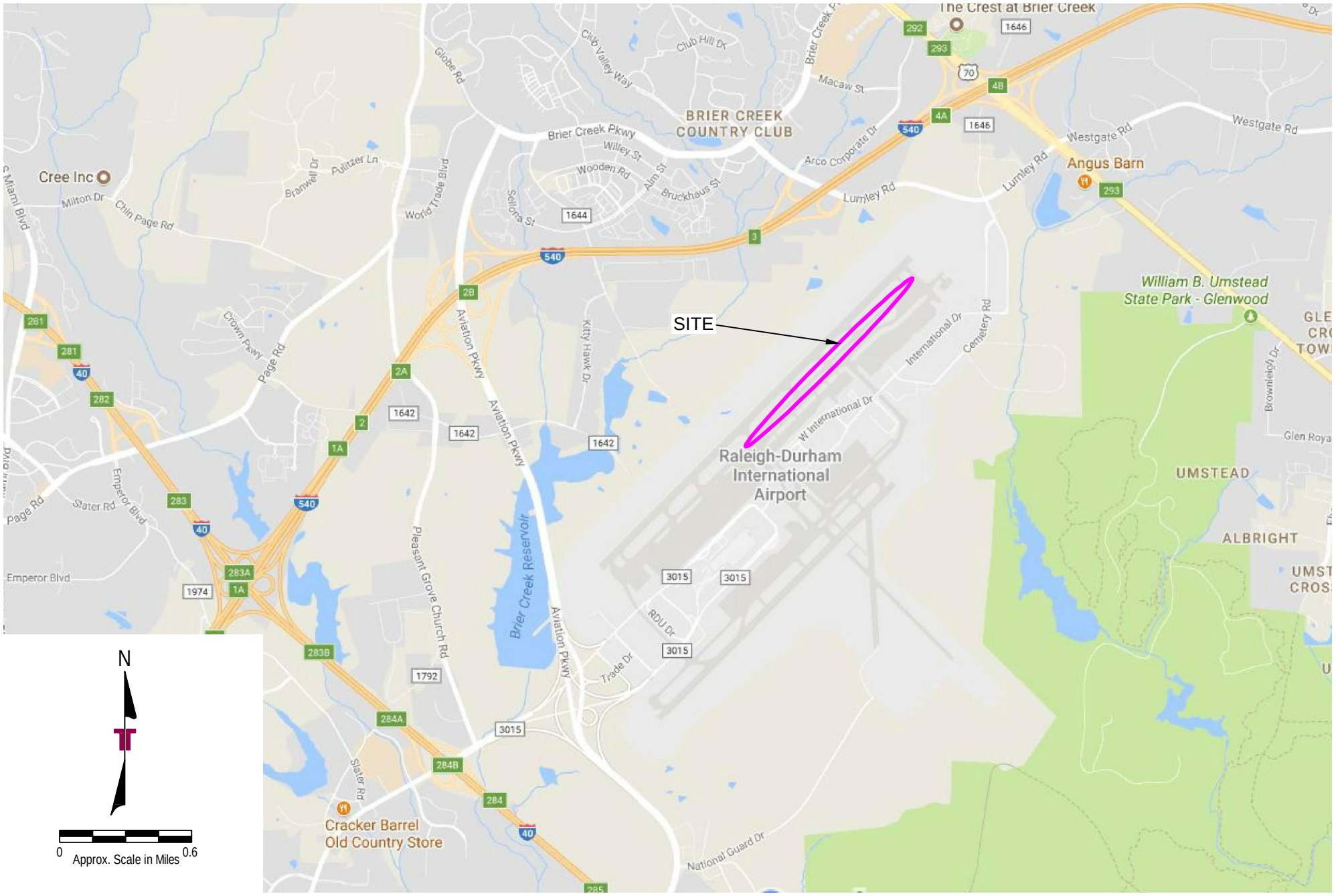
Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, paving, and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



Note: Diagram for general location only and is not intended for construction purposes. Image excerpted from Google Maps.

Project Mngr:	MHF
Drawn By:	MHF
Checked By:	PCL
Approved By:	MHF

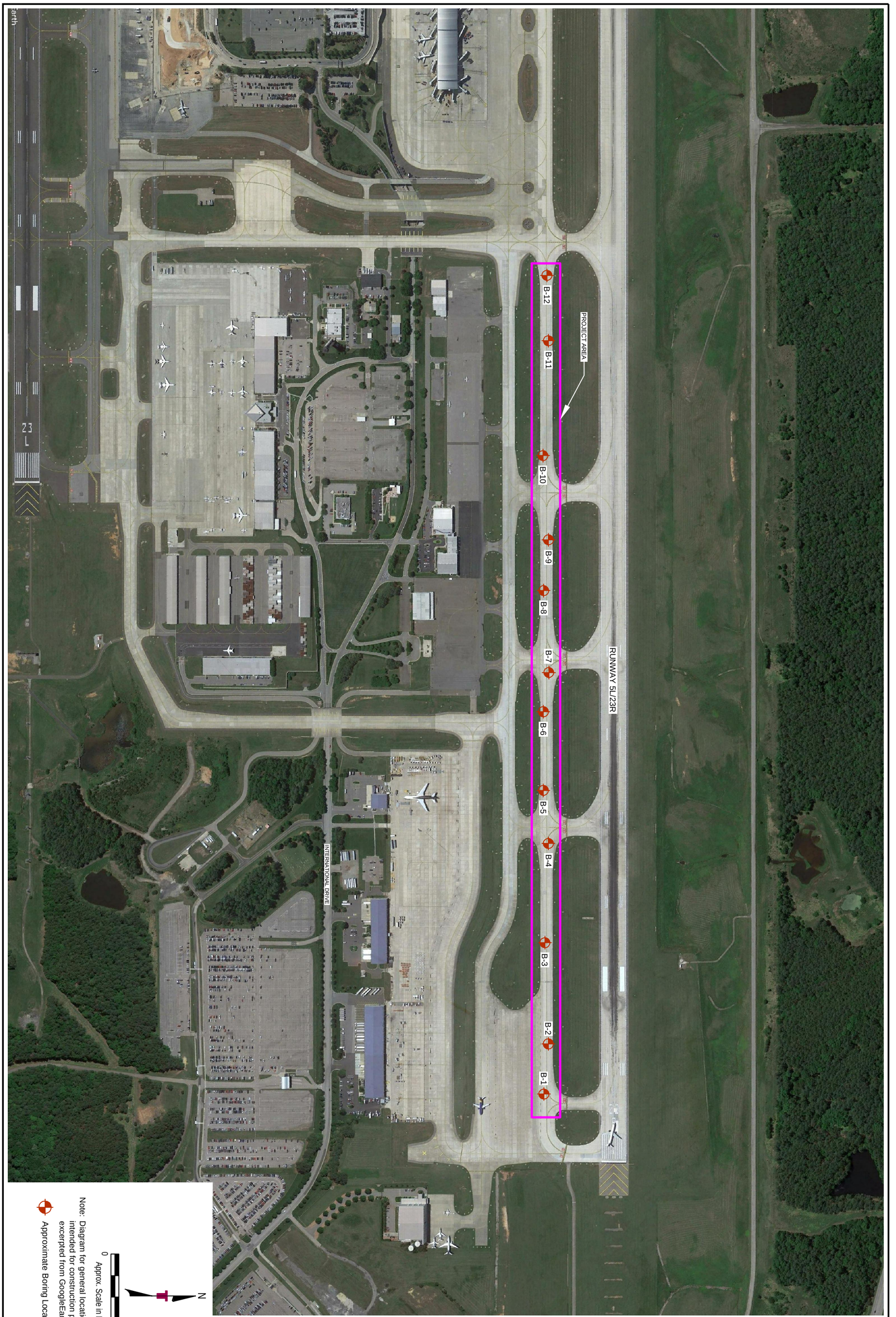
Project No.	70175162
Scale:	AS SHOWN
File No.	Boring Location Diagram.dwg
Date:	November 2017

Terracon
Consulting Engineers and Scientists
2401 Brentwood Road, Ste. 107 Raleigh, North Carolina
PH. (919) 873-2211 FAX. (919) 873-9555

SITE VICINITY MAP

TAXIWAY B PAVEMENT AND SUBGRADE REHABILITATION PROJECT
RALEIGH-DURHAM INTERNATIONAL AIRPORT (RDU)
RALEIGH, NORTH CAROLINA

Exhibit No.
A-1



Approximate Boring Location

Note: Diagram for general location only and is not intended for construction purposes. Image excerpted from GoogleEarth Pro.

0 Approx. Scale in Feet 500

N

Project Mngr:	MHF
Drawn By:	MHF
Checked By:	PCL
Approved By:	MHF

Project No.	70175162
Scale:	AS SHOWN
File No.	Boring Location Diagram.dwg
Date:	November 2017

Terracon
Consulting Engineers and Scientists
2401 Brentwood Road, Ste. 107 Raleigh, North Carolina
PH. (919) 873-2211 FAX. (919) 873-9555

BORING LOCATION DIAGRAM

TAXIWAY B PAVEMENT AND SUBGRADE REHABILITATION PROJECT
RALEIGH-DURHAM INTERNATIONAL AIRPORT (RDU)
RALEIGH, NORTH CAROLINA

Exhibit No.
A-2

Field Exploration Description

The boring locations were established in the field by the client. We understand that ground surface elevations and surveyed latitude and longitude will be provided by the client. The locations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled using 3¼ inch hollow stem augers with a CME-45 drill rig mounted on a truck equipped with an automatic hammer. Samples of the soil encountered in the borings were obtained using the split barrel sampling procedures.

In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound safety hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils. Soil samples were taken at 2.5-foot intervals.

An automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings prior to the drill crew leaving the site.

A field log of each boring was prepared by the drill crew and field engineer. These logs included visual classifications of the materials encountered during drilling as well as the driller’s interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

BORING LOG NO. B-1

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8922° Longitude: -78.7781°

Station: 1+14 Offset: 12' Left of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
1.4	433.5+/-												
CONCRETE, 16.75"													
1.9	433+/-												
ASPHALT, 5.5"													
6.0	429+/-				12	3-6-7 N=13							
FILL - LEAN CLAY WITH SAND (CL), low to medium plasticity, dark reddish brown, stiff to very stiff, fragments of partially weathered rock present					15	5-7-11 N=18					14		34-15-19
		5											
8.0	427+/-				12	5-4-3 N=7							
SANDY LEAN CLAY (CL), low to medium plasticity, reddish brown, medium stiff													
8.8	426+/-				3	50/3"							
PARTIALLY WEATHERED ROCK, Triassic Basin Siltstone/Mudstone, dark purplish red to reddish brown, laminar bedded, fine-grained material													
Boring Terminated at 8.8 Feet													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-06-2017 | Boring Completed: 11-06-2017

Drill Rig: CME 45 | Driller: J. Turnage

Project No.: 70175162 | Exhibit: A-4

BORING LOG NO. B-2

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8917° Longitude: -78.7788°

Station: 4+16 Offset: 12' Right of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
	CONCRETE, 17"												
1.4	433.5+/-												
	ASPHALT, 5.25"												
1.9	433+/-												
	FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff, fragments of partially weathered rock present				15	4-4-5 N=9	20.3						
					18	5-7-7 N=14							
5.0	430+/-	5											
	Boring Terminated at 5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-06-2017 Boring Completed: 11-06-2017

Drill Rig: CME 45 Driller: J. Turnage

Project No.: 70175162 Exhibit: A-5

BORING LOG NO. B-3

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8905° Longitude: -78.7802°

Station: 10+18 Offset: 12' Left of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
	CONCRETE, 16.75"												
1.4	433.5+/-												
1.8	**ASPHALT**, 5.25" 433+/-												
	FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff to very stiff, fragments of partially weathered rock present												
					12	3-4-5 N=9					15		33-16-17
											14		34-16-18
					15	6-7-9 N=16							
		5											
					10	6-8-11 N=19							
					12	3-5-6 N=11							
10.0	425+/-	10											
	Boring Terminated at 10 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-02-2017 Boring Completed: 11-02-2017

Drill Rig: CME 45 Driller: J. Turnage

Project No.: 70175162 Exhibit: A-6

BORING LOG NO. B-4

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8894° Longitude: -78.7816°

Station: 15+98 Offset: 12' Right of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
	CONCRETE, 15.5"												
1.3	433.5+/-												
	ASPHALT, 6"												
1.8	433+/-												
	FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff to very stiff, fragments of partially weathered rock present												
					15	6-6-7 N=13	27.6						
					18	4-7-11 N=18							
5.0	430+/-	5											
	Boring Terminated at 5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-02-2017 | Boring Completed: 11-02-2017

Drill Rig: CME 45 | Driller: J. Turnage

Project No.: 70175162 | Exhibit: A-7

BORING LOG NO. B-5

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8887° Longitude: -78.7824°

Station: 19+21 Offset: 12' Left of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
	CONCRETE, 17.25"												
1.4	433.5+/-												
	ASPHALT, 5.25"												
1.9	433+/-												
	FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff to hard, fragments of rock present, boulders and cobbles present				18	4-4-7 N=11					13		34-17-17
					18	5-7-8 N=15							
		5											
					12	8-15-21 N=36							
8.0	427+/-												
	LEAN CLAY WITH SAND (CL), low to medium plasticity, reddish brown, very stiff												
9.0	426+/-				10	8-23-50/2"							
9.7	**PARTIALLY WEATHERED ROCK**, Triassic Basin Siltstone/Mudstone, dark purplish red to reddish brown, laminar bedded, fine-grained material 425.5+/-												
	Boring Terminated at 9.7 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-02-2017 | Boring Completed: 11-02-2017

Drill Rig: CME 45 | Driller: J. Turnage

Project No.: 70175162 | Exhibit: A-8

BORING LOG NO. B-6

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8879° Longitude: -78.7834°

Station: 23+74 Offset: 12' Left of C/L

Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
0.0	435+/-										
CONCRETE, 17"											
1.4	433.5+/-										
ASPHALT, 5.5"											
1.9	433+/-										
FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff, fragments of partially weathered rock present			15	3-3-6 N=9	25.6				12		30-16-14
			18	5-6-7 N=13							
5.0	430+/-	5									
Boring Terminated at 5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-02-2017 | Boring Completed: 11-02-2017

Drill Rig: CME 45 | Driller: J. Turnage

Project No.: 70175162 | Exhibit: A-9

BORING LOG NO. B-7

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8874° Longitude: -78.7841°

Station: 26+37 Offset: 12' Right of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
	CONCRETE, 15.5"												
1.3	433.5+/-												
	ASPHALT, 6.5"												
1.8	433+/-												
	FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff to hard, fragments of partially weathered rock present				12	5-4-7 N=11					11		33-17-16
					15	5-8-9 N=17							
		5											
6.0	429+/-												
	PARTIALLY WEATHERED ROCK, Triassic Basin Siltstone/Mudstone, dark purplish red to reddish brown, laminar bedded, fine-grained material				4	50/5"							
9.0	426+/-				6	50/6"							
	Boring Terminated at 9 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-02-2017 | Boring Completed: 11-02-2017

Drill Rig: CME 45 | Driller: J. Turnage

Project No.: 70175162 | Exhibit: A-10

BORING LOG NO. B-8

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8864° Longitude: -78.7852°

Station: 31+24 Offset: 12' Left of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
	CONCRETE, 16.5"												
1.4	433.5+/-												
	ASPHALT, 6"												
1.9	433+/-												
	FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff to very stiff, fragments of partially weathered rock present												
					12	2-4-5 N=9	43.7						
					12	8-8-12 N=20							
5.0	430+/-	5											
	Boring Terminated at 5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-01-2017 Boring Completed: 11-01-2017

Drill Rig: CME 45 Driller: J. Turnage

Project No.: 70175162 Exhibit: A-11

BORING LOG NO. B-9

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8859° Longitude: -78.786°

Station: 34+28 Offset: 12' Right of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
	CONCRETE, 16.5"												
1.4	433.5+/-												
	ASPHALT, 5.5"												
1.9	433+/-												
	FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff, fragments of rock present												
					15	9-6-7 N=13							
					18	9-7-6 N=13					12		27-15-12
5.5	429.5+/-	5											
	LEAN CLAY WITH SAND (CL), low to medium plasticity, reddish brown, stiff												
6.5	428.5+/-				8	8-50/6"							
	PARTIALLY WEATHERED ROCK, Triassic Basin Siltstone/Mudstone, dark purplish red to reddish brown, laminar bedded, fine-grained material												
8.8	426+/-				3	50/3"							
	Boring Terminated at 8.8 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-01-2017 Boring Completed: 11-01-2017

Drill Rig: CME 45 Driller: J. Turnage

Project No.: 70175162 Exhibit: A-12

BORING LOG NO. B-10

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8849° Longitude: -78.7871°

Station: 39+29 Offset: 12' Left of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
	CONCRETE, 16.5"												
1.4	433.5+/-												
1.8	**ASPHALT**, 5.5" 433+/-												
	FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff to very stiff, fragments of partially weathered rock present												
					14	4-7-8 N=15	41.4						
					12	8-10-9 N=19							
5.0	430+/-	5											
	Boring Terminated at 5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-06-2017 Boring Completed: 11-06-2017

Drill Rig: CME 45 Driller: J. Turnage

Project No.: 70175162 Exhibit: A-13

BORING LOG NO. B-11

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8836° Longitude: -78.7889°

Station: 46+33 Offset: 12' Right of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
	CONCRETE, 16.5"												
1.4	433.5+/-												
	ASPHALT, 6"												
1.9	433+/-												
	FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff to hard, some silt, trace fine gravel present				15	4-6-11 N=17					11		30-16-14
					18	9-10-13 N=23							
		5											
					12	17-27-22 N=49							
8.0	427+/-												29-14-15
	LEAN CLAY WITH SAND (CL), medium plasticity, reddish brown, medium stiff				12	7-3-2 N=5							
10.0	425+/-	10											
	Boring Terminated at 10 Feet												
	Note: Pavement was not in direct contact with underlying soil. Appeared to be a shallow depression or void directly beneath the pavement. Boring required more material to backfill than the other borings performed for the project.												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-06-2017 | Boring Completed: 11-06-2017

Drill Rig: CME 45 | Driller: J. Turnage

Project No.: 70175162 | Exhibit: A-14

BORING LOG NO. B-12

PROJECT: RDU -Taxiway B Rehab

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

SITE: International Drive
Raleigh, North Carolina

LOCATION See Exhibit A-2

Latitude: 35.8828° Longitude: -78.7898°

Station: 50+19 Offset: 12' Right of C/L
Approximate Surface Elev: 435 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	Correlated CBR Value	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI
	CONCRETE, 15.75"												
1.3	433.5+/-												
	ASPHALT, 6.25"												
1.8	433+/-												
	FILL - SANDY LEAN CLAY (CL), low to medium plasticity, dark reddish brown, stiff, fragments of partially weathered rock present												
					15	3-4-6 N=10	63.9						
					14	11-7-8 N=15							
5.0	430+/-	5											
	Boring Terminated at 5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" Core & Tri-Cone Rotary Wash

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

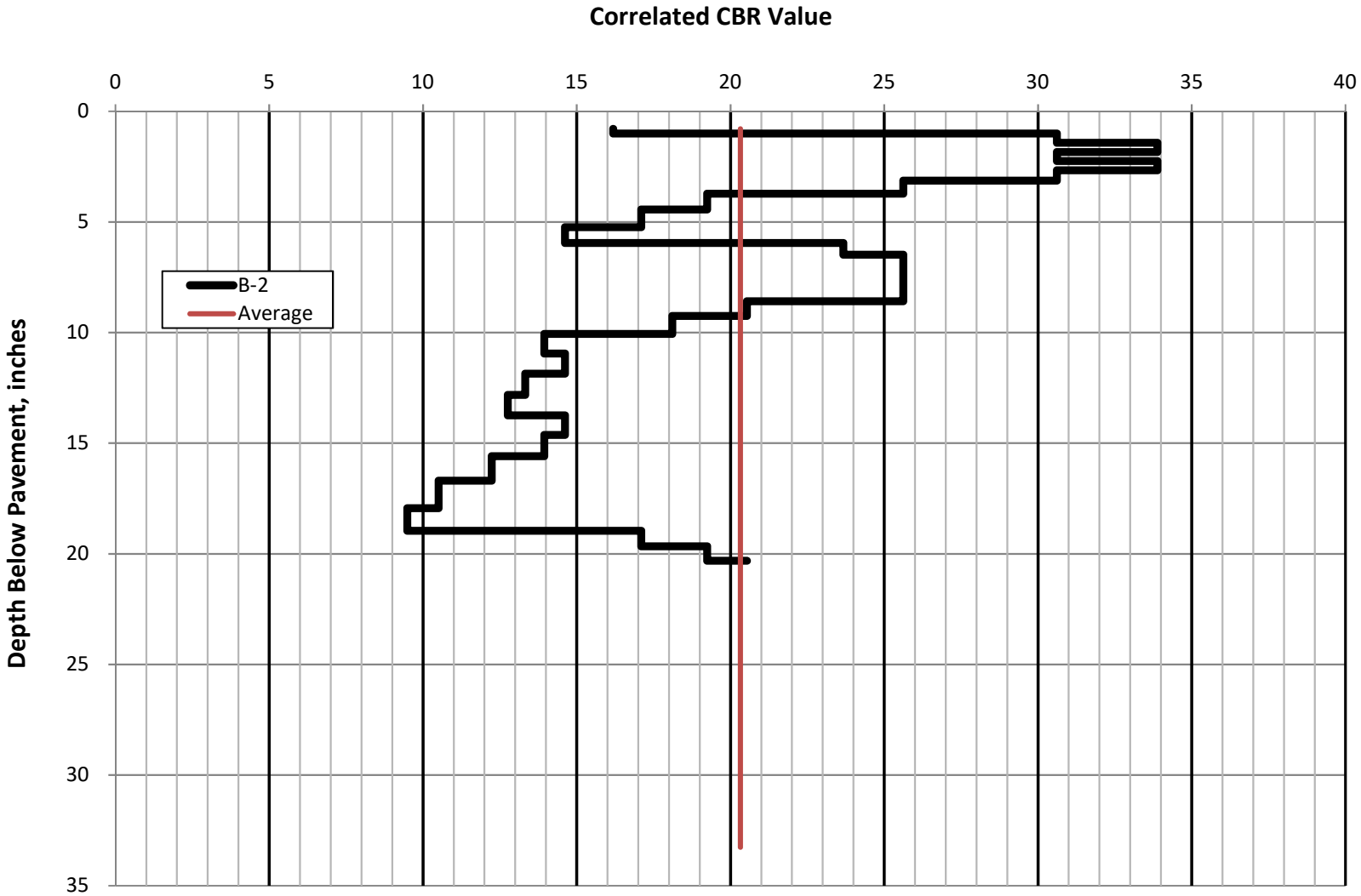
Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 11-06-2017 | Boring Completed: 11-06-2017

Drill Rig: CME 45 | Driller: J. Turnage

Project No.: 70175162 | Exhibit: A-15

Taxiway B Rehabilitation



Date: 28-Nov-17

Personnel: M. Frawley

Notes:

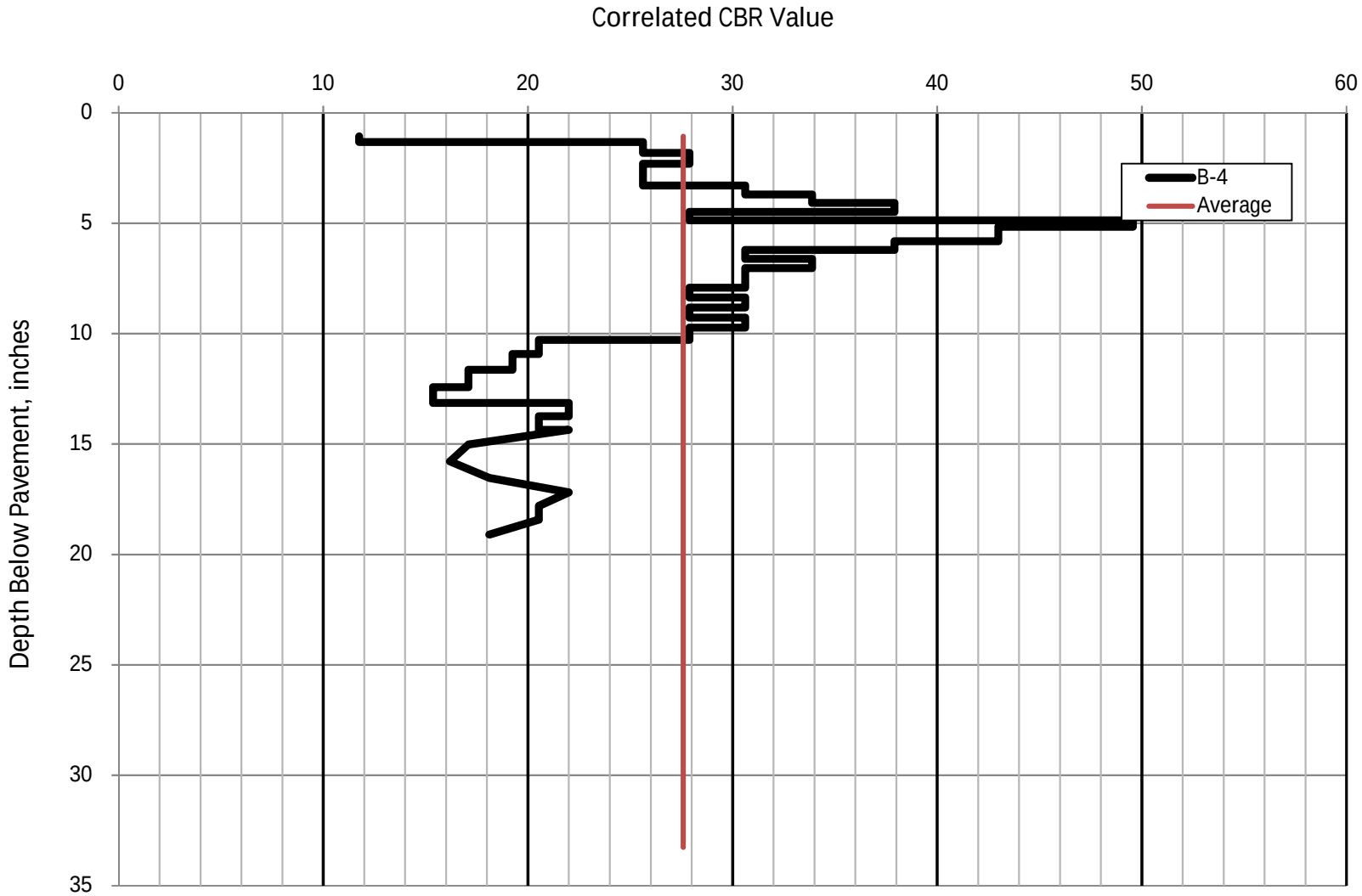
$CBR = 10^{1.53-1.066\times\log(p)}$

where p is incremental DCP penetration in cm

Terracon

Exhibit A-16

Taxiway B Rehabilitation



Date: 28-Nov-17

Personnel: M. Frawley

Notes:

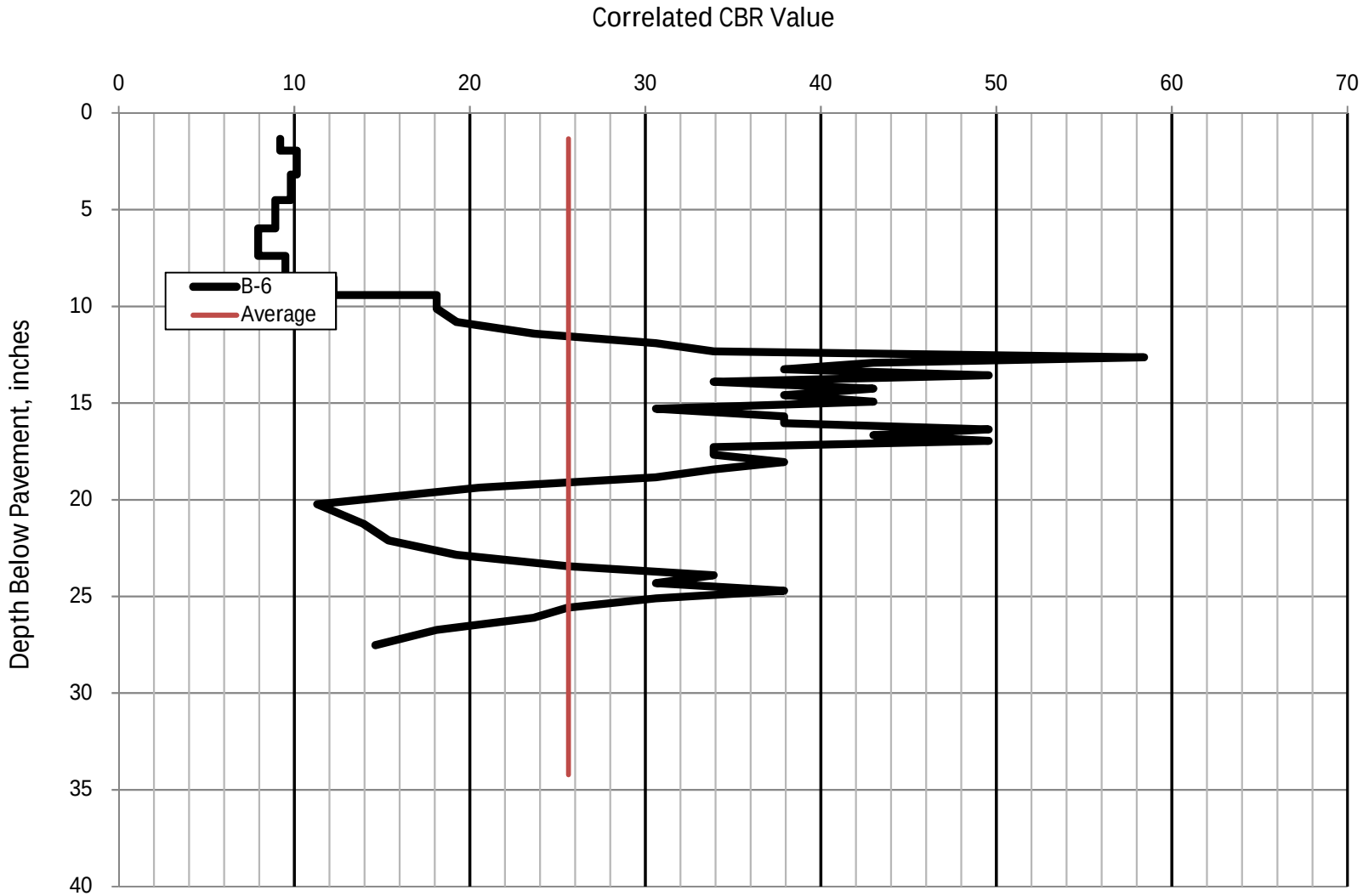
$CBR = 10^{1.53-1.066\times\log(p)}$

where p is incremental DCP penetration in cm

Terracon

Exhibit A-17

Taxiway B Rehabilitation



Date: 28-Nov-17

Personnel: M. Frawley

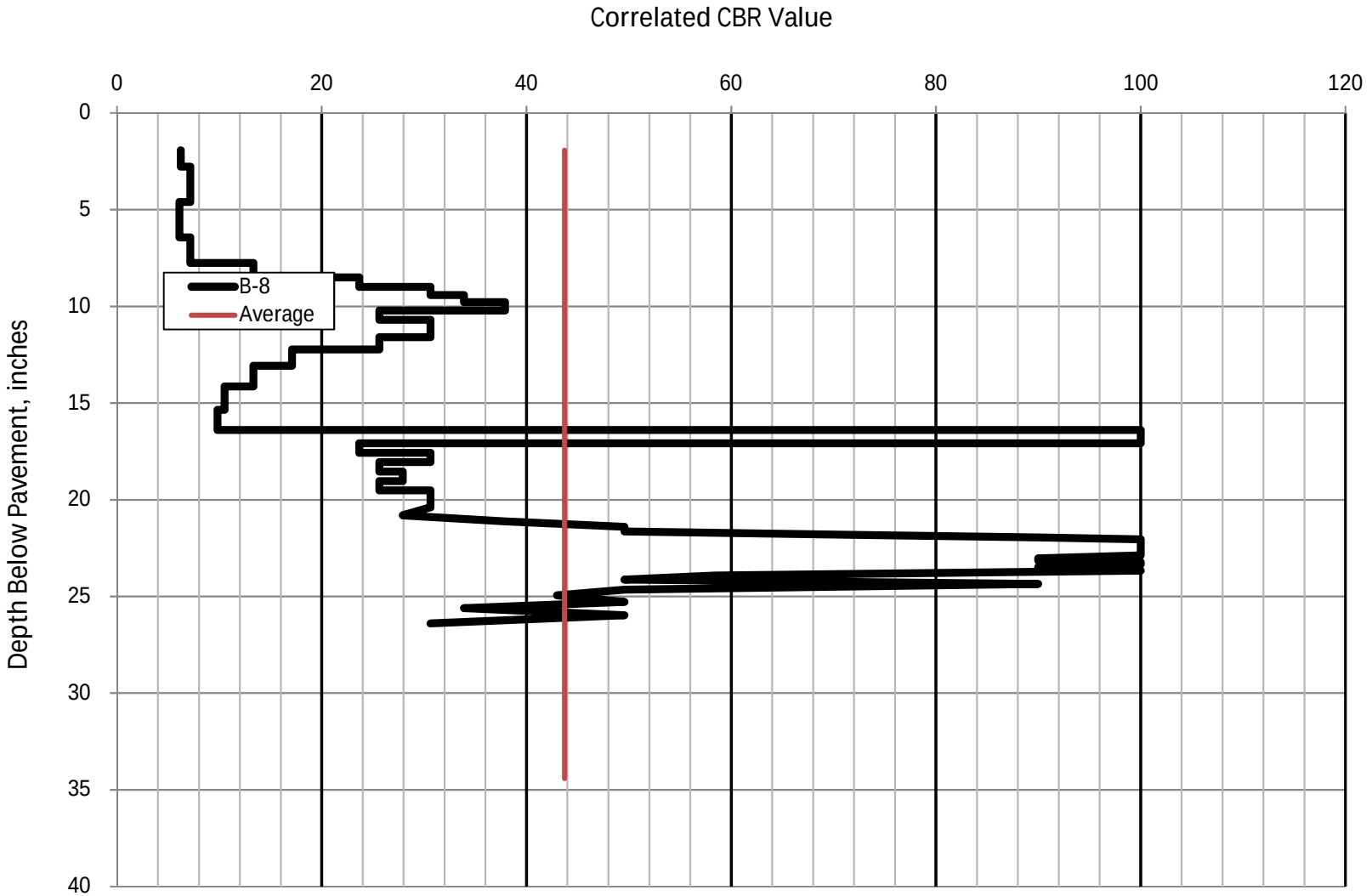
Notes:

$CBR = 10^{1.53-1.066\times\log(p)}$

where p is incremental DCP penetration in cm

Terracon

Taxiway B Rehabilitation



Date: 28-Nov-17

Personnel: M. Frawley

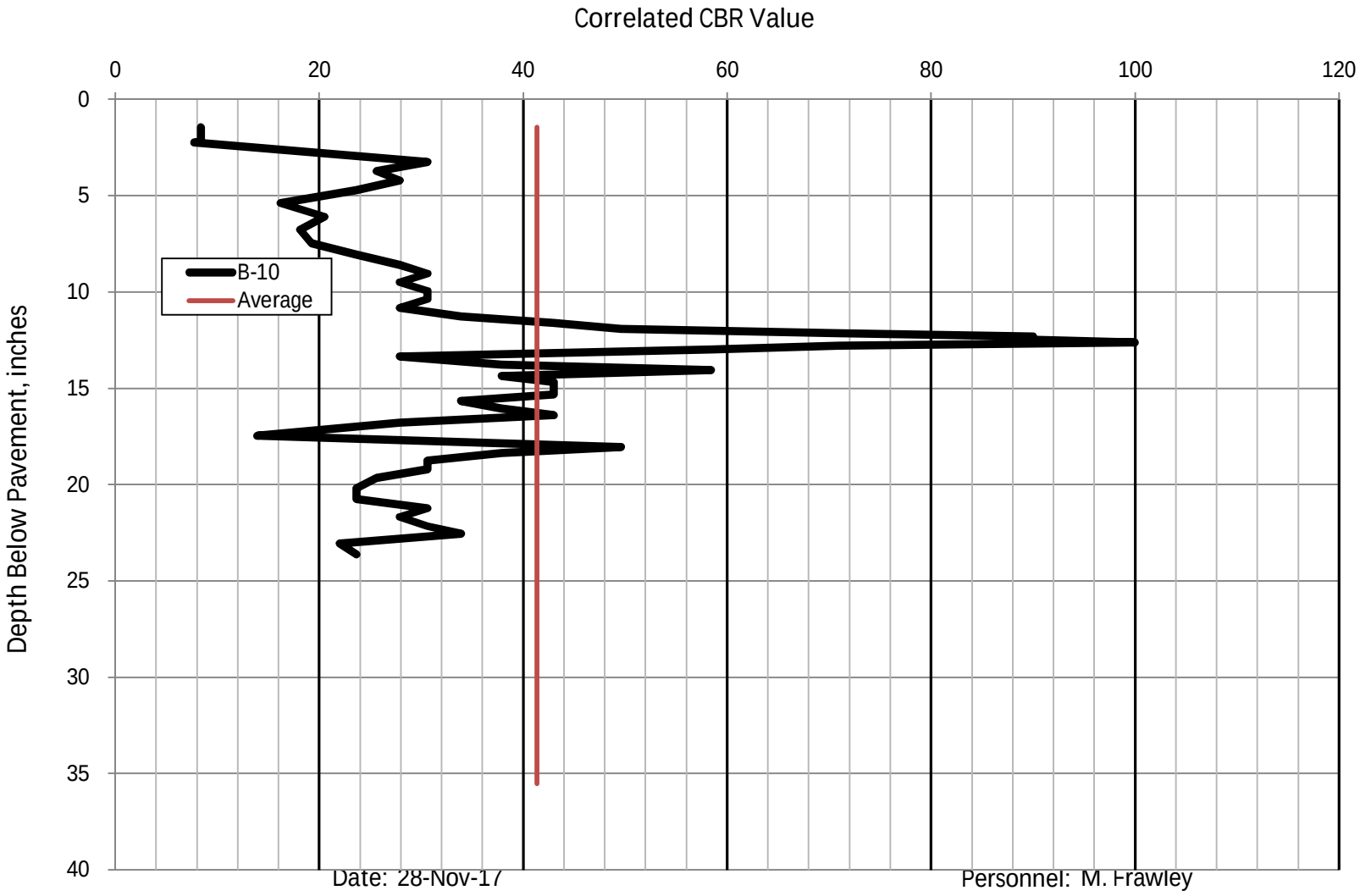
Notes:

$CBR = 10^{1.53-1.066\times\log(p)}$

where p is incremental DCP penetration in cm

Terracon

Taxiway B Rehabilitation



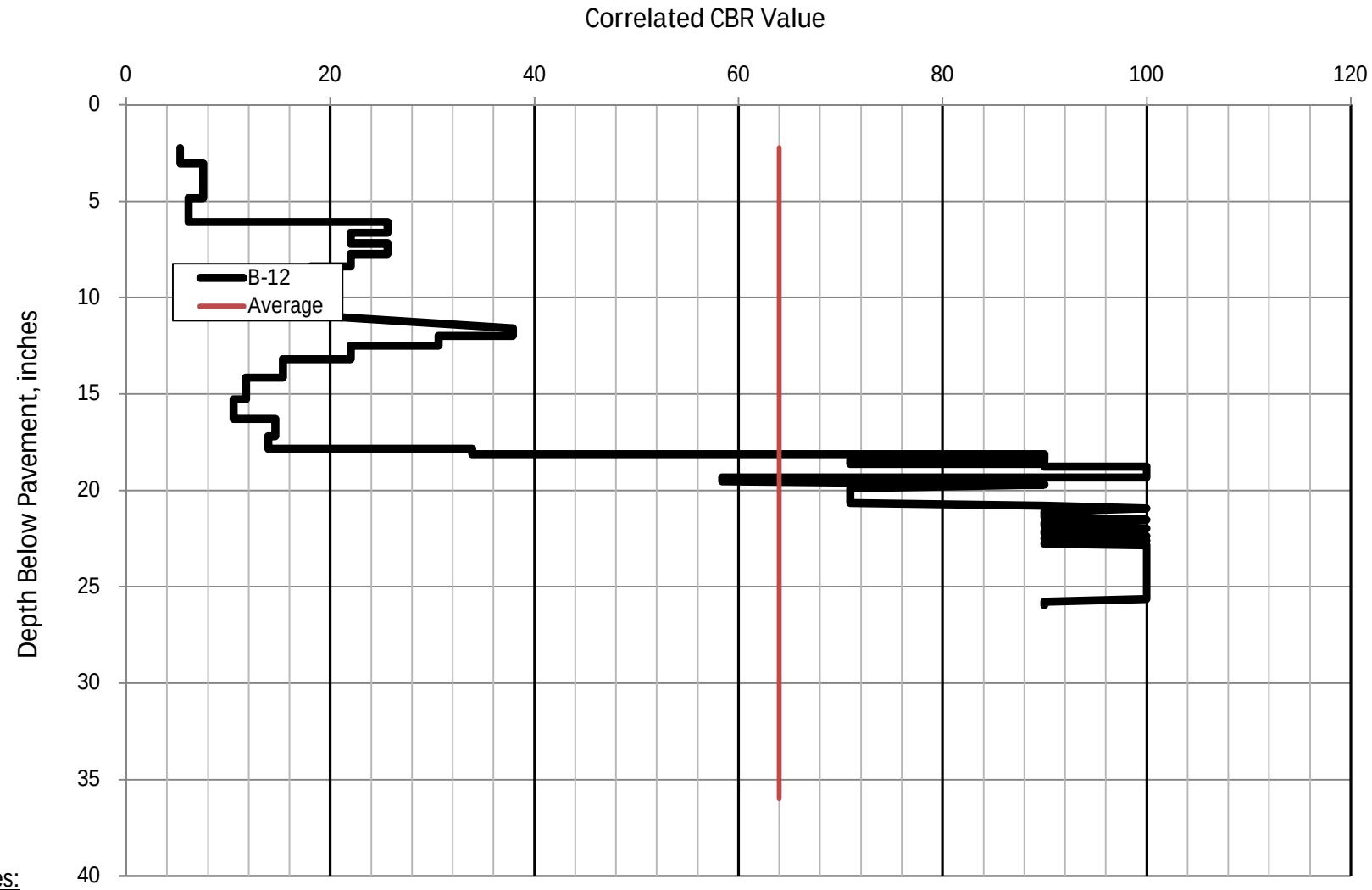
Notes:

$CBR = 10^{1.53-1.066\times\log(p)}$

where p is incremental DCP penetration in cm

Terracon

Taxiway B Rehabilitation



Notes:

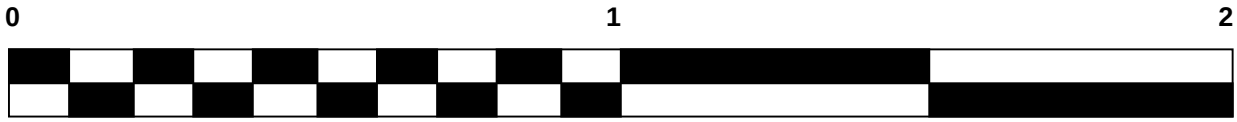
$CBR = 10^{1.53-1.066\times\log(p)}$

where p is incremental DCP penetration in cm

Terracon

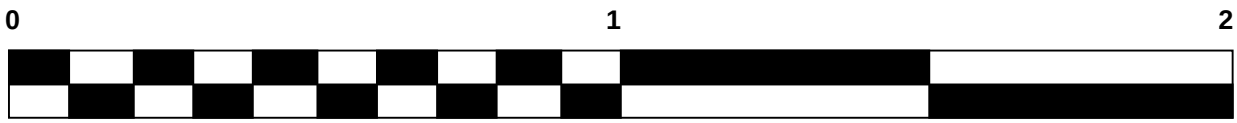
Exhibit A-21

Core B-1

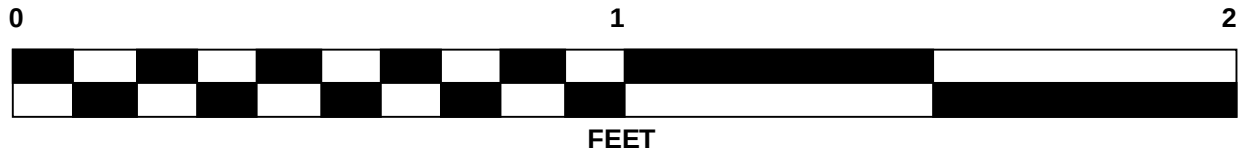


Core B-2

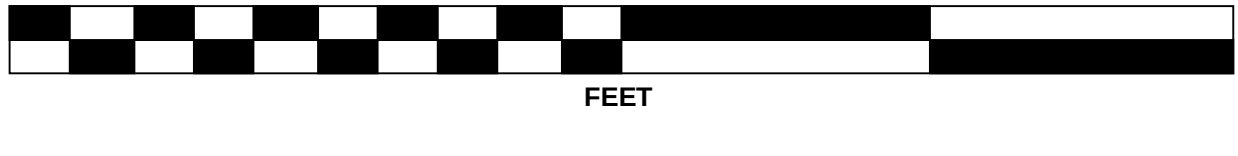
Core B-3



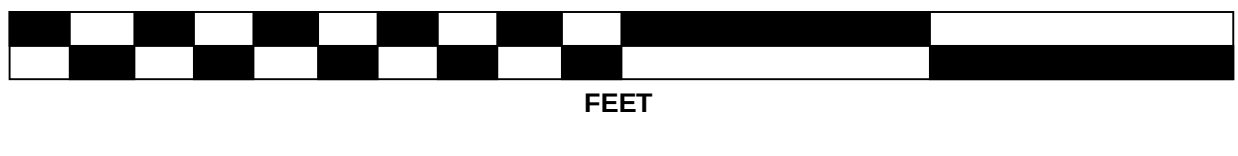
Core B-4



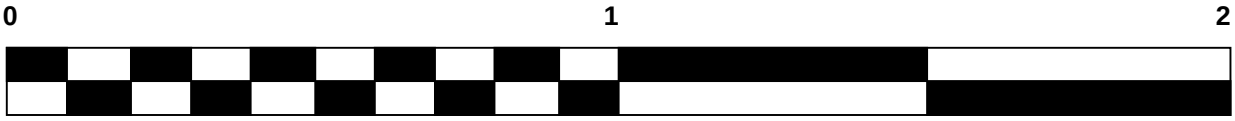
Core B-5



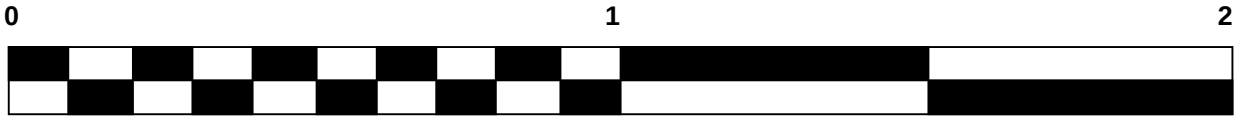
Core B-6



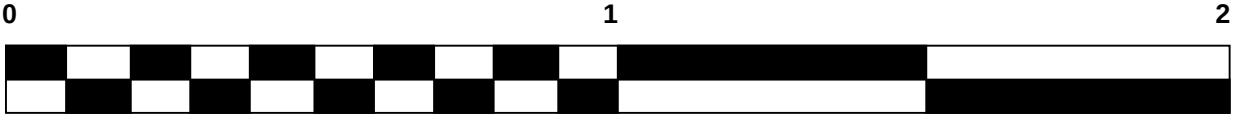
Core B-7



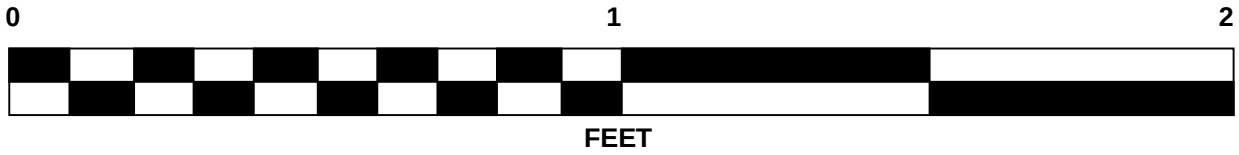
Core B-8



Core B-9

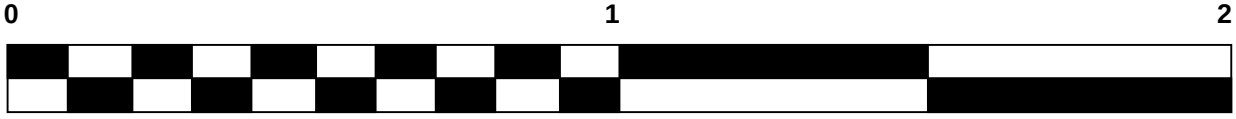


Core B-10



Core B-11

Core B-12



APPENDIX B
LABORATORY RESULTS

Laboratory Testing

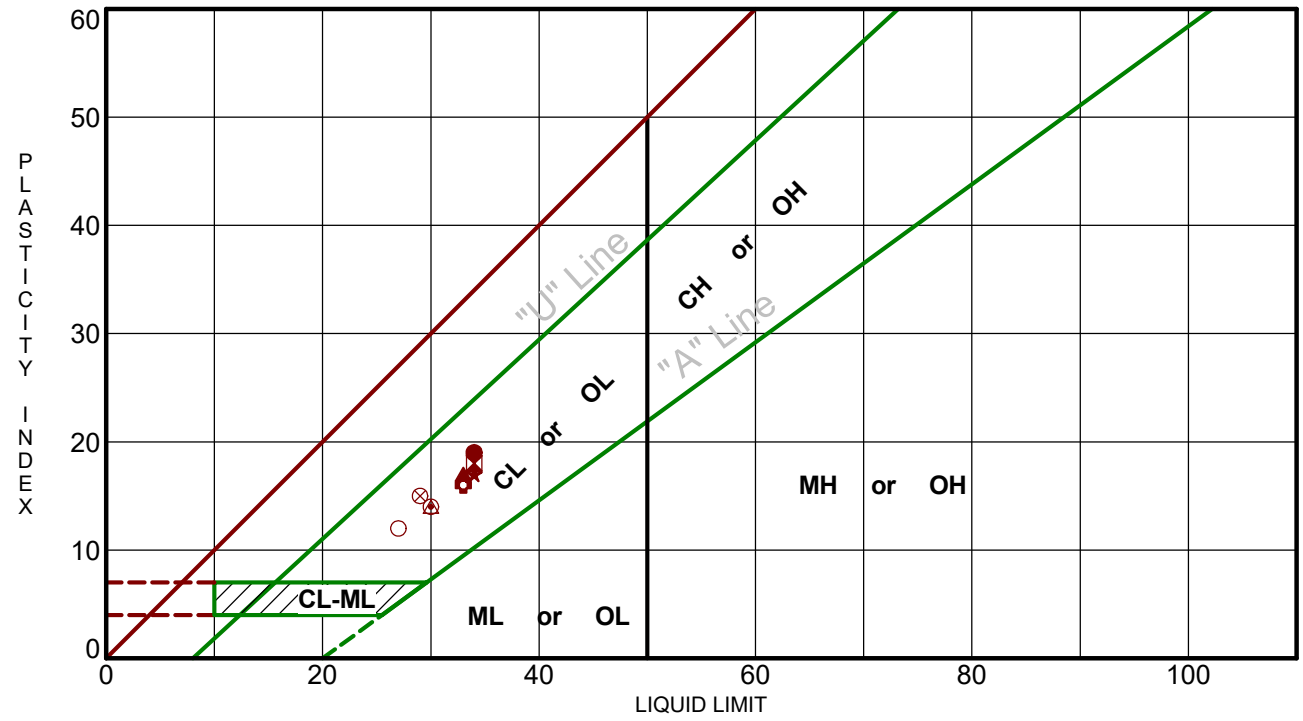
Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report. Soils laboratory testing was performed under the direction of a geotechnical engineer and included visual classification, moisture content, grain size analysis, modified proctor density, California Bearing Ratio (CBR), and Atterberg limits as appropriate. The results of the laboratory testing are shown on the borings logs and in Appendix B.

ASTM D2216 Standard Test Method of Determination of Water Content of Soil and Rock by Mass
ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488 Standard Practice of Description and Identification of Soils (Visual Manual Method)
ASTM D422 Standard Test Method for Particle Size Analysis of Soils
ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D1557 Standard Test Method for Laboratory Compaction of Soil using Modified Effort
ASTM D1883 Standard Test Method for California Bearing Ratio (CBR)

Procedural standards noted above are for reference to methodology in general. In some cases variations to methods are applied as a result of local practice or professional judgment.

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
B-1	3.5 - 5	34	15	19	71	CL	LEAN CLAY with SAND
B-3	2 - 3.5	34	16	18	67	CL	SANDY LEAN CLAY
B-3	2.5	33	16	17	67	CL	SANDY LEAN CLAY
B-5	2 - 3.5	34	17	17	60	CL	SANDY LEAN CLAY
B-6	2 - 3.5	30	16	14	53	CL	SANDY LEAN CLAY
B-7	2 - 3.5	33	17	16	51	CL	SANDY LEAN CLAY
B-9	3.5 - 5	27	15	12	53	CL	SANDY LEAN CLAY
B-11	2 - 3.5	30	16	14	53	CL	SANDY LEAN CLAY
B-11	8	29	14	15	58	CL	SANDY LEAN CLAY

PROJECT: RDU -Taxiway B Rehab

SITE: International Drive
Raleigh, North Carolina

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

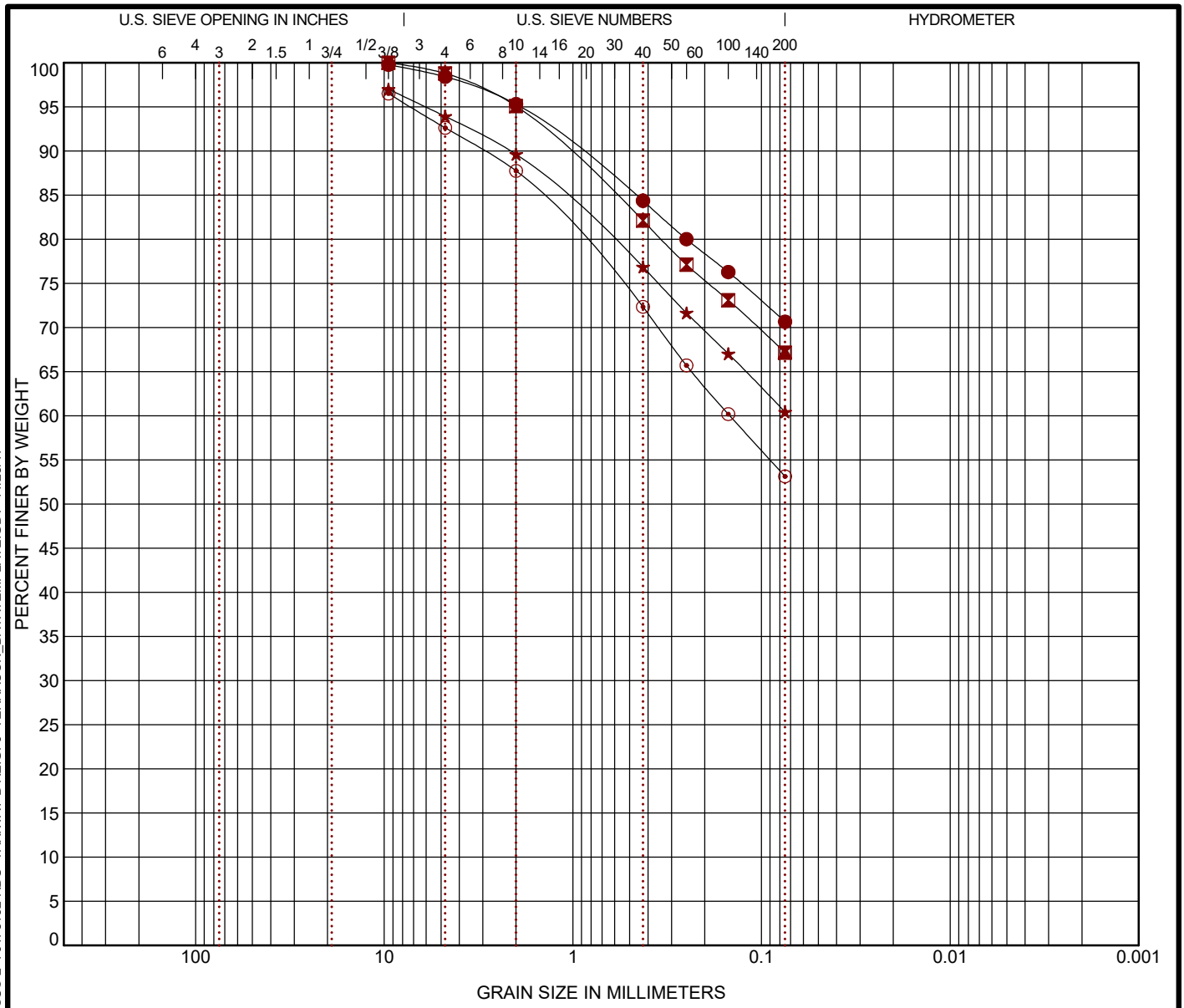
PROJECT NUMBER: 70175162

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

EXHIBIT: B-2

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● B-1	3.5 - 5	LEAN CLAY with SAND (CL)	14	34	15	19		
⊠ B-3	2 - 3.5	SANDY LEAN CLAY (CL)	14	34	16	18		
▲ B-3	2.5	SANDY LEAN CLAY (CL)	15	33	16	17		
★ B-5	2 - 3.5	SANDY LEAN CLAY (CL)	13	34	17	17		
⊙ B-6	2 - 3.5	SANDY LEAN CLAY (CL)	12	30	16	14		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
● B-1	3.5 - 5	9.5				1.4	27.7		70.7	
⊠ B-3	2 - 3.5	9.5				1.2	31.6		67.2	
▲ B-3	2.5	0.075				0.0	0.0		67.1	
★ B-5	2 - 3.5	9.5				3.1	33.5		60.4	
⊙ B-6	2 - 3.5	9.5	0.147			3.9	39.5		53.1	

PROJECT: RDU -Taxiway B Rehab

SITE: International Drive
Raleigh, North Carolina

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

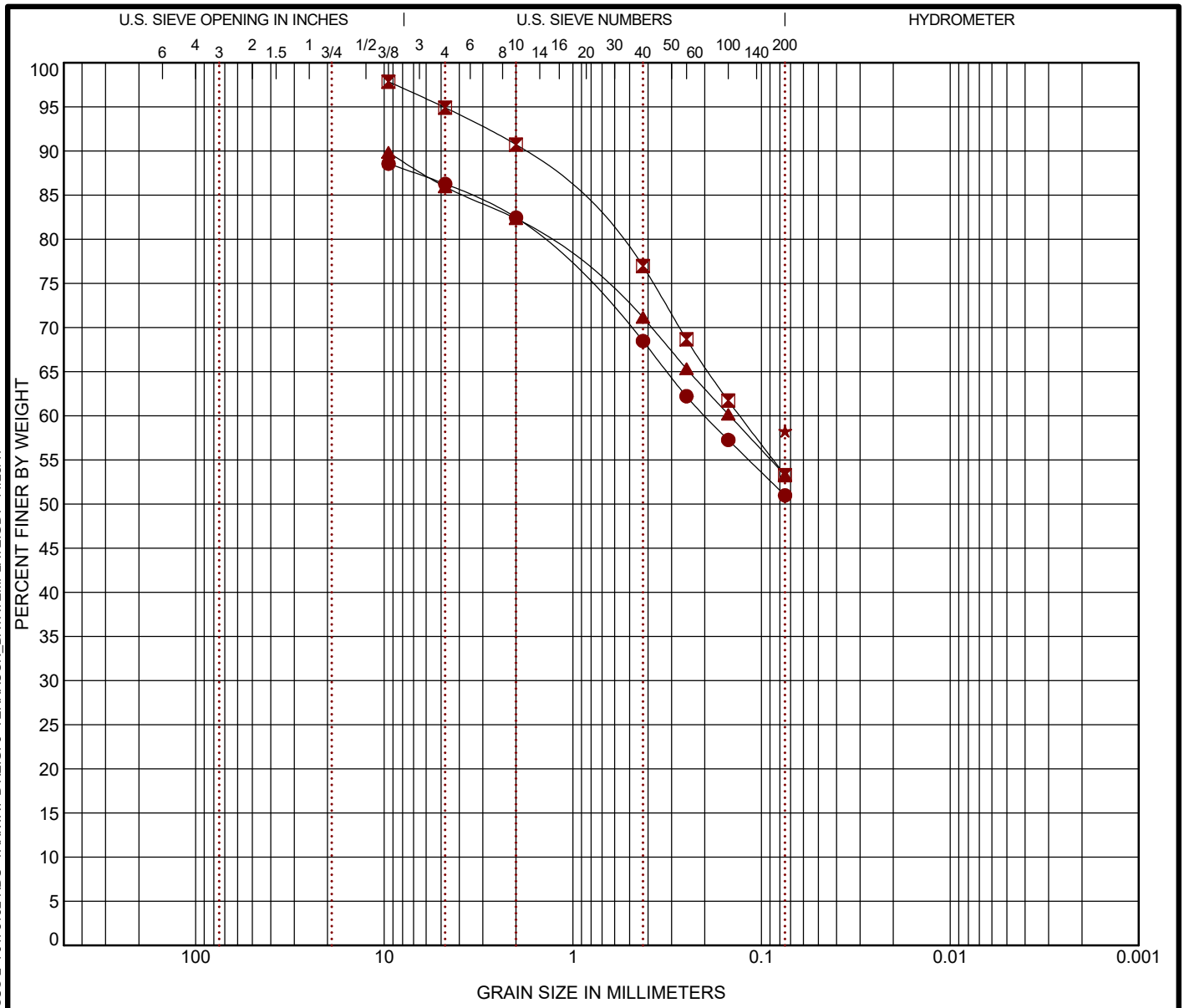
PROJECT NUMBER: 70175162

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

EXHIBIT: B-3

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B-7	2 - 3.5	SANDY LEAN CLAY (CL)	11	33	17	16		
⊠	B-9	3.5 - 5	SANDY LEAN CLAY (CL)	12	27	15	12		
▲	B-11	2 - 3.5	SANDY LEAN CLAY (CL)	11	30	16	14		
★	B-11	8	SANDY LEAN CLAY (CL)		29	14	15		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B-7	2 - 3.5	9.5	0.199			2.3	35.3		51.0	
⊠	B-9	3.5 - 5	9.5	0.13			3.0	41.6		53.3	
▲	B-11	2 - 3.5	9.5	0.147			3.9	32.7		53.3	
★	B-11	8	0.075				0.0	0.0		58.3	

PROJECT: RDU -Taxiway B Rehab

SITE: International Drive
Raleigh, North Carolina

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

PROJECT NUMBER: 70175162

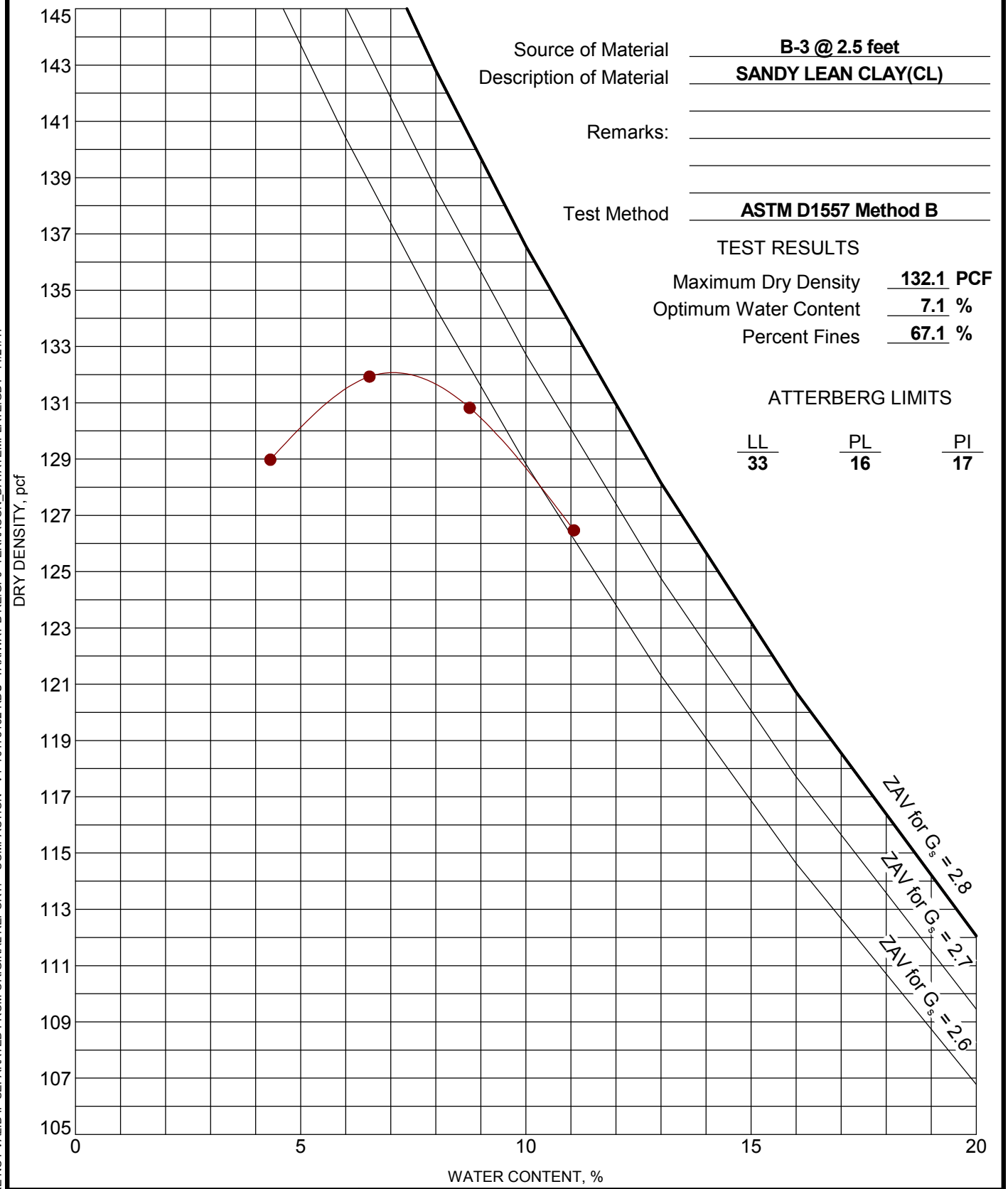
CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

EXHIBIT: B-4

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 70175162 RDU -TAXIWAY B RE.GPJ TERRACON_DATATEMPLATE.GDT 11/28/17

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**B-3 @ 2.5 feet**
Description of Material	**SANDY LEAN CLAY(CL)**
Remarks:	
Test Method	**ASTM D1557 Method B**

TEST RESULTS

Maximum Dry Density	**132.1 PCF**
Optimum Water Content	**7.1 %**
Percent Fines	**67.1 %**

ATTERBERG LIMITS

LL	PL	PI
33	**16**	**17**

PROJECT: RDU -Taxiway B Rehab

SITE: International Drive
Raleigh, North Carolina

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

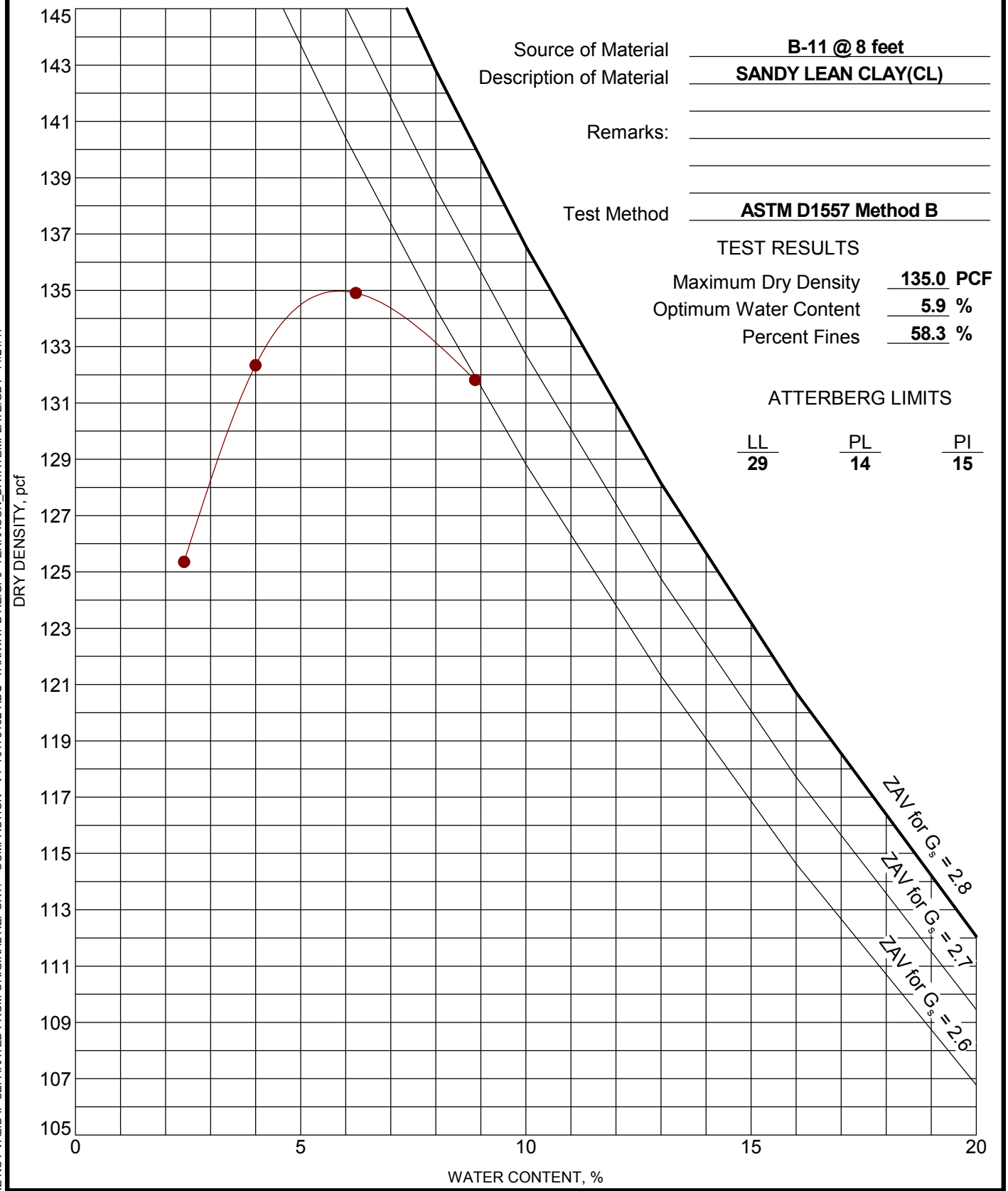
PROJECT NUMBER: 70175162

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

EXHIBIT: B-5

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**B-11 @ 8 feet**
Description of Material	**SANDY LEAN CLAY(CL)**
Remarks:	
Test Method	**ASTM D1557 Method B**

TEST RESULTS

Maximum Dry Density	**135.0 PCF**
Optimum Water Content	**5.9 %**
Percent Fines	**58.3 %**

ATTERBERG LIMITS

LL	PL	PI
29	**14**	**15**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V1 70175162 RDU -TAXIWAY B RE.GPJ TERRACON_DATATEMPLATE.GDT 11/21/17

PROJECT: RDU -Taxiway B Rehab

SITE: International Drive
Raleigh, North Carolina

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

PROJECT NUMBER: 70175162

CLIENT: WK Dickson & Company, Inc.
Raleigh, North Carolina

EXHIBIT: B-6

REPORT FOR CALIFORNIA BEARING RATIO

Terracon
2401 Brentwood Road, Suite 107
Raleigh, NC 27604
919-873-2211

Service Date: 11/14/17
Report Date: 11/21/17

Client

WK Dickson & Company, Inc
Attn: Paul Smith
720 Corporate Center Drive
Raleigh, NC 27616

Project

RDU - Taxiway B Rehab
International Drive
Raleigh, NC

Project No. 70175162

SAMPLE INFORMATION

Sample Number:	Bulk Sample	Proctor Method:	ASTM D1557 - Method B
Boring Number:	B-3	Maximum Dry Density (pcf):	132.1
Sample Location:	Fill Material	Optimum Moisture:	7.1
Depth:	2.5'	Liquid Limit:	33
Material Description:	Sandy Lean Clay	Plasticity Index:	17

CBR TEST DATA

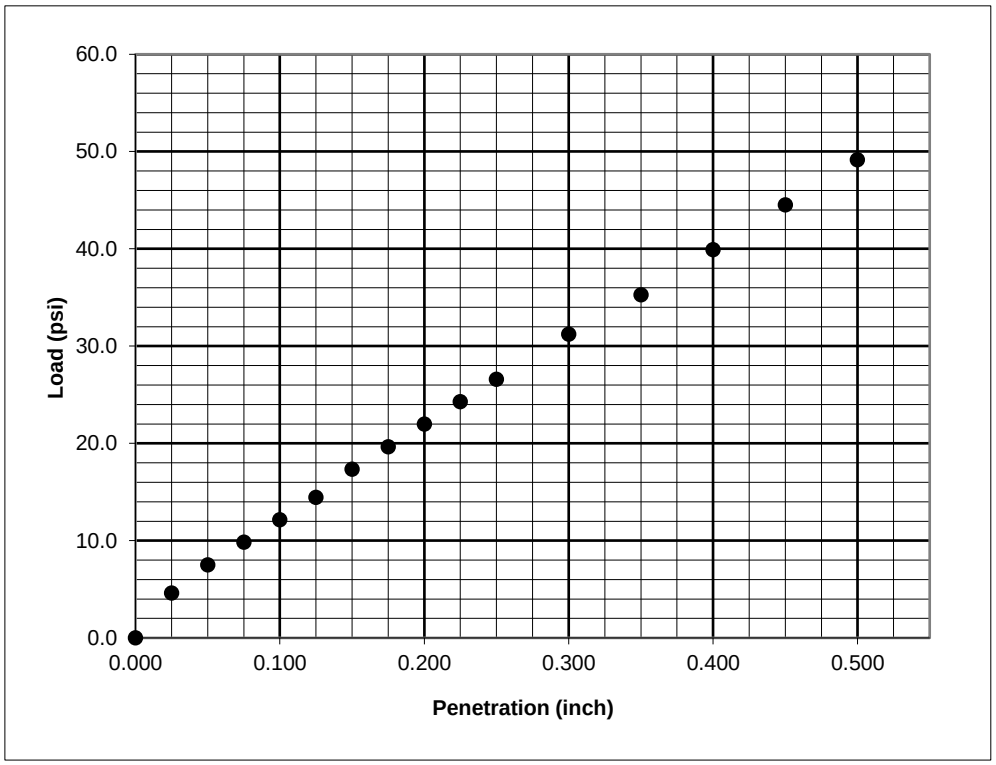
CBR Value at 0.100 inch	**1.2**
CBR Value at 0.200 inch	**1.5**
Surcharge Weight (lbs)	10
Soaking Condition	Soaked
Length of Soaking (hours)	96
Swell (%)	8.4

DENSITY DATA

Dry Density Before Soaking (pcf)	130.8
Compaction of Proctor (%)	99.0

MOISTURE DATA

Before Compaction (%)	7.2
After Compaction (%)	7.3
Top 1" After Soaking (%)	18.5
Average After Soaking (%)	14.4



Comments:

Services: Obtain soil sample and test for California Bearing Ratio

Terracon Rep: Stephanie Huffman
Reported To: Michael H. Frawley
Contractor:

Report Distribution

Reviewed by: _____
Michael H. Frawley
Geotechnical Project Manager

Test Methods: ASTM D1883

REPORT FOR CALIFORNIA BEARING RATIO

Terracon
2401 Brentwood Road, Suite 107
Raleigh, NC 27604
919-873-2211

Service Date: 11/14/17
Report Date: 11/21/17

Client

WK Dickson & Company, Inc
Attn: Paul Smith
720 Corporate Center Drive
Raleigh, NC 27616

Project

RDU - Taxiway B Rehab
International Drive
Raleigh, NC

Project No. 70175162

SAMPLE INFORMATION

Sample Number:	Bulk Sample	Proctor Method:	ASTM D1557 - Method B
Boring Number:	B-11	Maximum Dry Density (pcf):	135.0
Sample Location:	Residual Soil	Optimum Moisture:	5.9
Depth:	8'	Liquid Limit:	29
Material Description:	Sandy Lean Clay	Plasticity Index:	15

CBR TEST DATA

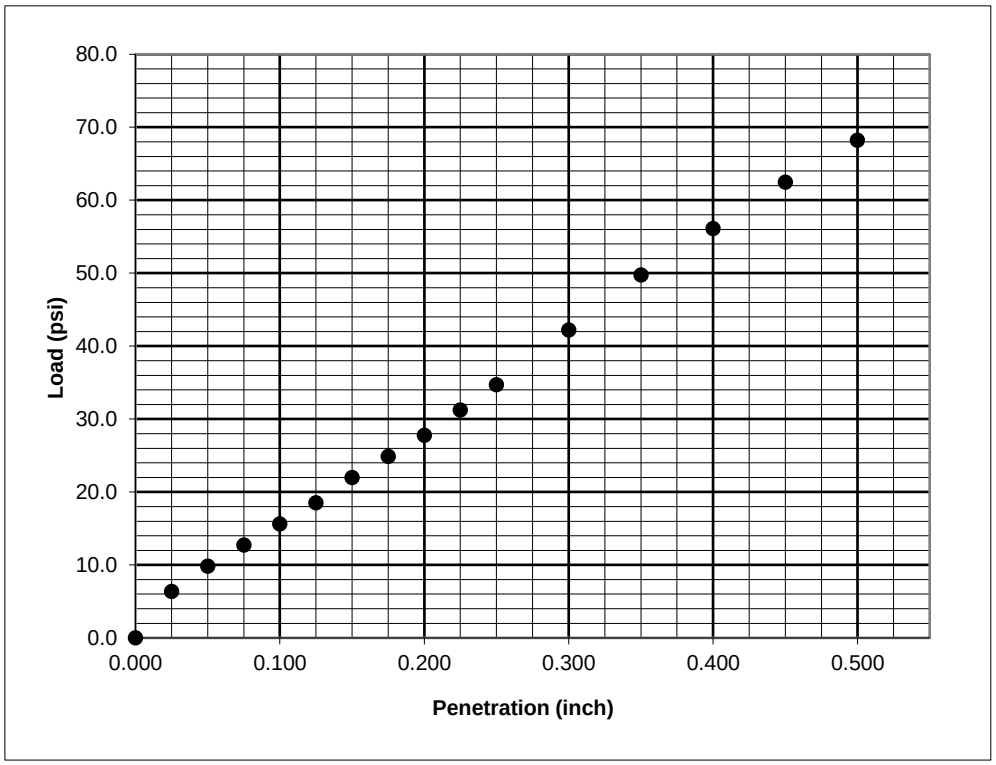
CBR Value at 0.100 inch	**1.6**
CBR Value at 0.200 inch	**1.9**
Surcharge Weight (lbs)	10
Soaking Condition	Soaked
Length of Soaking (hours)	96
Swell (%)	7.9

DENSITY DATA

Dry Density Before Soaking (pcf)	133.8
Compaction of Proctor (%)	99.1

MOISTURE DATA

Before Compaction (%)	6.0
After Compaction (%)	6.0
Top 1" After Soaking (%)	16.1
Average After Soaking (%)	12.3



Comments:

Services: Obtain soil sample and test for California Bearing Ratio

Terracon Rep: Stephanie Huffman
Reported To: Michael H. Frawley
Contractor:

Report Distribution

Reviewed by: _____
Michael H. Frawley
Geotechnical Project Manager

Test Methods: ASTM D1883

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Split Spoon

WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (psf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 500	0 - 1
Loose	4 - 9	Soft	500 to 1,000	2 - 4
Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8
Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15
Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30
		Hard	> 8,000	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

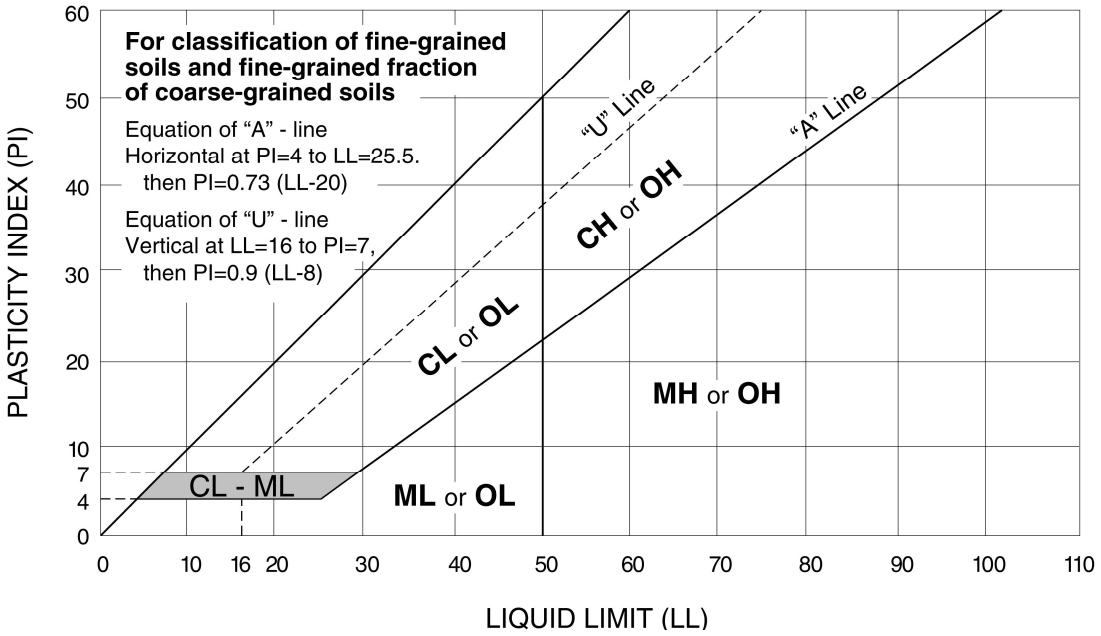
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon