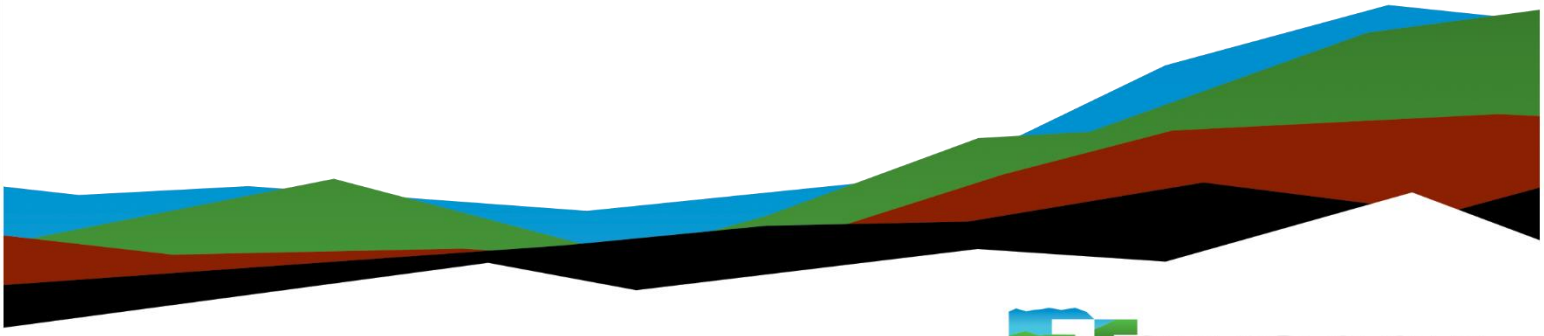
Circle K Access Road

Pavement Thickness Design Report

February 6, 2023 | Terracon Project No. 23225154

Prepared for:

Land Development Consultants
11811 North Tatum Boulevard, Suite 1051
Phoenix, Arizona 85028



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February 6, 2023

Land Development Consultants
11811 North Tatum Boulevard, Suite 1051
Phoenix, Arizona 85028

Attn: Michael Scarbrough
E: mike@ldcaz.com

Re: Pavement Thickness Design Report
Circle K Access Road
East of the intersection of Highway 24 and Meridian Road
Falcon, Colorado
Terracon Project No. 23225154

Dear Mr. Scarbrough:

We have completed the pavement thickness design services for the above referenced project in general accordance with Terracon Proposal No. P23225154 dated November 17, 2022. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of a shared access roadway. We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Scott B. Myers, P.E.
Approved Project Reviewer

Matthew A. Meier P.E.
2/7/2023
Geotechnical Project Engineer

Table of Contents

Figures

Attachments

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Report Summary

A geotechnical engineering exploration has been performed for the proposed roadway connecting Meridian Road and Old Meridian Road in Falcon, Colorado. Based on the information obtained from this subsurface exploration and the laboratory testing completed, the site appears suitable for the proposed construction; provided the following geotechnical conditions are considered:

- Laboratory test results indicate that the subgrade materials classify as A-2-4 soil type with a group index of 0 according to the American Association of State Highway and Transportation Officials (AASHTO) classification system. The pavement thicknesses presented in this report are based on the pavement subgrades consisting of A-2-4 soil.
- Based on the results of the laboratory testing and our experience in the area, the subgrade materials have negligible expansive or collapse potential. Mitigation of expansive or collapsible soils will not be necessary for construction of the proposed road.

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

Introduction

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed access road to be located east of the intersection of Highway 24 and Meridian Road between Meridian Road and Old Meridian Road in Falcon, Colorado. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Grading and drainage
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of two test borings, laboratory testing, engineering analysis, and preparation of this report. Drawings showing the site and boring locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs in the **Exploration Results** section.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration.

Item	Description
Parcel Information	The project is located east of the intersection of Highway 24 and Meridian Road in Falcon, Colorado. The site is bound by Old Meridian Road to the east and Meridian Road to the west. See **Site Location**
Existing Improvements	The alignment of the proposed road is undeveloped.
Current Ground Cover	The vegetation observed on the site generally consisted of low to moderately tall native grasses and weeds.
Existing Topography	The site is relatively flat, with less than 5 feet of elevation change across the planned roadway area. Overall, the site slopes down from the north to the south at less than 5% slope.

Project Description

Item	Description
Information Provided	An email from Georgia Kofoed on October 19, 2022, contained comments from El Paso County on Terracon GeoReport 23185069. Subsequent emails on November 8, 2022 clarified the scope of work, and provided a site grading plan dated August, 2021.
Project Description	The project consists of the design and construction of an approximately 550 foot shared access road. The road is oriented in the east-west direction and will be constructed between Meridian Road and Old Meridian Road. We assume the access road will be paved in flexible asphalt.
Design Traffic Loading	At the time of this report, we understand a Pavement Design Traffic Study has not been performed for the access road. The pavement thickness recommendations are based on the access road having a functional classification of Urban-Local Road with and Equivalent Single Axle Load (ESAL) of 292,000.
Grading/Slopes	Approximately 5 feet of fill is anticipated to be required to develop final grade.
Underground Utilities	We anticipate the installation of underground utilities within about 5 to 8 feet of finished site grades. We understand the installation of underground utilities below the future road access road has not been completed at the project site.

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** and the GeoModel can be found in the **Figures** attachment of this report.

As part of our analyses, we identified the following model layer within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description	AASHTO Classification
1	**Native Sand**	Native silty sand; loose to medium dense	A-2-4 (0)

Based on laboratory test results and our experience in the area, the native sand soils are considered to be non-expansive and have a low collapse potential expansive potential. A summary of laboratory test results is included in the **Exploration Results**.

Laboratory test results indicate that the subgrade materials classify as A-2-4 soil type with a group index of 0 according to the American Association of State Highway and Transportation Officials (AASHTO) classification system.

Groundwater Conditions

The borings were observed while drilling and upon completion of drilling for the presence and level of groundwater. The water levels encountered in the boreholes can be found on the boring logs in **Exploration Results** and are summarized below.

Boring No.	Shallowest depth to groundwater encountered upon completion of drilling
P-1	Approximately 6 feet
P-2	Approximately 6 feet

These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times or at other locations. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. Groundwater levels during construction or at other times in the life of the pavement may be higher or lower than the levels indicated on the boring logs.

Geotechnical Overview

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings, provided that the recommendations provided in this report are implemented.

Pavements

General Pavement Comments

Design of pavements for the project have been performed in general accordance with the guidelines outlined by the *1993 Guidline for Design of Pavement Structures* by the American Association of State Highway and Transportation Officials (AASHTO) and El Paso County's *Engineering Criteria Manual (ECM) – Revision 6* (Standards).

Design Traffic

Traffic loads for the proposed access road were based on the assumption the road has a functional classification of Urban-Local and were determined from the Standards and are presented in the following table.

Roadway Functional Classification	ESAL
Urban – Local	292,000

Pavement Design Parameters

Laboratory test results indicate that the subgrade materials classify as A-2-4 soils with a group index of 0 according to the American Association of State Highway and Transportation Officials (AASHTO) classification system. A Hveem Stabilometer R-value test (AASHTO T-190) was performed on a composite sample of A-2-4 soils from Borings Nos. P-1 and P-2 and resulted in an R-value of 76.5. based on our experience with similar subgrade soils and seasonal variations, an R-value of 40 was used for the pavement thickness design. The R-value was used to calculate a resilient modulus (M_R) of approximately 9,500 psi based on the Standards.

Fill Material Types

Fill for this project should consist of engineered fill. Engineered fill is fill that meets the criteria presented in this report and has been properly documented. On-site silty sands may be reused as engineered fill below pavement areas. Engineered fill should meet the following material property requirements:

Fill Type	AASHTO Classification	Acceptable Location for Placement
Onsite sand soils	A-1, A-2, and A-3 soils	Onsite sand and gravel soils are considered suitable for use as compacted fill below pavement areas and as general fill for this project.

- Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.
- Care should be taken during the fill placement process to avoid zones of dis-similar fill. Improvements constructed over varying fill types are at a higher risk of differential movement compared to improvements over a uniform fill zone.

Imported Fill Materials: Imported fill materials should meet the following material property requirements. Regardless of its source, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.

Gradation	Percent finer by weight (ASTM C136)
1”	100
¾”	50-100
No. 4 Sieve	50-100
No. 200 Sieve	<35

- Minimum R-value……40 (min)
- Liquid Limits……30 (max)
- Plasticity Index……..15 (max)
- Maximum Expansive Potential (%)……0.5*

*Measure on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at optimum water content. The sample is confined under a 200-psf surcharge and submerged.

Engineered and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Fill Placement and Compaction Requirements

Engineered and general fill should meet the following compaction requirements.

Item	Engineered Fill
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirements [1,2]	95% of maximum modified Proctor dry density (ASTM D1557 or AASHTO T180)
Moisture Content Range [1]	-2% to +2% of optimum

1. We recommend that engineered fill be tested for water content and compaction during placement. Should the results of the in-place density tests indicate the specified water or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified water and compaction requirements are achieved.
2. Water levels should be maintained low enough to allow for satisfactory compaction to be achieved without the compacted fill material pumping when proofrolled.

Recommended Minimum Pavement Sections

The pavement thickness designs were performed using asphalt and aggregate base course strength coefficients and minimum thicknesses as recommended in the Standards. The following strength coefficients were used for the pavement designs:

Component	Strength Coefficient
Hot Mix Asphalt (HMA)	0.44
Aggregate Base Course (ABC)	0.11

Using the traffic volume assumptions and resilient modulus of the A-2-4 soils, a structural number (SN) of 2.4 was calculated based on the Standard for the proposed roadway. The recommended pavement thicknesses for hot mix asphalt (HMA) pavement using the traffic loading, subgrade soil strength, and the design parameters presented in the Standards are summarized in the table below:

Recommended Minimum Pavement Thickness (Inches)		
Hot Mix Asphalt (HMA)	**Aggregate Base Course (ABC)**	**Calculated SN**
4.0	8.0	2.82

- All materials should meet the current El Paso County's Engineering Criteria Manual.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic upkeep should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Pavement care consists of both localized (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Additional engineering consultation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.

- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and pavements), evaluation and remediation of existing fill materials, as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Corrosivity

The table below lists the results of laboratory water-soluble sulfate, sulfides, pH, chlorides, electrical resistivity, Red-Ox, and total salts testing performed on a sample obtained during our field exploration. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary

Boring	Sample Depth (feet)	Soluble Sulfate (% by mass)	Sulfides (ppm)	Chlorides (mg/kg)	pH	Electrical Resistivity (Ω-cm)	Red-Ox (mV)	Total Salts (mg/kg)
P-2	0.0-5.0	<0.10	Nil	<0.10	7.15	9700	+731	355

1. Results of water-soluble sulfate testing indicate that samples of the on-site soils has an exposure class of S0 when classified in accordance with Table 19.3.1.1 of the American Concrete Institute (ACI) Design Manual. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 19.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration.

Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

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

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

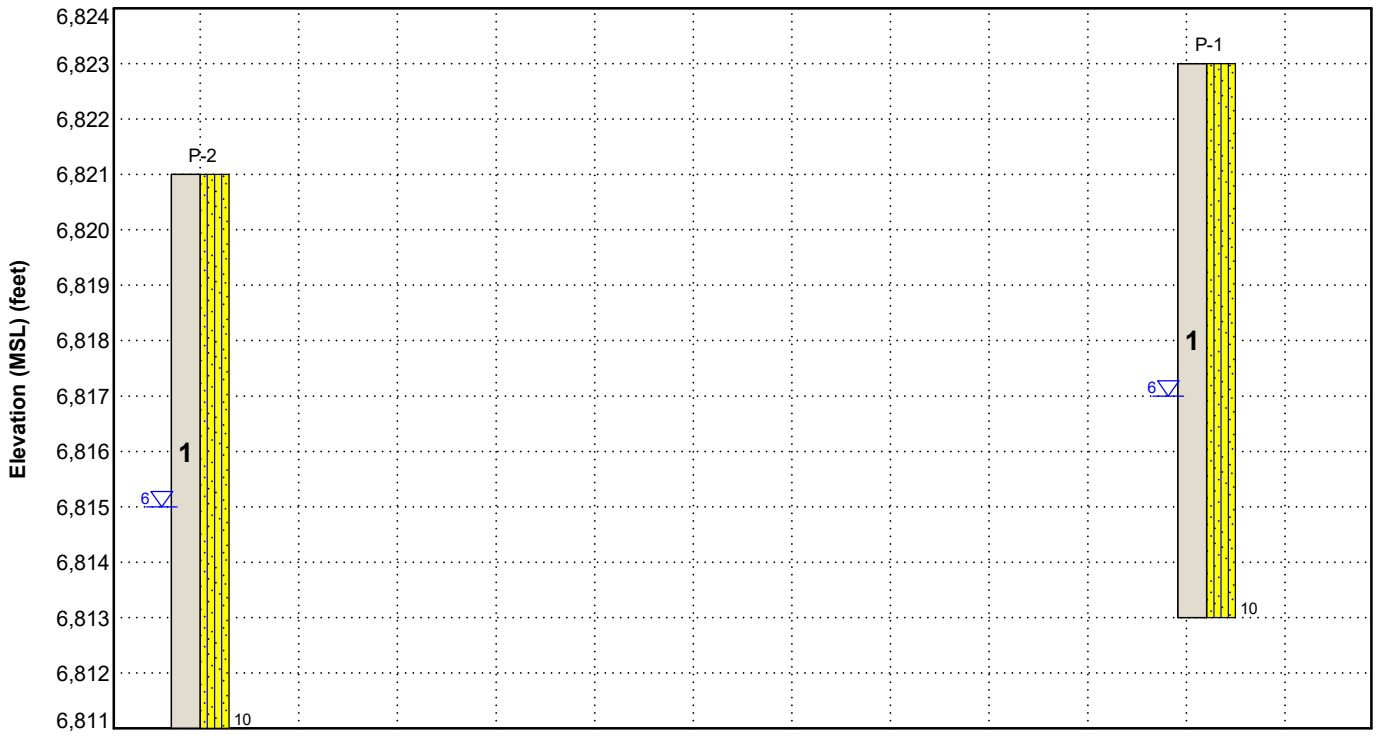
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly effect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, structure movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Figures

Contents:

Terracon
4172 Center Park Dr
Colorado Springs, CO

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Native Sand**	Silty sand; loose to medium dense

LEGEND

Silty Sand

▽ First Water Observation

The groundwater levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
2	10	Along proposed roadway alignment

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ±10 feet) and referencing existing site features. Elevations were interpolated from a topographic site plan. If elevations and a more precise boring layout are desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted rotary drill rig using continuous flight augers. Four samples were obtained in the upper 10 feet of each boring. A 3-inch O.D. split-barrel sampling spoon with 2.5-inch I.D. ring lined sampler was used for sampling. Ring-lined, split-barrel sampling procedures are similar to standard split spoon sampling procedure; however, blow counts are typically recorded for 6-inch intervals for a total of 12 inches of penetration. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Dry Unit Weight
- Atterberg limits
- Grain size analysis

- Swell/consolidation
- Chemical analyses
- Hveem Stabilometer (R-Value)

The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan with Project Overlay
Pavement Thickness Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

Circle K Access Road ■ Falcon, Colorado
February 7, 2023 ■ Terracon Project No. 23225154

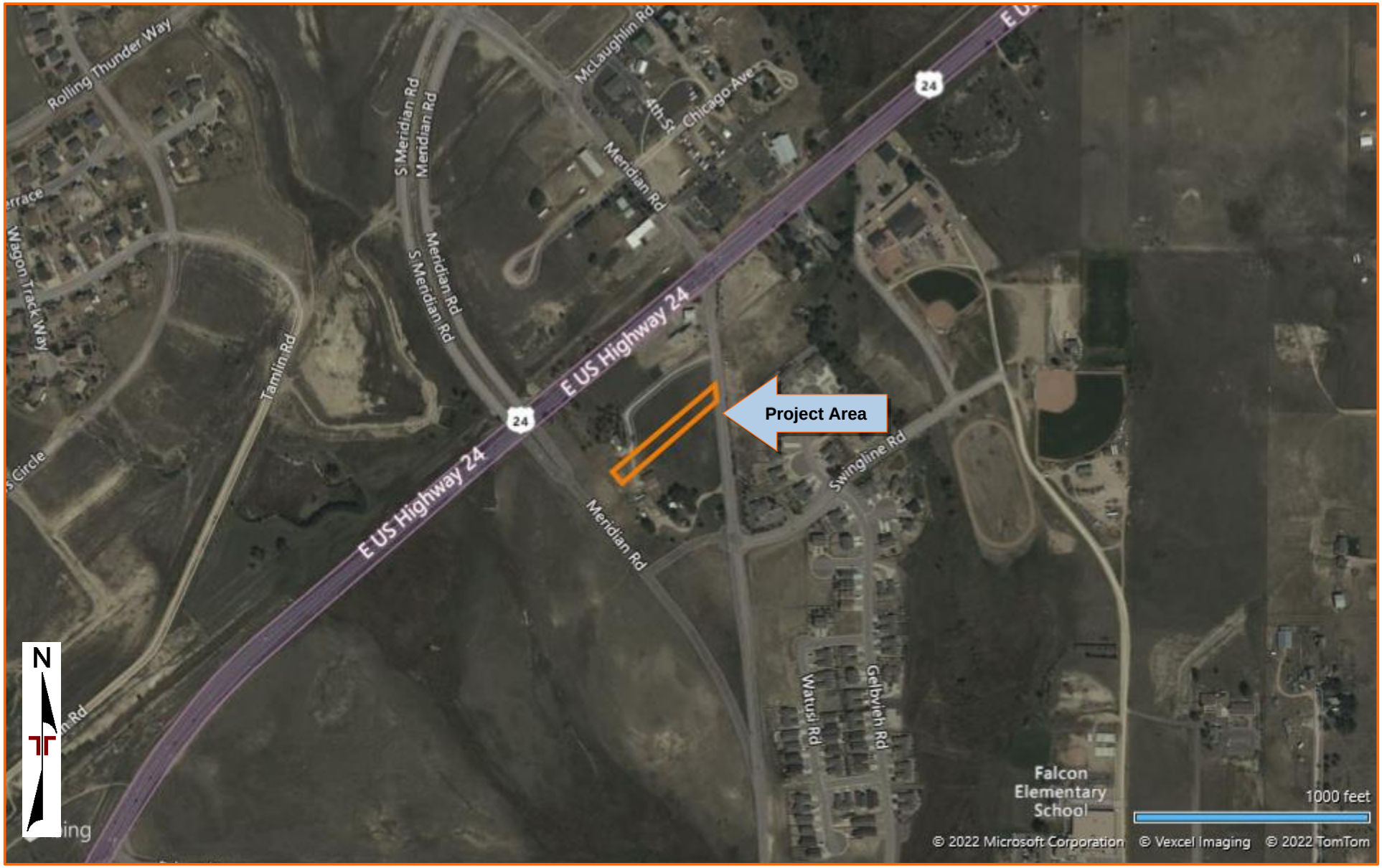


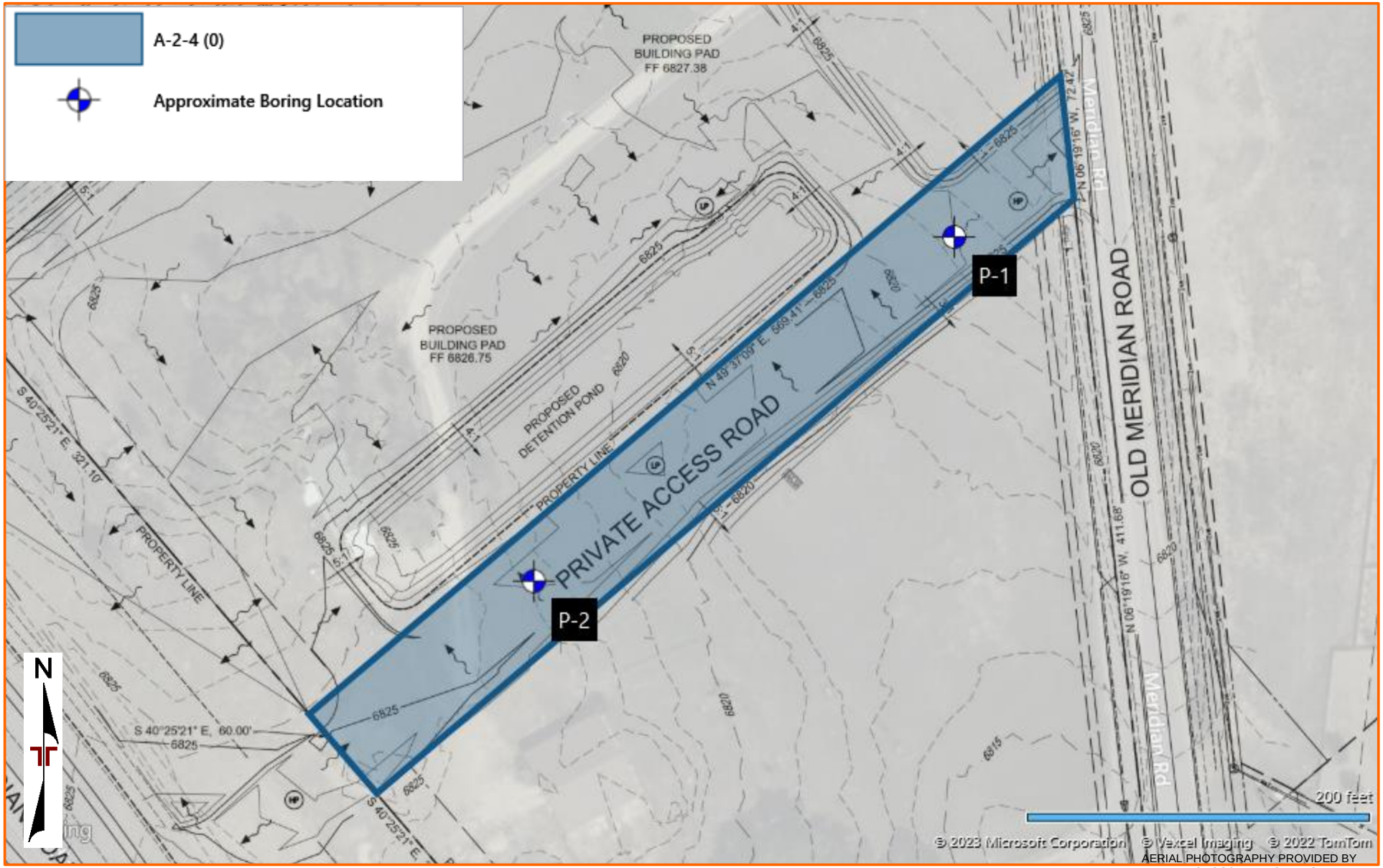
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN WITH PROJECT OVERLAY

Circle K Access Road ■ Falcon, Colorado

February 7, 2023 ■ Terracon Project No. 23225154



AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

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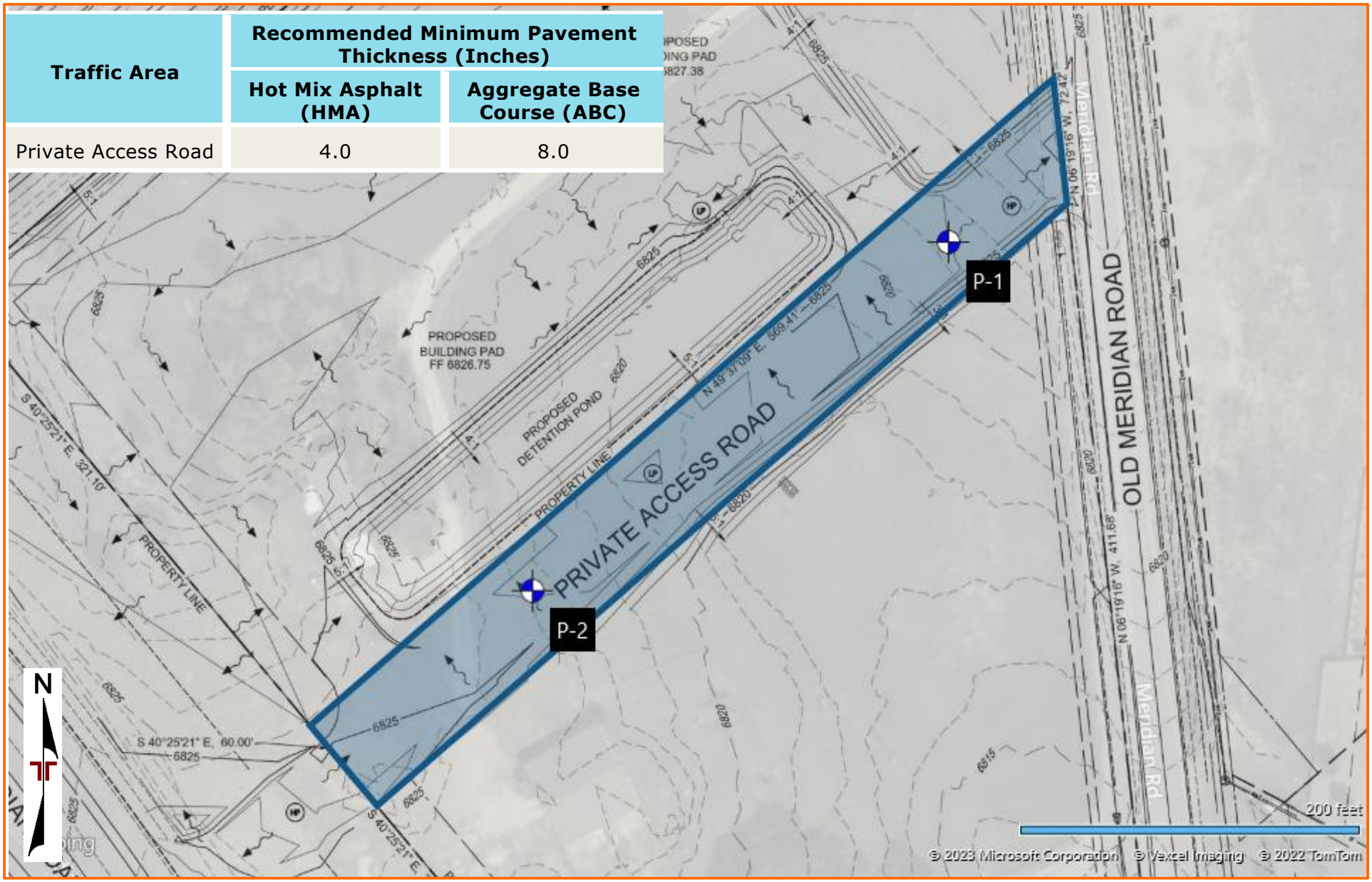
PAVEMENT THICKNESS PLAN

Circle K Access Road ■ Falcon, Colorado

February 7, 2023 ■ Terracon Project No. 23225154

Terracon GeoReport

Traffic Area	Recommended Minimum Pavement Thickness (Inches)	
	Hot Mix Asphalt (HMA)	Aggregate Base Course (ABC)
Private Access Road	4.0	8.0



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AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Note: All attachments are one page unless noted above.

Circle K Access Road
U.S Highway 24 & Meridian Road | Falcon, Colorado
Terracon Project No. 23225154

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Log No. P-1

Location: See Exploration Plan

Latitude: 38.9317° Longitude: -104.6087°

Depth (Ft.) Elevation: 6823 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	SWELL (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		0								
					6-13		1.2		NP	13
					6-8	-0.1 @ 500 psf	15.9	109		
		5	▽							
					7-15		17.0	108		
					6-7					
		10								

SILTY SAND (SM), A-2-4 (0), fine to coarse grained, light brown to gray, loose to medium dense

10.0 6813

Boring Terminated at 10 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations

▽ 6 feet upon completion of drilling

Notes

Elevation Reference: Elevations were interpolated from a topographic site plan.

Advancement Method
4-inch diameter solid stem continuous flight power auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
GDI

Logged by
MAM

Boring Started
12-02-2022

Boring Completed
12-02-2022

Circle K Access Road
U.S Highway 24 & Meridian Road | Falcon, Colorado
Terracon Project No. 23225154

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Log No. P-2

Location: See Exploration Plan

Latitude: 38.9311° Longitude: -104.6096°

Depth (Ft.) Elevation: 6821 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	SWELL (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		0								
					4-10		1.6	101	NP	14
					7-8		1.7			
		5	▽							
					6-11					
					7-9		11.5	120		
		10								

SILTY SAND (SM), A-2-4 (0), fine to coarse grained, light brown to gray, loose

10.0 6811

Boring Terminated at 10 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ 6 feet upon completion of drilling

Notes
Elevation Reference: Elevations were interpolated from a topographic site plan.

Advancement Method
4-inch diameter solid stem continuous flight power auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
GDI

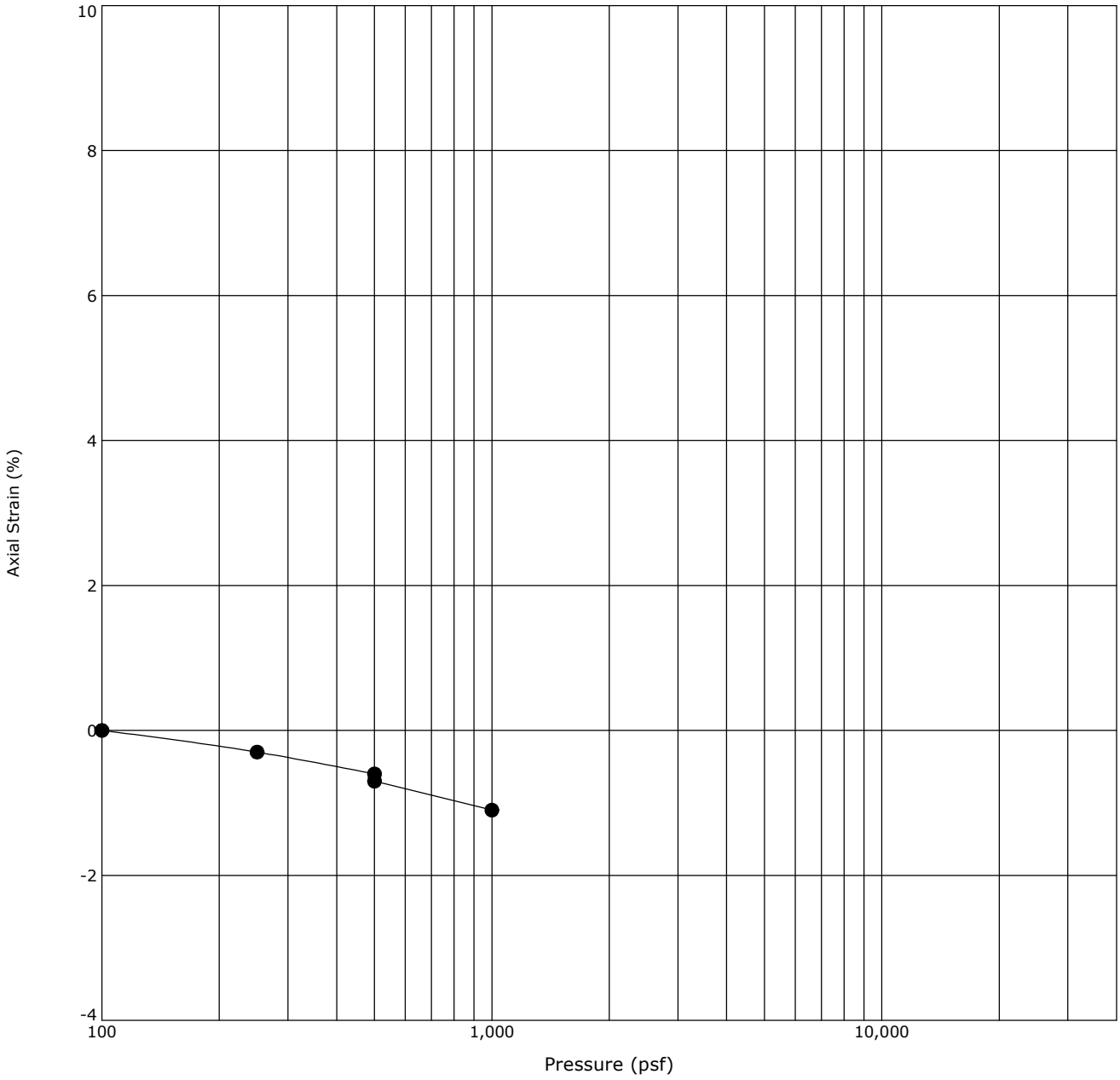
Logged by
MAM

Boring Started
12-02-2022

Boring Completed
12-02-2022

Terracon
4172 Center Park Dr
Colorado Springs, CO

Swell Consolidation Test



Boring ID		Depth (Ft)	Description	AASHTO	γ_d(pcf)	WC (%)
●	P-1	4 - 5	SILTY SAND	A-2-4	109	15.9

Notes: Water was added at 500 psf.

Circle K Access Road
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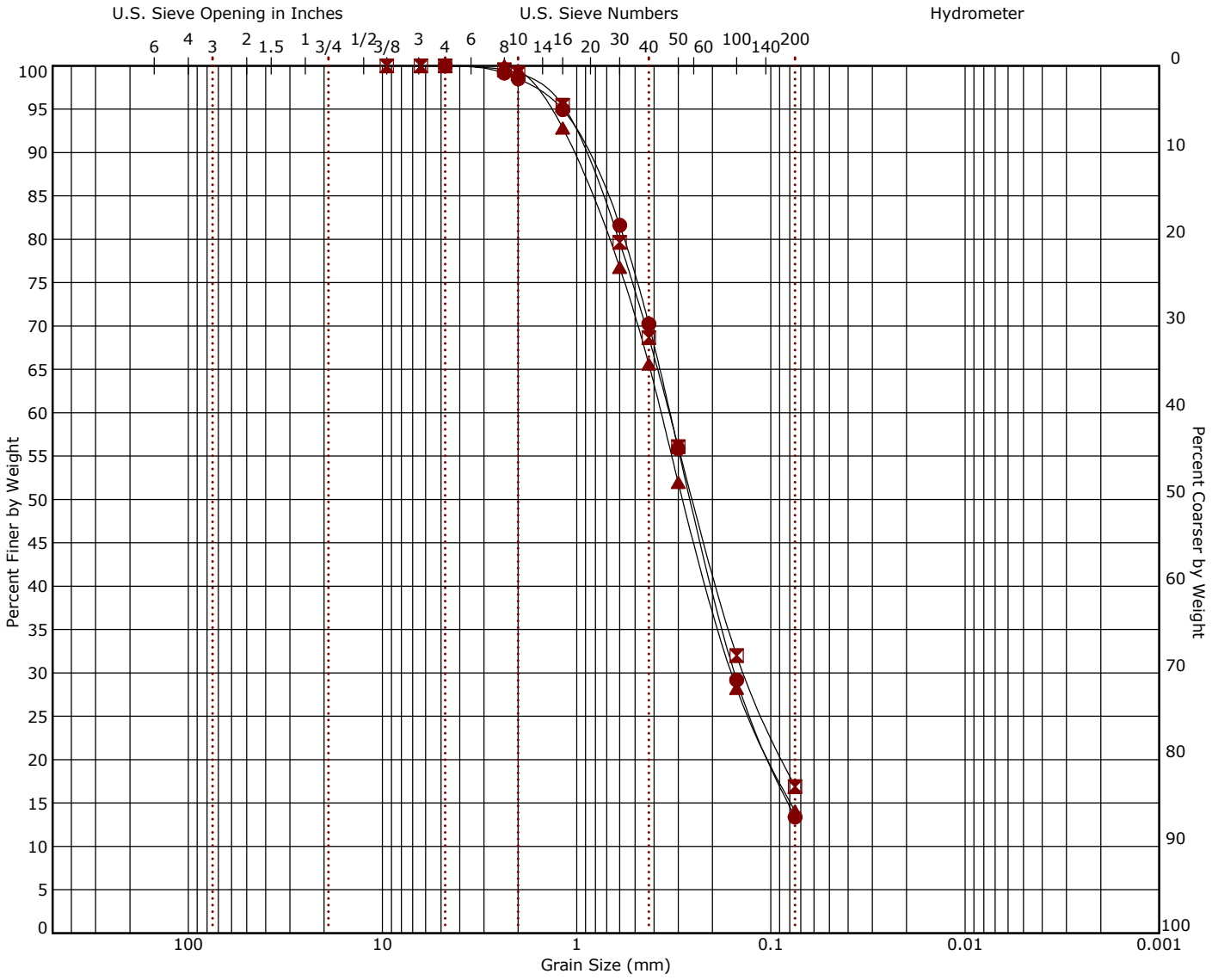
Grain Size Distribution

ASTM D422 / ASTM C136



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Boring ID	Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
● P-1	0 - 5	SILTY SAND	SM	A-2-4 (0)	NP	NP	NP		
⊠ P-1 & P-2	0 - 5	SILTY SAND	SM	A-2-4 (0)	NP	NP	NP		
▲ P-2	0 - 5	SILTY SAND	SM	A-2-4 (0)	NP	NP	NP		

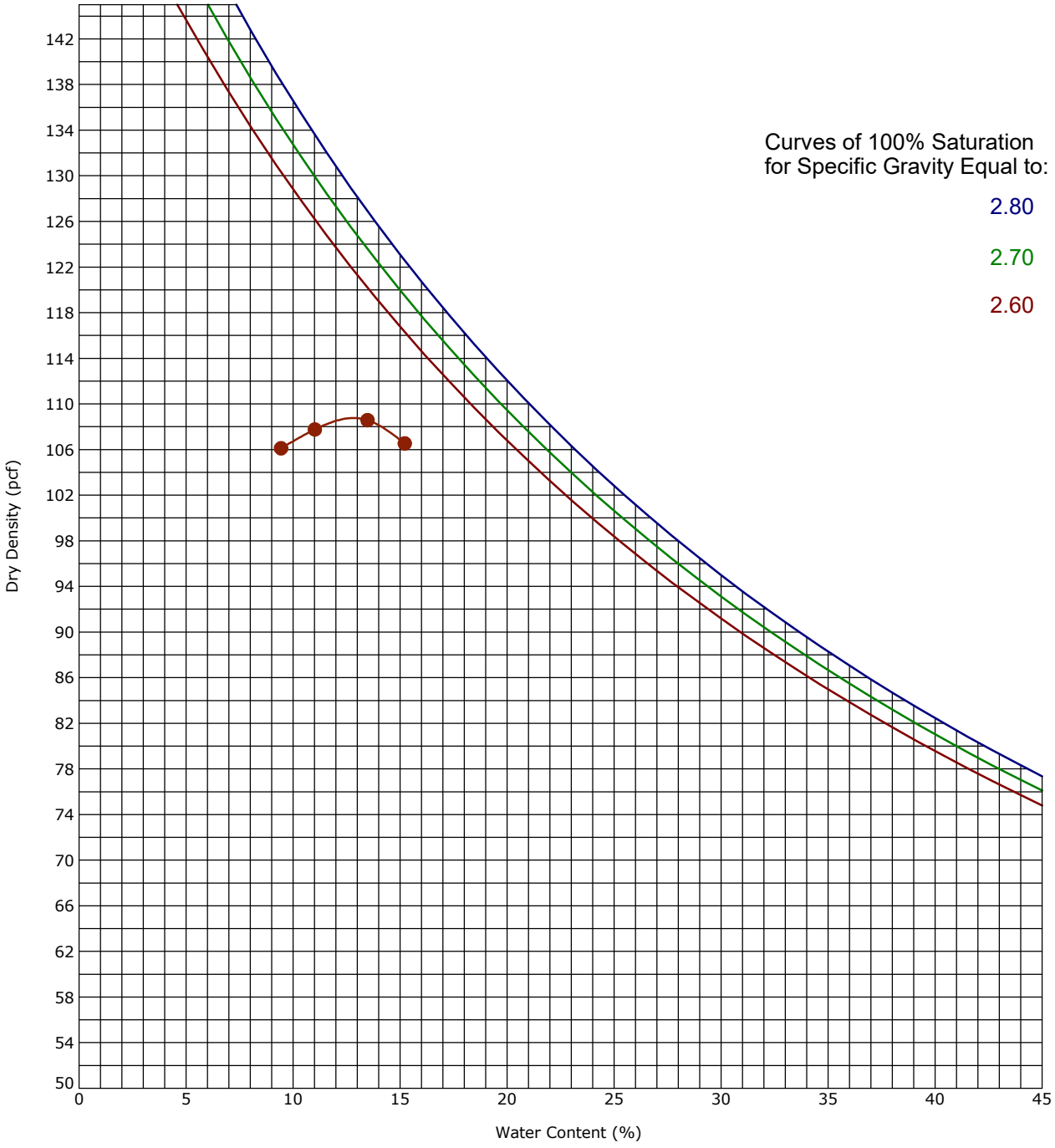
Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
● P-1	0 - 5	4.75	0.332	0.153		0.0	0.0	86.6	13.4		
⊠ P-1 & P-2	0 - 5	9.5	0.334	0.137		0.0	0.0	83.1	16.9		
▲ P-2	0 - 5	2.36	0.368	0.158		0.0	0.0	85.9	14.1		

Circle K Access Road
U.S Highway 24 & Meridian Road | Falcon, Colorado
Terracon Project No. 23225154

Terracon
4172 Center Park Dr
Colorado Springs, CO

Moisture-Density Relationship

AASHTO T99



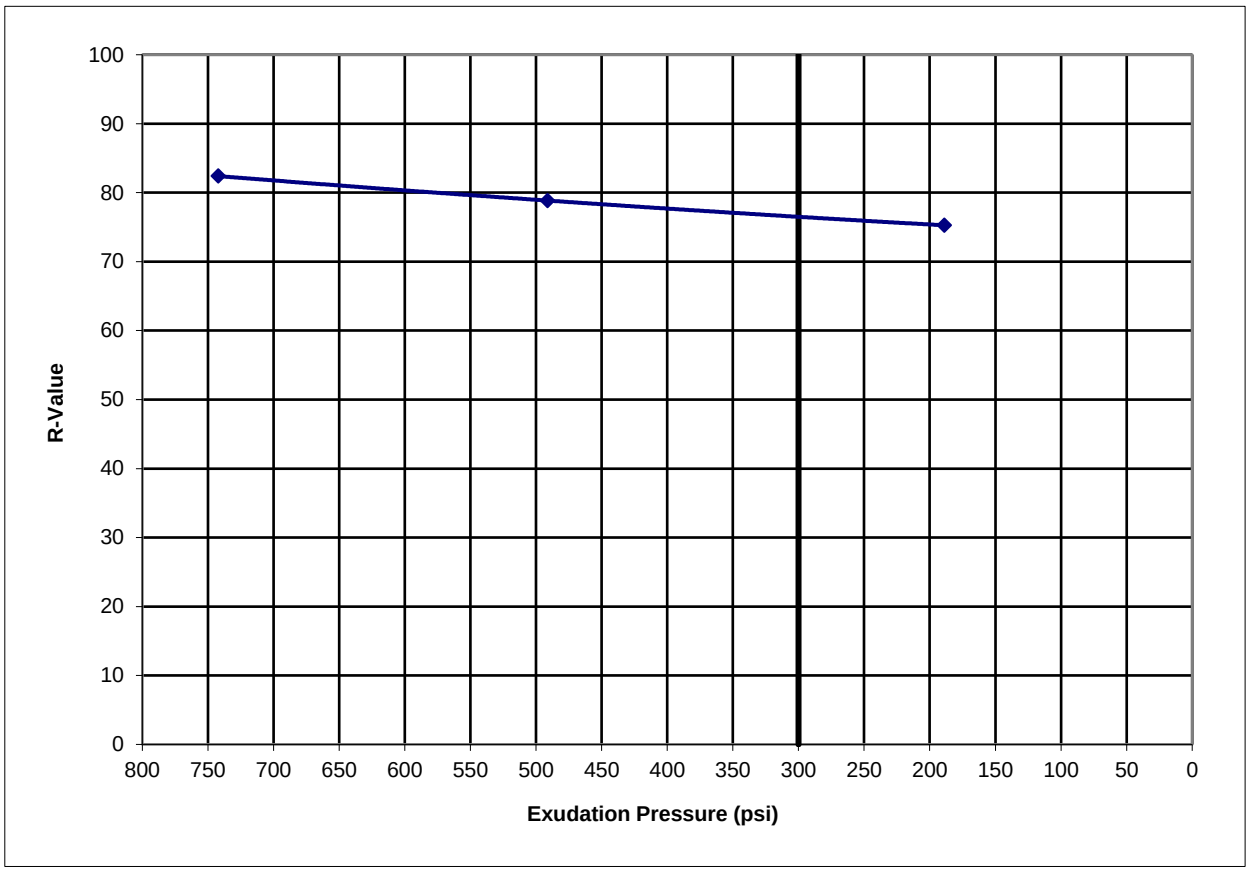
Boring ID	Depth (Ft)	Description of Materials
P-1 & P-2	0 - 5	A-2-4

Fines (%)	Fraction >19mm size (%)	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
17	83	NP	NP	NP	AASHTO T99	108.8	12.8

PROJECT:	Circle K Access Road	**JOB NO:**	23225154
LOCATION:	Falcon, Colorado	**WORK ORDER NO:**	-
MATERIAL:	Silty Sand	**LAB NO:**	P-1 & P-2 @ 0-5'
SAMPLE SOURCE:	P-1 & P-2 @ 0-5'	**DATE RECEIVED:**	01/10/23

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	11.8%	10.9%	10.5%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.62	2.60	2.58
Dry Density (pcf)	117.6	117.8	118.1
Horiz. Pres. @ 1000lbs (psi)	13.0	12.0	11.0
Horiz. Pres. @ 2000lbs (psi)	26.0	22.0	18.0
Displacement	4.79	4.66	4.57
Expansion Pressure (psi)	0.0	0.0	0.0
Exudation Pressure (psi)	189	491	742
R Value	75	79	82



AASHTO R18

R Value at 300 PSI = 76.5

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client
Land Development Consultants

Project
Circle K Access Road

Sample Submitted By: Terracon (23) **Date Received:** 12/15/2022 **Lab No.: 22-0827**

Results of Corrosion Analysis

Sample Number	--
Sample Location	P-2
Sample Depth (ft.)	0.0-5.0
pH Analysis, ASTM G 51	7.15
Water Soluble Sulfate (SO4), ASTM D516 (mg/kg)	136
Chlorides, ASTM D 512, (mg/kg)	82
Total Salts, AWWA 2520 B, (mg/kg)	355
Sulfides, AWWA 2760 G, (ppm)	Nil
Red-Ox, ASTM G 200, (mV)	+731
Saturated Minimum Resistivity, ASTM G 57, (ohm-cm)	9700

Analyzed By N. Campo

Nathan Campo
Engineering Technician II

SUMMARY OF LABORATORY TEST RESULTS

Circle K Access Road - Falcon, Colorado
Terracon Project No. 23225154

Boring No.	Depth (ft)	AASHTO Class. (Group Index)	Initial Water Content (%)	Initial Dry Density (pcf)	Swell/Consolidation		R-Value	Moisture-Density Relationship			Particle Size Distribution, Percent Passing by Weight					Atterberg Limits		Water Soluble Sulfates (mg/kg)	Sulfides (ppm)	Chlorides (mg/kg)	pH	Total Salts (mg/kg)	Red-Ox (mV)	Resistivity (ohm-cm)	Remarks
					Surcharge (ksf)	Swell (%)		Maximum Dry Density (pcf)	Optimum Water Content (%)	Test Method	3/4"	#4	#10	#40	#200	LL	PI								
P-1	0 - 5	A-2-4 (0)									100	100	98	70	13	NV	NP								
P-1	2		1.2																						4
P-1	4		15.9	109	0.5	-0.1																			3,4
P-1	7		17.0	108																					4
P-2	0 - 5	A-2-4 (0)									100	100	100	66	14	NV	NP	136	Nil	82	7.15	355	+731	9700	
P-2	2		1.6	101																					4
P-2	4		1.7																						4
P-2	9		11.5	120																					4
P-1 & P-2	0 - 5	A-2-4 (0)					76.5	108.8	12.8	T99	100	100	99	69	17	NV	NP								6

Notes:
Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.
* = Partially disturbed sample
- = Compression/settlement
NV = no value
NP = non-plastic

Remarks:
1 Remolded Compacted density (about 95% of ASTM D698 maximum density near optimum moisture content)
2 Remolded Compacted density (about 95% of ASTM D1557 maximum density near optimum moisture content)
3 Water added to sample
4 Dry density and/or moisture content determined from one ring of a multi-ring sample
5 Minus #200 Only
6 Moisture-Density Relationship Test Method ASTM D698/AASHTO T99
7 Moisture-Density Relationship Test Method ASTM D1557/AASHTO T180

Pavement Design
(AASHTO 1993 Method)

Design Inputs		**Asphalt**	
Sugrade Support	R-value=	40	
	Mr =	9,500	psi
Reliability		80	%
Standard Deviation	So =	0.45	
Initial Serviceability	Po =	4.5	
Serviceability Index	Pt =	2.0	
Design Serviceability Loss,	ΔPSI =	2.5	

Layer Coefficients:

AC Surface and Binder	a_1 =	0.44
Aggregate Base	a_2=	0.11

Asphalt Section Traffic (18 kip ESAL) = 292,000

Asphalt Pavement Section

AC Surface + Binder	**4.0**	in.
Aggregate Base	**8.0**	in.

Structural Number: **2.8**

Structural Number - Required ***2.4***

Project: Circle K Access Road Location: Falcon, Colorado

Project No. 23225154 Date: 02/07/23

Terracon

Supporting Information

Contents:

Note: All attachments are one page unless noted above.

Terracon
4172 Center Park Dr
Colorado Springs, CO

General Notes

Sampling	Water Level	Field Tests
Auger Cuttings Modified Dames & Moore Ring Sampler	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Descriptive Soil Classicification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils
(More than 50% retained on No. 200 sieve.)
Density determined by Standard Penetration Resistance

Relative Density	Standard Penetration or N-Value (Blows/Ft.)	Ring Sampler (Blows/Ft.)
Very Loose	0 - 3	0 - 6
Loose	4 - 9	7 - 18
Medium Dense	10 - 29	19 - 58
Dense	30 - 50	59 - 98
Very Dense	> 50	> 99

Consistency of Fine-Grained Soils
(50% or more passing the No. 200 sieve.)
Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance

Consistency	Unconfined Compressive Strength Qu (psf)	Standard Penetration or N-Value (Blows/Ft.)	Ring Sampler (Blows/Ft.)
Very Soft	less than 500	0 - 1	< 3
Soft	500 to 1,000	2 - 4	3 - 4
Medium Stiff	1,000 to 2,000	4 - 8	5 - 9
Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Stiff	4,000 to 8,000	15 - 30	19 - 42
Hard	> 8,000	> 30	> 42

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[Q] PI plots below "A" line.