



November 10, 2020
Kleinfelder Project No.: 20211374.001A-2

Ms. Cynthia Y. Lynn, President
Thunderhead Testing, LLC
1540 N. 107th E. Ave.,
Tulsa, Oklahoma 74116

**Subject: Letter for Geotechnical Explorations
Roadway Improvements
City of Tulsa Project 2036N4014Z
North of University of Tulsa Campus
Tulsa, Oklahoma**

Dear Ms. Lynn:

Kleinfelder has completed the authorized subsurface explorations for the above referenced project. Kleinfelder conducted the field work by coring twelve (12) pavement cores and advancing the borings to three feet below the bottom of the pavement, or power auger refusal, whichever occurs first, on October 6, 2020. The borings were located in the field by a Kleinfelder representative using a hand-held Global Positioning System (GPS) with an accuracy of approximately 15 feet. The general site location and the approximate borings (P-1 through P-12) are shown on Figures 1 and 2, Exploration Location Plan and Vicinity Map(s).

FIELD EXPLORATION PROGRAM

The existing pavement was cored with a 6-in diameter core barrel and were advanced with a hand-held power auger to three feet into the subgrade below the bottom of the pavement, or auger refusal, whichever occurs first. Field logs included visual classification of the materials encountered during drilling, as well as drilling characteristics. Stratification boundaries indicated on the coring logs are based on observations during our field work, an extrapolation of information obtained by examining samples from the cores, and comparisons of soils with similar engineering characteristics. Locations of these boundaries are approximate, and the transitions between material types may be gradual rather than clearly defined.

SUBSURFACE CONDITIONS

The existing pavement consisted of approximately 1 to 3.5 inches of asphaltic concrete pavement underlain by 5 to 8 inches of Portland cement concrete. No aggregate base was encountered in any of the borings. Fill material, consisting of lean clay with sand and silty sand with gravel, were encountered underneath the pavement in borings P-4, P-7, P-8 and P-12 and extended to depths ranging from 6 to 24 inches below the bottom of pavement. Native soils of mostly lean clay with varying amounts of sand, and sand with varying amounts of clay, silt and gravel, were encountered underneath the pavement or fill materials and continued to the terminal depths of the borings. The coring logs are attached in Attachment A.

LABORATORY TESTING PROGRAM

Laboratory tests including sieve analyses tests, Atterberg limit tests, and moisture contents were performed by Thunderhead on selected samples for classification purposes. In addition, soil samples were visually classified in accordance with the Unified Soil Classification System. All the lab results are summarized in Attachment B.

LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

The report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two years from the date of this report. The work performed was based on project information provided by Client.

CLOSING

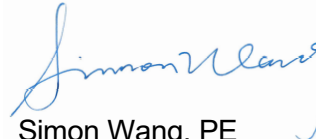
We appreciate the opportunity to be of service to you on this project. Please call us if you have any questions concerning the information presented within this letter.

Sincerely,
KLEINFELDER, INC.

Certificate of Authorization #7292, Expires 6/30/21



Bobby Gobin
Staff Professional I



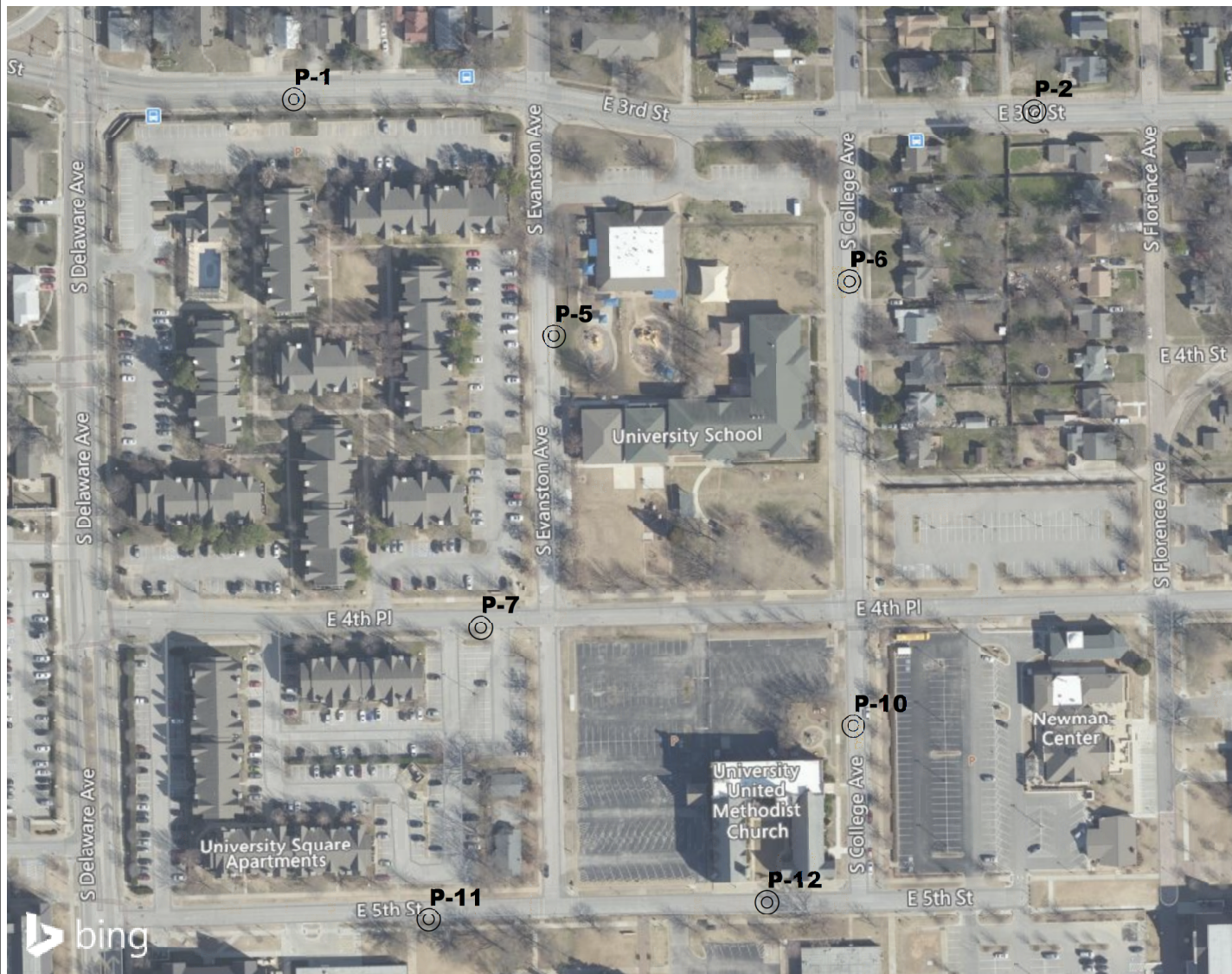
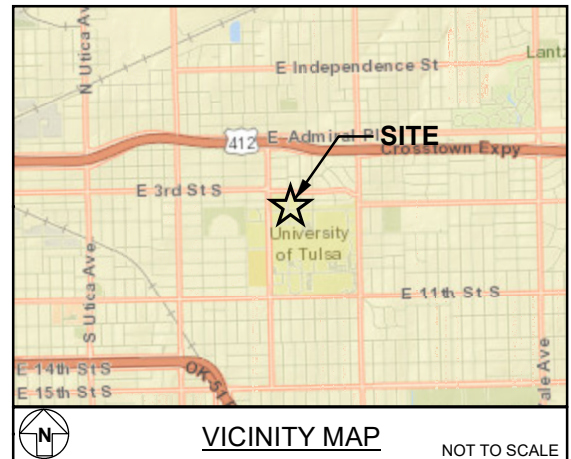
Simon Wang, PE
Senior Professional

Attachments:

- Figures 1 and 2 - Exploration Location Plan and Vicinity Map(s)
- Attachment A – Field Exploration Program
- Attachment B – Lab Testing Program

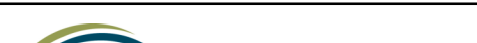


LEGEND	
	PAVEMENT CORING



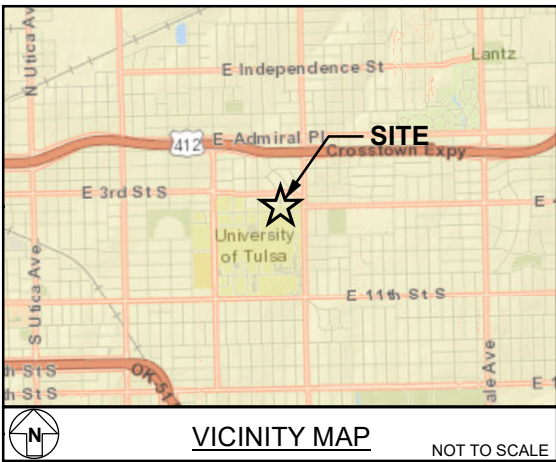
The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



 KLEINFELDER <i>Bright People. Right Solutions.</i>	PROJECT NO. 20211374.001A-2	EXPLORATION LOCATION PLAN AND VICINITY MAP	FIGURE 1
	DRAWN BY: B. Goben CHECKED BY: S. Wang DATE: 11-05-2020	COT Project 2036N4014Z North of the University of Tulsa Campus Tulsa, Oklahoma	



LEGEND	
	PAVEMENT CORING



NOTE:
 BASE MAPPING AND VICINITY MAP CREATED FROM LAYERS
 COMPILED BY ESRI PRODUCTS AND 2020 MICROSOFT CORPORATION.
 COORDINATE SYSTEM: NAD 1983 2011 STATEPLANE OKLAHOMA NORTH FIPS
 3501



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



	PROJECT NO. 20211374.001A-2	EXPLORATION LOCATION PLAN AND VICINITY MAP		FIGURE 2
	DRAWN BY: B. Goben CHECKED BY: S. Wang DATE: 11-05-2020			

PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

E. 3rd St. Eastbound

GPS

36.15641° N / -95.94840° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☐ Stripping

☒ Separation

☐ N/A

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics	Layer Thickness (in)
P-1	ASPHALTIC CONCRETE	Separation at 1.75 inches.	1.75
P-1	PORTLAND CEMENT CONCRETE		8

Total Core Thickness

9.75

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-1A	Lean CLAY (CL): brown, moist	0.0 to 6.0
P-1B	Lean CLAY (CL): reddish brown, moist	6.0 to 36.0

TOP



PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

E. 3rd St. Westbound

GPS

36.15632° N / -95.94537° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☐ Stripping

☒ Separation

☐ N/A

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics	Layer Thickness (in)
P-2	ASPHALTIC CONCRETE	Separation at 1.75 inches.	1.75
P-2	PORTLAND CEMENT CONCRETE		6.75

Total Core Thickness

8.5

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-2A	Lean CLAY with Sand (CL): brown, moist	0.0 to 6.0
P-2B	Lean CLAY with Sand (CL): reddish brown, moist	6.0 to 36.0

TOP



PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

E. 3rd St. Eastbound

GPS

36.15630° N / -95.94354° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☐ Stripping

☒ Separation

☐ N/A

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics	Layer Thickness (in)
P-3	ASPHALTIC CONCRETE	Separation at 1.75 inches.	1.75
P-3	PORTLAND CEMENT CONCRETE		7.5

Total Core Thickness

9.25

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-3A	Lean CLAY with Sand (CL): brown, moist	0.0 to 6.0
P-3B	Lean CLAY with Sand (CL): reddish brown, moist	6.0 to 10.0

TOP



	PROJECT NO.: 20211374.001A-2	BORING LOG P-3	CORE
	DRAWN BY: B GOBEN CHECKED BY: SYW DATE: 10/14/2020	COT Project 2036N4014Z North of the University of Tulsa Campus Tulsa, Oklahoma	P-3

PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

E. 3rd St. Westbound

GPS

36.15640° N / -95.94198° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☐ Stripping

☒ Separation

☐ N/A

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics	Layer Thickness (in)
P-4	ASPHALTIC CONCRETE	Separation at 2.5 inches.	2.5
P-4	PORTLAND CEMENT CONCRETE		6.75

Total Core Thickness

9.25

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-4A	Fill - Lean Clay with Sand (CL) dark gray, moist	0.0 to 6.0
P-4B	Fill - Lean Clay with Sand (CL) dark gray, moist	6.0 to 24.0
P-4C	Silty SAND (SM): reddish brown, moist	24.0 to 36.0

TOP



PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

S. College Ave. Northbound

GPS

36.15577° N / -95.94614° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☒ Stripping

☒ Separation

☐ N/A

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics	Layer Thickness (in)
P-6	ASPHALTIC CONCRETE	Separation at 3.5 inches.	3.5
P-6	PORTLAND CEMENT CONCRETE		5

Total Core Thickness

8.5

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-6A	Lean CLAY (CL): brown, moist	0.0 to 6.0
P-6B	Lean CLAY (CL): reddish brown, moist	6.0 to 36.0

TOP



	PROJECT NO.: 20211374.001A-2	BORING LOG P-6	CORE
	DRAWN BY: B GOBEN CHECKED BY: SYW DATE: 10/14/2020	COT Project 2036N4014Z North of the University of Tulsa Campus Tulsa, Oklahoma	P-6

PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

E. 4th Pl. Eastbound

GPS

36.15465° N / -95.94768° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☐ Stripping

☒ Separation

☐ N/A

☒ 0

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

☒ 0

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics*	Layer Thickness (in)
P-7	ASPHALTIC CONCRETE	Separation at 1 inch.	1
P-7	PORTLAND CEMENT CONCRETE		6.5

Total Core Thickness

7.5

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-7A	Fill - Silty SAND with Gravel (SM): reddish brown, moist	0.0 to 6.0

TOP



REMARKS:
- Power auger refusal in concrete was encountered at 6 inches below the bottom of pavement.



PROJECT NO.:
20211374.001A-2

DRAWN BY: B GOBEN

CHECKED BY: SYW

DATE: 10/14/2020

BORING LOG P-7

COT Project 2036N4014Z
North of the University of Tulsa Campus
Tulsa, Oklahoma

CORE

P-7

PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

E. 4th Pl. Westbound

GPS

36.15469° N / -95.94465° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☐ Stripping

☐ Separation

☒ N/A

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics	Layer Thickness (in)
P-8	ASPHALTIC CONCRETE		1
P-8	PORTLAND CEMENT CONCRETE		6.25

Total Core Thickness

7.25

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-8A	Fill - Lean CLAY with Sand (CL): dark brown, moist	0.0 to 6.0
P-8B	Lean CLAY with Sand (CL): brown to yellowish brown, moist	6.0 to 36.0

TOP



	PROJECT NO.: 20211374.001A-2	BORING LOG P-8	CORE
	DRAWN BY: B GOBEN CHECKED BY: SYW DATE: 10/14/2020	COT Project 2036N4014Z North of the University of Tulsa Campus Tulsa, Oklahoma	P-8

PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

E. 4th Pl. Eastbound

GPS

36.15467° N / -95.94192° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☐ Stripping

☒ Separation

☐ N/A

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics*	Layer Thickness (in)
P-9	ASPHALTIC CONCRETE	Separation at 1.5 inches.	1.5
P-9	PORTLAND CEMENT CONCRETE		5.5

Total Core Thickness

7

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-9A	Silty SAND with Gravel (SM): reddish brown, moist	0.0 to 6.0
P-9B	Silty SAND with Gravel (SM): reddish brown, moist	6.0 to 24.0

REMARKS:

- Power auger refusal was encountered at 24 inches below the bottom of pavement.



PROJECT NO.:

20211374.001A-2

DRAWN BY:

B GOBEN

CHECKED BY:

SYW

DATE:

10/14/2020

BORING LOG P-9

COT Project 2036N4014Z
North of the University of Tulsa Campus
Tulsa, Oklahoma

CORE

P-9

TOP



PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

S. College Ave. Southbound

GPS

36.15430° N / -95.94617° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☒ Stripping

☒ Separation

☐ N/A

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics	Layer Thickness (in)
P-10	ASPHALTIC CONCRETE	Separation at 3.5 inches.	3.5
P-10	PORTLAND CEMENT CONCRETE		5

Total Core Thickness

8.5

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-10A	Sandy Lean CLAY (CL): reddish brown, moist	0.0 to 6.0
P-10B	Sandy Lean CLAY (CL): reddish brown, moist	6.0 to 36.0

TOP



PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

E. 5th St. Eastbound

GPS

36.15369° N / -95.94791° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☐ Stripping

☐ Separation

☒ N/A

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics	Layer Thickness (in)
P-11	ASPHALTIC CONCRETE		1.75
P-11	PORTLAND CEMENT CONCRETE		7

Total Core Thickness

8.75

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-11A	Lean CLAY (CL): reddish brown, moist	0.0 to 6.0
P-11B	Lean CLAY (CL): reddish brown to yellowish brown, moist	6.0 to 36.0

TOP



	PROJECT NO.: 20211374.001A-2	BORING LOG P-11	CORE
	DRAWN BY: B GOBEN CHECKED BY: SYW DATE: 10/14/2020	COT Project 2036N4014Z North of the University of Tulsa Campus Tulsa, Oklahoma	P-11

PROJECT / LOCATION DATA:

CORE DATE

October 6, 2020

LOCATION

E. 5th St. Westbound

GPS

36.15372° N / -95.94653° E

CORE LAYER DATA:

Surface Material Type:

☒ A.C.

☒ P.C.C.

☐ Continuously Reinforced Concrete

Stripping or Separation in Asphalt:

☐ Stripping

☒ Separation

☐ N/A

Honeycomb or "D" Cracking PCC:

☒ Honeycomb

☐ "D" Cracking

☐ N/A

Stabilized Subgrade Beneath Pavement or Subbase?

☐ Yes

☒ No

☐ Unknown

CORE & BASE LAYER DATA (FROM TOP TO BOTTOM):

Core No.	Layer Type	Layer Characteristics	Layer Thickness (in)
P-12	ASPHALTIC CONCRETE	Separation at 2.75 inches.	2.75
P-12	PORTLAND CEMENT CONCRETE		5.25

Total Core Thickness

8

SUBGRADE LAYER DATA (FROM BELOW CORES, OR AGGREGATE BASE, IF PRESENT):

Sample No.	Layer Type	Layer Depth (in)
P-12A	Fill - Lean CLAY with Sand (CL): dark brown, moist	0.0 to 6.0
P-12B	Lean CLAY with Sand (CL): brown, moist	6.0 to 36.0

TOP



Field No.	Soil Group	Station	Description	Depth (in)	LL	PI	Percent Passing						Water Content (%)	Soluble Sulfates (mg/kg)
							Passing 3 in.	Passing 3/4 in.	Passing #4	Passing #10	Passing #40	Passing #200		
P-1A	A-6		LEAN CLAY	0 - 6	35	15	100	100	100	99	97	90	19.9	
P-1B				6 - 36									20.2	
P-2A				0 - 6									20.9	
P-2B	A-6		LEAN CLAY WITH SAND	6 - 36	35	15	100	100	97	95	91	79	22.7	
P-3A	A-6		LEAN CLAY WITH SAND	0 - 6	34	12	100	100	99	98	95	76	24.4	
P-4A				0 - 6									13.6	
P-4B				6 - 24	28	9							25.9	
P-4C	A-4			24 - 36			100	81	57	51	48	40	21.5	
P-5A				0 - 6									7.2	
P-5B	A-4		LEAN CLAY WITH SAND	6 - 36	28	9	100	100	99	99	97	82	26.2	
P-6A	A-6		LEAN CLAY	0 - 6	32	11	100	100	100	98	94	86	26.9	
P-6B				6 - 36									23.6	
P-7A	A-4			0 - 6			100	100	70	65	63	43	23.2	
P-8A	A-6		LEAN CLAY WITH SAND	0 - 6	32	12	100	100	100	100	96	84	26.5	
P-8B				6 - 36									20.7	
P-9A				0 - 6									23.2	
P-9B	A-4		SILTY SAND WITH GRAVEL	6 - 24	29	4	100	92	76	70	64	46	16.3	
P-10A	A-6		SANDY LEAN CLAY	0 - 6	38	18	100	100	95	93	91	62	19.7	
P-10B				6 - 36									17.9	
P-11A				0 - 6									25.4	
P-11B	A-6		LEAN CLAY	6 - 36	38	19	100	100	99	99	98	87	21.7	
P-12A	A-4		LEAN CLAY WITH SAND	0 - 6	25	8	100	100	100	100	98	85	19.4	
P-12B				6 - 36									14.7	

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = Nonplastic
NA = Not Available



PROJECT NO.:
20211374.001A

DRAWN BY: B. GOBEN

CHECKED BY: SYW

DATE: 11/5/2020

LABORATORY TEST RESULT SUMMARY

COT Project 2036N4014Z
North of the University of Tulsa Campus
Tulsa, Oklahoma

TABLE

B-1