



## REPORT OF PAVEMENT INVESTIGATION

Guthrie County Road Investigations Guthrie County, Iowa

## AET Report No. P-0020125

**Date:** August 6, 2023

#### **Prepared for:**

Veenstra & Kimm Inc. 3000 Westown Pkwy West Des Moines, IA 50266

Geotechnical 

Materials
Forensic

Environmental
Building
Technology
Petrography/Chemistry

## American Engineering Testing

550 Cleveland Avenue North St. Paul, MN 55114-1804 TeamAET.com • 800.792.6364 August 6, 2023



Veenstra & Kimm Inc. 3000 Westown Pkwy West Des Moines, IA 50266

Attn: Mr. Greg Roth

RE: Report of Pavement Investigation Guthrie County Road Investigations West Des Moines, IA 50266 AET Project No. P-0020125

Dear Mr. Roth:

American Engineering Testing, Inc. (AET) is pleased to present the results of our pavement investigation services for the above-referenced project.

We are submitting an electronic (PDF) version of this report to you. Unless you request otherwise, we will not submit any hard copies of the report.

We appreciate the opportunity to work with you on this phase of the project. Please contact us if you have questions about this report or require further assistance.

Sincerely, **American Engineering Testing, Inc.** 

Jacob O. Michalowski Senior Engineer, Pavement Division E-mail: jmichalowski@teamaet.com Phone: 651.283.2481



## SIGNATURE PAGE

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- APPENDIX D Geotechnical Report Limitations and Guidelines for Use



# 1.0 INTRODUCTION

Veenstra & Kimm Inc. ("V&K") is assisting Guthrie County Engineering Department to evaluate possible options for the rehabilitation of several roads ("Project") in Guthrie County, Iowa. To assist planning and engineering, V&K has retained American Engineering Testing, Inc. (AET) to perform geotechnical exploration and nondestructive pavement testing at the Project to evaluate the roads. This report (AET P-0020125) presents the results of our services for the Project.

# 2.0 SCOPE OF SERVICES

The authorized scope consists of the following services.

- Falling weight deflectometer (FWD) testing of the Project roads
- Ground penetrating radar (GPR) testing on the Project roads
- Engineering evaluation of the Project roads using GPR, FWD, pavement core, and soil boring data to evaluate the existing conditions of the Project roads
- Production of this report summarizing our evaluation of Project roads

In addition to the scope of services AET provided, Allender Butzke Engineers, Inc. (ABE) was contracted by V&K to obtain 46 pavement cores with soil probing and dynamic cone penetrometer (DCP) tests to depths of approximately 4 feet below existing grades. These results were used in our review and analysis of the GPR data, FWD data, and preparation of this report.

These services are exclusively intended to evaluate the Project roads. The scope is not intended to explore for the presence or extent of environmental contamination in the soil or groundwater. Specific details on the analysis performed are described in the sections below and in appendices to this report.

# 3.0 PROJECT INFORMATION

## 3.1 Project location and road

The Project is in Guthrie County, Iowa (Figure 1) and it consists of the following selected roads:

- White Pole Rd, from Frontier Rd to Kelsey Rd (6.40 miles)
- White Pole Rd, from E Grant St to 340th St (1.87 miles)
- White Pole Rd, from Pecan Ave to Sheridan St (2.34 miles)
- White Pole Rd, from Adair St (Menlo) to N Adair St (Stuart) (4.17 miles)
- Wagon Rd, from N 10th St to 248th Trail (9.55 miles)

## 3.2 Traffic data

We consulted the recent traffic information through the Iowa DOT Interactive Traffic Counts Map



Application (TCMap)<sup>1</sup>. These were used for our preliminary FWD analyses that were discussed during the meeting with the V&K, the County and ABE that occurred on August 1, 2023. After the meeting, V&K provided additional and updated traffic information, including trucks count percentages. This new data was used to finalize our analyses and the final report. The available average daily traffic (ADT) for the Project roads ranged from 770 to 3,200 vehicles with a truck traffic (ADTT) ranging from 15 to 20 percent

# 4.0 SUBSURFACE EXPLORATION, ROAD TESTING, AND RESULTS

AET allocated the Project roads (totaling approximately 24.3 centerline miles) into 14 sections according to pavement structure and traffic conditions. Tests and test results on the Project roads are described in the subsections below and summarized in the appended Table 1 and Table 2. We encountered two different pavement structures:

- White Pole Road is surfaced with bituminous pavement (BP) over a Portland cement concrete layer (PCC), considered as bituminous over concrete (BOC).
- Wagon Road is surfaced with PCC

Our classification of the road section follows basic pavement engineering principles to help us organize field/lab activities, analysis, and evaluation. These general classifications are not intended to conflict with or replace state agency road classifications, which rely on as-built information, road histories, agency material classifications, and other matters whose review are beyond the scope described in Section 2.

## 4.1 Subsurface conditions

ABE performed forty-six (46) pavement cores with soil probing and dynamic penetrometer (DCP) to depths of approximately 4 feet below existing grade along the Project road during the timeframe 6/12/23-6/26/23. Collected samples were analyzed to evaluate surfacing material and soil layering and classification. Detailed results of subsurface testing are provided in Appendix A which includes pavement core photographs together with boring logs, and water level measurements. These results are summarized below by road type and structural layer.

<u>Bituminous pavement</u>. From the pavement cores obtained, the pavement had a recovered bituminous pavement thickness ranging from 0.75 to 8.75 inches.

<u>Portland cement concrete pavement</u>. From the pavement cores obtained, the pavement had a recovered Portland cement concrete pavement thickness ranging from 6.5 to 8.25 inches.

- The bituminous layer generally shows low to high severity weathering.
- In seven of the cores, we observed high severity stripping and separation of lifts.

<sup>&</sup>lt;sup>1</sup> Iowa Department of Transportation (2023). Traffic Counts Map Application (TCMap). Available from <u>https://iowadot.maps.arcgis.com/apps/MapSeries/index.html?appid=0cce99afb78e4d3b9b24f8263717f910</u>



- The PCC layer that is underneath the bituminous layer shows presence of medium to high severity cracks propagating mainly horizontally. The concrete layer is delaminated from the bituminous layer above except for core C-3, C-4, C-12, C-13, C-28, and C-33.
- Core C-29 to C-46 are generally solid except for C-32 that shows signs of possible incomplete recovery.
- Core C-24 shows a thin bituminous overlay of 0.75" over a layer of concrete, indicating a localized area with a pavement structure thickness different from the surrounding areas.

<u>Layers directly supporting paved surfaces</u>. Below the pavement materials (BP over PCC and PCC), we observed mostly cohesive soil with high clay content.

## 4.2 Surface course thickness (ground penetrating radar)

The road layer thickness testing program involves the use of a high-speed (air coupled) GPR antenna to collect pavement data that is later analyzed to evaluate layer thicknesses. AET performed GPR testing on approximately 24.3 centerline miles of Project roads on 5/1/23 using a 2 GHz antenna, which allows material layer measurements at depths of 18 inches with a resolution of approximately one-half inch. The GPR data was collected in the driving lanes.

Our analysis of collected GPR data (summarized by road section in Table 1 and Table 2) included statistical analysis to determine 15th-percentile values for each section. Engineers often use the 15th percentile value – instead of an average or mean (the 50th percentile value) – as a structural "safety factor" to represent layer thickness for pavement design purposes.

- The average thickness of bituminous surfacing ranged from 1.5 to 7.4 inches and the thickness of Portland cement concrete layer beneath ranged from 5.5 to 11.3 inches.
- The average thickness of Portland cement concrete surfacing ranged from 6.8 to 7.0 inches.

Assessing layer thicknesses is a matter of engineering judgement. The distinction between layers in the road is not always explicit. Factors influencing definition of radar scans include ambient electromagnetic interference, the presence of moisture, the presence of voids, and the similarity of material layer type between layers. More specific detail, including statistical analysis of GPR data describing average thickness and variability by section, is provided in Appendix B. Figure 2 shows a visual representation of the GPR thicknesses of the bituminous pavement.

## 4.3 Pavement strength (falling weight deflectometer)

Deflection testing was performed on 24.3 centerline miles of the Project roads on 5/1/23, using a Dynatest 8002 falling weight deflectometer (FWD). Locations of FWD tests are indicated in Figure 3. Collected FWD data – along with information described in the sections above – are used to estimate the elastic stiffness of pavement layers using backcalculation analysis according to the method in the AASHTO *Guide for Design of Pavement Structures* (1993) and Texas Department of Transportation (TxDOT) Modulus 7.0 Program for backcalculation.



Our backcalculation results were used to estimate the effective subgrade resilient modulus (Mr), the effective structural number (ESN), k-value and elastic modulus of concrete slab of all Project road sections. As with GPR-based thickness analysis results, the results of backcalculation analysis of collected Project FWD data are summarized below (and in Table 1 and Table 2) using 15th-percentile values.

- The subgrade Mr for all sections ranged from 2.1 to 3.5 ksi.
- The SN value for all sections ranged from 3.5 to 6.7 inches.
- The k-value for all the sections ranged from 68.1 to 89.8 pci.
- The elastic modulus of concrete slab ranged from 2,395 to 3,334 ksi

Additional details of the FWD testing and analysis procedures, including field test data, are provided in Appendix C.

## 4.5 Summary results of testing and road condition rating

As noted above, all road test and survey results, including summary analysis of test data, are reported in Table 1 and Table 2 for 14 paved sections.

# 5.0 EVALUATION OF ROAD CONDITION

#### 5.1 Discussion

We understand the County is evaluating different pavement improvement methods for White Pole Road and Wagon Road. AET met with V&K, the County and ABE on 8/1/2023 to discuss the preliminary results of the FWD backcalculation together with the cores, borings, and GPR data.

We observed the following in review of the data:

- The pavement structure along White Pole Road was classified as BOC (composite layer of bituminous over Portland cement concrete or semi rigid). This classification should be intended for pavement type classification only. Based on the FWD analyses, PASER and core pictures, it appears that a crack and seat rehabilitation method may have been performed in this section of roadway prior to bituminous surfacing, resulting in a behavior of flexible pavement instead of semi rigid pavement.
- Reflective cracks on the bituminous layer propagating from the Portland cement concrete layer are visible along White Pole Road. This is another factor that supports that a crack & seat may have been performed in the past. However, the presence of reflective cracks at regular intervals indicates that the crack and seat did not stop or mitigate the propagation of reflective cracks through the bituminous layer.
- Section S03B shows an average bituminous surface thickness of 4.5 in over a layer of concrete (PCC) with thickness 11.2 inches which describes a different pavement structure if compared to



the other sections along White Pole Road. This section behaves like a semi rigid pavement.

- Section S08B on Wagon Rd, 0.42 mi N of Wagn Ln has an average bituminous thickness of 1.5 inches over a layer of concrete of thickness (PCC) of approximately 7.1. The high deflections, recorded from the FWD on this section, resulted in a low modulus of PCC, which is inconsistent with the results of coring and our GPR analyses Consideration should be given to further investigation along this section, such as targeted FWD test locations and additional cores and borings to understand the condition and strength of the pavement layers and supporting materials
- The surface condition of the pavement was judged through the Pavement Surface and Evaluation Manual for Asphalt, 2013 (PASER) rating ranging from 4 to 5. This rating system result in a PASER rating that describes road condition on a scale of 1 to 10 for bituminous surfaced roads. This rating was limited to a desktop review of the video collected during the GPR testing and should not be taken as a formal pavement condition rating.
  - "Failed" (1), "Very Poor" (2), "Poor" (3), "Fair" (4-5), "Good" (6-7), "Very Good" (8), and "Excellent" (9-10)

Based on the results of the investigation and our conversations with V&K, the County, and ABE, we understand the projects are being considered for different rehabilitation methods. We are providing the following for discussion purposes and your consideration.

Wagon Road (existing PCC)

- Dowel bar retrofit
  - Pros correct faulting, provide load transfer back to joints, does not raise road profile.
  - Cons does not address other distresses in PCC or soft subgrade areas.
- Crack and seat with bituminous overlay
  - Pros Less expensive than reconstruction, removes surface distresses and allows existing PCC to act as base for new bituminous pavement
  - Cons Requires a strong subgrade that doesn't require subgrade repairs, significant rise in road profile, edge drains need to be installed prior to crack and seat.

White Pole Road (existing BOC)

- Bituminous mill and overlay
  - Pros controls grade, provides new surfacing for smooth ride quality.
  - Cons does not address PCC concerns and reflective cracking will return.
- Unbonded concrete overlay (Whitetopping)
  - Pros will provide a long-lasting pavement, corrects ride quality.
  - Cons does not address subgrade concerns, requires some pre-overlay repairs if asphalt surface is in poor condition.



## 5.2 Structural properties of road subgrade

The subgrade type for the project corridor consists of mostly cohesive soil with high clay content. Our FWD backcalculation analysis of the structural properties of the subgrade determined that subgrade soils under White Pole Road had an average 15th-percentile Mr value of 2.9 ksi and under Wagon Road a modulus of subgrade reaction (k-value) of 81.8 pci.

The modulus of subgrade reaction (k-value) along the road surfaced with Portland cement concrete results to be less than 100 pci, with an average 15<sup>th</sup> percentile of 82 pci. This number is in agreement with the information provided by boring logs that report presence of fat clays in many locations. Figure 3A and Figure 3C, respectively, show values of Mr and k-value calculated at each of the tested locations.

## 5.3 Structural properties of road surface layers

We anticipate that the structural capacity of the road surfacing will vary with changes in subgrade support and surfacing thickness. Additional variation may occur due to pavement condition.

- The sections with Portland cement concrete overlaid by bituminous layer have an average 15thpercentile SN of 4.3 inches, with minimum and maximum SN of 3.5 and 6.7 inches, respectively.
- The sections paved with a single layer of Portland cement concrete have an average 15thpercentile elastic modulus of concrete slab 2,888 ksi, with minimum and maximum elastic modulus of concrete of 2,395 and 3,334 ksi, respectively.

Figure 3B and Figure 3D show respectively values of SN and E concrete modulus calculated at each of the tested locations.

5.4 Project Considerations

# 6.0 TEST STANDARDS

When we refer to a test standard (e.g., ASTM, AASHTO) in this report, we mean that our services were performed in general accordance with that standard. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

# 7.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at present time and this location. Other than this, no warranty, express or implied, is intended. Important information regarding risk management and proper use of this report is given in Appendix D, "Geotechnical Report Limitations and Guidelines for Use."



# **Figures and Tables**

Figure 1A – Testing Locations

- Figure 1B Testing Locations
- Figure 1C Testing LocationsFigure 2A Surface Thickness
- Figure 2B Surface Thickness

Figure 2C – Surface Thickness

- Figure 3 Mr
- Figure 3 SN
- Figure 3 k-value
- Figure 3 Modulus of concrete

Table 1 – Summary of evaluation results for Project road BOC sections

Table 2 – Summary of evaluation results for Project road PCC sections



# Appendix A

Geotechnical Field Exploration and Testing Boring Log Notes AASHTO Soil Classification System Unified Soil Classification System Subsurface Boring Logs and Pavement Core Pictures





















Section ID	Road	From	То	Length (mi)	Туре	PASER	Surface Thickness (in)*	Base Thickness (in)*	Mr Subgrade (ksi)*	Structural Number (in)*
S01	White Pole Rd/CTH 925	Frontier Rd	CTH N72	4.0	BOC	5	6.5	7.3	3.5	3.8
S02	White Pole Rd/CTH 925	CTH N72	Kelsey Rd	2.4	BOC	5	7.3	5.8	3.0	4.2
S03A	White Pole Rd/CTH 925	E Grant Rd	0.87 mi E	0.9	BOC	4	7.0	7.0	2.8	5.1
S03B	White Pole Rd/CTH 925	0.87 mi E of E Grant Rd	0.37 mi E	0.4	BOC	4	4.5	11.2	3.4	6.7
S03C	White Pole Rd/CTH 925	0.45 mi W	STH 25	0.5	BOC	4	7.9	8.3	3.1	3.7
S04	White Pole Rd/CTH 925	STH 25	CTH P20	2.0	BOC	4	6.6	7.2	2.2	3.5
S05	White Pole Rd/CTH 925	CTH P20	Seridan St	0.3	BOC	4	6.7	8.2	2.8	4.5
S06	White Pole Rd/CTH 925	Adair St (Menlo)	340th St	1.9	BOC	4	6.7	7.2	2.4	3.5
S07	White Pole Rd/CTH 925	340th St	N Adair St (Stuart)	1.9	BOC	4	6.8	7.4	2.1	3.7
S08B	White Pole Rd/CTH 925	0.42 mi N of Wagon Ln	0.2 mi N	0.2	BOC	5	1.5	7.1	3.5	**



\* - 15th Percentile Values

\*\*- Inconclusive

Section ID	Road	From	То	Length (ft)	Туре	PASER	Surface Thickness (in)*	Base Thickness (in)*	Modulus of Subgrade Reaction k- value (pci)*	Elastic Modulus of Concrete Slab (ksi)*
S08A	Wagon Rd/CTH P28	N 10th St	2.06 mi N	2.1	PCC	5	7.2		68.1	2394.5
S08C	Wagon Rd/CTH P28	2.44 mi S	Bridge	2.4	PCC	5	7.1		80.3	2822.0
S09	Wagon Rd/CTH P28	Bridge	280th Rd	1.8	PCC	5	6.9		89.0	3334.0
S10	Wagon Rd/CTH P28	280th Rd	CTH F51 N Jct	3.1	PCC	5	6.9		89.8	3002.0

\* 15th Percentile Values

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#### DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
AR:	Sample of material obtained from cuttings blown out
	the top of the borehole during air rotary procedure.
B, H, N:	Size of flush-joint casing
CAS:	Pipe casing, number indicates nominal diameter in
	inches
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
DP:	Direct push drilling; a 2.125 inch OD outer casing
	with an inner 1 <sup>1</sup> / <sub>2</sub> inch ID plastic tube is driven
	continuously into the ground.
FA:	Flight auger; number indicates outside diameter in
	inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter
10	In Inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of
N (DDE).	Standard population registeries (N. value) in blows per
N (BPF):	Standard penetration resistance (N-value) in blows per
NO	NO wireline core barrel
NQ.	NQ witeline core barrel
PDA	Rotary drilling with compressed air and roller or drag
KDA.	bit.
RDF:	Rotary drilling with drilling fluid and roller or drag bit
REC:	In split-spoon (see notes), direct push and thin-walled
	tube sampling, the recovered length (in inches) of
	sample. In rock coring, the length of core recovered
	(expressed as percent of the total core run). Zero
	indicates no sample recovered.
SS:	Standard split-spoon sampler (steel; 1.5" is inside
	diameter; 2" outside diameter); unless indicated
	otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in
	inches
WASH:	Sample of material obtained by screening returning
	rotary drilling fluid or by which has collected inside
	the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and
WD.	nammer
WK:	O4 millimator wiraling core barrel
94mm: ▼.	94 minimeter whenne core darrei Weter level directly measured in horing
<u>•</u> .	water level uneculy measured in borning

 $\overline{\bigtriangledown}$ : Estimated water level based solely on sample appearance

#### TEST SYMBOLS

Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field;
	L - Laboratory
PL:	Plastic Limit, %
$q_p$ :	Pocket Penetrometer strength, tsf (approximate)
$q_c$ :	Static cone bearing pressure, tsf
$q_u$ :	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent
	(aggregate length of core pieces 4" or more in length
	as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remolded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve

#### STANDARD PENETRATION TEST NOTES

#### (Calibrated Hammer Weight)

The standard penetration test consists of driving a split-spoon sampler with a drop hammer (calibrated weight varies to provide  $N_{60}$  values) and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM: D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

#### AASHTO SOIL CLASSIFICATION SYSTEM AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

Cleasification of	Calle	ام مر م	Call A mana mata	Mischung
Classification of	Solis	ana	Soll-Aggregate	wixture

				55.5							
			Gra		Silt-Clay Materials						
General Classification		(3	5% or less		(More than 35% passing No. 200 sieve)						
	A	-1		A-2							A-7
Group Classification	A 1 a	A 1 h	A 2	A 2 4	A 2 5	A 2 6	A-2-7	A-4	A-5	A-6	A-7-5
	A-1-a	A-1-0	A-3	A-2-4	A-2-3	A-2-0					A-7-6
Sieve Analysis, Percent passing:											
No. 10 (2.00 mm)	50 max.										
No. 40 (0.425 mm)	30 max.	50 max.	51 min.								
No. 200 (0.075 mm)	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.
Characteristics of Fraction Passing No. 40 (0.425 mm)											
Liquid limit				40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.
Plasticity index	6 m	nax.	N.P.	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.
Usual Types of Significant Constituent Materials	Stone Fragments, Gravel and Sand		Fine Sand	Silty or Clayey Gravel and Sand			Sand	Silty Soils		Clayey Soils	
General Ratings as Subgrade	Exc	cellent to G	ood			Fair to Poor					

The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30.

Group A-8 soils are organic clays or peat with organic content >5%.



#### Definitions of Gravel, Sand and Silt-Clay

The terms "gravel", "coarse sand", "fine sand" and "silt-clay", as determinable from the minimum test data required in this classification arrangement and as used in subsequent word descriptions are defined as follows:

GRAVEL - Material passing sieve with 3-in. square openings and retained on the No. 10 sieve.

COARSE SAND - Material passing the No. 10 sieve and retained on the No. 40 sieve.

 $\mathsf{FINE}\ \mathsf{SAND}\ \mathsf{-}\ \mathsf{Material}\ \mathsf{passing}\ \mathsf{the}\ \mathsf{No}.\ 40\ \mathsf{sieve}\ \mathsf{and}\ \mathsf{retained}\ \mathsf{on}\ \mathsf{the}\ \mathsf{No}.\ 200\ \mathsf{sieve}.$ 

COMBINED SILT AND CLAY - Material passing the No. 200 sieve

BOULDERS (retained on 3-in. sieve) should be excluded from the portion of the sample to which the classification is applied, but the percentage of such material, if any, in the sample should be recorded.

The term "silty" is applied to fine material having plasticity index of 10 or less and the term "clayey" is applied to fine material having plasticity index of 11 or greater.



#### 01CLS022 (07/11)

#### UNIFIED SOIL CLASSIFICATION SYSTEM ASTM Designations: D 2487, D2488





										ENGINEERING TEST		
Critoria fo	vr Assigning Group Su	mbols and Group N	Jamas Using La	oratory TastsA	Crown	Soil Classif	ication	A	Pasad on the me	Notes		
Chiena io	a Assigning Gloup Syl	moors and Group N	vallies Using La	boratory rests	Symbo	ol Gre	Sup Name-	(7	5 sased on the ma 75-mm) sieve.	terial passing the 3-in	n	
Coarse-Grained Soils More	Gravels More than 50% coarse	Clean Gravels Less than 5%	$Cu \ge 4$ and	l≤Cc≤3 <sup>E</sup>	GW	Well gra	nded gravel <sup>F</sup>	B] bo	f field sample co oulders, or both,	ontained cobbles or add "with cobbles o	or	
than 50% retained on	fraction retained on No. 4 sieve	fines <sup>C</sup>	Cu<4 and/	or 1>Cc>3 <sup>E</sup>	GP	Poorly g	Poorly graded gravel		<sup>F</sup> boulders, or both" to group name. <sup>C</sup> Gravels with 5 to 12% fines requi			
No. 200 sieve		Gravels with Fines more	Fines classify as ML or MH		GM	Silty gra	wel <sup>F.G.H</sup>	sy	-graded gravel with si	ilt		
		than 12% fines <sup>C</sup>	Fines class	ify as CL or CH	GC	Clayey §	gravel <sup>F.G.H</sup>	GW-GM weil-graded GW-GC well-graded GR GM poorly grad		graded gravel with cla	ay silt	
	Sands 50% or more of coarse	Clean Sands	$Cu \ge 6$ and	l <u>≤</u> Cc <u>≤</u> 3 <sup>E</sup>	SW	Well-gra	aded sand <sup>I</sup>	De	GP-GC poorly graded gravel with st GP-GC poorly graded gravel with cla <sup>D</sup> Sands with 5 to 12% fines require dual			
	fraction passes	fines <sup>D</sup>	Cu<6 and/	or 1>Cc>3 <sup>E</sup>	SP	Poorly-g	graded sand	sy	araded sand with silt			
		Sands with Fines more	Fines class	ify as ML or MH	SM	Silty sar	d <sup>G.H.I</sup>		SW-SC well-g SP-SM poorly	raded sand with clay graded sand with silt	t	
		than 12% fines D	Fines class	ify as CL or CH	SC	Clayey s	sand <sup>G.H.I</sup>		SP-SC poorly	graded sand with clay	y	
Fine-Grained	Silts and Clays	inorganic	PI>7 and p	lots on or above	CL	Lean cla	y <sup>K.L.M</sup>		1 5	$(D_{20})^2$		
more passes	than 50		PI<4 or plo	ots below	ML	Silt <sup>K.L.M</sup>		E(	$Cu = D_{60} / D_{10}$	$Cc = \frac{(D_{30})}{D_{10} \times D_{10}}$		
sieve		organic	Liquid lim	it_oven dried <0.75	, OL	Organic	clay <sup>K.L.M.N</sup>			D <sub>10</sub> X L	$D_{60}$	
(see Plasticity			Liquid lim	it – not dried	,	Organic	Organic silt <sup>K.L.M.O</sup>		FIf soil contains $\geq 15\%$ sand, add "w sand" to group name.			
Chart below)	Silts and Clays	inorganic	PI plots on or above "A" line CH Fat clay <sup>KLM</sup>						f fines classify a mbol GC-GM,	as CL-ML, use dual or SC-SM.		
	Liquid limit 50 or more		PI plots be	low "A" line	МН	Elastic s	ilt <sup>K.L.M</sup>	H] fi	If fines are organ nes" to group na	ic, add "with organic ame.	с	
		organic	Liquid lim	it over dried to 7	- OH	Organic	Organic clay <sup>K.L.M.P</sup> Organic silt <sup>K.L.M.Q</sup>		f soil contains <pre>&gt; ravel" to group r</pre>	15% gravel, add "with name.	:h	
		e e	Liquid lim	it – not dried $<0.75$	5	Organic			f Atterberg limit oil is a CL-ML s	s plot is hatched area, ilty clay.	ι,	
Highly organia			Drimorily	organia mattar	darl PT	PoatR		K	íf soil contains 1	5 to 29% plus No. 20	00	
soil			in color, a	nd organic in odo	or	1 cat		ac w	ld "with sand" o hichever is pred	r "with gravel",		
								L	f soil contains >	30% plus No. 200.		
	SIEVE ANALYSIS		.60			1			predominantly	sand, add "sandy" to	0	
-Screen Opening	(in.) Sieve Number		For classifi fine-graine	cation of fine-grained soils and d fraction of coarse-grained so	d <u>pils</u> .				group name.	-		
.100	<b>%</b> <u>4</u> <u>10</u> <u>20</u> <u>40</u> <u>60</u> <u>140</u> <u>2</u>	00 . 0	50-	( 1 A 1 1			$\wedge$	M	If soil contains <u>&gt;</u>	<u>&gt;</u> 30% plus No. 200,		
			Horizontal	at PI = 4 to LL = 25.5.	LUNE .	A INE			predominantly	gravel, add "gravelly	y"	
.80		.20	40	0.73 (LL-20)	<u> </u>			N	to group name			
	Du = 15mm	INE	∠ Equation of Vertical at	f "U"-line LL = 16 to PI = 7.	<u></u>				$\frac{21}{4}$ and plots of	n or above "A" line.		
SE .60		.40	2 30 then PI =	0.9 (LL-8)					Plate or pious bei	ow A line.		
E H		H. LF	-AST					Q	Pl plots below "	Δ" line		
-40 Д. 40	Do = 2.5mm	.60 🛱	료 <sub>. 20</sub> –		<u>&gt;</u>			R	Fiber Content de	scription shown belor	w	
8		E			/ MH				iber content de	semption shown bero		
.20		.80 Dra = 0.075mm	.10									
			4 /////									
.0 uluuri 50 ti	0 5 1:0 0:5 0:1	1.100 L	.0 0 .10	.16 20 .30 .40	50 .60	.70 .80	.90 .100	.110				
PARTICLI	e size în millimeters				LIQUID LIMIT (LL)							
$C_u = \frac{D_{00}}{D_{10}} = \frac{.15}{.0.075} =$	= 200 $C_{c} = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{2.5^2}{0.075 \times 15} =$	5.6			Plasticity Char	rt						
	ADDIT	IONAL TERMIN	OLOGY NOT	ES USED BY AE	T FOR SOIL I	DENTIFICA	TION AN	D DESCR	IPTION			
Term	<u>Grain Size</u> Particle S	Size	<u>Gravel Pe</u> Term	ercentages Percent	Consister Term	ncy of Plastic N-Va	<u>: Soils</u> due, BPF	Re Terr	<u>lative Density c</u> m	of Non-Plastic Soils N-Value, BPF	-	
Boulders	Over 1	2"	A Little Gravel	3% - 14%	Very Soft	100	than ?	Verv	– Loose	0 - 4		
Cobbles	3" to 1	2" v	With Gravel	15% - 29%	Soft	2	2 - 4	Loose	20050	5 - 10		
Gravel	#4 sieve	to 3" C	Gravelly	30% - 50%	Firm	4	5 - 8	Mediu	um Dense	11 - 30		
Sand	#200 to #4	4 sieve			Stiff	9	- 15	Dense	÷	31 - 50		
Fines (silt & cl	lay) Pass #200	sieve			Very Stiff	10	5 - 30	Very	Dense	Greater than 50	)	
Мо	isture/Frost Condition		Laverin	g Notes	Hard Pea	Great at Description	er than 30	C	Organic Descript	ion (if no lab tests)		
D (Dm/):	(MC Column)	a dusty dry to				* · ·		Soils ar	e described as <u>o</u>	<u>organic</u> , if soil is not	peat	
D (Diy).	touch.		Laminations: La	yers less than	Term	Fiber (	Content Estimate)	content	to influence the	Liquid Limit proper	rties.	
M (Moist):	Damp, although free visible. Soil may sti	e water not ill have a high	42 di	ffering material		<u>(visual</u>		<u>Slightly</u>	organic used fo Root Inclu	r borderline cases.		
	water content (over	"optimum").	01	color.	Fibric Peat:	Greater	than $67\%$	With ro	ots: Judged to	have sufficient quant	tity	
W (Wet/	Free water visible, in	ntended to T	ancac n	ockets or lavor	Hemic Peat:	33 – 6 L coo th	01% an 33%		of roots to	o influence the soil		
Waterbearing):	: describe non-plastic	soils.	Juises. P	reater than 1/4"	Sapric reat:	Less III	an 5570	-	properties	3.		
	Waterbearing usuall	y relates to	gi th	ick of differing				Trace re	oots: Small roo	ts present, but not jud	iged	
E (Erozon):	sands and sand with	siit.	m	aterial or color.					to be in su	the affect soil properti	ies	
r (riozen).	JOII HOZEII				1			1	significali	ay anect son properti	.ius.	

01CLS021 (01/2022)

# ALLENDER BUTZKE ENGINEERS INC





July 6, 2023

Guthrie County c/o Veenstra & Kimm, Inc. 3000 Westown Parkway West Des Moines, IA 50266 Attn: Greg Roth, P.E. RE: Geotechnical Exploration Guthrie County Pavement Cores White Pole Road | Co. Hwy P28 Guthrie County, Iowa PN 221438

Dear Mr. Roth:

Enclosed you will find the Laboratory/Field Test Results and Core Logs for the above referenced project. Forty-six pavement cores with soil probing and dynamic cone penetrometer (DCP) tests to depths of 4 feet below existing grades were conducted at each location on June 12 through 14, 21 through 23, and 26, 2023. Moisture content tests were performed on the subgrade soil samples at about each foot encountered below the pavement in the cores. Approximate locations of the borings are shown on the enclosed Site Plans. Boring locations and ground surface elevations were provided by Veenstra & Kimm, Inc. Geotechnical subgrade and pavement thickness analyses were not in ABE's scope of services.

The pavement cores in Core Nos. 1 through 28 on White Pole Road from Adair to Stuart generally consisted of 5.75 to 8.75 inches of hot mix asphalt (HMA) overlying 6.75 to 11.75 inches of Portland cement concrete (PCC). Pavement in Core Nos. 29 through 46, conducted on Co. Hwy P28, north of Stuart, generally consisted of 6.5 to 9.25 inches of PCC. Pavements at the core locations were supported directly on mostly high clay content cohesive soil subgrades.

We appreciate the opportunity to provide our services for this project. If you have any questions or need further assistance, please contact us at your convenience.

Respectfully submitted, ALLENDER BUTZKE ENGINEERS INC.

Anton J. Schneider Jr., P.E. Project Engineer

David Logemann, P.E. Senior Principal Engineer

1 PC and Email Above Email AET; Attn: Jacob Micalowski, and Guthrie County; Attn: Joshua Sebern & Evan Subbert

				CORE	NO	1	Project	No.:	221438
Projec	t: <u>Wh</u> <u>Gut</u>	ite Pole hrie C	e Road and I ounty, Iowa	28 Pavem	nent Cores	221438 B-		TOP INCHES	
Client:	<u>Vee</u> <u>300</u>	nstra & 0 West	& Kimm, Inc zown Pkwy	2		_		3 3 4	
	We	st Des ]	Moines, IA 5	0266		-		5	
Date D Drilling Surfac Datum	Drillec g Met æ Ele n:	l: hod: _ evation	6/2 Core, DCP : Site Su	2/2023 ', and Han 1383.0' irvey	d Probe			7 8 9 10	
Remar	ks:							11 12 13 14 14 15 16	
Elevation ft.	Depth ft.	Moisture Content, %	California E Correlated from Penetrometer	Bearing Ra m Dynamic Cc r (ASTM D695	ntio one 1)	Material Description*	Graphic Log	nscs	Water Level Depth Elevation ft.
	0					HMA (7.0'')			0.6
1382.4 -						PCC (9.75'')			1382.4
_	- 1.8	24.1			Brov	vn lean to fat clay, moist B-HORIZON LOESS		CL- CH	1381.6
1380.6 -	- 3.6	26.5			Brow	vn-gray lean clay, very moist LOESS		CL	1380.7 -
1378.8 –	-	20.2			End of	f Boring			4.3 - 1378.7
	- 5.4								_
The s	stratifica W	ation line: /ater Lev	s represent the a el Observation	pproximate b	oundary lines	between material types: in-situ, the transition		dual.	
Time: Depth to	at c	ompletio	on	hrs.	ALL	otechnical   Environmental   C	onstruct	Kð,	
water:	U	ry n.	· =	II. =			.onsu uct		<u>ر.ب.</u>

					COR	E NO		2			Project	No.:	22	<u>1438</u>
Projec	Project: White Pole Road and P28 Pavement Cores Guthrie County, Iowa								2214	38 B-2	2	OP INCHES		
Client: Veenstra & Kimm, Inc. <u>3000 Westown Pkwy</u> West Des Moires, IA 50266												2		
Date D Drilling Surfac Datum	Drilleo g Met ce Ele n:	t: hod: _ vation	Cor	<u>6/2</u> <u>6/2</u> <u>6, DCI</u> <u>Site S</u>	22/2023 P, and Ha 1345.3' urvey	and Pro	obe					5 6 7 8 9		
Remar	ks:													
Elevation ft.	Depth ft.	Moisture Content, %	Cal Cor Pe	ifornia	Bearing R om Dynamic ( er (ASTM D69	Cone 051)		Materia	l Descriptio	n*	Graphic Log	nscs	Water Level	Depth  Elevation ft.
	0							HN	MA (7.5'')					0.6
1344.6 -	- - - 1.8	16.9					Brown gravel,	P( to brown-gray moist	CC (7.5")	fat clay, trac	ce	CL- CH		<u>1344.7</u> <u>1.3</u> <u>1344.1</u>
1342.8 -	-  3.6	21.1				13→	Mixed	with dark gray	<b>FILL</b> after 2.8'					-
1341 -	-	17.1					End of B	oring						<u>4.0</u> 1341.3 - -
	- 5.4													_
*The s	stratific	ation line	s repres	sent the a	approximate	boundar	ry lines bet	ween material	types: in-situ, th	e transition	may be gra	dual.		
Time:	at c	ompletion	on	avation	hrs.	A	ALLE	NDER 1	BUTZKE	E ENG	INEE	RS,	IN	<b>IC.</b>
Depth to water:	D	<b>'ry</b> ft.			ft. 🕎		Geote	echnical	Environme	ental   Co	onstruct	ion (	<u>).</u> C	•

	CORE NO	)3	Project No.: 221438
Project: <u>White Pol</u> <u>Guthrie C</u>	le Road and P28 Pavement County, Iowa	<u>Cores</u> 221438 B-	·3
Client: <u>Veenstra</u> <u>3000 Wes</u> <u>West Des</u>	& Kimm, Inc. town Pkwy Moines, IA 50266		
Date Drilled: Drilling Method: Surface Elevatior Datum:	6/23/2023 Core, DCP, and Hand Pr 1: 1391.0' Site Survey	robe	
Remarks:			
Elevation ft. Depth ft. Moisture Content, %	California Bearing Ratio Correlated from Dynamic Cone Penetrometer (ASTM D6951)	Material Description*	Graphic Log USCS Water Level Depth Elevation ft.
0		HMA (7.25")	0.6
-		REINFORCED PCC (7.75'')	
1389.6 - 1.8 20.3		Brown lean to fat clay, moist B-HORIZON LOESS	CL- CH CH 25
1387.8 19.9	22=	Brown-gray lean clay, very moist LOESS Sandy after 3'	CL 1388.5
1386 -	18	End of Boring	4.0
The stratification line	es represent the approximate bounda	iry lines between material types: in-situ, the transition	n may be gradual.
Water Lev Time: at completi	on hrs.	ALLENDER BUTZKE ENG	GINEERS, INC.
Depth to water: Dry f	t. 茔 ft. 🕎	Geotechnical   Environmental   C	Construction Q.C.

						C	ORI	e no	•	4						Pro	oject	No.:	22	:1438	
Project: <u>White Pole Road and P28 Pavement Cores</u> <u>Guthrie County, Iowa</u>													2.	214	38 E	3-4		Р снез			
Client: <u>Veenstra &amp; Kimm, Inc.</u> 3000 Westown Pkwy																	2 3 4				
West Des Moines, IA 50266																5					
Date Drilled:   6/23/2023     Drilling Method:   Core, DCP, and Hand Probe																	6 7 8				
Datum		evation		Site	Sur	136 vey:	1.0								1			9			
Remark	ks:																	10 11 11 12 13 13 14 14 15 16			
Elevation ft.	Depth ft.	Moisture Content, %	Cor Pe	liforni rrelated enetrom	from	Dyna (ASTI	ng R amic C M D69	atio cone 51)			Material Description*						Graphic Log	nscs	Water Level	Depth  Elevation	ft.
_	0					,						HM	A (7.25	")						0.6	
1360.8												PC	C (7.75	")						1361.0	
	- 1.8	16.3			Ĺ			15→	Dark b fat clay	brov ay, d	vn mix lamp	ed wit	h brown	n and c	lark gray	/ lean to		CL- CH		1360.4	
1359 -	- 2 6	16.7						$\begin{array}{c} 22 \rightarrow \\ 28 \rightarrow \\ 33 \rightarrow \\ 25 \rightarrow \\ 39 \rightarrow \\ 25 \rightarrow \\ 16 \rightarrow \end{array}$	Brown	n sai PR	ndy lea	n to fa	at clay, AN GL	trace g	ravel, m L <b>TILL</b>	oist		CL- CH		1359.1	-
1357.2 -	- 3.0	16.9						33→ 18→ 39→ 11→	End of H	Bori	ing									4.0 1357.6	-
	- 5.4	ation line	s repre	sent th	e api	proxii	mate I	bounda	ry lines be	etwe	een ma	terial tv	ypes: in⋅	∙situ, th	e transiti	on mav	be gra	dual.			_
Time:	V at c	/ater Lev	el Obs	ervatio	n		hre		ALLE	EN		R B	BUTZ	ZKF	E EN	GIN		RS,	I	NC.	
Depth to water:	D	ry ft	, <u>–</u>			ft.	<u> </u>		Geot	otec	hnica	al   ]	Envire	onme	ntal	Cons	truct	ion (	Q.C	<b>1</b> ~•	

				CORE	NO	5	Project	No.:	221438
Projec	t: <u>Wh</u> <u>Gu</u> t	ite Pol thrie C	e Road and P ounty, Iowa	28 Paven	nent Cores	221438 B-	-5	ОР	
Client:	<u>Vee</u> <u>300</u> We	enstra a 0 West st Des 1	& Kimm, Inc. own Pkwy Moines, IA 54	0266				2 3 4 5	
Date D Drilling Surfac Datum	Drilleo 9 Met e Ele ::	d: hod: _ evation	6/23 Core, DCP, .: Site Su	3/2023 , and Han 1349.3' rvey	d Probe			6 7 8 9 9	
Remark	ks:							10 11 12 13 13 14 15 15	
Elevation ft.	Depth ft.	Moisture Content, %	California B Correlated fron Penetrometer	Dearing Ra	ne 1)	Material Description*	Graphic Log	nscs	Water Level Depth Elevation
-	0					HMA (7.25'')			0.6
1348.2 –					Brow	PCC (8.5")		CI	1348.7 1.3 1348.0
-	- 1.8	17.2			grave	el, moist		CH	15+0.0
1346.4 –		19.0				PRE-ILLINOIAN GLACIAL TILL			
	- 3.6	18.9			End of	Boring			4.0
1344.6 -	- 5.4								
*The s	tratific	ation line	s represent the ap	proximate bo	oundary lines	between material types: in-situ, the transitio	n may be gra	dual.	
Time:	۷ at c	vater Lev completio	el Observation	hrs.	ALL	ENDER BUTZKE ENG	GINEE	RS,	INC.
water:	D	ry ft	. 🔄 🔄	ft. 🖳	Geo	otechnical   Environmental   G	Construct	ion (	J.C.

						CC	)RI	e nc	)	6						Pro	ject	No.:	22	1438	5
Projec	t: <u>Wh</u> <u>Gu</u> t	<u>ite Pole</u> thrie C	<u>e Roa</u> ounty	<u>ıd an</u> y, Iov	nd P2 wa	28 Pa	<u>ivei</u>	<u>nent</u>	Cores				22	2143	38 B-	-6	TO	DP NCHES 1			
Client:	Vee	<u>nstra &amp;</u>	<u>&amp; Kir</u>	nm,	Inc.													3			
	<u>300</u>	0 West	<u>own</u>	<u>Pkw</u>	<b>y</b>													4			
	<u>We</u>	st Des I	Moin	<u>es, L</u>	A 50	266												5			
Date D Drilling Surfac Datum	Drilleo g Met ce Ele n:	1: hod: _ vation	Cor :	re, D Site	6/23 CP, e Sur	2023 and 1287 tvey	3 Hai '.4'	nd Pı	robe									6 7 8 9			
Remar	ks:														A REALIZED			10 11 12 13 14 15 16			
Elevation ft.	Depth ft.	Moisture Content, %	Cal Cor Pe	liforn rrelated	d from	Dynar (ASTM	g Ra nic C D69	atio one 51)	_	Material Description*							Graphic Log	nscs	Water Level	Depth	Elevation ft.
1287 -	0						Т					НМ	A (7.25	5'')						0.6	
1207	-											PC	С (8.25				6.44 A			1286	.8
-	-	-							Red to	o rec	l-brow	n with	grav-h	orown s	andv at o	lav.	17	СН	$\vdash$	$\frac{1.3}{1286}$	
	- 1.8	19.3			7				trace	grav	el, moi	st	8, -			<b>j</b> ,					_
1285.2	-	18.0		<	$\bigvee$					PRE-ILLINOIAN GLACIAL TILL											_
1283 4 -	- 3.6	17.0						>												4.0	
1281.6	- - - 5.4							15-	≝ End of	Bori	ing									1283	.4 -
*The s	- stratific	ation lines	s repre	sent th	he ap	proxim	ate I	ounda	ary lines b	betwe	en mat	erial ty	ypes: in	-situ, th	e transitio	on may	be gra	dual.			
Time:	۷ at c	/ater Leve completic	el Obse on	ervatio	on	h	rs.		ALL	EN	[DE]	R E	BUT	ZKF	E EN	GIN	EE	RS,	I	JC.	
Depth to water:	D	<b>ry</b> ft.	. 🕎			ft.	Ţ		Geo	otec	hnica	1   ]	Envir	onme	ental	Cons	truct	ion (	Q.C	1	

					С	ORI	E NO	•	7				Proj	ject l	No.:	22	1438
Projec	t: <u>Wh</u> <u>Gut</u>	<u>ite Pole</u> thrie C	e Roa ounty	d and ( y, Iowa	P28 I	Paver	ment (	Cores			221	438 B-	7		TOP INCHES		
Client: Veenstra & Kimm, Inc. 3000 Westown Pkwy West Des Moines, IA 50266											•				2		
Date Drilled:       6/23/2023         Drilling Method:       Core, DCP, and Hand Probe         Surface Elevation:       1251.5'         Datum:       Site Survey																	
Remar	ks:														9 - 10 - 11 - 12 - 13 - 14 - 14 - 15		
Elevation ft.	Depth ft.	Moisture Content, %	Cal Cor Pe	ifornia related fro	Beari	ng Ra amic C M D69	atio Cone 51)		Material Description*						nscs	Water Level	Depth  Elevation ft.
	0		1		Ť	1				HN	MA (6.75"	)				$\left  \right $	0.6
										PO	CC (7.25''	)		0.44 0 0.46			1250.9
	- 1.8	18.3		$\leq$				Dark b trace g	orown gravel	with bro , moist	own-gray s	andy lean to fa	t clay,		CL- CH		1.2
1249.2  	- 3.6	15.5			כ			Less s	FILL Less sand after 3'								-
1247.4	-	18.1				-		End of I	Borin	5				~~~			4.0 1247.5
	- 5.4														1		-
1 <u>245.6</u> *The s	stratifica	ation line:	s repre	sent the a	approxi	mate I	boundar	l ry lines be	etwee	n material	types: in-s	itu, the transitio	n may b	be gra	dual.		
<b>_</b> .	V	/ater Lev	el Obse	ervation				ALLE	ENI	)ER	BUT7	KE ENG	GIN	EE	RS.	IN	JC.
Depth to water:	at c D	ompletic <b>ry</b> ft	on Ţ		 ft	nrs.		Geo	tech	nical	Enviro	nmental   (	Const	ructi	~, ion (	2.C	

					CORI	E NO.		8	Project	No.:	221	<u>438</u>			
Project: <u>White Pole Road and P28 Pavement Cores</u> <u>Guthrie County, Iowa</u>								221438 B-	8 • • • •	р Энз 1					
Client: Veenstra & Kimm, Inc. <u>3000 Westown Pkwy</u> West Des Moines 1A 50266										2 3 4 5					
Date Drilled:       6/23/2023         Drilling Method:       Core, DCP, and Hand Probe         Surface Elevation:       1245.1'         Datum:       Site Survey										6 7 8 9 9					
Remark	KS:									11_ 12 - 13 - 14 - 15 - 16					
Elevation ft.	Depth ft.	Moisture Content, %	Cal Corr Per	ifornia E related fror netrometer	Bearing Ranne R (ASTM D69	one 51)		Material Description*	Graphic Log	nscs	Water Level Denth	Elevation ft.			
	0				5			HMA (8.5'')			-	0.7 -			
1243 8 -								PCC (8.25'')	0.44 1.0 0.44 0.44 0.44 0.44 0.44 0.44 0		1	244.4 1.4			
-	- 1.8	24.8					Very o	lark gray lean to fat clay, moist FILL		CL- CH	1	243.7 _			
1242	- 3.6	31.0	~			Eı	End of Boring 4.0								
1240.2	- 5.4		JJ									_			
*The st	tratifica V	ation line /ater Lev	s repres el Obse	sent the ap ervation	oproximate l	ooundary li	ines b	etween material types: in-situ, the transition	may be gra	dual.	<b>TN</b> T				
Time: Depth to	at c	completio	on ⊻		hrs. ft ⊻		LLI Geo	LNDEK BUTZKE ENG	JINEE	KS,	IN(	U.			


				CORE	E NO	•	10	Project	No.:	221	438
Projec	ct: <u>Wh</u> <u>Gu</u>	ite Pole thrie C	e Road and P ounty, Iowa	28 Paven	nent (	Cores	221438 B-1	0	TOP INCHES		
Client	: <u>Vee</u> <u>300</u>	enstra & 0 West	& Kimm, Inc. own Pkwy						<u> </u>		
	We	st Des 1	Moines, IA 50	266					5		
Date I Drillin Surfac Datun	Drilleo g Met ce Ele n:	d: thod: _ evation	6/26 Core, DCP, :	/2023 and Har 1239.2' rvey	nd Pro	obe			6 7 8		
Rema	rks:								9 10 11 11 12 13 14 15		
Elevation ft.	Depth ft.	Moisture Content, %	California B Correlated from Penetrometer	Dynamic Co	atio one 51)		Material Description*	Graphic Log	USCS	Water Level	Elevation ft.
	0						HMA (7.0'')			-	0.6
1238.4 -	-						PCC (6.75'')	ः स्ट ः ०. ०. •		]	1238.6 1.2
-	- 1.8 	31.0				Very	dark gray lean to fat clay, moist		CL- CH	1	-
1236.6 —	-	30.4		Z		C.1.	COHESIVE ALLUVIUM				-
	- 3.6 -	33.7		2	<b>20</b> → 28→	Silty	with dark gray after 3.5				4.3 -
1234.8 -	_				<u>3</u> 9→	End of	Boring				1234.9
-	- 5.4										_
*The	_ stratific	ation lines	s represent the ap	proximate b	oundar	y lines l	petween material types: in-situ, the transitior	may be gra	dual.		
Time:	V at c	Vater Lev completio	el Observation	hrs.	A	<b>ALL</b>	ENDER BUTZKE ENG	GINEE	RS,	IN	C.
Depth to water:	) D	<b>)ry</b> ft.	<u> </u>	ft. 🕎		Geo	otechnical   Environmental   C	Construct	ion (	<b>J</b> .C.	

			CORE NO	)	11	Project	No.:	221438
Projec	et: <u>Wh</u>	ite Pol	e Road and P28 Pavement	Cores	221438B-1	1		
	<u>Gut</u>	thrie C	ounty, Iowa				TOP	
					-		1	
Client:	Vee	enstra d	& Kimm, Inc.				3	
	<u>300</u>	0 West	town Pkwy		-		4	
	We	st Des ]	Moines, IA 50266		-		5	
Date D	Drilled	d:	6/26/2023				6	
Drilling	g Met	hod:	Core, DCP, and Hand Pr	robe			- 7	
Surfac	e Ele	evation	:1238.5'				8	
Datum	ו:		Site Survey			at the	9	
Domor	koj					C C C	10	
Remar	KS:					-20	11	
							12	
							13	
							14	
						C. W	15	
			Colifornio Decrine Dotio				16	
ation	ţ,	ture nt, %	California Bearing Ratio	_		g	လို	th bth ation
Eleva ft.	Dep ft.	Mois	Correlated from Dynamic Cone Penetrometer (ASTM D6951)		Material Description	Grap Lo	NS(	Dep Dep Eleva
1220 4	0	0	5					
1238.4	-				HMA (7.5'')	805 (525)		0.6
	-				PCC (7.0")		2	1237.9
-	-			Very	dark brown with dark gray lean to fat clay	у, 🎇	CL-	1237.3
1236.6 -	- 1.8	21.2		mois	FILL		СН	-
-	-			Dark	grav lean to fat clay moist		CL-	2.3
-	-	23.6		Durk	gruy louit to fut only, moist		CH	1250.2
-	-	23.0			COHESIVE ALLUVIUM			
1234.8 -	- 3.6			Very	dark gray silty, very moist after 3.5'			-
-	-	24.3						4.3
	-			End of	Boring			1234.2
-	-							
1233 -	- 5.4							
*=	-						L	
I he s	stratifica W	ation line: Vater I ev	s represent the approximate bounda el Observation	ary lines	between material types: in-situ, the transition	i may be gra	idual.	
Time:	at c	completio	on hrs.	ALL	ENDER BUTZKE ENG	GINEE	RS,	INC.
Depth to water:	D	rv ft	. ऱ⊑ft. Ψ	Geo	otechnical   Environmental   C	Construct	ion (	D.C.



			CORE NO	)	13	Project	No.:	221438
Projec	t: <u>Wh</u> <u>Gu</u> t	ite Polo thrie C	e Road and P28 Pavement ounty, Iowa	<u>Cores</u>	221438 B-1	3	ГОР	
Client:	<u>Vee</u> <u>300</u> We	<u>nstra &amp;</u> <u>0 West</u> st Des ]	& Kimm, Inc. cown Pkwy Moines, IA 50266				1 2 3	
Date D Drilling Surfac Datum	Drillec g Met æ Ele	l: hod: _ ≱vation	6/26/2023 Core, DCP, and Hand Pr : 1249.2' Site Survey	obe			4 5 6 7 7 8	
Remar	ks:						9 10 11 12 13 14 15	
Elevation ft.	Depth ft.	Moisture Content, %	California Bearing Ratio Correlated from Dynamic Cone Penetrometer (ASTM D6951)	_	Material Description*	Graphic Log	nscs	Water Level Depth Elevation ft.
1249.2	0				HMA (6.5'')			0.5
	-				PCC (7.5")	0.44 A	4	1248.7
-	-			Brow	n with dark brown lean to fat clay, moist		CL-	1.2
1247.4 —	- 1.8	21.1			FILL		СН	2.5 -
1245.6	- 3.6	27.6		Brown	n lean to fat clay, damp <b>B-HORIZON LOESS</b>		CL- CH	1246.7
	-			End of	Boring			4.3 - 1244.9
1243.8	- 5.4							-
*The s	stratifica	ation lines	s represent the approximate bounda	ary lines b	etween material types: in-situ, the transition	i may be gra	idual.	
Time:	at c	completic	on hrs.	ALLI	ENDER BUTZKE ENG	<b>JINEE</b>	RS,	INC.
Depth to water:	D	<b>'ry</b> ft.	. <del>∑</del> ft. <b>▼</b>	Geo	technical   Environmental   C	Construct	ion (	Q.C.

				CORE	E NO.		14	Project	No.:	221438	
Project	t: <u>Wh</u> <u>Gut</u>	ite Pole hrie C	e Road and P ounty, Iowa	28 Paver	nent (	Cores	221438 B-	14	)P Kons		
Client:	<u>Vee</u> <u>300</u> We	<u>nstra &amp;</u> 0 West st Des 1	& Kimm, Inc. own Pkwy Moines, IA 5(	)266					1 2 3 4		
Date D Drilling Surface Datum	orillec Met e Ele :	l: hod: _ evation	6/26 Core, DCP, :  Site Su	5/2023 and Har 1240.6' rvey	nd Pro	obe			5 6 7 7 9 9		
Remark	<s:< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>10 11 12 13 14 15</td><td></td><td></td></s:<>								10 11 12 13 14 15		
Elevation ft.	Depth ft.	Moisture Content, %	California B Correlated from Penetrometer	earing Ra Dynamic Co (ASTM D695	one 51)		Material Description*	Graphic Log	NSCS	Water Level Depth Elevation	ft.
1240.2	0	ſ		Ĭ			HMA (5.5")			0.5	
-							PCC (9.25")			1240.1	
-			ς			Brown	n-gray sandy lean to fat clay, moist		CL-	1239.4	
1238.4	- 1.8	20.3		>		Less s	and after 2.3'		CII		-
_	- 3.6	17.8	~		<b>11</b>	More	gray after 3.5'				-
1236.6		19.5			$ \begin{array}{c} 1 \\ 4 \\ 1 \\ 1 \\ 1 \\ \end{array} $	End of	Boring			4.3	
	- 5.4										_
1234.8	tratifia					(lines h	ature an antarial types in aitu, the transition				_
	W	ater Leve	el Observation	provinate L							$\neg$
Time:	at c	ompletic	on	hrs.		LL	ENDER BUTZKE ENG	JINEE	KS,	INC.	
Depth to water:	_D	<b>ry</b> ft.	<u> </u>	ft. 💆		Geo	technical   Environmental   C	Construct	ion (	J.C.	

			COR	RE NO	15	Project No.:	221438
Project	t: <u>Wh</u> <u>Gut</u>	ite Pol hrie C	e Road and P28 Pave ounty, Iowa	ement Core	<u>s</u> 221438 B-	15	
Client:	<u>Vee</u> 300 Wes	enstra & 0 West st Des ]	& Kimm, Inc. own Pkwy Moines, IA 50266				
Date D Drilling Surface Datum	orillec Met e Ele :	d: hod: _ evation	6/26/2023 Core, DCP, and Ha 1238.0 Site Survey	and Probe			
Remark	<s:< td=""><td></td><td></td><td></td><td></td><td>11 12 13 13 14 14 15 15</td><td></td></s:<>					11 12 13 13 14 14 15 15	
Elevation ft.	Depth ft.	Moisture Content, %	California Bearing F Correlated from Dynamic Penetrometer (ASTM D6	Ratio Cone 951)	Material Description*	Graphic Log USCS	Water Level Depth  Elevation ft.
	0				HMA (8.75'')		0.7 -
-					<b>PCC</b> (7.5")		1237.3
1236.6	- 1.8	22.1		Bro	own to brown-gray lean to fat clay, moist	CL- CH	1236.7
1234.8	- 3.6	25.8			FILL		_
-		26.1	<u> </u>				4.3 -
1233 —	- 5.4			End	of Boring		1233.7
*The st	tratifica	ation line	s represent the approximate	e boundary lines	s between material types: in-situ, the transitio	n may be gradual.	
Time:	W at c	/ater Lev	el Observation	ALI	LENDER BUTZKE EN	GINEERS	, INC.
Depth to water:	D	ry ft	. 💆 ft. 💆	Ge	eotechnical   Environmental	Construction	Q.C.

				CORE N	10	16	Project	No.:	2214	<u>438</u>
Projec	t: <u>Wh</u> <u>Gut</u>	ite Pol hrie C	e Road and P2 ounty, Iowa	28 Pavemer	nt Cores	221438 B-1	6	OP INCHES 1 2		
Client	Vee	nstra d	& Kimm, Inc.					3		
	<u>300</u>	0 West	town Pkwy			-	e sware	4		
	We	st Des	Moines, IA 50	266				5		
Date [	Drilled	d:	6/22	/2023				6		
Drilling	g Met	hod:	Core, DCP,	and Hand	Probe					
Surfac	e Ele	vation	1.	1233.9'			-6-5-			
Datum	า:		Site Sur	vey				9		
Remar	ks:							10 		
Elevation ft.	Depth ft.	Moisture Content, %	California Be Correlated from Penetrometer (	Dynamic Cone ASTM D6951)	)	Material Description*	Graphic Log	nscs	Water Level Depth	Elevation ft.
-	0					HMA (8.0'')				0.7
1233 -	-					PCC (7.75'')			12	$\frac{0.7}{233.2}$
-	-		L		Very	dark gray with brown-gray lean to fat clay	y, 🗭	CL-	11	232.6
-	- 1.8	22.6			mois	t		СН		_
-	-					FILL				-
1231.2 —	-	28.6								
-	-				Dorl	group heaven loop to fat alore your maint	-H	CI		$\frac{3.3}{220.6}$
-	- 3.6	26.2	$\leq$		Dark	COHESIVE ALLUVIUM		CL- CH		230.0 _
-	-	20.2								4.3 -
1229.4 —	-				End of	Boring				229.6
-	-									
-	- 5.4									_
*The s	- stratifica	ation line	s represent the apr	proximate bour	ndary lines	between material types: in-situ, the transition	may be gra	dual.		
	W	/ater Lev	el Observation		ATT	ENIDED DUTZVE ENIC		חפ	TNI	r -
Time:	at c	ompletio	on	hrs.	ALL	ENDER DUILKE ENG	IINCE.	лð,	TIN	<b>U</b> •
water:	D	<b>ry</b> ft	. =	ft.	Geo	otechnical   Environmental   C	onstruct	ion (	Q.C.	

				CORE N	NO	17	Project	No.:	22143	<u>38</u>
Projec	t: <u>Whi</u> <u>Gut</u>	ite Pole hrie C	e Road and P ounty, Iowa	28 Paveme	nt Cores	221438 B-1	7	OP INCHES		
Client:	<u>Vee</u> <u>300</u> Wes	nstra & 0 West st Des 1	& Kimm, Inc. own Pkwy Moines, IA 50	266		- - -		2		
Date D Drilling Surfac Datum	Drillec g Met e Ele	l: hod: _ vation	6/22 Core, DCP, :	/2023 and Hand 1282.2' vey	Probe			6 7 8 9 9		
Remark	ks:							11 12 13 14 14 15 16		
Elevation ft.	Depth ft.	Moisture Content, %	California Be Correlated from Penetrometer	Dynamic Cone ASTM D6951)	D	Material Description*	Graphic Log	nscs	Water Level Depth	Elevation ft.
	0			,	1	HMA (7.5'')			0	6
1281.6 -						PCC (7.75'')			128	31.6
	1.0	-			Very	/ dark brown with brown lean to fat clay, n FILL	noist	CL- CH	128	<u>.5</u> 30.9
	- 1.8	21.8			Brow	wn to brown-gray lean to fat clay, moist		CL-	2. 128	$\frac{.0}{.0.2}$
1279.8		26.3				<b>B-HORIZON LOESS</b>		СН	3.	.3
1278 -	- 3.6	30.7			Brow	wn-gray lean clay, very moist LOESS		CL	127 4.	'8.9 _ .3 _
	- 5.4	-			End of	f Boring			127	'7.9 _
The s	tratifica	ation lines	s represent the ap	proximate bou	ndary lines l	between material types: in-situ, the transition	may be gra	dual.		
Time:	W at c	ater Lev	el Observation	hrs.	ALL	ENDER BUTZKE ENG	GINEE	RS,	INC	•
Depth to water:	D	<b>ry</b> ft.		ft.	Geo	otechnical   Environmental   C	onstruct	ion (	).C.	

						COR	E NO	D	18					Pro	ject	No.:	22	1438
Project	t: <u>Wh</u> <u>Gut</u>	ite Pole hrie Co	<u>Roa</u> Sunty	<u>d and</u> 7, Iowa	<u>P28</u> a	3 Pavo	ement	Cores	-		2	2143	38 B-	18		P DHES 1		
Client:	<u>Vee</u> <u>300</u>	nstra & 0 Westo	z Kin own l	<u>nm, Ir</u> Pkwy	<u>1C.</u>				-							3		
	We	st Des N	<u>Aoine</u>	es, IA	<u>502</u>	66										6		
Date D	rillec	l:		6/	/22/2	2023										7		
Drilling	Met	hod: _	<u>Cor</u>	e, DC	<u>P, a</u> 1	nd Ha	and Pi	robe								9		
Datum	е сіе :	valion.		Site S	 Surv	<u>250.4</u> 'ey							A.C.	in the		10		
Remark	<b>(S</b> :											Le st				11 12 13 14 15 16		
Elevation ft.	Depth ft.	Moisture Content, %	Cal Corr Per	ifornia related fr	rom D ter (A	aring F ynamic STM D6	Cone 0951)	_		Materi	ial Des	scriptic	on*		Graphic Log	nscs	Water Level	Depth  Elevation ft.
1256.4	0									H	IMA (8.	25'')						0.7 -
+		-									PCC (8.	.5'')			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			1255.7
1254.6	- 1.8	31.7						Very	dark g	gray lear	n to fat c	lay, moi	st			CL- CH		1255.0
-		36.9									FILL	_						-
1252.8 —	- 3.6	36.3						_										4.0
							18-	→ End of	Borin	g								4.0
1251 -	- 5.4	-						_										_
The s	tratifica	ation lines	repres	sent the	appr	oximate	e bounda	ary lines t	petwee	n materi	al types:	in-situ, t	ne transiti	on may	be gra	dual.		
Time:	W at c	/ater Leve ompletio	l Obsen	rvation		hrs.		ALL	ENI	DER	BUI	[ZK]	E EN	GIN	EE	RS,	IN	IC.
Depth to water:	_D	<b>ry</b> ft.	Ţ	_		ft. 🛓	-	Geo	otech	nical	Env	ironm	ental	Const	truct	ion (	Q.C	۱ •

				CORE N	<b>O.</b>	19	Project	No.:	221438
Project	t: <u>Wh</u> <u>Gut</u>	ite Pole hrie C	e Road and P ounty, Iowa	28 Pavemer	nt Cores	221438 B-	19	FOP INCHES	
Client:	<u>Vee</u> <u>300</u> <u>Wes</u>	nstra & 0 West st Des ]	& Kimm, Inc own Pkwy Moines, IA 50	)266				2.	
Date D Drilling Surfac Datum	orillec Met e Ele :	l: hod: _ vation	6/22 Core, DCP, :	2/2023 and Hand 1 1224.3' rvey	Probe			5 7 8 9	
Remark	(S:							10 	
Elevation ft.	Depth ft.	Moisture Content, %	California B Correlated fron Penetrometer	earing Ratio		Material Description*	Graphic Log	nscs	Water Level Depth  Elevation ft.
1224 -	0					HMA (6.75'')			0.6
		-				PCC (8.5'')	0 • • • • • •		1223.7
1222.2 -	- 1.8	26.9			Brow	n-gray lean to fat clay, moist FILL		CL- CH	1223.0
1220.4 -	- 3.6	29.4 32.3			Dark End of	brown after 2.8'			4.0
1218.6 -	- 5.4					Donne			-
*The s	tratifica	tion line	s represent the ap	proximate boun	idary lines b	etween material types: in-situ, the transition	ו may be gra	dual.	
Timo	W at c	ater Lev	el Observation	bre	ALLI	ENDER BUTZKE ENG	GINEE	RS,	INC.
Depth to water:	D	<b>ry</b> ft.		ft. ¥	Geo	technical   Environmental   C	Construct	ion (	Q.C.

				CORE NO	)	20	Project	No.:	2214	38
Projec	t: <u>Wh</u> <u>Gut</u>	ite Pole hrie Co	Road and P2 Dunty, Iowa	28 Pavement	Cores	221438 B-2	0	OP INCHES		
Client:	: <u>Vee</u> <u>300</u> <u>We</u> s	nstra 8 0 Westo st Des N	k Kimm, Inc. own Pkwy Moines, IA 50	266				2		
Date D Drilling Surfac Datum	Drillec g Met ce Ele n:	l: hod: evation:	6/21/ Core, DCP, a Site Sur	/2023 and Hand Pı 1262.0' vey	robe			6 7 8 9		
Remar	ks:							10 11 12 13 13 14 14 15 16		
Elevation ft.	Depth ft.	Moisture Content, %	California Be Correlated from Penetrometer (/	earing Ratio Dynamic Cone ASTM D6951)	_	Material Description*	Graphic Log	NSCS	Water Level Depth	Elevation ft.
1261.8 -	0					HMA (7.0'')				0.6
-	-					PCC (8.5")			12	<u>5.0</u> 61.4 1.3 -
1260 -	- - 1.8 -	24.1		>	Very	dark brown-gray lean to fat clay, moist		CL- CH	12	-60.7
1258.2 -	- 3.6 -	27.5			Brow	n to brown-gray lean to fat clay, moist B-HORIZON LOESS		CL- CH	12	59.0 
1256.4 -	- 5.4				End of	Boring			12	.57.7
Time:	stratifica W at c	ation lines /ater Leve completio	represent the app I Observation	hrs.	ALL	ENDER BUTZKE ENC	may be gra	<sup>dual.</sup>	INC	2.
Depth to water:	D	<b>ry</b> ft.	<u></u>	ft. 🕎	Geo	technical   Environmental   C	onstruct	ion (	Q.C.	

				CORE	NO.	2	1	Project No	.: <u>2214</u> 3	38
Project	t: <u>Whi</u> <u>Gutl</u>	te Pole hrie C	e Road and P2 ounty, Iowa	8 Paven	nent C	Cores	221438	B-21	TOP mores 1	
Client:	<u>Veer</u> <u>3000</u> <u>Wes</u>	nstra & ) West t Des ]	& Kimm, Inc. own Pkwy Moines, IA 502	266					2 3 4 4	
Date D Drilling Surface Datum	orilled   Meth e Ele <sup>:</sup> :	: nod: _ vation	6/21/2 Core, DCP, a :1 Site Surv	2023 and Han 236.0' /ey	id Pro	be				
Remark	KS:								10 11 11 12 12 13 14 14 15 16	
Elevation ft.	Depth ft.	Moisture Content, %	California Bea Correlated from D Penetrometer (A	aring Ra Dynamic Cc STM D695	ntio one 1)		Material Description*	Graphic Log	Water Level Depth	Elevation ft.
-	0						HMA (7.0'')		0	6
-							PCC (8.0")		123	35.4
1234.8 -	- 1.8	28.1				Very da	rk gray lean to fat clay, moist		H	<u></u> 34.8 _
1233 -	- 3.6	<ul><li>34.7</li><li>28.7</li></ul>			$16 \rightarrow 14 \rightarrow 11 \rightarrow 16 \rightarrow 20 \rightarrow 15 \rightarrow 15$		LOCAL ALLUVIUM			-
		-				End of B	oring		123	<u>.</u> 3
1231.2 -	- 5.4									_
*The st	tratifica W	tion lines	s represent the appr el Observation	oximate b	oundary	lines bet	ween material types: in-situ, the transition	n may be gradua	l.	
Time:	at co	ompletio	on	_ hrs.	A	LLE	NDER BUTZKE ENG	GINEERS	S, INC	1 ′•
Depth to water:	D	ry ft.	<u> </u>	ft.		Geote	echnical   Environmental   C	Constructior	Q.C.	

					CO	RE N	0	22	_			Projec	t No.:	22	2143	<u>8</u>
Projec	t: <u>Whi</u> <u>Gut</u>	ite Pole hrie Co	e Roa ounty	d and i , Iowa	P28 Pa	vement	t Cores	-		2214	38 B-	22				
Client:	<u>Vee</u> 3000 Wes	nstra & 0 Westo st Des N	<u>k Kin</u> own l Moine	nm, In <u>Pkwy</u> es, IA 5	c. 50266			-						-		
Date D Drilling Surfac Datum Remark	Drilled 9 Met e Ele :	l: hod: evation:		6/2 e, DCH Site Si	21/2023 2, and 1 1217 urvey	B Hand P .3'	robe							and the second secon		
5		e %	Cal	fornia	Bearinç	g Ratio							12 13 14 15 16	ivel		uc
Elevatio ft.	Depth ft.	Moistur Content,	Corr Per	elated frontete	m Dynam r (ASTM	ic Cone D6951)		Ma	aterial	Descriptio	on <sup>*</sup>	Graphic	Log	Water Lev	Depth	Elevatio ft.
1216 9	0			1					HM	A (7.0'')					0.0	6
-									PCO	C (8.5'')		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			1210	5.7 3 -
	- 1.8	<ul><li>30.6</li><li>34.7</li><li>36.3</li></ul>		<		<b>11</b> 12 14 16	Very → →	dark gray	v lean to :	fat clay, moi	st M		CL-CH		1210	5.0
	- 5.4	-				18	→ End of	Boring					2		4	<u>3 -</u> 3.0 -
1211.4 The s	tratifica	tion lines	repres	sent the a	approxima	ate bound	lary lines	between m	naterial ty	pes: in-situ, t	he transitior	n may be g	radual.			
Time:	W at c	ater Leve ompletio	୬I Obse ∞n	rvation	hr:	s.	ALL	END	ER B	UTZK	E ENO	GINE	ERS	, II	NC.	
Depth to water:	_ <b>D</b>	<b>ry</b> ft.	<u> </u>	_	ft	<u>₹</u>	Geo	otechnie	cal   E	Environm	ental   C	Constru	ction	Q.(	2.	

				CORE	NO	23	Project	No.:	221	438		
Project	t: <u>Wh</u> Gut	ite Pole thrie C	e Road and P ounty, Iowa	28 Paveme	ent Cores	22/438	523 TOP	5				
Client:	<u>Vee</u> <u>300</u> We	enstra & 0 West st Des ]	& Kimm, Inc. own Pkwy Moines, IA 50	)266				3				
Date D Drilling Surfac Datum	Drillec I Met e Ele :	d: hod: _ evation	6/13 Core, DCP, : Site Sur	2/2023 and Hand 1223.1' :vey	l Probe							
Remark	KS:											
Elevation ft.	Depth ft.	Moisture Content, %	California Be Correlated from Penetrometer (	Dynamic Cone (ASTM D6951)	iO e )	Material Description*	Graphic Log	nscs	Water Level	Lepur  Elevation ft.		
	0					HMA (5.75'')				0.5		
1222.2 -						<b>REINFORCED PCC (11.75'')</b>			1	1.5		
-	- 1.8	25.4 25.3			Brow	vn-gray lean clay, moist to very moist		CL	1	1221.6		
1220.4 —		28.7				LOESS				-		
+	- 3.6	28.3		$\sim$		LUESS				_		
1218.6 —		29.5			Gray	after 4.5'				-		
	- 5.4	27.9			End of	Boring				<u>5.3</u> 1217.8 -		
*The s	tratifica	ation lines	s represent the ap	proximate bou	undary lines	between material types: in-situ, the transition	n may be gra	dual.				
Time:	ALLENDER BUTZKE ENGINEERS, INC.											
water:	<b>D</b>	<b>ry</b> ft.	<u> </u>	ft. 🖳	Geo	otechnical   Environmental   C	Construct	ion (	Q.C.	1		

			CC	ORE NO	)	24	Project	No.:	22	1438
Projec	t: <u>Wh</u> <u>Gut</u>	ite Pol hrie C	e Road and P28 Pa ounty, Iowa	avement	Cores	211434	TOF			
Client	: <u>Vee</u> 300	enstra d 0 West	& Kimm, Inc.					1		
	We	st Des	Moines, IA 50266					3		
Date [ Drilling	Drilleo g Met	1: hod: _	6/13/202 Core, DCP, and	3 Hand Pr	obe			4		
Surfac	e Ele	vation	:1215	5.8'				7		
Datum	ו:		Site Survey				T	8		
Remar	ks:							9 10 11 12 13 13 13		
Elevation ft.	Depth ft.	Moisture Content, %	California Bearin Correlated from Dynar Penetrometer (ASTM	g Ratio nic Cone D6951)	_	Material Description*	Graphic Log	USCS	Water Level	Depth  Elevation ft.
	0					HMA (0.75")	<sup>2</sup>	2 4 4		0.1
1215 -	-					PCC (9.75")	् <b>क</b> र्ज ्रिस क ्रिस क			0.9
_				14 11	- (	CRUSHED ROCK SUBBASE (9.5"±)				1214.9 <u>1.8</u>
-	-	23.1			Dark	gray to gray-brown fat clay, moist		СН		1214.1
1213.2 -	-		$\langle      $							
	-	26.6				PALEOSOL				_
	- 3.6 -	26.6			NV: 1					_
1211.4 -	-	26.9			With	sand after 4				-
-	-	26.8			E 1 6				$\parallel$	5.0 -
	- 5.4	-				Doring				1210.8
The s	stratifica	ation line	s represent the approxim	ate bounda	 ary lines b	petween material types: in-situ, the transitio	n may be gr	dual.		
Time:	W at c	/ater Lev completion	el Observation	rs.	ALLI	ENDER BUTZKE EN	GINEE	RS,	IN	IC.
Depth to water:	D	<b>ry</b> ft	. <u>↓</u> ft.	<u>¥</u>	Geo	otechnical   Environmental	Construc	tion (	Q.C	•

						CO	ORI	E NC	)	25	5	-				Pro	oject	No.:	22	21438	3
Project	: <u>Whi</u> <u>Gut</u>	ite Pole hrie Co	e Road ounty	d and , Iow	l P2 a	28 P	avei	ment	Cores	-				21	1433 B-	15	ТОР	3			
Client:	<u>Vee</u> <u>300(</u> <u>Wes</u>	nstra & ) Weste st Des N	<u>è Kin</u> own I Moine	nm, In Pkwy es, IA	nc. . 502	266				-								L			
Date D Drilling Surface Datum:	rilled Metl e Ele	: hod: vation:	 :	6 e, DC Site S	/12/ CP, a	/202 and 123( vey	.3 Ha: 0.8'	nd Pı	robe	-							5 6 7 8 9				
Remark										_							10 11 12 13 13 14 15 16				
Elevation ft.	California Bearing Ratio					atio Cone 51)			Ma	aterial	Desc	criptio	n*		Graphic Log	nscs	Water Level	Depth	Elevation ft.		
	0			1			1	1				HM	/IA (7.5	5'')						0.6	
1220.4		-										РС	CC (9.5	")						1230	.2
	1.8	39.8 36.6							Very mois	v dar st	k brov F	vn lean TILL/O	to fat c LD TO	elay wit <b>PPSOII</b>	h organic	cs,		CL- CH		1229	.4 _
1227.6	3.6	<ul><li>33.9</li><li>32.9</li></ul>							Brow	vn le	ean to E	fat clay	r, moist	LOESS	;			CL- CH		<u> </u>	.8
1225.8 -	5.4						1		End of	f Bo	ring									1226	.3 _
The st	ratifica W	ition lines ater Leve	i repres el Obse	ent the rvation	e app I	oroxin	nate I	bounda	ary lines	betw	veen m	aterial t	types: ir	n-situ, th	e transitio	on may	be gra	idual.			
Time: Depth to	at co	ompletio	n ⊻	-		h 	nrs. 		ALL Geo	EN oteo	NDE chnia	CR I	BUT Envir	ZKF onme	E EN	GIN Cons	(EE) truct	RS, ion (	11 0.0	NC.	

						CO	RE NO	D	26				Proj	ect l	No.:	22	1438
Projec	ct: <u>Wh</u> <u>Gu</u> t	ite Pol thrie C	e Roa ounty	ad and y, Iow	l P2 a	8 Pav	vement	t Cores	-			221438 B-	200		DP vcHrs		
Client	: <u>Vee</u> <u>300</u> <u>We</u>	enstra d 0 West st Des 1	& Kin cown Moin	mm, I Pkwy es, IA	nc.	266			-						2 3 4 5		
Date I Drilling Surfac Datum	Drilleo g Met ce Ele n:	d: hod: _ evation	Coi :	6 re, DC Site S	/12// CP, a 1 Surv	2023 and H 230.2 yey	land P 2'	robe					C		6 7 8 9 10		
Remar	ks:														12 13 14 15 16		
Elevation ft.	Depth ft.	California Bearing Ratio							Materia	al Descri	otion*		Graphic Log	nscs	Water Level	Depth  Elevation ft.	
	0		I		Ĩ					I	HMA (7'')						0.6
1229.4 –	-									Ι	PCC (11")			ः • • • • • • • • • • • • • • • • • • •			1229.6 1.5
1227.6 -	- 1.8 - -	<ul><li>33.1</li><li>31.8</li><li>36.6</li></ul>		$\sum$	2			Very moist	dark t to v	t brown lea very moist FILL/	n to fat clay	with organic	÷S,		CL- CH		1228.7
-	37.5								Brown to brown-gray lean clay, very moist     3.0       LOESS     CL					<u>3.0</u> 1227.2 –			
1225.8 -	225.8 - 4.5 - 5.4 End of Boring																
The *	stratific	ation line	s repre	sent the	appi	roxima	te bound	ary lines t	betwe	een materia	l types: in-si	tu, the transitic	on may b	e gra	dual.		
Time:	Water Level Observation me: at completion hrs.																
Depth to water:	D	ry_ft	. 茔	_		ft.	Z_	Geo	otec	hnical	Enviror	nmental	Const	ructi	ion (	Q.C	•



					CO	RE NO	)	28	8	Project	No.:	22	21438
Project	t: <u>Wh</u> <u>Gut</u>	ite Pole hrie C	e Road an ounty, Iov	ld P2 wa	8 Pav	vement	Cores	-	221438 82	8	OP INCHES		
Client:	<u>Vee</u> 300	nstra & 0 West	& Kimm, own Pkw	Inc. y				-		-0	2		
	Wes	st Des 1	Moines, L	<u>A 502</u>	266			-			4		
Date D Drilling	orillec Met	l: hod: _	Core, D	6/12/ CP, a	2023 and F	Iand Pi	robe				- 6 - 7		
Surfac	e Ele	evation	:	1	1222.	9'				()	8		
Datum	-		Site	Surv	vey					-	9		
Remark	KS:								R:70	040	- 10 - 11 - 12 - 13 - 14 - 15 - 16		
Elevation ft.	Depth ft.	Moisture Content, %	Californ Correlated Penetron	ia Be from [ heter (A	Dynami	Ratio c Cone 06951)			Material Description*	Graphic Log	nscs	Water Level	Depth  Elevation ft.
	0								HMA (7'')				0.6
1222.2 -		-							PCC (8.25'')				1222.3
		30.5				>	Very	dar	rk brown lean to fat clay, trace organic	s, 💢	CL-		1221.6
	- 1.8		$\langle$				moist	t	FILL/OLD TOPSOIL		СН		23
1220.4 –		26.1					Brow	vn-g	gray lean to fat clay, moist		CL- CH		1220.6
	- 3.6	27.1		>					<b>B-HORIZON LOESS</b>				-
1218.6 -		27.8											-
	- 5.4			+			End of	Bo	oring			$\left  \right $	<u>5.5</u> – 1217.4
*The s	tratifica	ation lines	s represent th	ie app	roxima	te bounda	I ary lines b	betv	ween material types: in-situ, the transition	may be gra	udual.		
Time	W at c	/ater Leve	el Observatio	'n	hre		ALLI	EN	NDER BUTZKE ENG	SINEE	RS,	I	NC.
Depth to water:	D	<b>ry</b> ft.			ft. 🖣		Geo	ote	chnical   Environmental   C	Construct	ion (	Q.C	2.

			CORE NO	)	29	Project	No.:	22	<u>1438</u>				
Projec	t: <u>Wh</u> <u>Gu</u> t	<u>ite Pole</u> thrie C	e Road and P28 Pavement ounty, Iowa	Cores	221438 8-1	.0							
Client:		enstra {	& Kimm, Inc.			T	OP						
	<u>500</u> <u>We</u>	<u>u west</u> st Des ]	Moines, IA 50266		1.3	E'	NCHES 						
Date I Drilling Surfac Datum	Drilleo g Met ce Ele n:	J: hod: _ vation	6/13/2023 Core, DCP, and Hand Pr : 1181.7' Site Survey	robe			2						
Remar	ks:						- <u>5</u> - <u>6</u> - <u>7</u> 8						
Elevation ft.	Depth ft.	Moisture Content, %	California Bearing Ratio Correlated from Dynamic Cone Penetrometer (ASTM D6951)		Material Description*	Graphic Log	nscs	Nater Level	Depth  Elevation ft.				
	0				PCC (7.5")				0.6				
180.8 —	-	19.7		Brow	n with gray lean clay with sand, moist FILL		CL		1181.1				
1179 -	- 1.8 - -	21.0		Brow	n-gray lean to fat clay, moist LOESS		CL- CH		2.0 -				
-	-	24.3		Gray	with brown fat clay, moist		СН		$\frac{3.0}{1178.7}$				
-	- 3.6	32.6 29.6		_	PALEOSOL				-				
177.2 —	- - 5.4			End of	Boring				<u>4.5</u> 1177.2				
*The s	- stratific	ation line:	s represent the approximate bounda	ary lines b	etween material types: in-situ, the transition	n may be gra	dual.						
Time:	Water Level Observation ALLENDER BUTZKE ENGINEERS, INC.												
Depth to water:	D	<b>)ry</b> ft.	. ऱ ft. Ψ	Geo	technical   Environmental   C	Construct	ion (	Q.C					



			CORE N	NO	31	Project No.:	221438
Project	t: <u>Wh</u> <u>Gu</u> t	ite Pole thrie C	e Road and P28 Pavemer ounty, Iowa	nt Cores	221434	-31	P
Client:	<u>Vee</u> <u>300</u> <u>We</u>	enstra & 0 West st Des 1	& Kimm, Inc. own Pkwy Moines, IA 50266		- - -		2
Date D Drilling Surfac Datum	orilleo I Met e Ele :	d: hod: _ evation	6/13/2023 Core, DCP, and Hand : <u>1131.4'</u> Site Survey	Probe			3
Remark							5 6 7 8 9
Elevation ft.	Depth ft.	Moisture Content, %	California Bearing Ratio	<b>D</b>	Material Description*	Graphic Log USCS	Water Level Depth  Elevation ft.
	0				PCC (7.5'')		-
130.4 -	- 1 8	18.9		Brov	vn lean to fat clay, moist B-HORIZON LOESS	CL- CH	0.6
128.6 -	1.0	19.7 23.9		Drov	un arou loon alau moiat to uom moiat		2.8
-	- 3.6	25.9 26.5		2→ .4→	LOESS		-
126.8 -		28.2		End of	f Boring		4.5
The s	- 5.4 tratific	ation lines	s represent the approximate bour	ndary lines	between material types: in-situ, the transi	tion may be gradual.	
Time:	V at c	Vater Lev completio	el Observation	ALL	ENDER BUTZKE EN	NGINEERS,	INC.
Depth to water:	D	<b>)ry</b> ft.	$ft. \frac{\nabla}{\overline{z}}$	Ge	otechnical   Environmental	Construction Q	Į.C.

			COR	RE NO	32	Project No.	.: <u>221438</u>
Projec	t: <u>Wh</u> <u>Gut</u>	ite Pole hrie C	e Road and P28 Pave ounty, Iowa	ement Cores	221348 8-3	Z TOF	э
Client:	Vee	enstra &	& Kimm, Inc.		-		1
	<u>300</u>	0 West	own Pkwy				2
	We	st Des 1	Moines, IA 50266				3
Date D	)rillec	4.	6/13/2023				4
Drilling	a Met	hod:	Core. DCP. and Ha	and Probe			5
Surfac	e Ele	vation	: 1034.1	,			6
Datum	:		Site Survey				7
Remarl	ks:						2
Elevation ft.	Depth ft.	Moisture Content, %	California Bearing F Correlated from Dynamic Penetrometer (ASTM D6	Ratio Cone 1951)	Material Description*	Graphic Log USCS	Mater Level Depth Elevation ft.
	0	-			HMA (1.25'')		
					PCC (9.25'')		
1033.2 -			J	Broy	vn-gray with maroon shaley fat clay, moist	t 🔀 CI	I 1033.2
		17.7					
	- 1.8	17.5					
							_
1031.4 —		19.0		Less	maroon after 3'		
	26	22.4		Lese	FILL		
	- 5.0	25.4					
1029 6						$\bigotimes$	
1027.0		19.5				$\otimes$	
	- 5.4	20.6		Endo	f Boring	XX	5.3
							1020.0
*The s	tratifica	ation lines	s represent the approximate	boundary lines	between material types: in-situ, the transition	may be gradual	
Time:	at c	ompletic	on hrs.	ALL	ENDER BUTZKE ENG	JINEERS	, INC.
Depth to water:	D	<b>ry</b> ft.	ft. ¥ٍ	Ge	otechnical   Environmental   C	onstruction	Q.C.



				CORE	NO.		34	_			Project	No.:	22	1438
Project	t: <u>Whi</u> <u>Gut</u>	ite Pole hrie C	e Road and P2 ounty, Iowa	28 Paven	nent C	Cores		12	1434	8-34		TOF		
Client:	<u>Vee</u> <u>3000</u> Wes	nstra & ) West st Des ]	& Kimm, Inc. own Pkwy Moines, IA 50	266									1 2	
Date D Drilling Surface Datum	orilled   Meti e Ele :	l: hod: _ vation	6/13 Core, DCP, : Site Sur	/2023 and Han 1121.8' 'vey	nd Pro	be							3 4 5	
Remark	(S:												6 7 8 9	
Elevation ft.	Depth ft.	Moisture Content, %	California Be Correlated from Penetrometer (	earing Ra Dynamic Co ASTM D695	ntio one 1)		Ma	aterial I	Descriptio	n*	Graphic Log	NSCS	Water Level	Depth  Elevation ft.
1121.4 - - 1119.6	0	20.8 20.0 25.6		· · · · ·		C Brow Dark	<b>RUSHE</b> n lean to gray afte	PCC D ROCI fat clay, r 1.5'	C ( <b>7.75''</b> ) K SUBBASE moist FILL	2 (2.25"±)		CL- CH		0.6 1121.2 0.8 1121.0
1117.8	- 3.6	19.9 25.9			13→ 11→	Brow: Dark End of	n-gray sa gray-bro Boring	ndy after	r 3.3' 3.8'					<u>4.3</u> 1117.5
1116 The st	- 5.4 tratifica W at c	tion lines ater Leve ompletic	s represent the app el Observation on	proximate b	oundary	ines b	etween n ENDI	naterial ty E <b>R B</b>	pes: in-situ, th	e transition E ENG	may be gra	<sup>dual.</sup>	IN	
water:	D	<b>ry</b> ft.	<u> </u>	ft. 🕎		Geo	techni	cal   E	Environme	ental   C	onstruct	ion (	Q.C	2.

			CORE NO	•	35	Project	No.:	221438	5
Projec	t: <u>Wh</u> <u>Gu</u> t	<u>ite Pol</u> thrie C	e Road and P28 Pavement ( County, Iowa	Cores	2214358-3	5			
Client:	<u>Vee</u> <u>300</u> <u>We</u>	<u>nstra &amp;</u> 0 West st Des ]	& Kimm, Inc. town Pkwy Moines, IA 50266			A_11.	TOP INCHES		
Date D Drilling Surfac Datum	Drillec 3 Met 2 Ele 1:	l: hod: _ vation	6/13/2023 Core, DCP, and Hand Pre 1132.1' Site Survey	obe				<u>}</u>	
Remar	ks:							5 7 8 9	
Elevation ft.	Depth ft.	Moisture Content, %	California Bearing Ratio Correlated from Dynamic Cone Penetrometer (ASTM D6951)		Material Description*	Graphic Log	nscs	Water Level	Elevation ft.
	0				PCC (7.5")			0.6	
		16.8		Dark	gray lean to fat clay, moist FILL		CL- CH	1131.	.5
130.4 –	- 1.8	16.2		Brow mois	vn-gray sandy lean to fat clay, trace gravel t		CL- CH	1130.	.5 –
1128.6 -	- 36	13.5		Dark	gray after 2.5' PRE-ILLINOIAN GLACIAL TILL			2.0	-
				End of Dark	Boring gray-brown after 3.8'		1	1128.	.3 -
1126.8 -	- 5.4								
*The s	stratifica	ation line:	s represent the approximate boundar	ry lines l	between material types: in-situ, the transition	may be gra	idual.		
Time	M at c	ater Lev	on hrs	ALL	ENDER BUTZKE ENG	INEE	RS,	INC.	
Depth to water:	D	ry ft		Geo	otechnical   Environmental   C	onstruct	ion (	Q.C.	

				CORE NO	)	36	Proj	ect No.:	221438
Project	:: <u>Wh</u> <u>Gut</u>	ite Pole hrie C	e Road and P ounty, Iowa	28 Pavement	Cores	21438	8-56		
Client:	<u>Vee</u> <u>300</u> Wes	nstra & 0 West st Des ]	& Kimm, Inc. own Pkwy Moines, IA 5(	)266					неs
Date D Drilling Surface Datum	vrillec Met e Ele :	l: hod: _ evation	6/14 Core, DCP, : Site Sur	/2023 and Hand P 1126.0' rvey	robe				3
Remark	KS:								5 6 7 8
Elevation ft.	Depth ft.	Moisture Content, %	California B Correlated from Penetrometer	earing Ratio		Material Description*	979 <b>9,</b> 200 (24).	Graphic Log USCS	Water Level Depth Elevation ft.
	0					PCC (6.5")			0.5
1125 -		24.2			Gray	SAND SUBBASE (1/2"±) with brown fat clay, moist PALEOSOL	/	СН	1125.5 0.6 1125.4
-	1.8	20.2 14.9			Brown	n-gray sandy lean to fat clay, trace g	gravel,	CL- CH	1.8
123.2 -		15.4				PRE-ILLINOIAN GLACIAL TI	LL		-
1121.4 -	3.6	13.4		15- 25- <b>11</b>	Dark : End of	gray-brown after 3.8' Boring			4.0
	5.4								
*The st	tratifica	ation line	s represent the ap	proximate bound	ary lines b	etween material types: in-situ, the trar	nsition may b	e gradual.	
Time:	۷۷ at c	ompletic	er Observation	hrs.	ALLI	ENDER BUTZKE E	NGIN	EERS,	INC.
Depth to water:	D	- <b>ry</b> ft.		ft. 🕎	Geo	technical   Environmental	Const	ruction (	Q.C.

			С	ORE NO	37	Pro	oject No.: 2	21438
Projec	t: <u>Wh</u> <u>Gut</u>	ite Pole hrie C	e Road and P28 I ounty, Iowa	Pavement (	<u>Cores</u> <u>221</u>	438 B-3	3	
Client:	<u>Vee</u> <u>300</u> <u>We</u>	enstra & 0 West st Des ]	& Kimm, Inc. own Pkwy Moines, IA 50266	6				
Date D Drilling Surfac Datum	Drillec J Met e Ele :	d: hod: _ evation	6/14/20 Core, DCP, and :99 Site Survey	23 d Hand Pro 1.3' y	be			4
Remark	<s:< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td>5 7 8</td></s:<>							5 7 8
Elevation ft.	Depth ft.	Moisture Content, %	California Beari Correlated from Dyn Penetrometer (AST	amic Cone M D6951)	Material Des	scription*	Graphic Log USCS Water Level	Depth  Elevation ft.
 - 990	0	21.2			PCC (7. Gray with brown fat clay, n FILI	<b>75''</b> ) noist	СН	0.7
-	- 1.8	25.5			Gray weathered clay shale, WEATHERED	moist BEDROCK	СН	2.0 - 989.3 -
700.2	- 3.6	23.3		$ \begin{array}{c} 2 \overrightarrow{0} \rightarrow \\ 4 \overrightarrow{8} \rightarrow \\ 4 \overrightarrow{0} \rightarrow \\ 4 \overrightarrow{8} \rightarrow \\ 4 \overrightarrow{8} \rightarrow \\ \end{array} $	End of Boring			<u>3.3</u> 988.0 _
986.4	- 5.4							-
*The s	tratifica	ation line	s represent the approxi	imate boundar	v lines between material types:	in-situ, the transition may	be gradual.	
Time:	۷ at c	/ater Lev completio	el Observation	hrs.	LLENDER BUT	TZKE ENGIN	EERS, I	NC.
Depth to water:	D	ry ft.	ft	t. 🕎	Geotechnical   Env	ironmental   Cons	truction Q.	C.

			CORE	Z NO	38	Project No.: 221	438
Projec	rt: <u>Wh</u> <u>Gut</u>	ite Pol thrie C	e Road and P28 Paven ounty, Iowa	nent Cor	es Lilles 8-3	38	
Client	: <u>Vee</u> <u>300</u> We	enstra a 0 West st Des 1	& Kimm, Inc. cown Pkwy Moines, IA 50266				
Date [ Drilling Surfac Datum	Drilleo g Met ce Ele n:	d: hod: _ evation	6/14/2023 Core, DCP, and Har :	id Probe			
Remar	ks:						
Elevation ft.	Depth ft.	Moisture Content, %	California Bearing Ra Correlated from Dynamic Co Penetrometer (ASTM D695	atio one 1)	Material Description*	Graphic Log USCS Water Level	Elevation ft.
986.4 -	0   1.8	15.9 16.5		$18 \rightarrow V_{0}$ $20 \rightarrow V_{0}$ $22 \rightarrow V_{0}$	REINFORCED PCC (7.0") bry dark brown clayey sand, moist bry dark gray lean to fat clay, moist after 1' FILL	SC CL- CH	<u>0.6</u> 986.7 –
984.6	- - - 3.6	16.5		$33 \rightarrow Pc$ $14 \rightarrow End$ $48 \rightarrow$ $33 \rightarrow$ $48 \rightarrow$ $29 \rightarrow$ $22 \rightarrow$ $16$	ssible sand layer near or after 2.3' of Boring		<u>2.3</u> 985.0 -
982.8 -	- 			$12 \rightarrow$			_
ine s	Stratifica V	Vater Lev	el Observation				$\overline{\mathbf{C}}$
Time: Depth to	at c	completio	on hrs.	AL	LENDEK BUIZKE EN	GINEEKS, IN	<b>U.</b>
water:	D	<b>ry</b> ft	. ¥ ft. ₩	G	eotechnical   Environmental	Construction Q.C.	

						CORI	E NO	3	9		1	Project	No.:	22	21438
Project	t: <u>Wh</u> <u>Gut</u>	ite Pol hrie C	e Roa ounty	<u>d and</u> 7, Iowa	<b>P28</b> a	Pave	ment	<u>Cores</u>		22143	8 B-39	1			
Client:	<u>Vee</u> <u>300</u> <u>We</u>	enstra & 0 West st Des ]	<u>&amp; Kin</u> own I Moine	<u>nm, In</u> Pkwy es, IA	<u>nc.</u> 5026	66					ettera an			P CHES	
Date D Drilling Surface Datum	Drillec J Met e Ele :	l: hod: _ evation	 :	6/ e, DC Site S	' <u>14/2</u> P, ar <u>1(</u> Surve	023 nd Ha )38.7' ey	nd Pr	obe	-					2 3 4	
Remark	KS:													5 6 7 8	
Elevation ft.	Depth ft.	Moisture Content, %	Cali Corr Per	ifornia related fr	Bea rom Dy ter (AS	ring R mamic C TM D69	atio Cone (51)		Mater	ial Descrip	tion*	Graphic Log	nscs	Water Level	Depth  Elevation ft.
1038.6	0				Ť					PCC (7.25'')		0.14 0.16			0.6
	- 1.8	13.4 11.4 10.5					11 11→ 13→ 14→ 11+ 22→	Brown	to dark gray	y lean to fat cla FILL	iy with sand, m	oist	CL- CH		1038.1
-	- 3 6	12.4					$ \begin{array}{c} 14 \rightarrow \\ 33 \rightarrow \\ 16 \rightarrow \end{array} $	Brown End of B	sandy lean GI oring	clay, damp L <b>ACIAL TIL</b> I	L		CL		2.5 - 1036.2 3.3 1035.4
1035 -	5.0						18→								-
1033.2 -	- 5.4 tratifica	ation lines	s repres	sent the	apprc	ximate	boundai	ry lines bet	ween mater	ial types: in-situ	, the transition r	nay be gr	adual.		
Time:	W at c	ater Lev	el Obse	rvation		hrs	A	ALLE	NDER	BUTZH	KE ENG	INEE	RS,	Π	NC.
Depth to water:	D	ry ft.	<u> </u>	_		ft. ¥		Geote	echnical	Environ	mental   Co	onstruc	tion	Q.C	2.

Project: White Pole Road and P28 Pavement Cores Guthrie County, Iowa Client: Veenstra & Kimm, Inc. 3000 Westown Pkwy West Des Moines, IA 50266 Date Drilled:	В4/8 ТОР МСНЕS 1
Client: Veenstra & Kimm, Inc. <u>3000 Westown Pkwy</u> West Des Moines, IA 50266 Date Drilled: <u>6/14/2023</u> Drilling Method: Core DCP and Hand Probe	TOP INCHES 1
3000 Westown Pkwy         West Des Moines, IA 50266         Date Drilled:       6/14/2023         Drilling Method:       Core DCP and Hand Probe	
Date Drilled: 6/14/2023	1 - 1 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -
Surface Elevation:     1133.8'       Datum:     Site Survey	
Remarks:	
	7
California Bearing Ratio       Image: Stress of the stress of	* Graphic Log USCS Vater Level
<b>PCC (7.0'')</b>	0.6
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$\begin{array}{c c} 1.0 \\ 22.1 \\ 22.1 \\ 22.1 \\ 22.1 \\ 22.1 \\ 22.1 \\ 22.1 \\ 20.1 \\ 14 \rightarrow \\ 12 \rightarrow \\ 1$	CL- CH
130.4 3.6	4.0
128.6 - 5.4	
*The stratification lines represent the approximate boundary lines between material types: in-situ, th	transition may be gradual.
Water Level Observation     ALLENDER BUTZKE       Time:     at completion     hrs.       Depth to     Draw in V     Contrachnical   Environment	ENGINEERS, INC.

Water Level Depth Elevation ft.

1133.2

4.0 1129.8

ABE\_DCP

				CORE NO.	•4	1	Project N	lo.:	221438
Projec	ct: <u>Wh</u> <u>Gu</u>	ite Pole thrie C	e Road and P2 ounty, Iowa	8 Pavement (	Cores	121438 3.	41	ОР	
Client	: <u>Vee</u> <u>300</u> <u>We</u>	enstra & 0 West st Des ]	& Kimm, Inc. own Pkwy Moines, IA 502	266				1 2	
Date I Drilling Surfac Datum	Drilleo g Met ce Ele n:	d: hod: _ evation	6/14/ Core, DCP, a :1 Site Surv	2023 and Hand Pro 1156.3' vey	obe			3	5
Remar	ˈksː							6 7 8 9	
Elevation ft.	Depth ft.	Moisture Content, %	California Be Correlated from I Penetrometer (A	aring Ratio Dynamic Cone STM D6951)		Material Description*	Graphic Log	nscs	Water Level
	0					PCC (8.25'')			
155.6 -	- - - 1.8	24.6 21.2 21.6	Ĺ		Very da Dark gi	ark gray lean to fat clay, moist ray after 1.3'		CL- CH	0.7 - 1155.6 -
1153.8 -	-	22.9				FILL			_
	-	23.2		$\leq$					_
1152 -	- 3.6 - -	24.0		<b>13</b> 22- 35- 50-	End of B	oring			4.0
- - - 	- 5.4 - stratific	ation line:	s represent the app	roximate boundar	y lines be	tween material types: in-situ, the transition	n may be grad	lual.	
Time:	۷ at c	Vater Lev completio	el Observation	hrs.	ALLE	NDER BUTZKE ENG	GINEEI	RS, ]	INC.
Depth to water:	D	<b>)ry</b> ft.	<u> </u>	_ ft. 🖳	Geot	echnical   Environmental   C	Constructi	on Q	.C.

				CORE NO	)	42				Projec	t No.	: 2	21438
Projec	t: <u>Wh</u> <u>Gut</u>	ite Pol thrie C	e Road and P ounty, Iowa	28 Pavement	Cores		221	43	8 B	-42	2		
Client:	<u>Vee</u> <u>300</u> We	enstra & 0 West st Des 1	& Kimm, Inc. own Pkwy Moines, IA 50	)266					30				TOP INCHES 1
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Remark	KS:												<u>5</u> <u>6</u> <u>7</u> <u>8</u>
Elevation ft.	Depth ft.	Moisture Content, %	California Be Correlated from Penetrometer (	earing Ratio	_	Material Description*					Log USCS	Water Level	Depth  Elevation ft.
	0	20.2		, 	Very o	dark gra dark bro	PCC ay and gray FI own clayey	( <b>7.0''</b> ) lean to fa LL sand with	nt clay, moist	· 1.3'	CL CH SC	-	0.6
159.2 -	- 3.6	13.8		60- 48- 39- 12-	End of I	Boring					×		2.0
157.4 - _ _ *The s	- 5.4	ation line	s represent the ap		ry lines by	etween	material type	es: in-situ	the transition	1 may be (			- -
Time: Depth to water:	v at c D	Vater Lev completio	el Observation	hrs /	ALLI Geor	END techn	ER BU	J <b>TZK</b> nvironr	<b>E EN</b>	<b>GINE</b> Constru	ERS ction	, I Q.0	NC. C.

				CORE NO	)43	}		Project	No.:	221438
Project	t: <u>Wh</u> <u>Gut</u>	ite Pol thrie C	e Road and P2 ounty, Iowa	8 Pavement	<u>Cores</u>	2214	438 ]	B-43		TOP
Client:	<u>Vee</u> <u>300</u> We	enstra d 0 West st Des 1	& Kimm, Inc. cown Pkwy Moines, IA 502	266			2.			
Date D Drilling Surface Datum	Drillec J Met e Ele :	d: hod: _ evation	6/21/2 Core, DCP, a :1 Site Surv	2023 and Hand Pr 163.0' 7ey	robe		ČE K			<u>3</u>
Remark	KS:									5 6 7 8
Elevation ft.	Depth ft.	Moisture Content, %	California Bea Correlated from D Penetrometer (A	aring Ratio Dynamic Cone STM D6951)	-	Material De	escription*	Graphic Log	NSCS	Water Level Depth  Elevation ft.
1162.8 -	0					PCC (6	5.75'')			0.6
1161 -	- 1.8	24.7 17.3		20- 15- 15-	Very dar	k gray fat clay, m FIL d after 1.8'	oist L		СН	1162.4
1159.2 -	- 3.6	24.1		<b>14</b> 20-	Very dar	k gray lean to fat LOCAL AL ring	clay, moist LUVIUM		CL- CH	<u>2.8</u> 1160.2 - <u>3.3</u> 1159.7 _
1157.4 –	- 5.4 tratifica W	ation line	s represent the appr el Observation	roximate bounda		reen material types	s: in-situ, the tran	sition may be gra	dual.	
Depth to water:	at c	ry ft	· <sup>Ţ</sup>	ft. ¥	Geote	chnical   En	vironmental	Construct	ion (	2.C.

					CORE	Z NO.	4	4				Proje	ect I	No.:	22	1438
Projec	xt: <u>Wh</u> <u>Gu</u> t	ite Pol thrie C	e Road ounty, ]	and P2 Iowa	28 Paven	nent C	Cores	22	214	-38	B		44	1		OP
Client	: <u>Vee</u> <u>300</u>	enstra a 0 West	& Kimn town Pk	n, Inc. xwy								071.				1
	We	st Des	Moines	, IA 50	266											2
Date I Drilling Surfac	Drilleo g Met ce Ele	d: hod: _ evation	Core,	6/21 DCP,	/2023 and Han 1151.0'	nd Pro	be									3
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Elevation ft.	Depth ft.	Moisture Content, %	Califo Correla Penet	ornia Be ated from crometer (	earing Ra Dynamic Co ASTM D695	one	Material Description*					cidad?	Log	nscs	Nater Level	Leptn Elevation ft.
	0								PCC (6.5	")			10 10 10		-	0.5
150.2 -	_	21.9			$\leq$		Dark gra	ay to very	dark gray	ean to fat c	lay, mo	ist	$\bigotimes$	CL- CH		1150.5
	-	17.0				-	Sandy le	ean to fat c	clay after 1	.5'			$\bigotimes$			-
	- 1.8 -	17.5			Ę		5		FILL				$\bigotimes$			_
148.4 -	_	14.8			$\geq$	$14 \rightarrow 12$							$\bigotimes$			2.8
-	- 3.6				~		End of Bo	oring								- 1148.2
146.6 -	-															-
	_															-
-	- 5.4															_
*The	- stratific	ation line	s represer	nt the ap	proximate b	oundary	lines bet	ween mate	rial types: ir	n-situ, the tra	ansition	may be	e gra	dual.		
Time:	v at c	vater Lev completio	ei Observ on	ation	hrs.	A	LLE	NDER	BUT	ZKE ]	ENG	INE	E	RS,	IN	<b>C.</b>
Depth to water:	D	<b>ry</b> ft			ft. 🕎		Geote	chnical	Envi	ronmenta	al   Co	onstr	ucti	ion (	Q.C	
			CO	RE NO	. 45				Project I	No.:	221438					
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Project	t: <u>Wh</u> <u>Gut</u>	ite Pole hrie C	e Road and P28 Pa ounty, Iowa	vement (	<u>Cores</u>	2214	138	B-4	45		ТОР					
Client:	<u>Vee</u> <u>300</u> Wee	<u>nstra &amp;</u> 0 West	& Kimm, Inc. own Pkwy Moines 14 50266								INCHES					
Date D Drilling	)rillec ) Met	l: hod: _	6/21/2023 Core, DCP, and I	Hand Pro	obe						3					
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Elevation ft.	Depth ft.	Moisture Content, %	California Bearing Correlated from Dynam Penetrometer (ASTM I	Ratio ic Cone D6951)		Material De	escription	*	Graphic Log	USCS	Mater Level Depth 6					
1146.6 —	0	16.2		13→	Dark gray clay, trace	PCC (8) with very dark g gravel, moist	.25") gray sandy [	lean to fat		CL- CH	0.7 -					
	- 1.8	18.8		$\geq$		FIL	L				_					
1144.8 —		25.3			Less sand	after 2.5'					3.3					
1143 -	- 3.6			12→ 14→	End of Bori	ng					1144.2					
	- 5.4	ation lines	represent the approving		y lines botus	en material types	rin-citu tha	transition	may be grea	1121	_					
	W	ater Leve	el Observation				T7KF	FNC								
Time: Depth to water:	at c 	ompletic <b>ry</b> ft.	on hrs	$\mathbf{\underline{V}}_{\underline{\underline{r}}}$	Geotec	hnical   Env	vironmer	ntal   C	onstructi	on (	).C.					

			CORE NO	0. <u>46</u>	Project No.:	221438
Projec	ct: <u>Wł</u> <u>Gu</u>	nite Pol thrie C	e Road and P28 Pavement county, Iowa	<u>Cores</u> 221438 B	-46	TOP
Client	: <u>Ve</u> <u>30(</u>	enstra d 00 West	& Kimm, Inc. town Pkwy			
	<u></u>	est Des	Moines, 1A 50200			2
Date I Drilling Surfac	Drille g Me ce Ele	d: thod: _ evation	6/21/2023 Core, DCP, and Hand Pr 1141.1' Site Survey	robe		3
Remar	rks:					5 6 7 8 9
Elevation ft.	Depth ft.	Moisture Content, %	California Bearing Ratio Correlated from Dynamic Cone Penetrometer (ASTM D6951)	Material Description*	Graphic Log USCS	Nater Level Depth  Elevation ft.
	0			PCC (7.0")		0.6
	- - 1.8	22.1		Dark gray with very dark gray lean to fat cla FILL	ay, moist CL- CH	1140.5
-	-	22.7		Dark gray fat clay, moist PALEOSOL	СН	2.3 1138.8 3.3
137.6 -	- 3.6			End of Boring		1137.8
135.8 -						-
*The	stratific \	ation line Vater Lev	s represent the approximate boundate of the second se	ry lines between material types: in-situ, the transi	tion may be gradual.	
Time: Depth to	at	completio	on hrs.	ALLENDER BUTZKE EN	NGINEERS,	INC.
water:	Ī	Dry ft	. <u>↓</u> ft. <u>↓</u>	Geotechnical   Environmental	Construction (	Q.C.









Report of Pavement Investigation **Guthrie County Road Investigations** West Des Moines, IA August 6, 2023 AET Report No. P-0020125

## **Appendix B**

Ground Penetrating Radar Field Exploration and Testing GPR Plots

The pavement structural conditions at the site were evaluated nondestructively using Ground Penetrating Radar (GPR). The description of the equipment precedes the GPR Data and Analysis Results in this appendix.

## **B.2 EQUIPMENT DESCRIPTION**

#### B.2.1 GSSI GPR Test System

The GPR test system owned by AET is a bumper-mounted, 2 GHz air-coupled antenna; dual-channel controller/data acquisition system; wheel-mounted DMI (Distance Measuring Instrument); and laptop with the GSSI controller software. AET uses GPR systems for testing and analysis that meets the ASTM D4748-10 Determining the Thickness of Bound Pavement Layers Using Short-Pulse Radar and D6087 Evaluating Asphalt-Covered Concrete Bridge Decks Using Ground Penetrating Radar test standards. Figure B1 provides an example of a vehicle outfitted with the air-coupled antenna and the raw GPR data prior to processing.



Figure B1. (a) GSSI 2 GHz Air-coupled GPR Test System mounted to the rear of an AET survey vehicle and (b) example of raw data collected using the GPR test system

The GPR antenna emits a high-frequency electromagnetic wave into the material under investigation. The reflected energy caused by changes in the electromagnetic properties within the material is detected by a receiver antenna and recorded for subsequent analysis. The 2 GHz air-coupled GPR can collect radar waveforms at more than 100 signals per second, which allows for data to be collected at driving speeds along the longitudinal dimension of a road with the antennas fixed at the rear or in front of the vehicle.

AET prefers the 2 GHz antenna for road surveys as it combines excellent resolution with reasonable depth penetration (18-24 inches in pavement materials). As data collection is performed at normal driving speeds (45-55 mph), no lane closures are required. At this speed the 2 GHz antenna can collect data at 6-inch interval (2 scans/foot), however data collection varies by project. Specific data collection rates (in scans per foot) will be described in project reports. Vertical scans consist of 512 samples and the recorded length in time of each scan is 12 nanoseconds. Data acquisition uses 300 MHz high pass and 5,000 MHz low pass filters.

In a GPR test, the antenna is moved continuously across the test surface and the control unit collects data at a specified distance increment. In this way, the data collection rate is independent of the scan rate. Alternatively, scanning can be performed at a constant rate of time, regardless of the scan distance. Single point scans can be performed as well. Data is reviewed in the controller software in real-time during field testing to identify reflections and ensure proper data collection parameters.

## **B.2.2 System Calibrations**

Prior to each use, the GPR test system is calibrated using metal plate and air calibration methods suggested by the GPR manufacturer. In addition, the DMI is calibrated to within +/- 1 foot/mile.

• Metal plate calibration is obtained with the antenna placed over a metal plate at the same

elevation as a scan obtained over pavement. Time-based collection (as opposed to distance) is performed to provide the velocity of the radar energy in terms of reflection strengths (amplitudes) from a pavement layer interface relative to a perfect reflector (a metal plate).

- Air calibrations are also performed in time-based collection mode to account for the vertical travel of the antenna during vehicle-mounted testing. To approximate the range of travel encountered during testing, data is collected for fifteen seconds while an operator moves the vehicle vertically (by jumping up and down on the mounting point at the bumper) to record data. This information is used in later GPR analysis.
- The DMI is calibrated by laying out a long distance (typically 100 feet) with a tape measure, marking the termini, and traversing the known distance. Recorded distance in the controller software is confirmed against actual distance, and adjustments in the controller software are made to ensure that DMI information that is paired with GPR data is accurate.

## **B.2.3 Linear Distance and Spatial Reference System**

The distance measuring instrument (DMI) is a trailer mounted two phase encoder system. When DMI is connected to the GPR controller it provides for automatic display and recording distance information in both English and metric units within a 1-foot (0.3 meters) resolution when calibrated using provided procedure in the controller software.

The spatial reference system is provided using either Trimble or EOS Arrow Global Positioning System (GPS) systems that consist of a fully integrated receiver, antenna, and battery unit to provide subfoot (30 cm) post processed accuracy. All GPS information is coupled with raw GPR data within the GPR controller software.

## B.2.4 Camera Monitoring System

A truck-mounted, battery-operated independent 4K waterproof multi-functional digital camera with an SD card is used to capture digital video of the pavement surface during GPR data collection.

## **B.3 SAMPLING METHODS**

Sampling methods using the GPR test system comply with the test standard (ASTM D4748-10). Sampling rates (i.e. scans per foot), sampling location (e.g. right wheel path, middle lane, both wheel paths), and the use of alternative equipment for GPR collection, if applicable (e.g. ground-coupled antennas), are described in the body of the project report.

## B.4 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA)

Beside the daily metal plate calibration, the DMI is also calibrated at regular intervals by driving the vehicle over a known distance to calculate the distance scale factor. The GPR will be monitored in real time in the data collection vehicle to minimize data errors. The GPR units will be identified with a unique number and that number will accompany all data reported from that unit as required in the QC/QA plan.

Scheduled preventive maintenance ensures proper equipment operation and helps identify potential problems that can be corrected to avoid poor quality or missing data that results if the equipment malfunctions while on site. The routine and major maintenance procedures established by the Federal Highway Administration's Long-Term Pavement Performance research program are adopted and any maintenance has been done at the end of the day after the testing is complete and become part of the routine performed at the end of each test/travel day and on days when no other work is scheduled.

As noted in the applicable test standard (ASTM D4748-10), quality assurance of GPR data is compromised when suboptimal test conditions exist. Such conditions may include wet surfaces (including standing water), ambient electromagnetic interference, or pavement distresses that can significantly scatter the GPR signal.

#### **B.5 DATA ANALYSIS METHODS**

#### B.5.1 Data Editing

Field acquisition is seldom so routine that no errors, omissions, or data redundancy occur. Data editing encompasses issues such as data re-organization, data file merging, data header or background information updates, repositioning, and inclusion of elevation information with the data.

#### **B.5.2 Basic Processing**

Basic data processing addresses some of the fundamental manipulations applied to data to make a more acceptable product for initial interpretation and data evaluation. In most instances this type of processing is already applied in real-time to generate the real-time display. The advantage of post survey processing is that the basic processing can be done more systematically and non-causal operators to remove or enhance certain features can be applied.

The Reflection Picking procedure is used to eliminate unwanted noise, detects significant reflections, and records the corresponding time and depth. It uses antenna calibration file data to calculate the radar signal velocity within the pavement.

#### B.5.3 Advanced Processing

Advanced data processing addresses the types of processing which require a certain amount of operator bias to be applied and which will result in data which are significantly different from the raw information which were input to the processing. This stage of analysis relies on supplementary resources (e.g. boring/coring logs, design plans, as-built records, historical records, conversations with road engineers/supervisors).

#### B.5.4 Data Interpretation

In some cases, automated layer interpretation modules within the analysis software can be used from preliminary analysis to map structural layers and calculate the corresponding velocities and depths. When used, the results from these modules require engineering review and approval.

#### **B.6 TEST LIMITATIONS**

#### **B.6.1 Test Methods**

The testing we performed identified pavement conditions only at those points where we measured pavement thicknesses and observed pavement surface conditions. Depending on the sampling methods and sampling frequency, every location may not be tested. Test conditions may limit the quality of the data collected, and some anomalies may be present in the pavement that compromise data and/or data collection at a given location.

Furthermore, because analysis procedures involve matters of engineering judgement, the final analysis developed represents our professional opinions about the subsurface conditions. More specifically, as relates to pavement systems, assessing layer thicknesses using GPR is a matter of engineering judgement. To enrich the analysis, we rely on supporting test methods and project information. However, even with supporting information, the distinction between layers in the road is not always explicit. Factors influencing definition of radar scans include ambient electromagnetic interference, the presence of moisture, the presence of voids, and the similarity of material layer type between layers.

Other factors external to related to methods and analysis data may require that we alter our conclusions and recommendations accordingly.

#### B.6.2 Test Standards

Pavement testing is performed in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

#### **B.7 SUPPORTING TEST METHODS**

#### B.7.1 Soil Boring/Coring Field Exploration

If both pavement thicknesses and subgrade soil types and conditions are desired, pavement cores and soil borings are obtained. The limited number of cores and borings are necessary to verify the GPR layer thickness data.

#### **B.7.2 Pavement Surface Condition**

Certain pavement distresses may affect the electromagnetic signal to an extent that complicates the analysis of GPR data. The results of a pavement condition survey are useful to identify near-surface features (e.g. stripped asphalt) or sub-surface features (e.g. local saturated layers due to ingress of water at the surface) when reviewing GPR data.

When we do not perform a standard pavement condition survey alongside GPR data, we rely on GPR operators to note possible distresses as they traverse the pavement from about 1 ft (0.3 m) in front of vehicle to about 30 ft (9 m) ahead. These test notes are consulted during GPR analysis, however they are not a substitute for a conventional rigorous pavement condition survey.



	GEN	ERAL INF	ORMATIC	N: GRO	UND PEN	ETRATIN	G RADAF	ł
Project	Guthrie Co	unty Poads	Investigation		Data	7/13/23		
AET Job No.	P-0020125	unty Roads	investigation	г	Pate. Test Date:	5/1/23		
Road:	CTH 925			Sect	ion/Grid:	S01		
From:	Frontier Ro	1			To:	CTH N72		
			SUMN	MARY ST	ATISTIC	S		
					Units:	inches		
		E	B			W	/ <b>B</b>	-
Layer	Average	CV	15th	Min.	Average	CV	15th	Min.
BP	7.3	9%	6.5	5.6	7.7	9%	7.1	5.6
PCC	8.5	12%	7.3	6.1	8.6	18%	6.9	3.5





GENERAL INFORMATION: GROUND PENETRATING RADAR										
<b>Project</b>	Guthria Co	untu Dooda	Investigation		Data	7/12/22				
AFT Joh No.	D 0020125	unty Koaus	nivesugation	т	Date.	5/1/22				
AEI JUD NU.; Dood	CTU 025			I Soot	iest Date:	5/1/25				
Koau:	СТН 923 СТН N72			Sect	ion/Griu: To:	SU2 Kalsay Pd				
FTOIII;	CIHN/2				10:	Keisey Ku				
			SUMM	IARY ST	ATISTIC	S				
					Units:	inches				
		E	B			W	<b>B</b>			
Layer	Average	CV	15th	Min.	Average	CV	15th	Min.		
BP	7.8	7%	7.3	6.4	8.2	10%	7.5	5.0		
PCC	6.6	14%	5.8	4.2	6.7	22%	5.3	3.9		





<b>GENERAL INFORMATION: GROUND PENETRATING RADAR</b>											
Dustant	Castlaria Ca	unter De e de l	T		Data	7/12/02					
Project:	Guinrie Co	unty Roads	Investigation		Date:	//13/23					
AET Job No.:	P-0020125			]	<b>Fest Date:</b>	5/1/23					
Road:	CTH 925			Sect	ion/Grid:	S03A					
From:	E Grant Ro	l			To:	0.87 mi E					
			SUMN	IARY ST	ATISTIC	S					
					Units:	inches					
		E	СВ			W	VB				
Layer	Average	CV	15th	Min.	Average	CV	15th	Min.			
BP	7.6	8%	7.0	6.2	7.0	7%	6.6	4.8			
PCC	8.0	14%	7.0	5.9	7.3	16%	6.1	4.7			





	GEN	ERAL INF	ORMATIC	DN: GROU	UND PEN	IETRATIN	G RADAP	2	
Drojoot	Guthria Co	unty Doods	Investigation		Data	7/12/22			
AET Job No.:	P-0020125		nivestigation	' Т	Sest Date:	5/1/23			
Road	CTH 925			Secti	ion/Grid:	S03B			
From	0.87 mi E	of E Grant R	d		To:	0.37 mi E			
			SUM	MARY ST	ATISTIC	<b>S</b>			
·					Units:	inches			
		ŀ	EB			W	VB		
Laye	er Average	CV	15th	Min.	Average	CV	15th	Min.	
BP	5.3	23%	2.0	5.0	19%	4.3	2.7		
PCO	C 11.7	6%	11.2	8.6	11.7	8%	11.3	7.2	





	GENERAL INFORMATION: GROUND PENETRATING RADAR										
Drojog	t Gut	hria Co	unty Poods	Invostigation		Datas	7/12/22				
AFT Job No	$\sim P 0 0$	100125	unty Roads	investigation	า	Date.	5/1/23				
ALI JUDINU Door	л. г-ос Л. сті	1 0 2 5			I Soot	ion/Crid	5/1/25 S02C				
Kuau Enon	$\mathbf{u}:  \mathbf{C}\mathbf{I}\mathbf{f}$	1923			Sect	IOII/GITU:	SUSC STH 25				
FIU	<b>From.</b> 0.45 m w					10:	511125				
				SUM	MARY ST	ATISTIC	S				
						Units:	inches				
			Ε	B			STH 25  STH 25  MB				
Lay	yer Av	erage	CV	15th	Min.	Average	CV	15th	Min.		
B	Р	8.5	9%	7.9	6.9	8.2	14%	7.1	6.4		
РС	CC	9.1	10%	8.3	7.1	8.7	13%	7.5	6.8		





	GENERAL INFORMATION: GROUND PENETRATING RADAR										
Proje	oct.	Guthrie Cou	untu Poade l	Investigation		Data	7/13/23				
AET Ich N		D 0020125	anty Roads	investigation	י ת	Date.	5/1/22				
ALI JOD N	0.:	P-0020125			1	est Date:	3/1/23				
Roa	ad:	CTH 925			Sect	ion/Grid:	S04				
Fro	om:	STH 25				To:	CTH P20				
				SUM	MARY ST	ATISTIC	S				
						Units:	inches				
			E	В			W	/ <b>B</b>			
La	ayer	Average	CV	15th	Min.	Average	CV	15th	Min.		
	BP	7.5	10%	6.6	5.6	7.4	10%	6.6	5.8		
Р	CC	8.6	15%	7.2	5.3	8.2	12%	7.2	5.5		





	<b>GENERAL INFORMATION: GROUND PENETRATING RADAR</b>										
Project:	Guthrie Co	unty Roads	Investigation		Date:	7/13/23					
AET Job No.:	P-0020125	unity reduces	mvesugution	Т	Sest Date:	5/1/23					
Road:	CTH 925			Secti	ion/Grid:	S05					
From:	CTH P20				To:	Seridan St					
			SUMN	MARY ST	ATISTIC	S					
	•				Units:	inches					
		F	EB			W	VB				
Layer	Average	CV	15th	Min.	Average	CV	15th	Min.			
BP	7.6	12%	6.7	6.2	7.4	13%	6.4	5.7			
PCC	9.2	11%	8.2	7.4	9.3	21%	8.3	6.3			





	GENE	RAL INF	ORMATIC	)N: GRO	UND PEN	ETRATIN	G RADAI	R
<b>Drojoct</b>	Guthria Cou	untu Dooda	Invostigation		Data	7/12/22		
AET Job No ·	P-0020125	inty Roads	investigation	้า	Date.	5/1/23		
Road:	CTH 925			Sect	ion/Grid:	S06		
From:	Adair St (M	lenlo)			To:	340th St		
			SUM	IARY ST	ATISTIC	S		
	-				Units:	inches		
		F	EB			W	<b>VB</b>	
Layer	Average	CV	15th	Min.	Average	CV	15th	Min.
BP	7.3	14%	6.7	1.5	7.4	15%	6.8	1.7
PCC	8.3	15%	7.2	4.9	8.6	14%	7.6	5.7



550 Cleveland Avenue North St. Paul, Minnesota 55114 Phone: (651) 659-9001 Fax: (651) 659-1379



<b>GENERAL INF</b>	ORMATION:	GROUND	PENETRATING	RADAR
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Project:Guthrie County Roads InvestigationAET Job No.:P-0020125Road:CTH 925From:340th St

 Date:
 7/13/23

 Test Date:
 5/1/23

 Section/Grid:
 S07

 To:
 N Adair St (Stuart)

## **SUMMARY STATISTICS**

_					Units:	inches			
		E	В		WB				
Layer	Average	CV	15th	Min.	Average	CV	15th	Min.	
BP	7.8	13%	6.8	6.3	7.5	11%	6.6	5.5	
PCC	8.5	13%	7.4	5.9	8.7	10%	7.7	6.6	





	GENE	RAL INF	ORMATIC	DN: GRO	UND PEN	IETRATIN	G RADAI	ર
Project	Guthrie Cou	ntv Roads	Investigation		Date	7/13/23		
AET Job No.:	P-0020125	iny Roads	investigation	Ĩ	Sest Date:	5/1/23		
Road:	CTH P28 (W	vagon Rd)		Sect	ion/Grid:	S08A		
From:	N 10th St				To:	2.06 mi N		
			SUM	MARY ST	ATISTIC	S		
	1				Units:	inches		
		Ν	NB			S	B	
Layer	Average	CV	15th	Min.	Average	CV	15th	Min.
PCC	7.7	8%	7.2	5.8	7.5	9%	6.8	5.4





	GENE	ERAL INF	ORMATIC	DN: GRO	UND PEN	ETRATIN	IG RADAF	ł
Dustast	Castlaria Cas		T		Data	7/12/22		
Project:	Gutnrie Co	unty Koads	Investigation		Date:	//13/23		
AET Job No.:	P-0020125			Т	est Date:	5/1/23		
Road:	CTH P28 (	Wagon Rd)		Sect	ion/Grid:	S08B		
From:	0.42 mi N c	of Wagon Li	1		To:	0.2 mi N		
			SUM	MARY ST	ATISTIC	S		
					Units:	inches		
		N	B			S	B	
Laye	Average	CV	15th	Min.	Average	CV	15th	Min.
BP	2.1	44%	1.5	1.3	2.3	65%	1.4	1.4
PCC	7.6	9%	7.1	6.2	7.7	12%	7.1	5.0





	GENE	RAL INF	ORMATIO	N: GRO	UND PEN	IETRATIN	G RADAI	ર
Project:	Guthrie Cou	nty Roads	Investigation		Date:	7/13/23		
AET Job No.:	P-0020125			Т	Test Date:	5/1/23		
Road:	CTH P28 (W	vagon Rd)		Sect	ion/Grid:	S08C		
From:	2.44 mi S				To:	Bridge		
			SUMN	MARY ST	ATISTIC	S		
					Units:	inches		
		Ν	NB			S	B	
Layer	Average	CV	15th	Min.	Average	CV	15th	Min.
PCC	7.7	8%	7.1	6.0	7.6	8%	7.0	5.7





	GENE	RAL INF	ORMATIO	N: GRO	UND PEN	IETRATIN	G RADAI	R
Project:	Guthrie Cou	nty Roads	Investigation		Date:	7/13/23		
AET Job No.:	P-0020125		C	]	Test Date:	5/1/23		
Road:	CTH P28 (W	Vagon Rd)		Sect	tion/Grid:	S09		
From:	Bridge				To:	280th Rd		
			eum		ATICTIC	e		
			30MM	IART JI	Units:	s inches		
		F	B			W	<b>B</b>	
Layer	Average	CV	15th	Min.	Average	CV	15th	Min.
PCC	7.7	10%	6.9	5.8	7.7	11%	6.7	5.8





	GENE	RAL INF	ORMATIC	N: GRO	UND PEN	IETRATIN	G RADAI	R
Project:	Guthrie Cou	inty Roads	Investigation		Date:	7/13/23		
AET Job No.:	P-0020125			r	Fest Date:	5/1/23		
Road:	CTH P28 (W	Wagon Rd)		Sect	tion/Grid:	<b>S</b> 10		
From:	280th Rd				To:	CTH F51 N	N Jct	
						-		
			SUMN	MARY ST	TATISTIC	<b>S</b>		
		N	JB		Units:	inches	B	
Layer	Average	CV	15th	Min.	Average	CV	15th	Min.
DCC	77	11%	69	58	8.0	11%	7.2	5.8



Report of Pavement Investigation **Guthrie County Road Investigation** West Des Moines, IAH August 11, 2023 AET Report No. P-0020125



# Appendix C

## Falling Weight Deflectometer Field Exploration and Testing

## Appendix C Falling Weight Deflectometer Field Exploration and Testing AET Project No. P-0020125

#### C.1 PAVEMENT TESTING

The pavement structural conditions at the site were evaluated nondestructively using Falling Weight Deflectometer (FWD). The description of the equipment precedes the Deflection Data and Analysis Results in this appendix.

#### C.2 EQUIPMENT DESCRIPTION

## C.2.1 Dynatest 8000 FWD Test System

The FWD owned by AET is a Dynatest 8000 FWD Test System that consists of a Dynatest 8002 trailer and a third generation control and data acquisition unit developed in 2003, called the Dynatest Compact15, featuring fifteen (15) deflection channels. The new generation FWD, including a Compact15 System and a standard PC with the FwdWin Field Program constitutes the newest, most sophisticated Dynatest FWD Test System, which fulfills or exceeds all requirements to meet ASTM-4694 Standards. Figure C1 provides a view of this equipment.



Figure C1 Dynatest 8002 FWD Test System

The FWD imposes a dynamic impulse load onto the pavement surface through a load plate. Total pulse is an approximately half sine shape with a total duration typically between 25 to 30 ms. The FWD is capable of applying a variety of loads to the pavement ranging from 1,500 lbf (7 kN) to 27,000 ibf (120 kN) by dropping a variable weight mass from different heights to a standard, 11.8-inch (300-mm) diameter rigid plate.

The drop weights and the buffers are constructed so that the falling weight buffer subassembly may be quickly and conveniently changed between falling masses of 440 lbm (200 kg) for highways and 770 lbm (350 kg) for airports. With the 440 lbm (200 kg) package for highways three drop heights are used with the target load of 6,000 lbf (27 kN) at drop height 1, 9,000 lbf (40 kN) at drop height 2, and 12,000 lbf at drop height 3 (53 kN). The drop sequence consists of two seating drops from drop height 3 and 2 repeat measurements at drop height 1 and 1 measurement at drop height 2 for flexible pavements and 2 repeat measurements at drop height 2 and 1 measurement at drop height 3 for rigid pavements. The data from the seating drops is not stored.

The FWD is equipped with a load cell to measure the applied forces and nine geophones or deflectors to measure deflections up to 100 mils (2.5 mm). The load cell is capable of accurately measuring the force that is applied perpendicular to the loading plate with a resolution of 0.15 psi (1 kPa) or better. The force is expressed in terms of pressure, as a function of loading plate size.

Nine deflectors at the offsets listed in the following table in the Long Term Performance Program (LTPP) configuration are capable of measuring electronically discrete deflections per test, together with nine (9) separate deflection measuring channels for recording of the data. One (1) of the deflectors measures the deflection of the pavement surface through the center of the loading plate, while seven (7) deflectors are capable of being positioned behind the loading plate along the housing bar, up to a distance of 5 ft (2.5 m) from the center of the loading plate and one (1) being positioned in front of the loading plate along the bar.

## Appendix C Falling Weight Deflectometer Field Exploration and Testing AET Project No. P-0020125

Deflector	D9	D1	D2	D3	D4	D5	D6	D7	D8
Offset (in.)	-12	0	8	12	18	24	36	48	60

Field testing is performed in accordance with the standard ASTM procedures as described in ASTM D 4695-96, "Standard Guide for General Pavement Deflection Measurements" and the calibration of our equipment is verified each year at the Long Term Pavement Performance Calibration Center in Maplewood, MN.

## C.2.2 Linear Distance and Spatial Reference System

Distance measuring instrument (DMI) is a trailer mounted two phase encoder system. When DMI is connected to the Compact15 it provides for automatic display and recording distance information in both English and metric units with a 1 foot (0.3 meters) resolution and four percent accuracy when calibrated using the provided procedure in the Field Program.

Spatial reference system is a Trimble ProXH Global Positioning System (GPS) that consists of fully integrated receiver, antenna and battery unit with Trimble's new H-Star<sup>™</sup> technology to provide subfoot (30 cm) post-processed accuracy. The External Patch antenna is added to the ProXH receiver for the position of the loading plate. The External Patch antenna can be conveniently elevated with the optional baseball cap to prevent any signal blockage.

## C.2.3 Air and Pavement Temperature Measuring System

A temperature monitoring probe, for automatic recording of air temperature, is an electronic (integrated circuit) sensing element in a stainless steel probe. The probe mounts on the FWD unit in a special holder with air circulation and connects to the Compact15. A non-contact Infra-Red (IR) Temperature Transmitter, for automatic recording of pavement surface temperature only, features an integrated IR-detector and digital electronics in a weather proof enclosure. The IR transmitter mounts on the FWD unit in a special holder with air circulation and connects to the Compact15. Both probe and IR transmitter have a resolution of 0.9 °F (0.5 °C) and accuracy within  $\pm 1.8^{\circ}$ F (1 °C) in the 0 to 158 °F (-18 to +70°C) range when calibrated using the provided procedure.

#### C.2.4 Camera Monitoring System

A battery operated independent DC-1908E multi-functional digital camera with a SD card is used for easy positioning of the loading plate or recording of the pavement surface condition at the testing locations.

## C.3 SAMPLING METHODS

At the project level, the testing interval is set at 0.1 mi. (maximum) or 10 locations per uniform section in the Outside Wheel Path (OWP) =  $2.5 \text{ ft} \pm 0.25 \text{ ft} (0.76 \text{ m} \pm 0.08 \text{ m})$  for nominal 12 ft (3.7 m) wide lanes. Where a divided roadbed exists, surveys will be taken in both directions if the project will include improvements in both directions. If there is more than one lane in one direction the surveys will be taken in the outer driving lane versus the passing lane of the highway. FWD tests are performed at a constant lateral offset down the test section.

## C.4 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA)

In addition to the annual reference calibration, the relative calibration of the FWD deflection sensors is conducted monthly but not to exceed 6 weeks during the months in which the FWD unit is continually testing. The DMI is also calibrated monthly by driving the vehicle over a known distance to calculate the distance scale factor. The accuracy of the FWD air temperature and infra-red (IR) sensors are checked on a monthly basis or more frequently if the FWD operator observes "suspicious" temperature readings.

Some care in the placement of the load plate and sensors is taken by the survey crew, especially where the highway surface is rutted or cracked, to ensure that the load plate lays on a flat surface and that the load plate and all geophones lie on the same side of any visible cracks. Liberal use of comments placed

## Appendix C Falling Weight Deflectometer Field Exploration and Testing AET Project No. P-0020125

in the FWD data file at the time of data collection is required. Comments pertaining to proximity to reference markers, bridge abutments, patches, cracks, etc., are all important documentation for the individual evaluating the data.

Scheduled preventive maintenance ensures proper equipment operation and helps identify potential problems that can be corrected to avoid poor quality or missing data that results if the equipment malfunctions while on site. The routine and major maintenance procedures established by the LTPP are adopted and any maintenance has been done at the end of the day after the testing is complete and become part of the routine performed at the end of each test/travel day and on days when no other work is scheduled.

## C.5 DATA ANALYSIS METHODS

#### C.5.1 Inputs

The two-way AADT and HCADT are required to calculate the ESALs. The state average truck percent and truck type distribution are used when HCADT is not provided. The as-built pavement information (layer type, thickness, and construction year) are required and if not provided, GPR and/or coring and boring is needed.

#### C.5.2 Adjustments

Temperature adjustment to the deflections measured on bituminous pavements is determined from the temperature predicted at the middle depth of the pavement using the LTPP BELLS3 model that uses the pavement surface temperature and previous day mean air temperature. The predicted middle depth temperature and the standard temperature of 80 degrees Fahrenheit are used to calculate the temperature adjustment factor for deflection data analysis. Seasonal adjustment developed by Mn/DOT is also used.

#### C.5.3 Methods

For bituminous pavements, the deflection data were analyzed using the American Association of State Highway and Transportation Officials' (AASHTO) method for determining the in-place (effective) subgrade and pavement strength, as well as allowable axle loads for a roadway as in the AASHTO Guide for Design of Pavement Structures, 1993 and Modulus 7.0 from Texas Department of Transportation.

## C.6 TEST LIMITATIONS

#### C.6.1 Test Methods

The data derived through the testing program have been used to develop our opinions about the pavement conditions at your site. However, because no testing program can reveal totally what is in the subsurface, conditions between test locations and at other times, may differ from conditions described in this report. The testing we conducted identified pavement conditions only at those points where we measured pavement surface temperature, deflections, and observed pavement surface conditions. Depending on the sampling methods and sampling frequency, every location may not be tested, and some anomalies which are present in the pavement may not be noted on the testing results. If conditions encountered during construction differ from those indicated by our testing, it may be necessary to alter our conclusions and recommendations, or to modify construction procedures, and the cost of construction may be affected.

## C.6.2 Test Standards

Pavement testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.



AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S01 Roadway: White Pole Rd From: Frontier Rd To: CTH N 72

Status         Prop         Time         Air *P         Bit *P         Lead         D1         D2         D3         D4         D4         D6         D7         D8         D9         Comments           0.110         4         1233         68.0         70.0         1007         58         6.4         572         5.18         4.69         3.82         3.01         1158         17           0.200         4         12.56         68.0         67.0         1004         6.57         5.68         5.20         4.69         3.82         5.97         152.9         19           0.306         4         12.58         68.0         72.0         9914         12.80         65.1         64.0         4.78         3.89         775         17           0.464         4         13.01         68.0         70.0         1012         6.77         6.50         4.93         3.21         1436         19           0.44         13.02         68.0         70.0         1002         6.80         17.3         5.77         4.73         2.13         168.0         17.2         18           0.420         4         13.06         68.0         70.0 <t< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>ISM</th><th>AREA</th><th></th></t<>																ISM	AREA	
0.011         4         12:53         68.0         70.0         1007         7.59         6.04         5.50         5.00         4.54         3.70         2.94         13:26         16           0.102         4         12:55         68.0         67.0         10045         6.57         5.64         4.29         3.55         2.97         15:29         19           0.306         4         12:56         68.0         67.0         10045         6.57         6.68         5.00         4.78         3.83         2.88         961         17           0.406         4         12:56         68.0         71.0         10001         9.57         6.81         6.03         5.45         4.61         3.67         1043         18           0.601         4         13:00         68.0         69.0         99.0         5.43         5.64         4.22         1.43         1439         20           0.700         4         13:00         68.0         68.0         1013         7.13         5.60         4.52         5.7         2.73         2.13         1068         16           1.020         4         13:06         68.0         70.0         15:03	Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9			Comments
0.102       4       1256       680       710       10100       8.72       6.86       5.72       5.18       4.69       3.82       3.01       1158       17         0.200       4       1256       680       670       10045       6.57       5.68       5.20       4.68       4.22       3.55       2.97       1529       19         0.404       4       1256       680       720       9914       12.80       681       6.00       4.78       3.89       775       17         0.404       4       1259       68.0       700       101959       7.75       681       6.03       4.72       142       1439       1043       18         0.404       4       1304       68.0       700       10122       6.44       5.23       4.54       5.37       2.71       1436       19         0.904       4       1304       68.0       700       10039       9.27       7.03       5.04       4.23       3.56       1.28       1421       18         0.904       4       1304       68.0       700       10019       5.57       7.90       7.03       5.11       5.39       3.77       2.13	0.011	4	12:53	68.0	70.0	10067	7.59	6.04	5.59	5.00	4.54	3.70	2.94			1326	18	
0.300       4       12:57       68.0       67.0       10012       10.21       7.77       6.66       5.64       4.89       3.83       2.88       981       17         0.494       4       12:57       68.0       7.0       10012       10.21       7.77       6.81       6.00       4.78       3.89       9775       17         0.494       4       12:50       68.0       7.10       10001       9.59       7.75       6.81       6.03       7.87       14.81       6.03       7.84       1.87       1.24       1.439       20         0.601       4       13:00       68.0       70.0       10078       7.02       6.00       5.78       4.84       4.21       3.42       1.430       14.30       19         0.804       4       13:02       68.0       70.0       10122       6.44       5.23       4.86       3.21       2.55       1572       18         0.802       4       13:05       68.0       70.0       1009       5.57       7.86       6.15       3.47       2.43       1.401       18         0.802       1.301       68.0       70.0       10012       7.03       6.10       5.33 </td <td>0.102</td> <td>4</td> <td>12:55</td> <td>68.0</td> <td>71.0</td> <td>10100</td> <td>8.72</td> <td>6.46</td> <td>5.72</td> <td>5.18</td> <td>4.69</td> <td>3.82</td> <td>3.01</td> <td></td> <td></td> <td>1158</td> <td>17</td> <td></td>	0.102	4	12:55	68.0	71.0	10100	8.72	6.46	5.72	5.18	4.69	3.82	3.01			1158	17	
0.406       4       12:58       68.0       70.0       10012       10.21       7.77       6.6       5.64       4.89       3.89       775       17         0.406       4       12:58       68.0       71.0       10001       9.59       7.75       6.81       6.03       5.45       4.12       3.42       1439       20         0.601       4       13:01       68.0       70.0       1070       7.02       6.00       5.50       4.72       4.12       3.42       1439       20         0.604       4       13:02       68.0       70.0       1072       7.03       7.04       4.50       3.71       3.51       4.86       4.22       3.46       4.21       3.50       2.88       1421       18         0.808       4       13:05       68.0       70.0       1008       5.52       4.80       4.20       3.50       2.81       1421       18         0.808       4       13:06       68.0       70.0       1008       5.52       4.80       4.20       3.50       2.91       1862       1471       18         0.804       4       13:06       68.0       70.0       1001       5.55 <td< td=""><td>0.200</td><td>4</td><td>12:56</td><td>68.0</td><td>67.0</td><td>10045</td><td>6.57</td><td>5.68</td><td>5.20</td><td>4.68</td><td>4.22</td><td>3.55</td><td>2.97</td><td></td><td></td><td>1529</td><td>19</td><td></td></td<>	0.200	4	12:56	68.0	67.0	10045	6.57	5.68	5.20	4.68	4.22	3.55	2.97			1529	19	
0.406       4       12.58       68.0       71.0       1001       9.59       7.75       6.81       6.03       5.45       4.61       3.89       775       17         0.494       4       12.59       68.0       71.0       10001       9.59       7.75       6.81       6.03       5.45       5.43       5.05       4.72       4.12       3.42       1439       10         0.600       4       13.00       68.0       70.0       10078       7.02       6.00       5.50       4.93       4.50       3.87       3.21       1436       19         0.804       4       13.00       68.0       70.0       10078       7.03       5.60       4.23       3.45       2.55       1572       18         0.982       4       13.05       68.0       70.0       9005       5.52       4.80       4.27       4.01       3.50       2.91       1282       20         1.102       4       13.00       68.0       70.0       9005       5.77       7.43       6.81       5.45       4.39       3.22       1137       19         1.102       4       13.10       68.0       70.0       9005       5.77 <t< td=""><td>0.306</td><td>4</td><td>12:57</td><td>68.0</td><td>78.0</td><td>10012</td><td>10.21</td><td>7.77</td><td>6.66</td><td>5.64</td><td>4.89</td><td>3.83</td><td>2.88</td><td></td><td></td><td>981</td><td>17</td><td></td></t<>	0.306	4	12:57	68.0	78.0	10012	10.21	7.77	6.66	5.64	4.89	3.83	2.88			981	17	
0.494       4       12:59       68.0       71.0       10001       9.59       7.75       6.81       6.03       5.45       4.61       3.67       1043       18         0.601       4       13:00       68.0       69.0       9990       6.84       585       5.43       5.05       4.72       4.12       3.42       1439       20         0.700       4       13:02       68.0       70.0       1078       7.02       6.00       5.00       5.00       5.01       3.57       4.86       4.22       3.84       3.21       1.55       1572       18         0.908       4       13:04       68.0       70.0       10099       5.52       4.80       4.50       4.27       7.73       2.68       955       18         1.102       4       13:06       68.0       70.0       10019       9.55       7.90       7.03       6.11       5.33       3.22       1137       19         1.301       4       13:10       68.0       6.00       9999       8.77       7.43       6.83       6.13       5.85       5.04       4.21       1052       19       1.501       1.511       1.51       1.51       5.5	0.406	4	12:58	68.0	72.0	9914	12.80	9.91	8.24	6.87	6.00	4.78	3.89			775	17	
0.601       4       13:01       68.0       60.0       9900       6.94       5.85       5.43       5.05       4.72       4.12       3.42       1439       20         0.700       4       13:01       68.0       70.0       10078       7.02       6.00       5.50       4.93       4.50       3.87       3.21       1436       19         0.804       4       13:04       68.0       70.0       10:03       7.13       5.37       4.86       4.51       4.20       3.64       141       18         0.982       4       13:06       68.0       70.0       10089       5.27       4.80       4.51       4.20       3.56       2.88       14121       18         0.902       4       13:06       68.0       70.0       10089       5.27       4.80       4.50       2.73       2.13       1068       16         1.102       4       13:08       68.0       70.0       10019       5.77       4.83       4.72       4.73       3.32       1137       19         1.301       4       13:10       68.0       70.0       10012       7.40       6.56       5.04       4.21       1052       19 </td <td>0.494</td> <td>4</td> <td>12:59</td> <td>68.0</td> <td>71.0</td> <td>10001</td> <td>9.59</td> <td>7.75</td> <td>6.81</td> <td>6.03</td> <td>5.45</td> <td>4.61</td> <td>3.67</td> <td></td> <td></td> <td>1043</td> <td>18</td> <td></td>	0.494	4	12:59	68.0	71.0	10001	9.59	7.75	6.81	6.03	5.45	4.61	3.67			1043	18	
0.700       4       13.01       68.0       70.0       10078       7.02       6.00       5.50       4.93       4.50       3.87       3.21       1436       19         0.804       4       13.02       68.0       70.0       10012       6.44       5.37       4.86       4.22       3.84       3.21       2.55       1572       18         0.908       4       13.05       68.0       70.0       10089       5.52       4.80       4.51       4.20       3.56       2.88       1421       18         0.908       4       13.05       68.0       70.0       10089       5.52       4.80       4.50       4.77       3.58       2.73       2.13       1068       16         1.020       4       13.00       68.0       70.0       10019       5.57       4.647       5.33       3.77       2.68       9.65       18         1.102       4       13.10       68.0       70.0       10017       7.40       6.81       5.04       4.21       1052       19         1.403       4       13.11       68.0       70.0       10012       7.46       6.18       5.44       4.21       15.35       21	0.601	4	13:00	68.0	69.0	9990	6.94	5.85	5.43	5.05	4.72	4.12	3.42			1439	20	
0.804       4       13.02       68.0       72.0       10122       6.44       5.23       4.68       4.22       3.84       3.21       2.55       1572       18         0.908       4       13.04       68.0       1013       7.13       5.37       4.86       4.20       3.56       2.88       1421       18         0.902       4       13.05       68.0       70.0       10093       9.52       4.80       4.50       2.73       2.13       1068       16         1.020       4       13.06       68.0       70.0       1009       9.55       4.80       4.50       4.27       3.33       1047       18         1.102       4       13.10       68.0       9.09       9.87       7.43       6.83       5.45       4.47       4.22       3.71       3.16       1795       20         1.501       4       13.11       68.0       70.0       10012       7.40       6.58       6.44       5.04       4.12       1052       19         1.601       4       13.14       68.0       7.00       10012       7.40       6.58       5.04       4.12       1052       19         1.601 <t< td=""><td>0.700</td><td>4</td><td>13:01</td><td>68.0</td><td>70.0</td><td>10078</td><td>7.02</td><td>6.00</td><td>5.50</td><td>4.93</td><td>4.50</td><td>3.87</td><td>3.21</td><td></td><td></td><td>1436</td><td>19</td><td></td></t<>	0.700	4	13:01	68.0	70.0	10078	7.02	6.00	5.50	4.93	4.50	3.87	3.21			1436	19	
0.908       4       13:04       68.0       68.0       10133       7.13       5.37       4.86       4.51       4.20       3.56       2.88       1421       18         0.908       4       13:06       68.0       70.0       9903       9.27       7.03       5.60       4.22       3.57       2.13       1068       16         1.102       4       13:07       68.0       70.0       1008       5.2       4.27       4.01       3.50       2.91       1828       20         1.102       4       13:07       68.0       70.0       10019       9.55       7.90       7.03       6.11       5.33       4.27       3.43       1047       18         1.301       4       13:10       68.0       69.0       9969       8.77       7.43       6.83       6.13       5.44       4.39       3.32       1137       19         1.403       4       13:11       68.0       70.0       10015       9.56       6.88       6.80       5.70       4.22       3.71       2.70       1264       18         1.800       4       13:14       68.0       73.0       6.42       5.10       3.87       778 <td< td=""><td>0.804</td><td>4</td><td>13:02</td><td>68.0</td><td>72.0</td><td>10122</td><td>6.44</td><td>5.23</td><td>4.68</td><td>4.22</td><td>3.84</td><td>3.21</td><td>2.55</td><td></td><td></td><td>1572</td><td>18</td><td></td></td<>	0.804	4	13:02	68.0	72.0	10122	6.44	5.23	4.68	4.22	3.84	3.21	2.55			1572	18	
0.982       4       13:05       68.0       70.0       9903       9.27       7.03       5.60       4.25       3.57       2.73       2.13       1068       16         1.020       4       13:06       68.0       70.0       10089       5.52       4.80       4.50       4.27       4.01       3.50       2.91       1828       20         1.102       4       13:06       68.0       70.0       10001       9.55       7.90       7.03       6.11       5.33       4.27       3.43       1047       18         1.301       4       13:10       68.0       68.0       9969       8.77       7.48       6.83       6.13       5.45       4.93       3.22       1137       19         1.403       4       13:11       68.0       7.00       10012       7.40       6.86       6.34       5.85       5.04       4.21       1052       19         1.601       4       13:12       68.0       7.00       10012       7.46       6.86       6.34       5.70       3.41       2.70       1264       18         1.800       4       13:16       68.0       7.00       9925       1.276       9.86	0.908	4	13:04	68.0	68.0	10133	7.13	5.37	4.86	4.51	4.20	3.56	2.88			1421	18	
1.020       4       13:06       68.0       70.0       10089       5.52       4.80       4.27       4.01       3.50       2.91       1828       20         1.102       4       13:07       68.0       70.0       10001       9.55       10.39       9.26       8.12       6.47       5.33       3.27       2.68       955       18         1.109       4       13:01       68.0       70.0       10001       9.55       7.90       7.03       6.11       5.33       4.27       3.43       1047       18         1.301       4       13:10       68.0       70.0       10016       9.56       7.88       6.13       5.45       4.94       4.21       1513       1.61       4.13       13:10       68.0       70.0       10012       7.40       6.56       6.14       5.80       5.46       4.82       4.12       1353       21         1.601       4       13:16       68.0       72.0       9925       12.76       9.86       8.73       6.42       5.10       3.87       778       17         1.909       4       13:16       68.0       70.0       10034       7.65       5.19       4.79       4.41	0.982	4	13:05	68.0	70.0	9903	9.27	7.03	5.60	4.25	3.57	2.73	2.13			1068	16	
1.102       4       13:07       68.0       72.0       9925       10.39       9.26       8.12       6.47       5.39       3.77       2.68       955       18         1.199       4       13:08       68.0       70.0       10001       9.55       7.80       7.03       6.11       5.33       4.27       3.43       1047       18         1.301       4       13:10       68.0       68.0       9969       7.7       7.43       68.0       1.53       3.22       1137       19         1.403       4       13:10       68.0       70.0       10012       7.40       6.56       6.41       5.80       5.44       4.21       1052       19         1.601       4       13:12       68.0       7.00       10012       7.40       6.56       6.44       5.40       4.82       1.1       1353       21         1.709       4       13:13       68.0       7.00       9926       7.86       6.48       5.70       3.41       2.70       1264       18         1.800       4       13:16       68.0       7.00       9926       1.47       9.41       4.07       3.48       2.89       1599 <td< td=""><td>1.020</td><td>4</td><td>13:06</td><td>68.0</td><td>70.0</td><td>10089</td><td>5.52</td><td>4.80</td><td>4.50</td><td>4.27</td><td>4.01</td><td>3.50</td><td>2.91</td><td></td><td></td><td>1828</td><td>20</td><td></td></td<>	1.020	4	13:06	68.0	70.0	10089	5.52	4.80	4.50	4.27	4.01	3.50	2.91			1828	20	
1.199       4       13:08       68.0       70.0       1001       9.55       7.90       7.03       6.11       5.33       4.27       3.43       1047       18         1.301       4       13:10       68.0       69.0       9969       8.77       7.43       6.83       6.13       5.45       4.93       3.32       1137       19         1.403       4       13:11       68.0       74.0       10056       7.88       6.89       6.41       5.25       5.04       4.21       1052       19         1.601       4       13:12       68.0       70.0       10012       7.40       6.56       6.14       5.80       6.42       5.10       4.82       4.12       1353       21         1.709       4       13:14       68.0       72.0       986       6.41       5.80       6.42       5.10       3.87       7.78       17         1.909       4       13:16       68.0       70.0       10034       7.06       5.72       5.19       4.83       3.43       3.62       1599       19       19         2.011       4       13:16       68.0       69.0       10034       6.16       5.39 <td< td=""><td>1.102</td><td>4</td><td>13:07</td><td>68.0</td><td>72.0</td><td>9925</td><td>10.39</td><td>9.26</td><td>8.12</td><td>6.47</td><td>5.39</td><td>3.77</td><td>2.68</td><td></td><td></td><td>955</td><td>18</td><td></td></td<>	1.102	4	13:07	68.0	72.0	9925	10.39	9.26	8.12	6.47	5.39	3.77	2.68			955	18	
1.301       4       13:10       68.0       69.0       9969       8.77       7.43       6.83       6.13       5.45       4.39       3.32       1137       19         1.403       4       13:10       68.0       68.0       9947       5.54       4.94       4.69       4.47       4.22       3.71       3.16       1795       20         1.501       4       13:12       68.0       74.0       10056       9.56       6.81       6.31       5.46       4.82       4.12       1052       19         1.601       4       13:13       68.0       72.0       9936       7.86       6.48       5.70       4.90       4.23       3.41       2.70       1264       18         1.800       4       13:16       68.0       72.0       9848       1.167       9.16       7.72       6.19       4.98       3.47       2.55       844       16         1.909       4       13:16       68.0       69.0       9979       6.24       5.19       4.43       3.76       3.02       1421       19         2.011       4       13:18       68.0       78.0       7.06       5.72       5.19       4.43 <td< td=""><td>1,199</td><td>4</td><td>13:08</td><td>68.0</td><td>70.0</td><td>10001</td><td>9.55</td><td>7.90</td><td>7.03</td><td>6.11</td><td>5.33</td><td>4.27</td><td>3.43</td><td></td><td></td><td>1047</td><td>18</td><td></td></td<>	1,199	4	13:08	68.0	70.0	10001	9.55	7.90	7.03	6.11	5.33	4.27	3.43			1047	18	
1.403       4       13:10       68.0       68.0       9947       5.54       4.94       4.69       4.47       4.22       3.71       3.16       1795       20         1.501       4       13:11       68.0       70.0       10056       9.56       7.88       6.98       6.31       5.86       5.04       4.21       1052       19         1.601       4       13:12       68.0       70.0       10012       7.40       6.56       6.14       5.80       5.44       4.22       1353       21         1.709       4       13:13       68.0       72.0       9936       7.86       6.48       5.70       4.90       4.23       3.41       2.70       1264       18         1.800       4       13:16       68.0       72.0       9848       1.67       1.79       4.42       3.07       2.55       844       16         1.976       4       13:16       68.0       67.0       5.72       5.19       4.83       4.43       3.76       3.02       1421       19         2.011       4       13:16       68.0       73.0       10034       6.16       5.81       5.17       4.20       3.31 <t< td=""><td>1.301</td><td>4</td><td>13:10</td><td>68.0</td><td>69.0</td><td>9969</td><td>8.77</td><td>7.43</td><td>6.83</td><td>6.13</td><td>5.45</td><td>4.39</td><td>3.32</td><td></td><td></td><td>1137</td><td>19</td><td></td></t<>	1.301	4	13:10	68.0	69.0	9969	8.77	7.43	6.83	6.13	5.45	4.39	3.32			1137	19	
1.501413:1168.074.0100569.567.886.986.315.855.044.211052191.601413:1268.070.0100127.406.566.145.805.464.824.121353211.709413:1368.072.099367.866.485.704.904.233.412.701264181.800413:1468.072.0992512.769.868.587.376.425.103.87778171.909413:1668.072.0984811.679.167.726.194.983.472.55844161.976413:1668.069.099796.245.194.414.073.482.891599192.011413:1768.073.0100349.527.666.705.815.174.203.311621192.100413:1868.069.0100346.165.395.074.734.413.803.201629202.104413:1968.07.00100141.0788.857.356.315.013.89660162.306413:2268.07.010011.0187.646.515.544.903.31981172.402413:2368.07.0	1.403	4	13:10	68.0	68.0	9947	5.54	4.94	4.69	4.47	4.22	3.71	3.16			1795	20	
1.601413:1268.070.0100127.406.566.145.805.464.824.121353211.709413:1368.072.099367.866.485.704.904.233.412.701264181.800413:1468.073.0992512.769.868.587.376.425.103.87778171.909413:1668.072.098481.1679.167.726.194.983.472.558444161.976413:1668.069.099796.245.194.794.414.073.482.891599192.011413:1768.071.0100347.065.725.194.734.413.002.001629202.210413:1868.069.0100346.165.395.074.734.413.003.021629202.210413:2068.07.0100349.527.666.705.815.173.021629202.206413:2068.07.099036.115.074.674.933.522.771621192.306413:2068.07.099036.515.544.904.063.31981172.602413:2268.07.09903 <td>1.501</td> <td>4</td> <td>13:11</td> <td>68.0</td> <td>74.0</td> <td>10056</td> <td>9.56</td> <td>7.88</td> <td>6.98</td> <td>6.31</td> <td>5.85</td> <td>5.04</td> <td>4.21</td> <td></td> <td></td> <td>1052</td> <td>19</td> <td></td>	1.501	4	13:11	68.0	74.0	10056	9.56	7.88	6.98	6.31	5.85	5.04	4.21			1052	19	
1.7094 $13:13$ $68.0$ $72.0$ $9936$ $7.86$ $6.48$ $5.70$ $4.90$ $4.23$ $3.41$ $2.70$ $1264$ $18$ $1.800$ 4 $13:14$ $68.0$ $72.0$ $9848$ $11.67$ $9.16$ $7.72$ $6.19$ $4.98$ $3.47$ $2.55$ $844$ $16$ $1.976$ 4 $13:16$ $68.0$ $72.0$ $9848$ $11.67$ $9.16$ $7.72$ $6.19$ $4.98$ $3.47$ $2.55$ $844$ $16$ $2.011$ 4 $13:17$ $68.0$ $71.0$ $10034$ $7.06$ $5.72$ $5.19$ $4.33$ $4.43$ $3.76$ $3.02$ $1421$ $19$ $2.101$ 4 $13:17$ $68.0$ $73.0$ $10034$ $7.06$ $5.72$ $5.19$ $4.83$ $4.43$ $3.76$ $3.02$ $1421$ $19$ $2.101$ 4 $13:17$ $68.0$ $73.0$ $10034$ $6.16$ $5.39$ $5.07$ $4.73$ $4.41$ $4.07$ $3.48$ $2.69$ $1599$ $19$ $2.101$ 4 $13:18$ $68.0$ $73.0$ $10034$ $6.16$ $5.39$ $5.07$ $4.73$ $4.41$ $3.00$ $3.02$ $1421$ $19$ $2.306$ 4 $13:22$ $68.0$ $73.0$ $9903$ $6.11$ $5.07$ $4.67$ $4.28$ $3.37$ $2.77$ $1621$ $19$ $2.306$ 4 $13:22$ $68.0$ $77.0$ $9903$ $6.15$ $5.53$ $4.90$ $4.06$ $3.31$ $981$ $17$ <tr< td=""><td>1.601</td><td>4</td><td>13:12</td><td>68.0</td><td>70.0</td><td>10012</td><td>7.40</td><td>6.56</td><td>6.14</td><td>5.80</td><td>5.46</td><td>4.82</td><td>4.12</td><td></td><td></td><td>1353</td><td>21</td><td></td></tr<>	1.601	4	13:12	68.0	70.0	10012	7.40	6.56	6.14	5.80	5.46	4.82	4.12			1353	21	
1.800413:1468.073.0992512.769.868.587.376.425.103.87778171.909413:1668.072.0984811.679.167.726.194.983.472.55844161.976413:1668.069.099796.245.194.794.414.073.482.891599192.011413:1768.071.0100347.065.725.194.834.433.763.021629202.100413:1968.073.0100347.065.725.815.174.203.311054182.306413:2168.072.0979314.8410.788.857.356.315.013.89660162.306413:2268.077.0100110.197.646.515.544.903.31981172.602413:2268.077.099696.555.314.433.823.112.461065152.602413:2268.076.099336.355.314.433.823.112.461065152.602413:2668.076.099036.855.204.922.721499192.705413:2768.076.0100017.355.815.2	1.709	4	13:13	68.0	72.0	9936	7.86	6.48	5.70	4.90	4.23	3.41	2.70			1264	18	
1.909 $4$ $13:16$ $68.0$ $72.0$ $9848$ $11.67$ $9.16$ $7.72$ $6.19$ $4.98$ $3.47$ $2.55$ $844$ $16$ $1.976$ $4$ $13:16$ $68.0$ $69.0$ $9979$ $6.24$ $5.19$ $4.79$ $4.41$ $4.07$ $3.48$ $2.89$ $1599$ $19$ $2.011$ $4$ $13:17$ $68.0$ $71.0$ $10034$ $7.66$ $5.72$ $5.19$ $4.83$ $4.43$ $3.76$ $3.02$ $1421$ $19$ $2.100$ $4$ $13:18$ $68.0$ $73.0$ $10034$ $9.52$ $7.66$ $6.70$ $5.81$ $5.17$ $4.20$ $3.31$ $1054$ $18$ $2.306$ $4$ $13:20$ $68.0$ $73.0$ $9903$ $6.11$ $5.07$ $4.77$ $4.20$ $3.31$ $1054$ $18$ $2.396$ $4$ $13:21$ $68.0$ $72.0$ $9933$ $6.11$ $5.07$ $4.77$ $4.33$ $3.57$ $2.77$ $1621$ $19$ $2.306$ $4$ $13:22$ $68.0$ $72.0$ $9933$ $6.11$ $6.51$ $5.14$ $4.90$ $4.66$ $3.31$ $981$ $17$ $2.602$ $4$ $13:23$ $68.0$ $77.0$ $9069$ $6.55$ $5.32$ $4.92$ $3.92$ $2.72$ $1499$ $19$ $2.705$ $4$ $13:26$ $68.0$ $7.0$ $9903$ $7.81$ $6.55$ $5.32$ $4.92$ $3.67$ $5.81$ $5.11$ $2.46$ $2.886$ $4$ $13:26$ $68.0$ <td>1.800</td> <td>4</td> <td>13:14</td> <td>68.0</td> <td>73.0</td> <td>9925</td> <td>12.76</td> <td>9.86</td> <td>8.58</td> <td>7.37</td> <td>6.42</td> <td>5.10</td> <td>3.87</td> <td></td> <td></td> <td>778</td> <td>17</td> <td></td>	1.800	4	13:14	68.0	73.0	9925	12.76	9.86	8.58	7.37	6.42	5.10	3.87			778	17	
1.9764 $13:16$ $68.0$ $69.0$ $9979$ $6.24$ $5.19$ $4.79$ $4.41$ $4.07$ $3.48$ $2.89$ $1599$ $19$ $2.011$ 4 $13:17$ $68.0$ $71.0$ $10034$ $7.66$ $5.72$ $5.19$ $4.83$ $4.43$ $3.76$ $3.02$ $1421$ $19$ $2.100$ 4 $13:18$ $68.0$ $69.0$ $10034$ $6.16$ $5.39$ $5.07$ $4.73$ $4.41$ $3.00$ $1629$ $20$ $2.210$ 4 $13:19$ $68.0$ $73.0$ $10034$ $9.52$ $7.66$ $6.70$ $5.81$ $5.17$ $4.20$ $3.31$ $1054$ $18$ $2.306$ 4 $13:20$ $68.0$ $78.0$ $9903$ $6.11$ $5.07$ $4.67$ $4.28$ $3.93$ $3.37$ $2.77$ $1621$ $19$ $2.306$ 4 $13:22$ $68.0$ $77.0$ $9903$ $6.61$ $5.54$ $4.90$ $4.06$ $3.31$ $981$ $17$ $2.602$ 4 $13:22$ $68.0$ $77.0$ $10001$ $10.19$ $7.44$ $4.33$ $3.52$ $2.72$ $1499$ $19$ $2.602$ 4 $13:26$ $68.0$ $76.0$ $9933$ $6.35$ $5.31$ $4.43$ $3.82$ $3.11$ $9.81$ $17$ $2.602$ 4 $13:26$ $68.0$ $76.0$ $9903$ $7.81$ $6.55$ $5.32$ $4.92$ $3.67$ $11289$ $19$ $2.705$ 4 $13:26$ $68.0$ $76.0$ $9003$ $7.81$	1.909	4	13:16	68.0	72.0	9848	11.67	9.16	7.72	6.19	4.98	3.47	2.55			844	16	
2.011       4       13:17       68.0       71.0       10034       7.06       5.72       5.19       4.83       4.43       3.76       3.02       1421       19         2.100       4       13:18       68.0       69.0       10034       6.16       5.39       5.07       4.73       4.41       3.80       3.20       1629       20         2.210       4       13:19       68.0       73.0       10034       9.52       7.66       6.70       5.81       5.17       4.20       3.31       1054       18         2.306       4       13:22       68.0       73.0       9903       6.11       5.07       4.67       4.28       3.93       3.37       2.77       1621       19         2.306       4       13:22       68.0       77.0       1001       1.19       7.64       6.51       5.54       4.90       3.31       981       17         2.602       4       13:25       68.0       77.0       9009       6.55       5.31       4.43       3.82       2.11       2.46       1065       15         2.602       4       13:25       68.0       76.0       9003       7.81       6.49 <t< td=""><td>1.976</td><td>4</td><td>13:16</td><td>68.0</td><td>69.0</td><td>9979</td><td>6.24</td><td>5.19</td><td>4.79</td><td>4.41</td><td>4.07</td><td>3.48</td><td>2.89</td><td></td><td></td><td>1599</td><td>19</td><td></td></t<>	1.976	4	13:16	68.0	69.0	9979	6.24	5.19	4.79	4.41	4.07	3.48	2.89			1599	19	
2.100       4       13:18       68.0       69.0       10034       6.16       5.39       5.07       4.73       4.41       3.80       3.20       1629       20         2.210       4       13:19       68.0       73.0       10034       9.52       7.66       6.70       5.81       5.17       4.20       3.31       1054       18         2.306       4       13:20       68.0       78.0       9030       6.11       5.07       4.67       4.28       3.93       3.37       2.77       1621       19         2.396       4       13:22       68.0       77.0       10001       10.18       8.85       7.35       6.31       5.01       3.89       660       16         2.505       4       13:22       68.0       77.0       10001       10.18       8.85       7.35       6.31       5.01       3.89       660       16         2.505       4       13:23       68.0       77.0       10001       10.18       8.55       5.31       4.93       3.52       2.72       1499       19         2.602       4       13:26       68.0       74.0       9903       7.81       6.49       5.85	2.011	4	13:17	68.0	71.0	10034	7.06	5.72	5.19	4.83	4.43	3.76	3.02			1421	19	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	2.100	4	13:18	68.0	69.0	10034	6.16	5.39	5.07	4.73	4.41	3.80	3.20			1629	20	
2.306       4       13:20       68.0       78.0       9903       6.11       5.07       4.67       4.28       3.93       3.37       2.77       1621       19         2.306       4       13:21       68.0       72.0       9793       14.84       10.78       8.85       7.35       6.31       5.01       3.89       660       16         2.505       4       13:22       68.0       77.0       10001       10.19       7.64       6.51       5.54       4.90       4.06       3.31       981       17         2.602       4       13:25       68.0       77.0       9969       6.55       5.01       5.44       4.33       3.52       2.72       1499       19         2.602       4       13:25       68.0       74.0       9903       7.81       6.49       5.85       5.32       4.92       3.11       2.46       1065       15         2.805       4       13:26       68.0       76.0       10001       7.35       5.81       5.20       4.92       3.07       1361       18         2.866       4       13:26       68.0       75.0       982       8.71       5.17       4.73 <t< td=""><td>2.210</td><td>4</td><td>13:19</td><td>68.0</td><td>73.0</td><td>10034</td><td>9.52</td><td>7.66</td><td>6.70</td><td>5.81</td><td>5.17</td><td>4.20</td><td>3.31</td><td></td><td></td><td>1054</td><td>18</td><td></td></t<>	2.210	4	13:19	68.0	73.0	10034	9.52	7.66	6.70	5.81	5.17	4.20	3.31			1054	18	
2.396       4       13:21       68.0       72.0       9793       14.84       10.78       8.85       7.35       6.31       5.01       3.89       660       16         2.505       4       13:22       68.0       77.0       10001       10.19       7.64       6.51       5.54       4.90       3.31       981       17         2.602       4       13:23       68.0       77.0       9969       6.65       5.60       5.13       4.43       3.82       2.72       1499       19         2.705       4       13:25       68.0       74.0       9903       6.35       5.31       4.43       3.82       2.72       1499       19         2.705       4       13:26       68.0       76.0       9903       7.81       6.49       5.85       5.32       4.92       3.11       2.46       1065       15         2.805       4       13:27       68.0       76.0       10001       7.35       5.81       5.20       4.72       4.32       3.61       1268       19         2.886       4       13:27       68.0       7.0       9829       1.71       4.73       4.05       3.31       1137 <t< td=""><td>2.306</td><td>4</td><td>13:20</td><td>68.0</td><td>78.0</td><td>9903</td><td>6.11</td><td>5.07</td><td>4.67</td><td>4.28</td><td>3.93</td><td>3.37</td><td>2.77</td><td></td><td></td><td>1621</td><td>19</td><td></td></t<>	2.306	4	13:20	68.0	78.0	9903	6.11	5.07	4.67	4.28	3.93	3.37	2.77			1621	19	
2.505       4       13:22       68.0       77.0       10001       10.19       7.64       6.51       5.54       4.90       4.06       3.31       981       17         2.602       4       13:23       68.0       77.0       9969       6.65       5.60       5.13       4.74       4.33       3.52       2.72       1499       19         2.705       4       13:25       68.0       83.0       9936       9.33       6.35       5.31       4.43       3.82       2.72       1499       19         2.705       4       13:25       68.0       74.0       9903       7.81       6.49       5.85       5.32       4.92       4.21       3.51       1266       1065       15         2.856       4       13:26       68.0       7.0       10001       7.35       5.81       5.20       4.72       4.32       3.69       3.07       1361       18         2.866       4       13:28       68.0       75.0       9826       8.64       6.50       5.71       5.17       4.72       4.92       3.31       1137       17         2.886       4       13:30       68.0       72.0       9859 <td< td=""><td>2.396</td><td>4</td><td>13:21</td><td>68.0</td><td>72.0</td><td>9793</td><td>14.84</td><td>10.78</td><td>8.85</td><td>7.35</td><td>6.31</td><td>5.01</td><td>3.89</td><td></td><td></td><td>660</td><td>16</td><td></td></td<>	2.396	4	13:21	68.0	72.0	9793	14.84	10.78	8.85	7.35	6.31	5.01	3.89			660	16	
2.602       4       13:23       68.0       77.0       9969       6.65       5.60       5.13       4.74       4.33       3.52       2.72       1499       19         2.705       4       13:25       68.0       83.0       9936       9.33       6.35       5.11       4.43       3.82       2.72       1499       19         2.705       4       13:25       68.0       83.0       9936       9.33       6.35       5.11       4.43       3.82       3.11       2.46       1065       15         2.806       4       13:27       68.0       76.0       10001       7.35       5.81       5.20       4.72       4.32       3.69       3.07       1361       18         2.866       4       13:28       68.0       76.0       10001       7.35       5.81       5.20       4.72       4.32       3.69       3.07       1361       18         2.866       4       13:28       68.0       70.0       9828       6.50       5.71       5.17       5.17       4.73       4.05       3.31       1137       17         2.866       4       13:30       68.0       71.0       9749       9.71 <t< td=""><td>2.505</td><td>4</td><td>13:22</td><td>68.0</td><td>77.0</td><td>10001</td><td>10.19</td><td>7.64</td><td>6.51</td><td>5.54</td><td>4.90</td><td>4.06</td><td>3.31</td><td></td><td></td><td>981</td><td>17</td><td></td></t<>	2.505	4	13:22	68.0	77.0	10001	10.19	7.64	6.51	5.54	4.90	4.06	3.31			981	17	
2.705       4       13:25       68.0       83.0       9936       9.33       6.35       5.31       4.43       3.82       3.11       2.46       1065       15         2.805       4       13:26       68.0       74.0       9903       7.81       6.49       5.85       5.32       4.92       3.61       1268       19         2.856       4       13:27       68.0       76.0       10001       7.35       5.81       5.20       4.72       4.32       3.69       3.07       1361       18         2.866       4       13:28       68.0       75.0       9826       8.64       6.50       5.71       4.73       4.05       3.31       1137       17         2.866       4       13:30       68.0       72.0       9859       11.29       9.70       8.38       7.69       6.52       5.29       873       20         3.092       4       13:31       68.0       71.0       9749       9.71       8.08       7.69       6.52       5.29       873       20         3.099       4       13:31       68.0       71.0       9749       9.71       8.03       5.01       4.34       3.65	2.602	4	13:23	68.0	77.0	9969	6.65	5.60	5.13	4.74	4.33	3.52	2.72			1499	19	
2.805       4       13:26       68.0       74.0       9903       7.81       6.49       5.85       5.32       4.92       4.21       3.51       1268       19         2.856       4       13:27       68.0       76.0       10001       7.35       5.81       5.20       4.72       4.32       3.69       3.07       1361       18         2.866       4       13:28       68.0       75.0       9826       8.64       6.50       5.71       5.17       4.73       4.05       3.31       1137       17         2.866       4       13:30       68.0       72.0       9829       12.9       9.07       8.38       7.69       6.52       5.29       873       20         3.021       4       13:31       68.0       71.0       9749       9.71       8.00       7.18       6.24       5.41       4.31       3.41       1004       18         3.099       4       13:32       68.0       72.0       9859       7.26       6.31       5.64       5.01       4.34       3.65       1358       20	2.705	4	13:25	68.0	83.0	9936	9.33	6.35	5.31	4.43	3.82	3.11	2.46			1065	15	
2.856       4       13:27       68.0       76.0       10001       7.35       5.81       5.20       4.72       4.32       3.69       3.07       1361       18         2.866       4       13:28       68.0       75.0       9826       8.64       650       5.71       5.17       4.73       4.05       3.31       1137       17         2.982       4       13:30       68.0       72.0       9859       11.29       9.82       9.07       8.38       7.69       6.52       5.29       873       20         3.021       4       13:31       68.0       71.0       9749       9.71       8.00       7.18       6.24       5.41       4.31       3.41       1004       18         3.099       4       13:32       68.0       72.0       9859       7.26       6.31       5.64       5.01       4.34       3.65       1358       20	2.805	4	13:26	68.0	74.0	9903	7.81	6.49	5.85	5.32	4.92	4.21	3.51			1268	19	
2.886       4       13:28       68.0       75.0       9826       8.64       6.50       5.71       5.17       4.73       4.05       3.31       1137       17         2.982       4       13:30       68.0       72.0       9859       11.29       9.82       9.07       8.38       7.69       6.52       5.29       873       20         3.021       4       13:31       68.0       71.0       9749       9.71       8.00       7.18       6.24       5.41       4.31       3.41       1004       18         3.099       4       13:32       68.0       72.0       9859       7.26       6.31       5.64       5.01       4.34       3.65       1358       20	2.856	4	13:27	68.0	76.0	10001	7.35	5.81	5.20	4.72	4.32	3.69	3.07			1361	18	
2.982       4       13:30       68.0       72.0       9859       11.29       9.82       9.07       8.38       7.69       6.52       5.29       873       20         3.021       4       13:31       68.0       71.0       9749       9.71       8.00       7.18       6.24       5.41       4.31       3.41       1004       18         3.099       4       13:32       68.0       72.0       9859       7.26       6.31       5.61       4.34       3.65       1358       20	2.886	4	13:28	68.0	75.0	9826	8.64	6.50	5.71	5.17	4.73	4.05	3.31			1137	17	
3.021 4 13:31 68.0 71.0 9749 9.71 8.00 7.18 6.24 5.41 4.31 3.41 1004 18 3.099 4 13:32 68.0 72.0 9859 7.26 6.31 5.86 5.43 5.01 4.34 3.65 1358 20	2.982	4	13:30	68.0	72.0	9859	11.29	9.82	9.07	8.38	7.69	6.52	5.29			873	20	
3.099 4 13:32 68.0 72.0 9859 7.26 6.31 5.86 5.43 5.01 4.34 3.65 1358 20	3.021	4	13:31	68.0	71.0	9749	9.71	8.00	7.18	6.24	5.41	4.31	3.41			1004	18	
	3.099	4	13:32	68.0	72.0	9859	7.26	6.31	5.86	5.43	5.01	4.34	3.65			1358	20	
3.203 4 13:33 68.0 74.0 9826 8.88 6.76 5.98 5.35 4.85 4.07 3.30 1107 17	3.203	4	13:33	68.0	74.0	9826	8.88	6.76	5.98	5.35	4.85	4.07	3.30			1107	17	
3.297 4 13:34 68.0 72.0 9870 6.99 5.91 5.41 4.90 4.52 3.85 3.14 1412 19	3.297	4	13:34	68.0	72.0	9870	6.99	5.91	5.41	4.90	4.52	3.85	3.14			1412	19	
3.402 4 13:35 68.0 72.0 9870 10.79 8.11 7.22 6.48 5.80 4.76 3.81 915 17	3.402	4	13:35	68.0	72.0	9870	10.79	8.11	7.22	6.48	5.80	4.76	3.81			915	17	
3.501 4 13:36 68.0 76.0 9673 17.01 8.90 6.95 5.78 5.02 4.09 3.17 569 14	3.501	4	13:36	68.0	76.0	9673	17.01	8.90	6.95	5.78	5.02	4.09	3.17			569	14	
3.606 4 13:37 68.0 73.0 9947 10.74 8.65 7.69 6.84 6.23 5.37 4.51 926 18	3.606	4	13:37	68.0	73.0	9947	10.74	8.65	7.69	6.84	6.23	5.37	4.51			926	18	
3.699 4 13:38 68.0 74.0 9969 6.58 5.65 5.18 4.79 4.41 3.85 3.18 1515 20	3.699	4	13:38	68.0	74.0	9969	6.58	5.65	5.18	4.79	4.41	3.85	3.18			1515	20	
3.802 4 13:39 68.0 72.0 9870 11.15 9.22 8.25 7.26 6.43 5.41 4.45 885 18	3.802	4	13:39	68.0	72.0	9870	11.15	9.22	8.25	7.26	6.43	5.41	4.45			885	18	
3.901 4 13:40 68.0 73.0 9925 6.29 5.18 4.78 4.44 4.13 3.59 2.95 1578 19	3.901	4	13:40	68.0	73.0	9925	6.29	5.18	4.78	4.44	4.13	3.59	2.95			1578	19	
3.956 4 13:43 68.0 73.0 9903 6.51 5.27 4.75 4.33 3.97 3.38 2.80 1521 19	3.956	4	13:43	68.0	73.0	9903	6.51	5.27	4.75	4.33	3.97	3.38	2.80			1521	19	

Effective Values



AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S02 Roadway: White Pole Rd From: CTH N72 To: Kelsey Rd

															Effective	Values AREA	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9	10.01		Comments
3.996	4	13:44	68.0	72.0	10023	6.64	5.51	4.99	4.56	4.20	3.57	2.93			1509	19	
4.102	4	13:45	68.0	74.0	10067	6.91	6.11	5.75	5.43	5.11	4.48	3.78			1457	20	
4.201	4	13:46	68.0	72.0	9870	11.09	9.34	8.44	7.59	6.89	5.89	4.95			890	19	
4.305	4	13:47	68.0	74.0	10012	7.20	5.84	5.39	5.05	4.66	3.94	3.15			1391	19	
4.410	4	13:48	68.0	74.0	9859	9.78	8.07	7.38	6.61	5.98	5.05	4.12			1008	19	
4.499	4	13:49	68.0	74.0	9859	8.15	7.06	6.63	6.34	5.98	5.23	4.40			1210	20	
4.599	4	13:50	68.0	74.0	9947	5.94	5.44	5.24	5.02	4.73	4.20	3.54			1675	21	
4.700	4	13:51	68.0	74.0	9804	8.59	6.94	6.28	5.70	5.17	4.35	3.51			1141	18	
4.803	4	13:52	68.0	73.0	9837	6.86	6.20	5.94	5.69	5.41	4.61	3.85			1434	21	
4.821	4	13:55	68.0	72.0	9749	9.85	8.10	7.33	6.63	5.92	4.69	3.58			990	19	
4.900	4	13:56	68.0	79.0	9859	10.25	8.41	7.67	6.91	6.20	4.88	3.71			962	19	
4.997	4	13:57	68.0	74.0	9662	11.17	8.44	7.02	5.96	5.19	4.23	3.35			865	17	
5.102	4	13:58	68.0	74.0	9859	7.00	5.79	5.29	4.91	4.54	3.84	3.05			1408	19	
5.201	4	13:59	68.0	75.0	9859	8.40	6.85	6.21	5.67	5.24	4.47	3.67			1174	19	
5.302	4	14:00	68.0	74.0	9826	7.43	6.11	5.48	5.02	4.61	3.89	3.07			1322	19	
5.401	4	14:01	68.0	75.0	9815	9.00	6.77	5.85	5.13	4.63	3.89	3.11			1091	17	
5.494	4	14:02	68.0	75.0	9760	11.94	9.64	8.69	7.85	7.04	5.76	4.55			817	18	
5.598	4	14:04	68.0	75.0	9990	7.81	6.76	6.15	5.49	4.85	3.86	2.99			1279	19	
5.707	4	14:05	68.0	78.0	9793	7.24	5.78	5.11	4.56	4.12	3.40	2.72			1353	18	
5.800	4	14:06	68.0	73.0	9749	9.00	7.48	6.53	5.61	4.89	4.04	3.26			1083	18	
5.901	4	14:06	68.0	77.0	9925	6.39	5.48	5.10	4.74	4.35	3.68	2.97			1553	20	
6.006	4	14:07	68.0	74.0	9859	8.65	7.16	6.35	5.54	4.87	3.93	3.09			1140	18	
6.099	4	14:08	68.0	74.0	9749	9.44	8.20	7.38	6.63	6.06	5.21	4.31			1033	19	
6.196	4	14:10	68.0	75.0	9925	8.94	7.19	6.42	5.78	5.27	4.50	3.70			1110	18	
6.300	4	14:11	68.0	75.0	9804	7.83	6.65	6.17	5.72	5.28	4.48	3.61			1252	20	
6.394	4	14:12	68.0	74.0	9717	7.91	6.78	6.22	5.69	5.15	4.18	3.26			1228	19	



AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S03A Roadway: White Pole Rd From: E Grant Rd To: 0.87 mi E

															Effective ISM	Values AREA	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9			Comments
6.463	4	14:13	68.0	74.0	9749	7.05	5.81	5.33	5.06	4.74	4.14	3.43			1383	19	
0.019	4	14:19	68.0	79.0	9870	7.73	6.34	5.73	5.35	4.98	4.26	3.48			1277	19	
0.103	4	14:20	68.0	83.0	10089	6.53	5.57	5.30	5.11	4.81	4.13	3.43			1545	20	
0.200	4	14:21	68.0	79.0	9925	6.28	4.95	4.42	4.03	3.67	3.01	2.31			1580	18	
0.295	4	14:22	68.0	76.0	10111	6.94	5.89	5.47	5.19	4.91	4.36	3.65			1457	20	
0.400	4	14:23	68.0	75.0	10023	7.66	6.69	6.26	5.93	5.57	4.87	4.10			1308	20	
0.499	4	14:24	68.0	74.0	9990	6.84	5.96	5.65	5.39	5.09	4.52	3.81			1461	21	
0.601	4	14:25	68.0	76.0	9958	6.88	5.98	5.36	4.89	4.54	3.91	3.24			1447	20	
0.698	4	14:26	68.0	78.0	9947	8.04	6.67	6.02	5.52	5.13	4.45	3.69			1237	19	
0.804	4	14:27	68.0	78.0	9914	8.86	7.81	7.43	7.07	6.58	5.71	4.72			1119	21	



AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S03B Roadway: White Pole Rd From: 0.87 mi E of E Grant Rd To: 0.37 mi E

															Effective ISM	e Values AREA	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9			Comments
0.903	4	14:28	68.0	85.0	9815	3.63	3.27	3.21	3.12	2.96	2.56	2.08			2704	21	
1.000	4	14:29	68.0	87.0	9848	4.90	4.34	4.21	4.08	3.85	3.42	2.89			2010	21	
1.095	4	14:30	68.0	88.0	10001	4.27	3.75	3.59	3.41	3.20	2.78	2.32			2342	21	
1.200	4	14:31	68.0	77.0	9947	4.25	3.88	3.80	3.69	3.49	3.11	2.61			2340	22	



AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S03C Roadway: White Pole Rd From: 0.45 mi W To: STH 25

															Effective ISM	Values AREA	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9			Comments
1.298	4	14:32	68.0	83.0	9760	9.37	7.81	7.15	6.48	5.85	4.82	3.83			1042	19	
1.401	4	14:33	68.0	79.0	9903	5.42	4.48	4.16	3.89	3.60	3.11	2.57			1827	19	
1.508	4	14:35	68.0	75.0	9947	6.70	5.69	5.43	5.10	4.71	4.13	3.50			1485	20	
1.597	4	14:38	68.0	78.0	9870	7.62	6.07	5.34	4.60	3.92	3.13	2.48			1295	18	
1.687	4	14:39	68.0	80.0	9717	18.49	9.43	7.89	6.75	5.93	4.84	3.86			526	13	
1.687	4	14:39	68.0	79.0	9662	15.50	9.36	7.77	6.62	5.80	4.72	3.74			623	14	



AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: 504 Roadway: White Pole Rd From: STH 25 To: CTH P20

															Effectiv	e Values	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9	13.01	AREA	Comments
0.027	4	15:02	68.0	78.0	10034	6.26	4.37	3.77	3.58	3.42	3.04	2.56			1603	17	
0.104	4	15:03	68.0	80.0	9760	11.34	8.02	6.67	6.46	6.18	5.54	4.67			861	17	
0.104	4	15:04	68.0	80.0	9706	10.72	7.87	6.66	6.44	6.16	5.52	4.65			905	17	
0.204	4	15:05	68.0	78.0	9804	10.41	7.70	6.70	6.30	5.86	5.00	4.09			942	17	
0.306	4	15:06	68.0	81.0	9629	15.15	11.27	8.84	7.28	6.20	4.82	3.64			636	16	
0.399	4	15:07	68.0	76.0	9673	12.44	9.96	7.86	6.89	6.08	5.23	4.27			778	17	
0.502	4	15:08	68.0	79.0	9684	13.48	9.12	7.26	6.61	5.98	5.03	4.07			718	16	
0.602	4	15:09	68.0	77.0	9563	14.43	9.19	7.74	7.14	6.67	5.88	4.98			663	16	
0.703	4	15:10	68.0	78.0	9804	14.23	9.64	8.19	7.20	6.40	5.32	4.29			689	16	
0.799	4	15:11	68.0	77.0	9596	16.19	10.87	8.89	7.19	6.07	4.71	3.52			593	15	
0.906	4	15:12	68.0	77.0	9771	12.04	9.71	8.52	7.56	6.72	5.64	4.30			812	18	
0.989	4	15:13	68.0	85.0	9782	9.90	6.72	6.09	5.80	5.41	4.61	3.75			988	17	
1.019	4	15:14	68.0	82.0	9662	18.05	16.10	14.35	10.82	9.22	6.63	4.50			535	17	
1.109	4	15:15	68.0	77.0	9815	12.33	7.25	6.35	5.94	5.50	4.72	3.89			796	15	
1.205	4	15:16	68.0	77.0	9771	13.21	10.28	9.36	8.75	7.98	6.67	5.37			740	18	
1.303	4	15:17	68.0	79.0	9695	9.99	7.21	6.88	6.74	6.33	5.50	4.55			970	18	
1.401	4	15:18	68.0	77.0	9662	9.01	7.03	6.68	6.48	6.11	5.56	4.75			1072	19	
1.402	4	15:18	68.0	77.0	9607	8.46	6.96	6.58	6.38	6.07	5.41	4.65			1136	20	
1.500	4	15:19	68.0	78.0	9673	8.15	6.28	6.00	5.94	5.69	5.14	4.40			1187	19	
1.606	4	15:20	68.0	76.0	9629	9.46	6.89	6.00	5.59	5.31	4.65	3.91			1018	17	
1.699	4	15:21	68.0	78.0	9815	17.05	12.09	10.10	8.67	7.62	6.32	5.05			576	16	
1.802	4	15:22	68.0	82.0	9552	14.87	11.31	9.55	8.54	7.75	6.39	5.00			642	17	
1.896	4	15:23	68.0	74.0	9574	13.09	9.80	7.98	7.70	6.88	5.78	4.61			731	17	
1.992	4	15:24	68.0	77.0	9738	13.36	9.18	8.24	7.54	6.82	5.65	4.55			729	16	



AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S05 Roadway: White Pole Rd From: CTH P20 To: Sheridan St

															Effective ISM	e Values AREA	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9			Comments
2.100	4	15:26	68.0	77.0	10001	12.27	8.80	7.95	7.57	7.07	6.11	5.07			815	17	
2.200	4	15:27	68.0	81.0	9859	11.03	5.89	5.05	4.81	4.50	3.86	3.19			894	16	
2.299	4	15:28	68.0	79.0	9837	10.78	7.14	6.20	5.75	5.26	4.53	3.70			913	16	
2.408	4	15:29	68.0	84.0	9870	8.34	6.42	5.54	4.76	4.17	3.41	2.78			1183	17	



AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S06 Roadway: White Pole Rd From: Adair St (Menlo) To: 340th St

															Effectiv	e Values	
Station	Dron	Time	A : 9E	D:+ 9F	Load	D1	<b>D2</b>	D2	<b>D</b> 4	<b>D</b> 4	D4	<b>D7</b>	D9	D0	ISM	AREA	Commonte
Station	Drop	Time	AIIF	BIL F	Loau	10.10	0.55	0.01	04	04	1.05	0/	00	D9		10	Comments
0.010	4	15:34	68.0	81.0	9837	13.40	8.55	6.91	5.81	5.17	4.35	3.58			734	16	
0.102	4	15:36	68.0	79.0	9443	27.42	20.81	16.84	13.35	11.36	9.37	7.56			344	17	
0.198	4	15:37	68.0	80.0	9870	15.72	9.77	8.28	7.49	6.78	5.52	4.27			628	16	
0.299	4	15:38	68.0	78.0	9815	9.45	8.09	7.44	7.15	6.62	5.43	4.28			1039	20	
0.405	4	15:39	68.0	62.0	9706	10.29	7.97	6.98	6.24	5.66	4.80	3.83			943	18	
0.504	4	15:40	68.0	77.0	9749	9.54	8.15	7.27	6.80	6.31	5.21	4.07			1022	19	
0.608	4	15:41	68.0	76.0	9497	14.52	11.82	9.64	8.41	7.40	5.67	4.11			654	17	
0.702	4	15:42	68.0	74.0	9738	13.25	9.43	8.18	7.76	7.04	6.41	4.97			735	17	
0.806	4	15:43	68.0	75.0	9454	10.33	8.10	7.10	6.42	5.82	4.80	3.79			915	18	
0.898	4	15:44	68.0	75.0	9804	12.66	8.76	7.68	7.37	6.99	6.05	4.95			774	17	
0.997	4	15:45	68.0	75.0	9706	14.91	10.85	9.02	8.21	7.42	6.19	5.13			651	16	
1.103	4	15:46	68.0	74.0	9717	14.01	9.53	8.26	7.70	7.06	5.89	4.78			694	16	
1.194	4	15:46	68.0	78.0	9782	12.94	8.91	7.48	6.94	6.38	5.32	4.15			756	16	
1.302	4	15:47	68.0	77.0	9662	13.78	10.43	9.32	8.41	7.51	5.89	4.37			701	17	
1.400	4	15:49	68.0	78.0	9804	14.00	9.93	8.48	7.91	7.42	6.51	5.49			700	17	
1.505	4	15:50	68.0	76.0	9903	10.63	7.54	6.70	6.37	5.99	5.02	4.01			932	17	
1.604	4	15:51	68.0	79.0	9837	15.50	11.72	10.26	8.98	7.77	5.76	4.04			635	17	
1.694	4	15:52	68.0	77.0	9640	8.70	7.14	6.26	5.58	5.05	4.26	3.48			1108	18	
1.805	4	15:53	68.0	85.0	9717	12.23	8.24	6.97	6.24	5.72	5.08	3.96			795	16	



AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S07 Roadway: White Pole Rd From: 340th St To: N Adair St (Stuart)

															Effective ISM	Values AREA	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9			Comments
1.894	4	15:55	68.0	79.0	9574	12.02	8.33	7.01	6.39	5.80	4.83	3.83			797	16	
1.998	4	15:56	68.0	75.0	9771	13.65	9.85	8.37	7.67	7.06	5.86	4.56			716	17	
2.101	4	15:57	68.0	74.0	9585	18.77	12.48	9.46	7.30	6.09	5.03	4.10			511	15	
2.211	4	15:58	68.0	74.0	9738	12.03	9.27	7.63	6.48	5.70	4.72	3.81			809	17	
2.307	4	15:59	68.0	74.0	9662	15.23	11.09	9.12	7.63	6.64	5.39	4.31			634	16	
2.410	4	16:00	68.0	77.0	9925	9.87	7.72	6.97	6.59	6.15	5.22	4.14			1006	18	
2.503	4	16:01	68.0	74.0	9848	14.85	12.19	10.81	9.95	9.22	8.08	6.74			663	19	
2.595	4	16:04	68.0	74.0	9684	10.41	7.53	6.63	6.27	5.77	4.97	4.04			930	17	
2.714	4	16:05	68.0	75.0	9749	10.77	7.90	7.27	7.11	6.71	5.81	4.80			905	18	
2.806	4	16:06	68.0	73.0	9837	11.95	8.69	8.05	7.79	7.20	6.18	5.04			823	18	
2.905	4	16:07	68.0	75.0	9728	14.95	11.02	9.40	8.30	7.48	6.32	4.83			651	17	
3.004	4	16:08	68.0	74.0	9651	12.81	10.09	8.91	8.44	7.92	6.91	5.76			753	18	
3.100	4	16:09	68.0	75.0	9793	12.33	8.91	7.99	7.68	7.29	6.40	5.35			794	17	
3.200	4	16:10	68.0	76.0	9684	13.86	10.31	9.43	9.28	8.58	6.80	5.43			699	18	
3.300	4	16:10	68.0	75.0	9673	15.83	11.69	9.89	9.10	8.55	7.44	6.04			611	17	
3.403	4	16:12	68.0	76.0	9574	14.83	11.37	9.68	8.86	8.23	7.15	5.93			646	17	
3.498	4	16:13	68.0	77.0	9618	13.81	9.95	8.40	7.93	7.22	6.17	5.11			696	17	
3.606	4	16:14	68.0	75.0	9519	16.72	12.81	10.26	8.38	7.20	6.01	4.73			569	16	
3.712	4	16:15	68.0	75.0	9717	13.49	9.15	8.00	7.65	7.22	6.25	5.16			720	16	
3.800	4	16:15	68.0	76.0	9508	11.53	8.15	6.90	6.51	6.07	5.15	4.19			825	17	
3.897	4	16:16	68.0	73.0	9771	9.35	7.07	6.41	6.19	5.86	5.19	4.42			1045	18	
3.897	4	16:17	68.0	72.0	9629	9.23	7.01	6.37	6.15	5.83	5.15	4.38			1043	18	
4.008	4	16:18	68.0	82.0	9695	8.65	6.78	6.27	6.12	5.81	5.16	4.35			1121	19	
4.100	4	16:19	68.0	79.0	9958	7.66	5.65	5.34	5.22	4.90	4.30	3.59			1300	18	
4.167	4	16:20	68.0	79.0	9497	10.74	7.79	6.52	5.81	5.37	4.67	3.85			884	16	
American Engineering Testing, Inc.

550 Cleveland Avenue North St. Paul, Minnesota 55114 Phone: (651) 659-9001 Fax: (651) 659-1379



AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S08A Roadway: Wagon Rd From: N 10th St To: 2.06 mi N

															Effective	Values	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9	15101	AREA	Comments
0.018 1	1,2,3,4 Averaged	16:26	68	73.6	6244	7.28	7.08	6.78	6.41	5.83	4.78	3.61	2.58		858	22	
0.096 1	1,2,3,4 Averaged	16:27	68	78.8	6411	5.6	5.42	5.2	4.83	4.36	3.49	2.63	1.96		1145	22	
0.199 1	1,2,3,4 Averaged	16:36	68	74.9	6458	5.83	5.69	5.43	5.1	4.64	3.81	2.95	2.26		1108	22	
0.306 1	1,2,3,4 Averaged	16:37	68	74.8	6463	6.31	5.94	5.64	5.25	4.71	3.77	2.84	2.13		1024	21	
0.403 1	1,2,3,4 Averaged	16:38	68	73.1	6534	5.79	5.57	5.31	4.97	4.52	3.68	2.83	2.17		1128	22	
0.511 1	1,2,3,4 Averaged	16:39	68	72.2	6466	7.36	6.91	6.56	6.08	5.42	4.3	3.2	2.38		879	21	
0.602 1	1,2,3,4 Averaged	16:40	68	73.2	6490	6.5	5.94	5.64	5.19	4.65	3.72	2.81	2.14		998	21	
0.713 1	1,2,3,4 Averaged	16:41	68	78.8	6256	6.17	5.86	5.59	5.21	4.76	3.89	3	2.31		1014	22	
0.799 1	1,2,3,4 Averaged	16:42	68	73.9	6217	6.12	5.93	5.68	5.38	4.94	4.15	3.3	2.59		1016	22	
0.898 1	1,2,3,4 Averaged	16:43	68	72	6236	4.87	4.69	4.41	4.05	3.67	2.96	2.26	1.75		1280	21	
1.039 1	1,2,3,4 Averaged	16:45	68	74.6	6244	5.5	5.24	4.99	4.65	4.23	3.46	2.66	2.03		1135	22	
1.106 1	1,2,3,4 Averaged	16:46	68	74.4	6379	5.73	5.55	5.3	5	4.54	3.73	2.81	2		1113	22	
1.203 1	1,2,3,4 Averaged	16:47	68	74.4	6447	5.01	4.65	4.42	4.08	3.64	2.88	2.16	1.62		1287	21	
1.302 1	1,2,3,4 Averaged	16:48	68	72.5	6514	4.52	4.3	4.13	3.92	3.6	3.03	2.44	1.95		1441	22	
1.397 1	1,2,3,4 Averaged	16:49	68	71.4	6339	5.25	5.04	4.8	4.52	4.11	3.44	2.76	2.22		1207	22	
1.496 1	1,2,3,4 Averaged	16:50	68	71.3	6315	4.81	4.47	4.2	3.85	3.4	2.65	1.94	1.45		1313	21	
1.607 1	1,2,3,4 Averaged	16:51	68	77.3	6344	6.58	6.14	5.8	5.36	4.81	3.82	2.88	2.15		964	21	
1.695 1	1,2,3,4 Averaged	16:53	68	72.7	6161	5.57	5.31	5.1	4.8	4.38	3.62	2.8	2.17		1106	22	
1.803 1	1,2,3,4 Averaged	16:54	68	73.5	6148	5.57	5.41	5.22	4.96	4.55	3.8	2.97	2.26		1104	22	

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AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S08C Roadway: Wagon Rd From: 2.44 mi S To: Bridge

															Effective	Values	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9	15/0	AKEA	Comments
2.296	1,2,3,4 Averaged	16:57	68	73.54	6280	6.5	5.82	5.44	4.91	4.31	3.3	2.41	1.82		964	20	
2.401	1,2,3,4 Averaged	16:58	68	71.02	6241	5.32	4.8	4.72	4.43	3.99	3.19	2.43	1.86		1167	21	
2.401	1,2,3,4 Averaged	16:59	68	71.24	6129	5.33	4.89	4.69	4.34	3.91	3.15	2.42	1.85		1159	21	
2.495	1,2,3,4 Averaged	17:00	68	70.75	6323	5.89	5.61	5.29	4.93	4.43	3.53	2.62	1.94		1068	21	
2.6	1,2,3,4 Averaged	17:01	68	70.3	6228	4.47	4.18	3.95	3.65	3.26	2.63	2.03	1.58		1402	21	
2.7	1,2,3,4 Averaged	17:02	68	74.84	6331	5.81	5.82	5.66	5.56	4.72	3.54	2.52	1.78		1083	23	
2.798	1,2,3,4 Averaged	17:03	68	73	6331	5.22	4.94	4.72	4.41	3.99	3.25	2.5	1.92		1225	21	
2.898	1,2,3,4 Averaged	17:04	68	72.57	6296	4.74	4.52	4.3	3.97	3.59	2.91	2.28	1.8		1322	21	
3.002	1,2,3,4 Averaged	17:05	68	73.83	6133	4.6	4.38	4.2	3.96	3.59	2.95	2.35	1.85		1353	22	
3.101	1,2,3,4 Averaged	17:06	68	71.87	6331	6.08	5.89	5.59	5.24	4.76	3.9	3.04	2.34		1047	22	
3.203	1,2,3,4 Averaged	17:07	68	68.65	6384	5.52	5.28	5.03	4.72	4.26	3.48	2.68	2.02		1166	22	
3.299	1,2,3,4 Averaged	17:08	68	70.66	6225	5.55	5.31	5.08	4.75	4.28	3.47	2.67	2.06		1124	22	
3.401	1,2,3,4 Averaged	17:09	68	70.2	6217	5.19	4.94	4.75	4.46	4.07	3.36	2.63	2.05		1206	22	
3.512	1,2,3,4 Averaged	17:10	68	69.37	6315	5.46	5.18	4.88	4.51	4.07	3.26	2.54	1.96		1156	21	
3.596	1,2,3,4 Averaged	17:12	68	70.65	6201	5	4.84	4.62	4.35	3.96	3.29	2.57	1.96		1228	22	
3.699	1,2,3,4 Averaged	17:13	68	68.22	6276	5.64	5.39	5.11	4.78	4.33	3.57	2.79	2.13		1115	22	
3.808	1,2,3,4 Averaged	17:13	68	69.19	6514	4.96	4.75	4.59	4.34	3.97	3.31	2.58	2		1313	22	
3.901	1,2,3,4 Averaged	17:14	68	70.34	6434	5.79	5.32	5.02	4.59	4.11	3.24	2.44	1.81		1116	21	
3.996	1,2,3,4 Averaged	17:15	68	71.06	6423	4.5	4.28	4.12	3.92	3.59	3.04	2.43	1.91		1429	22	
4.089	1,2,3,4 Averaged	17:17	68	74.93	6209	5.76	5.48	5.24	4.88	4.42	3.57	2.73	2.07		1070	22	
4.198	1,2,3,4 Averaged	17:18	68	73.17	6113	5.27	5.08	4.87	4.61	4.23	3.52	2.76	2.1		1149	22	
4.305	1,2,3,4 Averaged	17:19	68	74.12	6106	4.54	4.41	4.19	3.96	3.63	3.02	2.38	1.82		1331	22	
4.399	1,2,3,4 Averaged	17:19	68	73.17	6156	4.45	4.17	3.92	3.56	3.14	2.41	1.79	1.33		1369	21	
4.507	1,2,3,4 Averaged	17:20	68	66.31	5820	5.67	5	4.59	4.14	3.62	2.78	2.05	1.53		1020	20	
4.597	1,2,3,4 Averaged	17:21	68	68.85	6249	3.84	3.72	3.55	3.33	3.02	2.48	1.95	1.54		1594	22	
4.671	1,2,3,4 Averaged	17:22	68	74.23	6415	5.48	5.19	4.96	4.63	4.17	3.4	2.65	2.03		1169	21	

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AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S09 Roadway: Wagon Rd From: Bridge To: 280th Rd

															Effective	Values	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9	1.5.01	AREA	Comments
4.799	1,2,3,4 Averaged	17:24	68	70.68	6471	4.7	4.39	4.15	3.86	3.48	2.87	2.26	1.81		1369.44	21.121	
4.898	1,2,3,4 Averaged	17:26	68	70.43	6299	4.38	4.07	3.83	3.54	3.16	2.52	1.94	1.54		1438.18	20.863	
4.995	1,2,3,4 Averaged	17:27	68	74.25	6280	5.07	4.83	4.6	4.3	3.91	3.22	2.57	2.07		1247.01	21.587	
5.193	1,2,3,4 Averaged	17:28	68	73.89	6355	6.01	5.63	5.33	4.94	4.44	3.62	2.8	2.14		1065.12	21.073	
5.195	1,2,3,4 Averaged	17:29	68	74.16	6193	4.23	4.11	3.94	3.72	3.43	2.87	2.3	1.8		1471.49	22.032	
5.297	1,2,3,4 Averaged	17:30	68	74.43	6268	3.49	3.39	3.25	3.11	2.89	2.51	2.07	1.72		1807.82	22.187	
5.397	1,2,3,4 Averaged	17:31	68	75.24	6336	4.68	4.5	4.32	4.06	3.68	3.04	2.38	1.88		1343.84	21.759	
5.491	1,2,3,4 Averaged	17:33	68	74.77	6360	4.37	3.99	3.77	3.45	3.05	2.37	1.75	1.3		1437.87	20.523	
5.603	1,2,3,4 Averaged	17:34	68	74.19	6307	3.96	3.67	3.55	3.3	2.95	2.38	1.84	1.42		1580.13	21.263	
5.694	1,2,3,4 Averaged	17:35	68	74.75	6264	4.09	3.85	3.67	3.43	3.1	2.58	2.06	1.69		1522.05	21.174	
5.8	1,2,3,4 Averaged	17:36	68	70.61	6339	5.77	5.51	5.26	4.92	4.44	3.61	2.79	2.12		1100.52	21.559	
5.901	1,2,3,4 Averaged	17:37	68	67.86	6204	5.99	5.49	5.16	4.72	4.2	3.28	2.44	1.76		1020.01	20.64	
6	1,2,3,4 Averaged	17:38	68	70.63	6268	5.96	5.64	5.34	4.94	4.39	3.49	2.61	1.98		1050.84	21.229	
6.102	1,2,3,4 Averaged	17:39	68	73.35	6252	4.31	4.13	3.99	3.73	3.43	2.86	2.24	1.74		1456.39	21.932	
6.198	1,2,3,4 Averaged	17:41	68	70.57	6384	4.41	4.25	4.09	3.87	3.56	2.91	2.24	1.73		1441.6	21.961	
6.297	1,2,3,4 Averaged	17:42	68	70.38	6503	4.25	4.03	3.86	3.6	3.25	2.62	2.02	1.55		1523.73	21.548	
6.404	1,2,3,4 Averaged	17:43	68	68.25	6296	5.47	5.22	5	4.65	4.23	3.49	2.75	2.2		1163.2	21.621	
6.492	1,2,3,4 Averaged	17:44	68	67.87	6379	4.19	3.97	3.79	3.6	3.26	2.7	2.15	1.71		1522.61	21.481	
6.592	1,2,3,4 Averaged	17:45	68	67.96	6426	4.86	4.53	4.35	4.07	3.7	3.07	2.44	1.96		1331.8	21.427	

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AET Project No. P-0020125 County: Guthrie, IA Test Date: May 1, 2023 Section: S10 Roadway: Wagon Rd From: 280th Rd To: CTH F51 N Jet

														ISM	AREA	
Station	Drop	Time	Air °F	Bit °F	Load	D1	D2	D3	D4	D4	D6	D7	D8	D9		Comments
6.7	1,2,3,4 Averaged	17:46	68	66.61	6276	4.12	3.89	3.69	3.41	3.07	2.45	1.89	1.48	1511	21	
6.799	1,2,3,4 Averaged	17:48	68	66.24	6252	4.45	4.2	3.96	3.65	3.3	2.66	2.09	1.64	1391	21	
6.904	1,2,3,4 Averaged	17:49	68	65.93	6482	4.96	4.69	4.49	4.19	3.79	3.12	2.43	1.89	1304	22	
6.997	1,2,3,4 Averaged	17:50	68	69.73	6241	5.52	5.22	4.92	4.56	4.1	3.31	2.59	2.04	1134	21	
7.096	1,2,3,4 Averaged	17:51	68	66.22	6431	5.12	4.87	4.57	4.21	3.76	3	2.31	1.8	1251	21	
7.204	1,2,3,4 Averaged	17:52	68	67.77	6395	4.89	4.57	4.37	4.09	3.71	3.04	2.37	1.88	1306	21	
7.302	1,2,3,4 Averaged	17:53	68	66.13	6355	5.28	4.92	4.68	4.33	3.86	3.07	2.38	1.87	1213	21	
7.403	1,2,3,4 Averaged	17:54	68	66.58	6283	5.61	5.32	5	4.67	4.16	3.35	2.54	1.98	1116	21	
7.501	1,2,3,4 Averaged	17:55	68	66.63	6403	5.34	5.07	4.81	4.49	4.02	3.28	2.56	2	1196	21	
7.598	1,2,3,4 Averaged	17:56	68	68.07	6304	5.72	5.41	5.09	4.7	4.16	3.25	2.39	1.77	1098	21	
7.699	1,2,3,4 Averaged	17:57	68	71.56	6379	5.63	5.43	5.2	4.86	4.42	3.65	2.91	2.32	1134	22	
7.796	1,2,3,4 Averaged	17:58	68	71.94	6463	4.56	4.36	4.13	3.84	3.44	2.76	2.07	1.6	1402	21	
7.9	1,2,3,4 Averaged	17:59	68	65.3	6371	4.07	3.82	3.65	3.43	3.14	2.61	2.08	1.67	1590	22	
7.997	1,2,3,4 Averaged	18:00	68	64.02	6450	5.3	5.06	4.83	4.49	4.07	3.31	2.61	2.04	1220	22	
8.1	1,2,3,4 Averaged	18:01	68	63.36	6447	4.72	4.44	4.2	3.91	3.52	2.87	2.24	1.79	1359	21	
8.2	1,2,3,4 Averaged	18:02	68	65.25	6196	4.98	4.73	4.5	4.18	3.77	3.06	2.37	1.87	1238	21	
8.298	1,2,3,4 Averaged	18:03	68	63.23	6490	5	4.78	4.55	4.23	3.82	3.09	2.35	1.79	1291	22	
8.407	1,2,3,4 Averaged	18:04	68	62.62	6360	5.19	4.78	4.5	4.15	3.7	2.96	2.28	1.76	1237	21	
8.495	1,2,3,4 Averaged	18:05	68	61.68	6439	4.57	4.37	4.12	3.85	3.52	2.94	2.34	1.9	1417	21	
8.601	1,2,3,4 Averaged	18:06	68	65.03	6347	4.57	4.33	4.16	3.91	3.56	2.97	2.37	1.89	1400	22	
8.694	1,2,3,4 Averaged	18:07	68	63.57	6530	5.51	5.34	5.17	4.96	4.64	4.05	3.39	2.79	1203	22	
8.794	1,2,3,4 Averaged	18:08	68	63.19	6426	6.36	5.74	5.42	4.93	4.37	3.43	2.56	1.95	1025	20	
8.898	1,2,3,4 Averaged	18:09	68	65.05	6307	5.09	4.86	4.63	4.35	3.96	3.28	2.56	1.98	1244	22	
9.001	1,2,3,4 Averaged	18:10	68	64.54	6307	5.19	4.94	4.78	4.49	4.1	3.38	2.64	2	1226	22	
9.124	1,2,3,4 Averaged	18:12	68	63.97	6328	4.23	4.08	3.91	3.71	3.41	2.89	2.37	1.89	1514	22	
9.192	1,2,3,4 Averaged	18:13	68	64.09	6479	5.59	5.27	4.91	4.42	3.86	2.92	2.12	1.56	1157	21	
9.295	1,2,3,4 Averaged	18:14	68	64.15	6411	9.69	8.32	7.47	6.46	5.41	3.8	2.59	1.83	664	19	
9.396	1,2,3,4 Averaged	18:16	68	65.3	6439	3.86	3.61	3.45	3.27	3	2.53	2.07	1.7	1689	21	
9.495	1,2,3,4 Averaged	18:17	68	66.07	6264	3.48	3.3	3.2	3.04	2.79	2.36	1.9	1.53	1806	22	
9.555	1,2,3,4 Averaged	18:18	68	66.11	6328	3.84	3.68	3.55	3.35	3.08	2.59	2.08	1.65	1650	22	

Effective Values

Report of Pavement Investigation **Guthrie County Road Investigations** West Des Moines, IA August 6, 2023 AET Report No. P-0020125



# **Appendix D**

Geotechnical Report Limitations and Guidelines for Use

## **D.1 REFERENCE**

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by GBA<sup>1</sup>, of which, we are a member firm.

## **D.2 RISK MANAGEMENT INFORMATION**

## D.2.1 Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. And no one, not even you, should apply the report for any purpose or project except the one originally contemplated.

## **D.2.2 Read the Full Report**

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## D.2.3 A Geotechnical Engineering Report is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a few unique, project-specific factors when establishing the scope of a study. Typically, factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a rule, always inform your geotechnical engineer of project changes, even minor ones, and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

# **D.2.4 Subsurface Conditions Can Change**

A geotechnical engineering report is based on conditions that existed at the time the study was performed. Do not rely on a geotechnical engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

<sup>1</sup> Geoprofessional Business Association, 15800 Crabbs Branch Way, Suite 300, Rockville, MD 20855 Telephone: 301/565-2733: www.geoprofessional.org

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# **D.2.5 Most Geotechnical Findings Are Professional Opinions**

Site exploration identified subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

# D.2.6 A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

## D.2.7 Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognizes that separating logs from the report can elevate risk.

## **D.2.8** Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In the letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure contractors having sufficient time to perform additional study. Only then might you be able to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

# **D.2.9 Read Responsibility Provisions Closely**

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their report. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

# **D.2.10** Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a geoenvironmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.