Colorado Interstate Gas Company, L.L.C.
a Kinder Morgan company

March 20, 2019

Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Attention: Ms. Kimberly D. Bose, Secretary

Re: Colorado Interstate Gas Company, L.L.C.;
Docket No. CP19-56-000;
Supplemental Environmental Information

Dear Ms. Bose:

On February 21, 2019, Colorado Interstate Gas Company, L.L.C. ("CIG") received an informal request for additional information from the Office of Energy Projects ("OEP") related to its proposed CIG High Plains Kiowa Lateral Expansion Project. Accordingly, CIG is herein filing with the Federal Energy Regulatory Commission ("Commission") in Docket No. CP19-56-000, responses associated with that request.

Description of Proceeding

On January 24, 2019, CIG filed a prior notice request to Sections 157.205(b), 157.208(b), and 157.210 of the Commission's Regulations under the Natural Gas Act for authorization to construct and operate two laterals and metering facilities located in Weld County, Colorado. The project is referred to as the "CIG High Plains Kiowa Lateral Expansion Project".

Description of Information Being Filed

CIG is herein submitting the pending responses to the February 21, 2019 informal request.

Filing Information

CIG is e-Filing this letter and attachment with the Commission's Secretary in accordance with the Commission's Order No. 703, *Filing Via the Internet*, guidelines issued on November 15, 2007 in Docket No. RM07-16-000.

Respectfully submitted,
COLORADO INTERSTATE GAS COMPANY L.L.C.

By /s/
Francisco Tarin
Director, Regulatory

Enclosures

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Responses to OEP Data Request - OEP/DG2E/Gas Branch 2
Dated October 11, 2012 in Docket No. CP12-496-000

High Plains 2013 Expansion Project

General

1. Provide revised alignment sheets on 1:6,000 or greater scale (for example 1" = 200 feet) aerial photographs or photo-based alignment sheets. Show:

a. clearly demarcated limits of disturbance for all Kiowa Lateral Pipeline Project (Project) work areas;
b. the full extent of all proposed access roads labeled as permanent and temporary, and the Fort Lupton Contractor Yard;
c. labels for all proposed facilities and temporary workspaces and access roads;
d. the labeled workspace for the Lancaster/High Five Tie-in and associated access road; and
e. the environmental survey corridor.

Updated Response:

On March 8, 2019 CIG provided a response to the informal request for information on General Question 1. CIG is supplementing its prior response with the following information regarding the Project.

CIG has attached alignment sheets showing all requested information that update the sheets previously filed on March 8, 2019. Please see Attachment 1 behind this response. CIG will separately provide Commission Staff full-size paper copies of the aerial alignment sheets.

Response prepared by or under the supervision of:

Claudia Leal
Project Manager
303-914-4626

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

General

7. For each planned HDD crossing, provide an alignment profile that incorporates site-specific geotechnical investigations (subsurface lithology along the drill path and the top of the water table [zone of saturation], Standard Penetration Test results, soil mechanic properties/Atterberg Limits, rock coring results including core recovery, and Rock Quality Designation for each bedrock core run).

Response:

The Concept HDD Layouts which include subsurface lithology, groundwater elevations, as well as other geotechnical information are provided in the Golder Technical Memo dated March 18, 2019. Please see Attachment 2 behind this response for the analysis of the HDDs. Also, CIG is providing the Terracon Geotechnical Report dated December 28, 2018 for additional geotechnical information being provided as Attachment 3 behind this response.

Response prepared by or under the supervision of:

Claudia Leal
Project Manager
303-914-4626

GOLDER

TECHNICAL MEMORANDUM

DATE March 18, 2019 **Project No.** 18108190

TO Ms. Claudia Leal
Kinder Morgan, Inc.

CC Matt Long (Golder Associates)

FROM Jeffrey Schneider, Matt Brown (Golder Associates) **EMAIL Jeffrey_Schneider@golder.com**

GEOTECHNICAL RISK REVIEW AND INADVERTANT DRILING FLUILD RETURAN ANALYSIS – KIOWA LATERAL – WELD COUNTY, COLORADO

Kinder Morgan, Inc. (KMI) requested that Golder Associates, Inc. (Golder) provide a geotechnical risk review of two proposed pipeline installations using horizontal directional drilling techniques along the proposed 24-inch Kiowa Lateral natural gas pipeline in Weld County, Colorado. This technical memorandum provides a summary of a geotechnical risk evaluation and the results of an inadvertent drilling fluid return potential analysis and for the proposed HDD crossings of I-76 and WCR-59 (see Attachment 1).

1.0 SUBSURFACE RISK EVALUATION

Typical subsurface risks that may impact the likelihood of success of an HDD installation include loss of drilling fluid circulation, encountering obstructions, ability to maintain design alignment and profile (steering difficulties), and collapse of the borehole during drilling or pullback. Typically, loose unsupported sands and deposits containing significant percentages (greater than 40 percent) of gravel, cobbles, or boulders and highly fractured bedrock with low RQD values (less than 75 percent) increase the risks to an HDD installation. Other subsurface risks include differential groundwater pressures along the bore path (e.g. artesian conditions, perched aquifers, etc.) or encountering other obstructions such as construction debris, logs, foundations (piles, piers).

Golder reviewed the subsurface conditions at the two proposed crossings that were identified during a geotechnical investigation program conducted by Terracon (2018). A summary of the conditions encountered at potential subsurface risks for an HDD installation at each crossing are summarized below.

1.1 I-76 Crossing

The proposed I-76 crossing is approximately 660 feet long. The proposed entry point is located on the east side of the crossing and the exit point is located on the west side of the crossing. Four exploratory boreholes were advanced along the crossing alignment to depths of approximately 40 feet below ground surface (bgs). Based on review of the geotechnical conditions documented in the report, the subsurface conditions at the site generally consist of approximately 5 to 10 feet of loose to medium silty sand, overlying an approximate 10-foot-thick layer of medium stiff to very stiff lean clay, overlying bedrock consisting of medium hard to very hard siltstone/claystone. The underlying siltstone/claystone bedrock appears to be a weak rock that behaves more like a firm to very hard clay. The proposed HDD drill path is expected to be predominantly within the lean clay and siltstone/claystone with the initial and final 75 to 100 feet within the silty sand deposits. These subsurface materials are considered

Golder Associates Inc.
N27 W23960 Paul Road, Suite 210 Pewaukee, Wisconsin, USA 53072 T: +1 262-347-0561 +1 262-347-0565

favorable for an HDD installation and the likelihood for a successful HDD installation is good provided a qualified contractor is selected.

The lean clay and claystone/siltstone deposits do present a potential risk for hydrolock. Hydrolock is a condition that occurs when drilling fluid circulation along the borehole annulus is lost during pullback and a hydraulic pressure cylinder from the drilling fluid pressure build up is created in the ground around the pipe that exceeds the rig's pullback capacity. Hydrolock is more likely to occur in fine-grained rock (e.g. shale, siltstone/claystone, sandstone) and uniform ground conditions that are resistant to fracturing or absorption. The contractor can mitigate the risks of hydrolock by slowing down the rate of advancement or pullback and maintaining good circulation. If hydrolock occurs, possible mitigation techniques may include maintaining circulation of the drilling fluids and stopping advancement of the drill stem or pullback until the pressure has subsided or use of a pneumatic percussive pipe rammer.

1.2 WCR-49 Crossing

The proposed WCR-49 crossing is approximately 835 feet long. The proposed entry point is located on the east side of the crossing and the exit point is located on the west side of the crossing. Four exploratory boreholes were advanced along the crossing alignment to depths of approximately 40 feet bgs. Based on review of the geotechnical conditions documented in the report, the subsurface conditions at the site generally consist of silty sand deposits extending to depths greater than 35 to 40 feet bgs. Bedrock consisting of siltstone was encountered at a depth of 35 feet in the furthest east borehole (CR49-B4) near the proposed exit point, but bedrock was not encountered in the other holes.

The proposed HDD drill path is expected to be predominantly within the silty sand deposits, which are considered acceptable for an HDD installation and the likelihood for a successful HDD installation is good provided a qualified contractor is selected.

The elevation difference between the entry point and exit point coupled with the relatively loose silty sand deposits does present a potential risk for hole collapse during the drilling process. Drilling fluid will have a tendency to reach hydraulic equilibrium with the lower entry side elevation, potentially leaving approximately 80 feet of borehole on the east side of the crossing unsupported with drilling fluid. The contractor can mitigate the risk by minimizing the amount of time between hole completion and pipe pullback, maintaining drilling fluid circulation during drilling, and potentially modifying the drilling fluid properties (i.e. gel strength and viscosity) to help create a better filter cake to stabilize the hole.

2.0 INADVERTENT DRILLING FLUID RETURN

During the HDD process, drilling fluid is pumped down the drill string, through the cutting head, and back along the borehole annulus to the entry point to help clear cuttings. The total drilling fluid pressure at the cutting head is dependent on the pumping pressures used, elevation difference between the drill rig and the cutting head, and friction losses due to the distance the fluid is pumped along the drill string. As the drill progresses, the distance to transport cuttings back along the annulus to the entry point increases and requires higher fluid pressure at the cutting head.

The loss of fluid to the surrounding formation is typically due to either (or both) hydraulic fracturing or formational fluid loss. Hydraulic fracture occurs when the downhole pressure exceeds the overburden effective stress and shear strength of the soil formation or the tensile strength of the bedrock along the drill path and typically occurs in weak cohesive soils or loose granular soils. Formation fluid loss typically occurs when the drilling fluid flows

through porous formation material surrounding the borehole and typically occurs in very porous material such as coarse sands and gravels with low percentages of fine material. Proper drilling fluid characteristics and additives can reduce the risk of formational fluid loss. Both hydraulic fracture and formational fluid loss may result in inadvertent drilling fluid return to the surface.

Since hydraulic fracture tends to occur due to high annular pressure, determining the maximum allowable annular pressure becomes a design tool to control the risk of hydraulic fracturing. By maintaining the annular pressure below this threshold, the risk of loss of circulation and hydraulic fracturing can be reduced, but not eliminated. The factor of safety (FOS) against hydraulic fracture assessment is calculated by comparing the formation limit pressure (i.e. strength of surrounding material) to the annular fluid pressure. The industry standard method for estimating the hydraulic fracture potential is to use the Delft equation, which is described in more detail below.

2.1 Inadvertent Drilling Fluid Return Analysis

An evaluation of the potential for hydraulic fracture using the industry standard Delft equation (Delft Geotechnics 1997), which utilizes the cavity expansion model was conducted for both the I-76 and WCR-49 crossings. This method calculates the formation limit pressure for the pilot hole assuming the plastic radius ($R_{p,max}$) is equal to the depth of cover (H). The Delft report (1997) recommends that maximum allowable drilling fluid pressure (MADFP) be determined by applying a factor of safety to the equation by limiting the plastic radius to ½ H in clays and ⅔ H in sands. However, recent studies of a comparison between the pressures calculated using the standard Delft equation and the occurrence of inadvertent drilling fluid returns suggest that the Delft equation may over-predict the MADFP (Staheli et al. 2011) and therefore, a more conservative assumption is to use the Delft equation with the plastic radius ($R_{p,max}$) set equal to 2·D, where D is the pilot borehole diameter.

Calculations using the Delft equation were also performed to estimate the minimum pressure required to maintain fluid circulation through the borehole. Risk of hydraulic fracture is considered low if the MADFP remains above the minimum pressure required. The MADFP calculated using the traditional Delft equation approach (R_{pmax} = ½ H in clays and ⅔ H) and the more conservative approach (R_{pmax} = 2·D) and the minimum pressure required was estimated at approximately 20 locations along the both of the proposed HDD bore paths (see Attachment 2).

The hydrofracture analysis was performed using a set of typical values with regard to the type and consistency of drill mud, pilot hole size, flow rate, drill rate, and drill bit and rod size. Soil and rock properties assumed for the analysis were estimated from interpretation of exploratory borehole logs and laboratory testing performed by Terracon.

I-76 Results

The analysis results indicate that the minimum downhole annular pressure required to maintain fluid circulation along the length of the bore path is less than estimated MADFP for almost the entirety of both bore path, except for the final approximate 100 feet of the bore, which is typical for most HDD bores. Based on the analysis, the highest risk of hydrofracture occurs near the exit point, which is expected, as higher pressures will be needed to transport cuttings back to the entry pit and the depth of cover is reduced. Additionally, the risk of hydraulic fracture is moderate along the exit curve as the drill path passes through the lean clay deposits. Recommend maximum annular pressures are approximately 45 pounds per square inch (psi) through this section compared to the estimated minimum pressure required of approximately 28 to 30 psi.

The risk of hydraulic fracture is considered low to moderate at the I-76 crossing provide the contractor follow proper drilling practices.

WCR-49 Results

The analysis results indicate that the minimum downhole annular pressure required to maintain fluid circulation along the length of the bore path is significantly less than estimated MADFP for almost the entirety of both bore path, except for the final approximate 50 feet of the bore. Similar to the I-76 crossing, the highest risk of hydrofracture occurs near the exit point.

The risk of hydraulic fracture is considered low at the WCR-49 crossing provide the contractor follow proper drilling practices.

2.2 Inadvertent Drilling Fluid Returns Recommendations

Golder recommends the contractor make all reasonable efforts to keep the downhole annular pressure below the estimated lower bound MADFP during drilling. Spikes in downhole annular pressure, which may temporarily exceed the lower bound MADFP, may occur periodically during the pilot hole advance, especially during pump startup and when drilling re-commences after temporary suspension for rod changes. These spikes are inherent to the drilling process, but pump pressures and fluid returns should be carefully and continuously monitored by the contractor; and the magnitude and duration of these spikes should be minimized to avoid hydraulic fracture and inadvertent return of drilling fluid.

During drilling, the ground surface along the HDD alignment, especially locations with lower depth of cover such as road side ditches, should be monitored visually for fluid release. If drilling fluids are observed, drilling should be shut down immediately, and the response actions outlined in the project spill control and containment plan should be implemented. Reduction of pump rates, advance rates, and modification of the drilling fluid properties may need to be implemented in inadvertent returns are observed. The contractor will need to exercise care throughout the entire drilling process, but especially near the exit points, in order to minimize the potential for hydraulic fracture and inadvertent fluid return.

3.0 SUMMARY

The geotechnical risks, potential for inadvertent drilling fluid returns, and potential subsurface risk mitigation is summarized in Table 2 for the two proposed HDD crossings along the Kiowa Lateral.

Table 1: Summary of Geotechnical Risks, Kiowa Lateral HDD Crossings

Crossing	HDD Feasibility based on Subsurface Conditions	Inadvertent Drilling Fluid Return Potential	Potential Subsurface Risks and Mitigation Measures
I-76	Good	Low to Moderate	**Potential Risk:** ■ Hydrolock **Mitigation Measures:** ■ Slower advancement rate ■ Maintain circulation and stop advancement until pressure dissipates ■ Percussive hammer

Crossing	HDD Feasibility based on Subsurface Conditions	Inadvertent Drilling Fluid Return Potential	Potential Subsurface Risks and Mitigation Measures
WCR-49	Good	Low	**Potential Risk:** ■ Unsupported hole/hole collapse due to elevation difference **Mitigation Measures:** ■ Minimize time between hole completion and pipe pullback ■ Maintain drilling fluid circulation ■ Modify drilling fluid properties to stabilize hole

4.0 CLOSING

Golder appreciates the opportunity to support Kinder Morgan on this project. Please contact us if you have any questions or require additional information regarding this technical memorandum.

5.0 REFERENCES

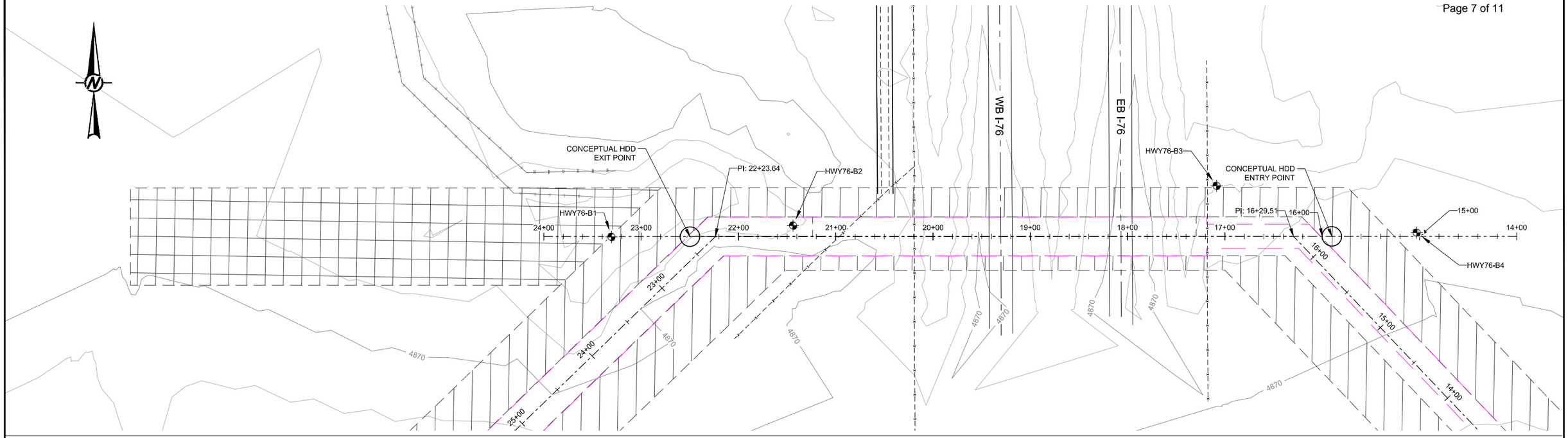
Delft Geotechnics. 1997. Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling, Delft Geotechnics, Foundations and Underground Engineering Department.

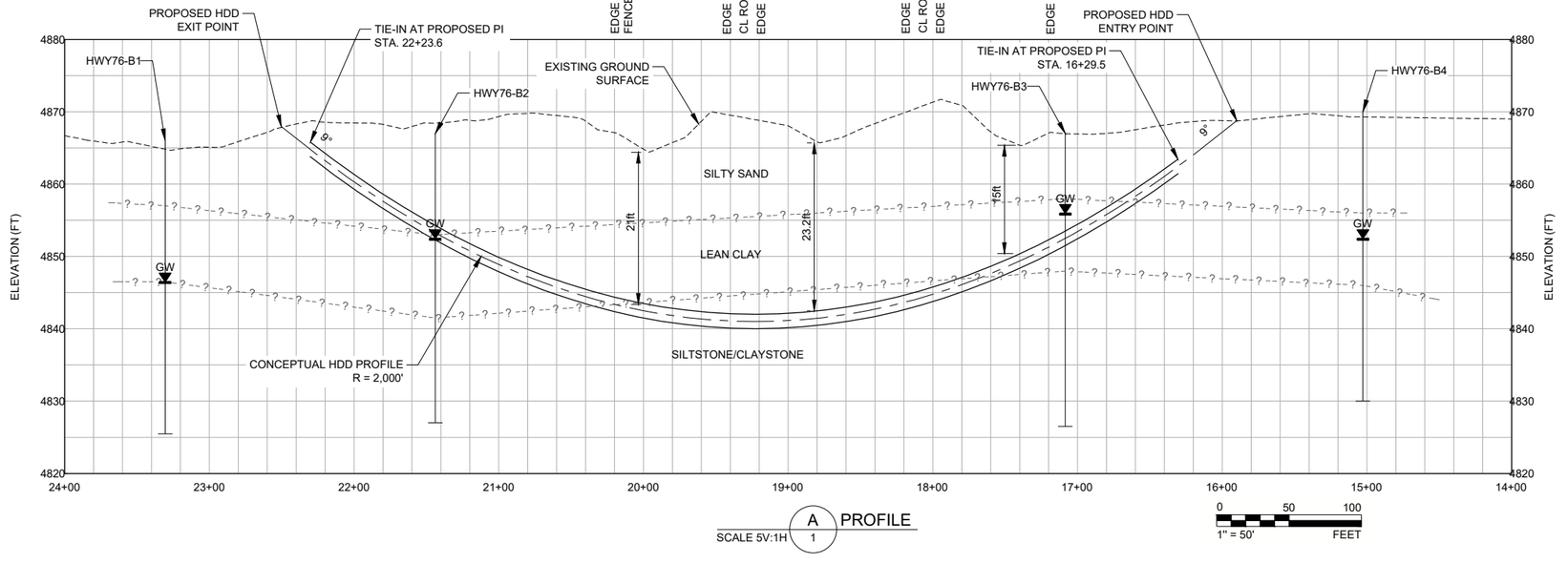
Staheli, K., C. Price, and L. Wetter. 2011. Effectiveness of Hydrofracture Prediction for HDD Design. *NASTT Pacific Northwest Chapter – PNW Trenchless Review – 2011,* p. 35-38.

Terracon, 2018. Geotechnical Engineer Report, High Plains to CIG 5C Expansion, Weld County, Colorado, Terracon Project No. 21185077, December 28, 2018.

ATTACHMENT 1

Conceptual HDD Layouts





A PROFILE
SCALE 5V:1H 1

0 50 100
1" = 50' FEET

NOTES:
1. PIPELINE ALIGNMENT, LINEWORK, AND SURVEY PROVIDED BY KINDERMORGAN. SURVEY FROM UINTA ENGINEERING & LAND SURVEYING (UELS).
2. DEPICTED SUBSURFACE CONDITIONS FROM TERRACON (DECEMBER, 2018).
3. GROUNDWATER LEVELS SHOWN FROM COMPLETION OF DRILLING (TERRACON, 2018).

CLIENT
KINDER MORGAN, INC

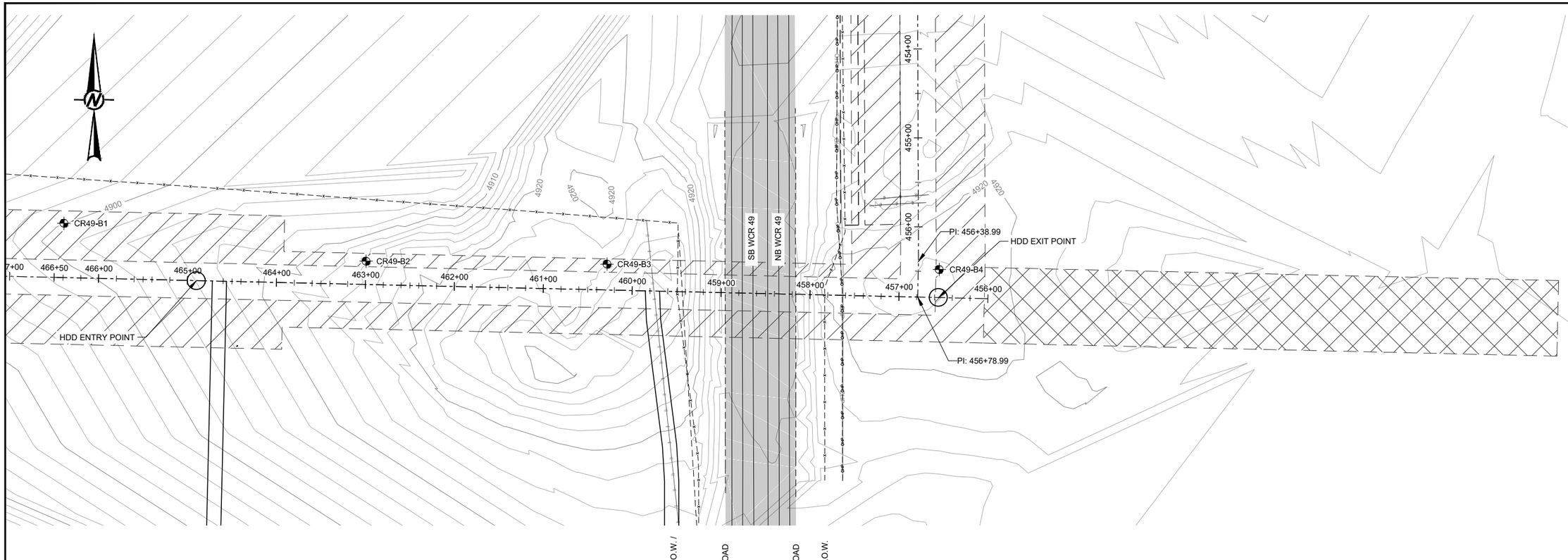
CONSULTANT
GOLDER

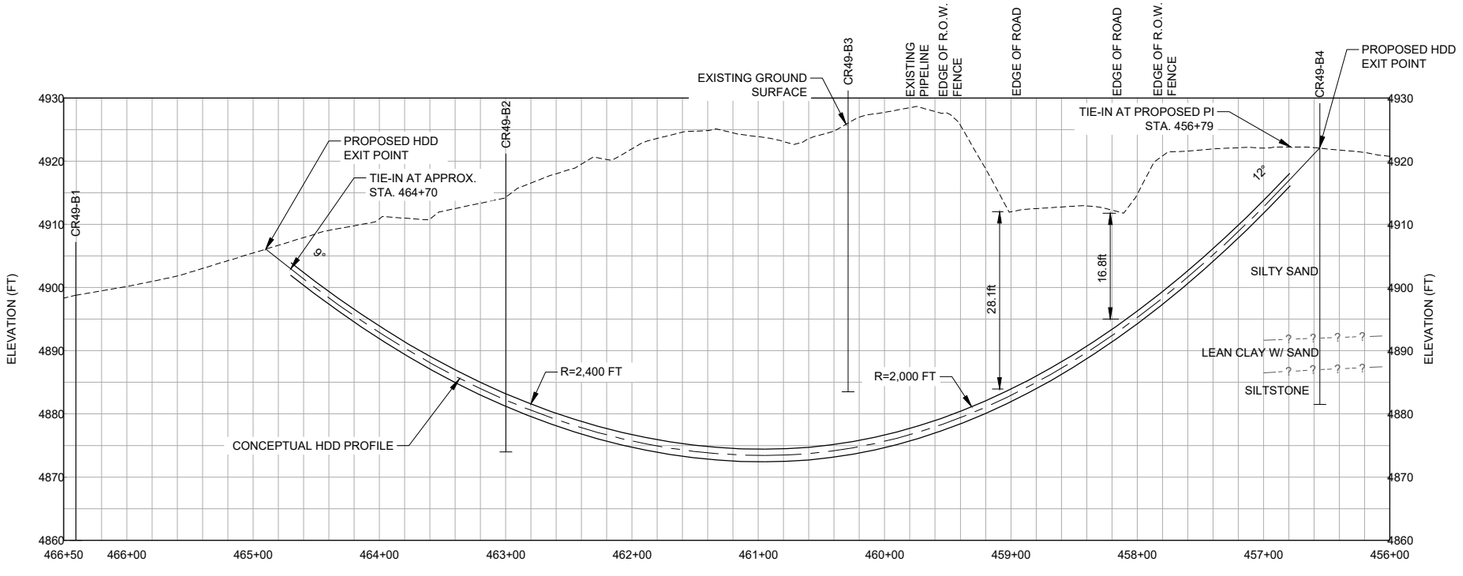
YYYY-MM-DD	2019-03-20
DESIGNED	JMS
PREPARED	JMS
REVIEWED	MB
APPROVED	ML

PROJECT
HIGH PLANIS TO CIG 5C EXPANSION
KIOWA LATERAL
WELD COUNTY, CO

TITLE
I-76 CROSSING

PROJECT NO.	CONTROL	REV.	FIGURE
18108190		A	01





NOTES:
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2. DEPICTED SUBSURFACE CONDITIONS FROM TERRACON (DECEMBER, 2018).
3. GROUNDWATER NOT ENCOUNTERED DURING DRILLING (TERRACON, 2018).

A/1 PROFILE
SCALE 5V:1H

0 50 100
1" = 50' FEET

CLIENT
KINDER MORGAN, INC

CONSULTANT
GOLDER

YYYY-MM-DD	2019-03-20
DESIGNED	JMS
PREPARED	JMS
REVIEWED	MB
APPROVED	ML

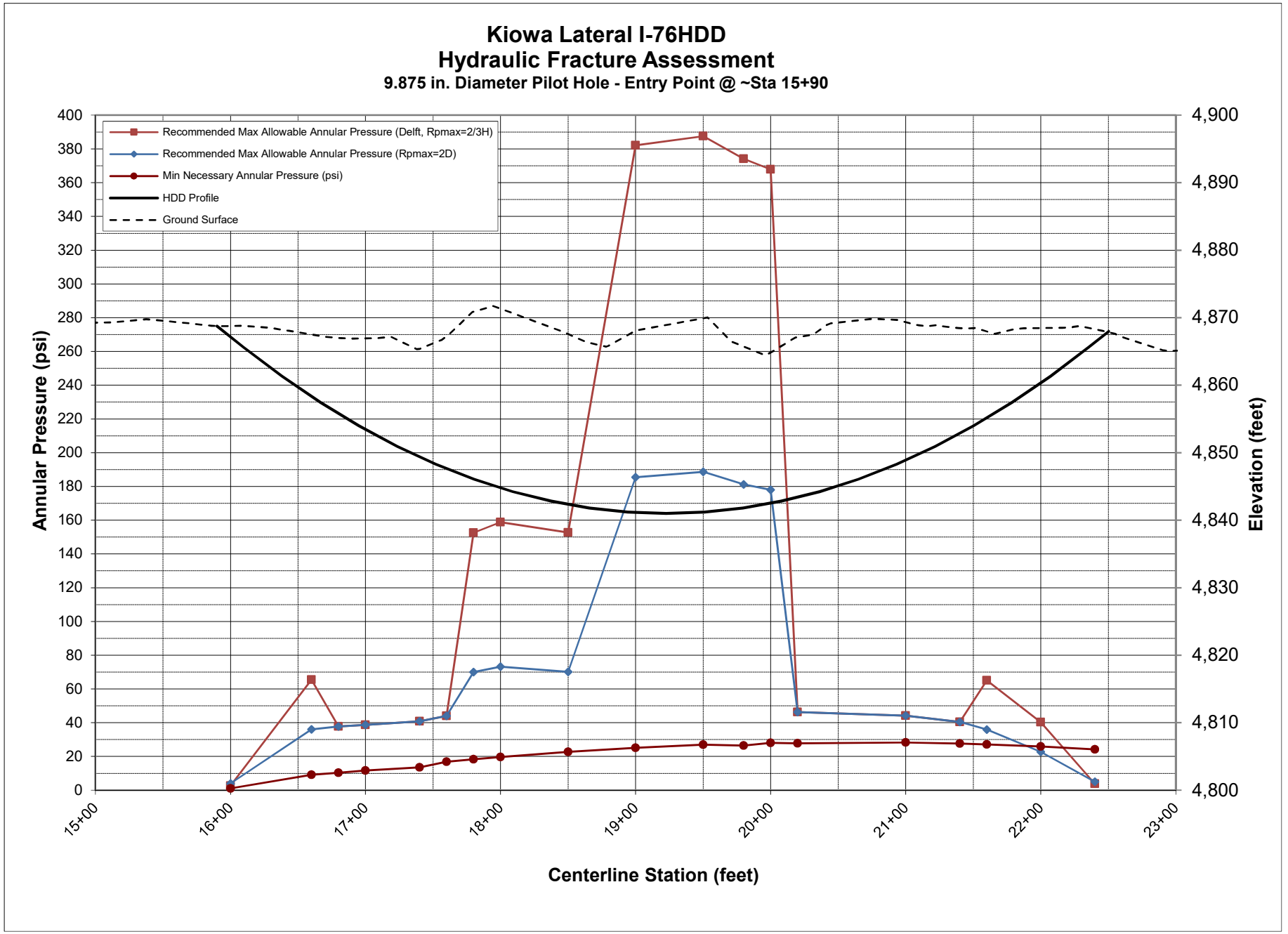
PROJECT
HIGH PLANIS TO CIG 5C EXPANSION
KIOWA LATERAL
WELD COUNTY, CO

TITLE
WCR49 CROSSING

PROJECT NO.	CONTROL	REV.	FIGURE
18108190		A	03

ATTACHMENT 2

Annular Pressure Diagrams


Kiowa Lateral I-76HDD
Hydraulic Fracture Assessment
9.875 in. Diameter Pilot Hole - Entry Point @ ~Sta 15+90
Recommended Max Allowable Annular Pressure (Delft, Rpmax=2/3H)
Recommended Max Allowable Annular Pressure (Rpmax=2D)
Min Necessary Annular Pressure (psi)
HDD Profile
Ground Surface
Annular Pressure (psi)
Elevation (feet)
Centerline Station (feet)
400
380
360
340
320
300
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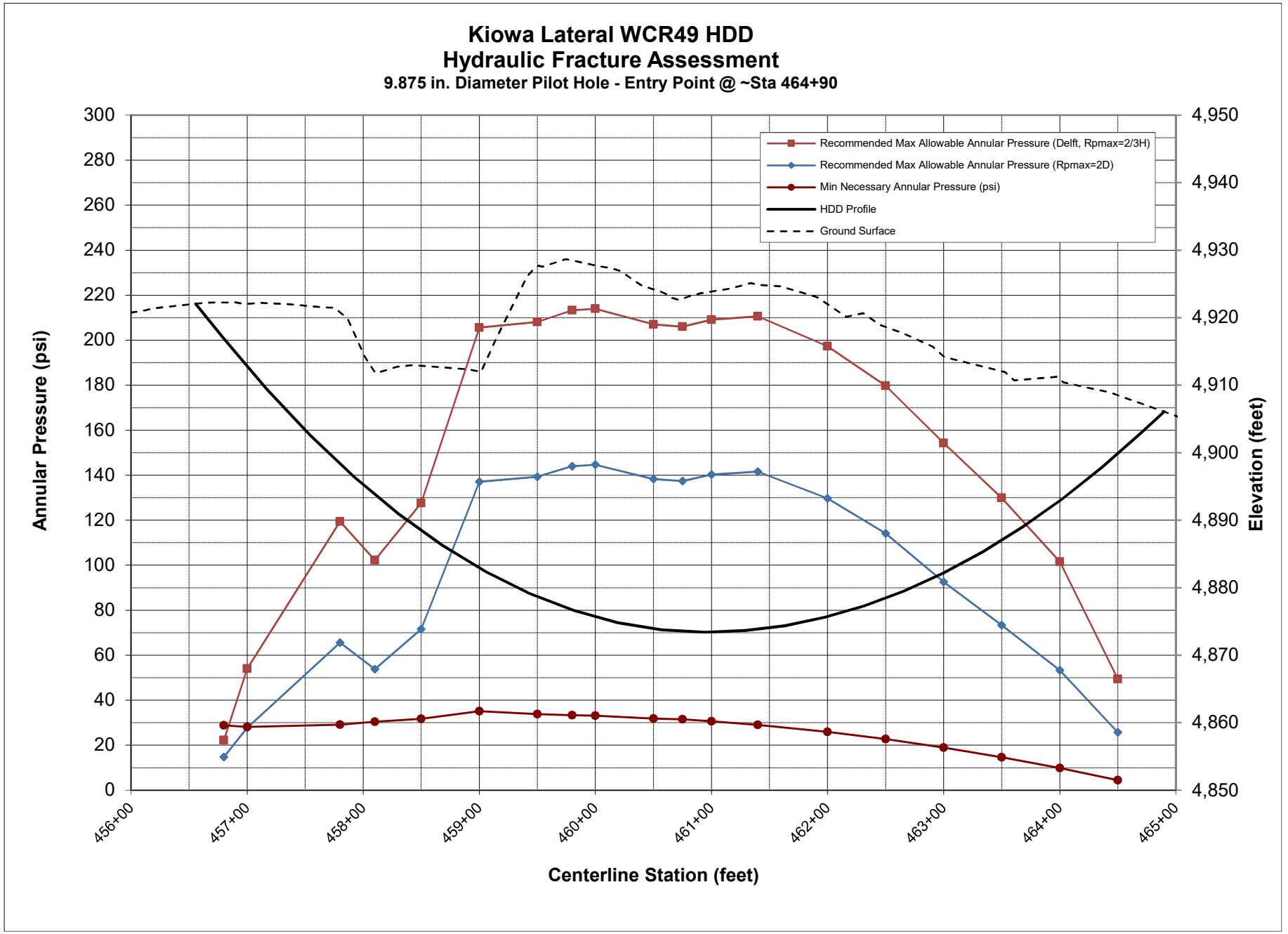
Kiowa Lateral WCR49 HDD
Hydraulic Fracture Assessment
9.875 in. Diameter Pilot Hole - Entry Point @ ~Sta 464+90
Annular Pressure (psi)
Elevation (feet)
Centerline Station (feet)
Recommended Max Allowable Annular Pressure (Delft, Rpmax=2/3H)
Recommended Max Allowable Annular Pressure (Rpmax=2D)
Min Necessary Annular Pressure (psi)
HDD Profile
Ground Surface
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
4,950
4,940
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Geotechnical Engineering Report

High Plains to CIG 5C Expansion
Weld County, Colorado
December 28, 2018
Terracon Project No. 21185077

Prepared for:
Uintah Engineering & Land Surveying, Inc.
Vernal, Utah

Prepared by:
Terracon Consultants, Inc.
Greeley, Colorado

December 28, 2018

Uintah Engineering & Land Surveying, Inc.
85 South 200 East
Vernal, Utah 84078

Attn: Mr. David G. Weston, P.E.
P: (435) 789-1017
E: dweston@uintahgroup.com

Re: Geotechnical Engineering Report
High Plains to CIG 5C Expansion
Intersection of I-76 and Weld County Road 49
Weld County, Colorado
Terracon Project No. 21185077

Dear Mr. Weston:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the project referenced above. This study was performed in general accordance with Terracon Proposal No. P21185077 dated August 24, 2018. This report presents the findings of the subsurface exploration.

We appreciate the opportunity to be of service to you on this project. Materials testing, and construction observation services are provided by Terracon as well. We would be please to discuss these services with you. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

COLORADO REGISTERED ERIC D. BERNHARDT 12/28/18 38829 PROFESSIONAL ENGINEER

Rachel C. Pott, E.I.
Field Engineer

Eric D. Bernhardt, P.E.
Geotechnical Department Manager

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange 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 ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents.

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Overview	A geotechnical exploration has been performed for the proposed High Plains to CIG 5C Expansion to be constructed east of Keenseburg under I-76 and north of the intersection of Weld County Road 49 and Weld County Road 22 in Weld County, Colorado. Four (4) borings at each proposed HDD crossing location were performed to a depth of approximately 40 feet below existing site grades.
Subsurface Conditions	Subsurface conditions encountered in our exploratory borings at the CR 49 HDD crossing location generally consisted of about 35 to 40 feet of silty sand with varying amounts of clay. Siltstone bedrock was encountered below the overburden soils in one of the borings at a depth of approximately 35 feet below existing site grades. The upper approximately 2 to 5 feet of bedrock was highly weathered. Subsurface conditions encountered in our exploratory borings at the I-76 HDD crossing location generally consisted of about 9 to 14 feet of silty sand above about 9 to 11 feet of lean clay. Siltstone and claystone bedrock was encountered below the overburden soils in all of the borings at depths of approximately 19 to 25½ feet below existing site grades. The upper approximately 2 to 6 feet of bedrock is weathered. Boring logs are presented in the **Exploration Results** section of this report.
Groundwater Conditions	Groundwater was not encountered in any of our test borings at the CR 49 HDD crossing location. Groundwater was encountered in all of our test boings at the I-76 HDD crossing location at depths of about 12 to 19.3 feet below existing site grades at the time of drilling. Groundwater levels can fluctuate in response to site development and to varying seasonal and weather conditions, irrigation on or adjacent to the site and fluctuations in nearby water features.
Seismic Considerations	As presented in the **Seismic Considerations** section of this report, the International Building Code, which refers to Section 20 of ASCE 7, indicates the seismic site classification for this site is D for both HDD crossing locations.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics (bold orange font) above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes. It should be recognized that specific 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.

Geotechnical Engineering Report

High Plains to CIG 5C Expansion
Intersection of I-76 and Weld County Road 49
Weld County, Colorado

Terracon Project No. 21185077
December 28, 2018

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed County Road 49 HDD Crossing and I-76 HDD Crossing to be located east of Keenseburg under I-76 and north of the intersection of Weld County Road 49 and Weld County Road 22 in Weld County, Colorado. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Seismic considerations

The geotechnical engineering scope of services for this project included the advancement of eight (8) test borings to a depth of approximately 40 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil and bedrock samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section of this report.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The two project sites are located east of Keenesburg to the northwest and southeast side of I-76 and north of the intersection of Weld County Road 22 and Weld County Road 49 in Weld County, Colorado. The approximate Latitude/Longitude of the center of the proposed HDD crossing alignments are: ■ I-76: 40.14522° N/104.47160° W ■ CR 49: 40.15264° N/104.60307° W (See **Site Location**).

Item	Description
Existing Improvements	The HDD crossings are planed below existing Interstate 76 and WCR 49 intersection. I-76 is currently a split interstate with 2 lanes in each direction and exit and entrance ramps. WCR 49 is a two-lane county road.
Current Ground Cover	The current ground cover is lightly to moderately vegetated.
Existing Topography	The site is relatively flat

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	The following project information was provided to us in a Request for Proposal by Colorado Interstate Gas Company, LLC, dated August 8, 2018 and revised August 22, 2018.
Project Description	The construction includes a natural gas pipeline with two potential HDD crossings.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

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 site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

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

County Road 49			
Model Layer	**Layer Name**	**General Description**	**Approximate Depth to Bottom of Stratum**
1	**Topsoil**	Light vegetation.	About 6 inches thick
2	**Sand**	Silty sand, loose to medium dense.	About 0.5 to 30 feet below existing site grades.

3	**Clay**	Lean clay with sand, stiff.	About 30 to 35 feet below existing site grades.
4	**Bedrock**	Siltstone, firm.	To a maximum depth of 40.5 feet.

Interstate 76			
Model Layer	**Layer Name**	**General Description**	**Approximate Depth to Bottom of Stratum**
1	**Topsoil**	Light vegetation.	About 5 inches thick.
2	**Sand**	Silty sand, loose to medium dense.	About 0.4 to 14 feet below existing site grades.
3	**Clay**	Lena clay, medium stiff to very stiff.	About 14 to 25.5 feet below existing site grades.
4	**Cemented Bedrock**	Cemented bedrock, very hard.	About 24 to 26 feet below existing site grades.
5	**Bedrock**	Claystone or siltstone bedrock, firm to very hard	To a maximum depth of 40.5 feet.

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes are noted on the attached boring logs, and are summarized below:

Boring Number	Depth to groundwater while drilling, ft.	Depth to groundwater after drilling, ft.	Elevation of groundwater after drilling, ft.
CR 49 B1	Not encountered	Backfilled after drilling	Backfilled after drilling
CR 49 B2	Not encountered	Backfilled after drilling	Backfilled after drilling
CR 49 B3	Not encountered	Backfilled after drilling	Backfilled after drilling
CR 49 B4	Not encountered	Backfilled after drilling	Backfilled after drilling
I-76 B1	21	19.3	4,846.7
I-76 B2	14	14.5	4,852.5
I-76 B3	19	12.0	4,855.0
I-76 B4	24	17.5	4,852.5

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, and other factors.

Groundwater level fluctuations occur due to seasonal variations in nearby water features, amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction may be higher or lower than the levels indicated on the

boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Fluctuations in groundwater levels can best be determined by implementation of a groundwater monitoring plan. Such a plan would include installation of groundwater piezometers, and periodic measurement of groundwater levels over a sufficient period of time.

Laboratory Testing

The siltstone and claystone bedrock are considered to have low expansive potential. Multiple samples of clay soils, claystone, and siltstone bedrock exhibited unconfined compressive strengths ranging from approximately 1,680 and 12,890 pounds per square foot (psf). Samples of site soils and bedrock selected for plasticity testing exhibited non-plastic to high plasticity with liquid limits ranging from non-plastic to 66 and plasticity indices ranging from non-plastic to 30. Laboratory test results are presented in the **Exploration Results** section of this report.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil/bedrock properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is D**, for both HDD crossing locations. Subsurface explorations at this site were extended to a maximum depth of 40.5 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

CORROSIVITY

Results of water-soluble sulfate testing indicate Exposure Class S2 according to ACI 318. ASTM Type V, or modified Type II portland cement should be specified for all project concrete on and below grade. As an alternative, ACI allows the use of cement that conforms to ASTM C150 Type II requirements, if it meets the Type V performance requirements (ASTM C452) of ASTM C150 Table 4. ACI 201 also allows a blend of any type of portland cement and fly ash with an expansion of less than 0.05 percent at 6 months when tested in accordance with ASTM C1012. Foundation concrete should be designed for severe sulfate exposure in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

Terracon was requested to perform laboratory testing on soil and bedrock samples collected from the site to determine the potential corrosive characteristics of the on-site soils and bedrock with respect to contact with the various underground materials that will be used for project construction. Laboratory test results for select samples tested exhibited the following properties:

Sample Identification	Water-soluble Sulfate	Redox Potential	Sulfide	Water-soluble chloride	Electrical Resistivity[1]	pH
	(%)	(mV)	(Presence)	(%)	(ohm-cm)	
Boring CR 49 B2 at 19 feet	0.226	677	Negative	0.045	12,610	8.25
Boring CR 49 B4 at 29 feet	0.035	684	Negative	0.030	7,178	8.84
Boring I-76 B1 at 29 feet	1.428	686	Negative	0.052	572	8.17
Boring I-76 B4 at 14 feet	0.182	686	Negative	0.50	1,746	8.54

1. Resistivity determined on saturated samples.

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. Natural 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 or collaboration through this system 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 impact 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. 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.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

The field exploration program consisted of the following:

Number of Borings	Planned Boring Depth (feet)	Planned Location
4	40 or auger refusal	County Road 49 HDD Crossing
4		I-76 HDD Crossing

Boring Layout and Elevations: We used handheld GPS equipment to locate borings with an estimated horizontal accuracy of +/-20 feet. A ground surface elevation at each boring location was provided by a licensed surveyor.

Subsurface Exploration Procedures: We advanced soil borings with a track-mounted drill rig using continuous-flight, solid-stem augers. Three samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling will be performed using modified California barrel and/or standard split-barrel sampling procedures. For the standard split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. For the modified California barrel sampling procedure, a 2½-inch outer diameter split-barrel sampling spoon is used for sampling. Modified California barrel sampling procedures are similar to standard split-barrel sampling procedures; however, blow counts are typically recorded for 6-inch intervals for a total of 12 inches of penetration. The samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer., taken to our soil laboratory for testing, and classified by a geotechnical engineer.

In addition, we observed and recorded groundwater levels during drilling observations.

Our exploration team prepared field boring logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information. Field logs included visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Final boring logs, prepared from field logs, represent the geotechnical engineer's interpretation, and include modifications based on observations and laboratory test results.

Property Disturbance: We backfilled borings with a mixture of auger cuttings, bentonite chips, and non-shrink grout after completion. Our services did not include repair of the site beyond backfilling our boreholes. Excess auger cuttings were dispersed in the general vicinity of the boreholes.

Laboratory Testing

The project engineer reviewed field data and assigned various laboratory tests to better understand the engineering properties of various soil and bedrock strata. Laboratory testing was conducted in general accordance with applicable or other locally recognized standards. Testing was performed under the direction of a geotechnical engineer and included the following:

- Visual classification
- Dry density
- Grain-size analysis
- Moisture content
- Atterberg limits
- Unconfined compressive strength
- Corrosive properties

Our laboratory testing program includes examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified soil samples in accordance with the Unified Soil Classification System (USCS). Soil and bedrock samples obtained during our field work will be disposed of after laboratory testing is complete unless a specific request is made to temporarily store the samples for a longer period of time.

Bedrock samples obtained had rock classification conducted using locally accepted practices for engineering purposes. Boring log rock classification is determined using the Description of Rock Properties.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

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

MAP PROVIDED BY MICROSOFT BING MAPS

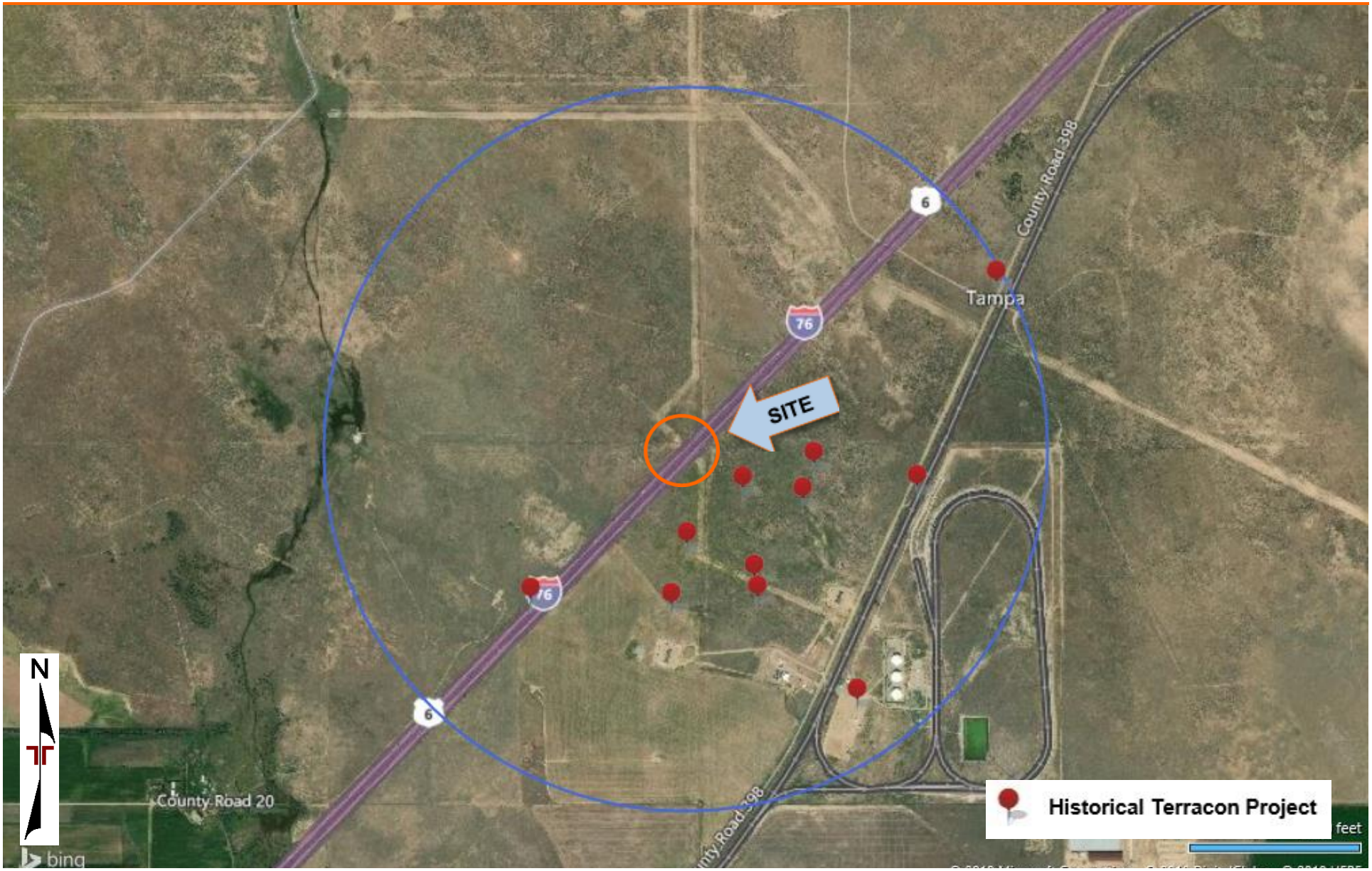

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

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MAP PROVIDED BY MICROSOFT BING MAPS

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

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

BORING LOG NO. CR49 B1

PROJECT: High Plains to CIG 5C Expansion Project

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

SITE: I-76 and WCR 49
Weld County, CO

LOCATION See Exploration Plan

Latitude: 40.1527° Longitude: -104.6058°

Surface Elev.: 4900 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		0.5	4899.5									
			TOPSOIL, about 6 inches thick									
			POORLY GRADED SAND WITH SILT (SP-SM), brown to tan, loose									
							4-4		3	104		
				5			4-3-5 N=8		3			
		9.0	4891									
2			**SILTY SAND (SM)**, loose to medium dense				5-9		4	104	NP	10
				10								
				15			2-4-5 N=9		4			
							2-7		3	105	NP	18
				20								
				25			6-7-9 N=16		3			
							8-14		3	107		
				30								
				35			9-9-16 N=25		5		NP	42
		40.0	4860									
				40			7-11		4	112		
			Boring Terminated at 40 Feet									

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

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with soil cuttings, bentonite chips, and cement upon completion.

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.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

No free water encountered while drilling

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 12-07-2018 | Boring Completed: 12-07-2018

Drill Rig: Track | Driller: Unlimited Access Drilling

Project No.: 21185077

BORING LOG NO. CR49 B2

PROJECT: High Plains to CIG 5C Expansion Project

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

SITE: I-76 and WCR 49
Weld County, CO

LOCATION See Exploration Plan

Latitude: 40.1526° Longitude: -104.6047°

Surface Elev.: 4914 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		0.5	4913.5									
		TOPSOIL, about 6 inches thick										
		SILTY SAND (SM), brown to tan, loose to medium dense										
							4-5		3	103		
				5			3-3-4 N=7		5			
							4-5		5	103		
				10								
				15			6-7-9 N=16		7		NP	19
2							8-10		5	106		
				20								
				25			5-8-14 N=22		5		NP	15
							7-10		7	104		
				30								
				35			5-9-11 N=20		5		NP	17
		40.0	4874				6-8		8	113		
		Boring Terminated at 40 Feet		40								

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

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with soil cuttings, bentonite chips, and cement upon completion.

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.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

No free water encountered while drilling

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 12-07-2018 | Boring Completed: 12-07-2018

Drill Rig: Track | Driller: Unlimited Access Drilling

Project No.: 21185077

BORING LOG NO. CR49 B3

PROJECT: High Plains to CIG 5C Expansion Project

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

SITE: I-76 and WCR 49
Weld County, CO

LOCATION See Exploration Plan

Latitude: 40.1526° Longitude: -104.6037°

Surface Elev.: 4924 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		0.5	4923.5									
							3-2-4 N=6		2			
				5			5-8		2	100		
				10			4-5-5 N=10		4			
				15			5-7		5	108		
2				20			5-7-9 N=16		8			
				25			8-16		6	110	NP	18
				30			5-6-5 N=11		7			
				35			12-12		6	107	NP	17
		40.5	4883.5	40			7-11-9 N=20		9		NP	32

TOPSOIL, about 6 inches thick

SILTY SAND (SM), brown to tan, loose to medium dense

Boring Terminated at 40.5 Feet

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

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with soil cuttings, bentonite chips, and cement upon completion.

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.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

No free water encountered while drilling

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 12-07-2018 | Boring Completed: 12-07-2018

Drill Rig: Track | Driller: Unlimited Access Drilling

Project No.: 21185077

BORING LOG NO. CR49 B4

PROJECT: High Plains to CIG 5C Expansion Project

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

SITE: I-76 and WCR 49
Weld County, CO

LOCATION See Exploration Plan

Latitude: 40.1526° Longitude: -104.6022°

Surface Elev.: 4922 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1		0.5	4921.5	**TOPSOIL**, about 6 inches thick
2				**SILTY SAND (SM)**, brown to tan, loose to medium dense
3		30.0	4892	**LEAN CLAY WITH SAND (CL)**, brown to gray, stiff
4		35.0	4887	**SILTSTONE (MH)**, gray to tanish orange, firm, trace FeOx
		40.5	4881.5	***Boring Terminated at 40.5 Feet***

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			2-2-3 N=5		3			
5			5-4		5	102		
10			3-4-5 N=9		6		NP	13
15			6-8		4	106		
20			5-8-8 N=16		12			
25			12-14		7	115		
30			5-3-5 N=8		8		NP	35
35			5-8	7010	21	106	27-17-10	72
40			7-9-15 N=24		20		56-30-26	93

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

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with soil cuttings, bentonite chips, and cement upon completion.

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.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

No free water encountered while drilling

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 12-07-2018 | Boring Completed: 12-07-2018

Drill Rig: Track | Driller: Unlimited Access Drilling

Project No.: 21185077

BORING LOG NO. HWY76 B1

PROJECT: High Plains to CIG 5C Expansion Project

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

SITE: I-76 and WCR 49
Weld County, CO

LOCATION See Exploration Plan

Latitude: 40.146° Longitude: -104.4728°

Surface Elev.: 4866 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1		0.4	4865.5	**TOPSOIL**, about 5 inches thick
2		9.0	4857	**SILTY SAND**, trace clay, brown, loose to medium dense
3		19.5	4846.5	**LEAN CLAY (CL)**, brown to light brown, medium stiff to very stiff
5		40.5	4825.5	**CLAYSTONE (CH)**, gray, medium hard, trace FeOx
				Boring Terminated at 40.5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			2-3-4 N=7		5			
5			6-10		13	116		44
			2-3-4 N=7		25			
10								
			4-5	1680	18	108	33-15-18	91
15								
	▽							
			4-8-10 N=18		18			
20	▽							
			12-26	9280	14	117		
25								
			8-14-18 N=32		21			
30								
			12-18	12140	21	108	53-18-35	96
35								
			8-15-18 N=33		23			
40								

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

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with soil cuttings, bentonite chips, and cement upon completion.

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.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *21 feet while drilling*

▽ *19.3 feet at completion of drilling*

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 12-14-2018 | Boring Completed: 12-14-2018

Drill Rig: Track | Driller: Unlimited Access Drilling

Project No.: 21185077

BORING LOG NO. HWY76 B2

PROJECT: High Plains to CIG 5C Expansion Project

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

SITE: I-76 and WCR 49
Weld County, CO

LOCATION See Exploration Plan

Latitude: 40.1457° Longitude: -104.4724°

Surface Elev.: 4867 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		0.4	4866.5									
			TOPSOIL, about 5 inches thick									
			SANDY SILT (ML), brown, loose									
							2-3		5			
				5			2-3-3 N=6		6			
2							8-6		18	111	NP	66
				10								
		14.0	4853									
			LEAN CLAY (CL), brown, medium stiff to very stiff				3-3-4 N=7		25			
3				15								
							3-5	12110	23	104	35-15-20	95
				20								
							4-8-9 N=17		18			
				25								
							7-18	8190	15	113		
5				30								
							8-14-18 N=32		24			
				35								
		40.0	4827				13-34	12890	13	118	35-16-19	97
				40								
			Boring Terminated at 40 Feet									

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

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with soil cuttings, bentonite chips, and cement upon completion.

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.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

14 feet while drilling

14.5 feet at completion of drilling

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 12-14-2018 | Boring Completed: 12-14-2018

Drill Rig: Track | Driller: Unlimited Access Drilling

Project No.: 21185077

BORING LOG NO. HWY76 B3

PROJECT: High Plains to CIG 5C Expansion Project

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

SITE: I-76 and WCR 49
Weld County, CO

LOCATION See Exploration Plan

Latitude: 40.1449° Longitude: -104.4711°

Surface Elev.: 4867 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		0.4	4866.5									
		TOPSOIL, about 5 inches thick										
2		**SILTY SAND**, trace clay, brown, loose					2-2-2 N=4		5			
				5			4-4		4			
		9.0	4858									
3		**LEAN CLAY (CL)**, brown, stiff to very stiff		10			3-5-6 N=11		23			
					▽							
				15			4-5		24	103	29-15-14	96
		19.0	4848		▽							
4		**SILTSTONE (ML)**, gray, firm to very hard		20			3-8-14 N=22		23			
				25			23, 50/1" N=73/7"	1790	20	107	NP	92
				30			N=50/5"					
		34.0	4833									
5		**CLAYSTONE/SILTSTONE (CL-ML)**, gray, firm to very hard, trace FeOx		35			N=50/11"	7900	16	116	26-19-7	89
				40			11-14-20 N=34		21			
		40.5	4826.5									
		Boring Terminated at 40.5 Feet										

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

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with soil cuttings, bentonite chips, and cement upon completion.

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.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *19 feet while drilling*

▽ *12 feet at completion of drilling*

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 12-14-2018 | Boring Completed: 12-14-2018

Drill Rig: Track | Driller: Unlimited Access Drilling

Project No.: 21185077

BORING LOG NO. HWY76 B4

PROJECT: High Plains to CIG 5C Expansion Project

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

SITE: I-76 and WCR 49
Weld County, CO

LOCATION See Exploration Plan

Latitude: 40.1445° Longitude: -104.4707°

Surface Elev.: 4870 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1		0.4	4869.5	**TOPSOIL**, about 5 inches thick
2				**SILTY SAND (SM)**, brown, loose to medium dense
		14.0	4856	
3				**LEAN CLAY (CL)**, brown, stiff
		24.0	4846	
6		26.0	4844	**CEMENTED CLAYSTONE**, red, very hard
5				**CLAYSTONE (CH)**, gray, firm to medium hard, trace FeOx
		40.0	4830	
				Boring Terminated at 40 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			2-4		5			
5			1-2-2 N=4		5			
			7-9		9	111	NP	15
10								
			2-5-7 N=12		23			
15								
	▽							
			3-6	8000	27	100	26-14-12	95
20								
	▽							
			9, 50/3" N=59/9"		19			
25								
			24-26	12010	18	114		
30								
			13-14-17 N=31		25			
35								
			13-17	9120	23	102	66-21-45	98
40								

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

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with soil cuttings, bentonite chips, and cement upon completion.

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.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *24 feet while drilling*

▽ *17.5 feet at completion of drilling*

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 12-14-2018 | Boring Completed: 12-14-2018

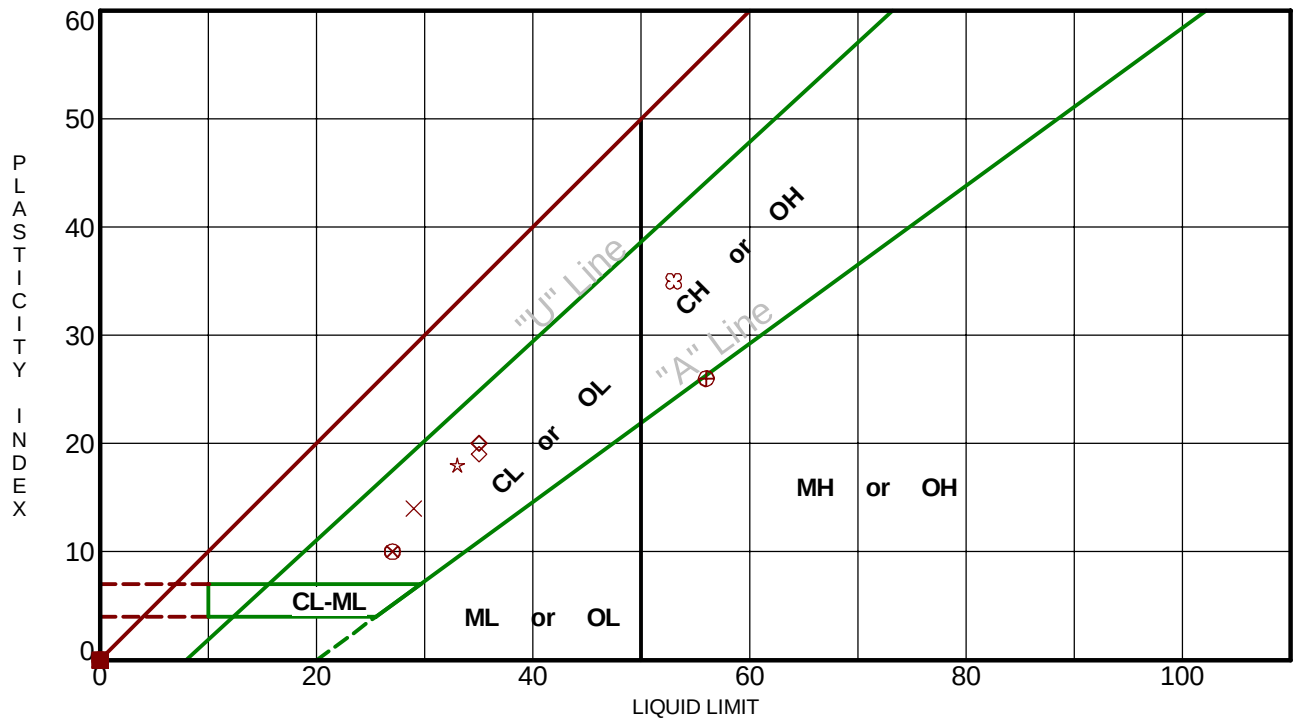
Drill Rig: Track | Driller: Unlimited Access Drilling

Project No.: 21185077

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 21185077 HIGH PLAINS TO CI.GPJ TERRACON_DATATEMPLATE.GDT 12/26/18

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
○	CR49 B1	9 - 10	NP	NP	NP	10	SP-SM	POORLY GRADED SAND with SILT
⊠	CR49 B1	19 - 20	NP	NP	NP	18	SM	SILTY SAND
△	CR49 B1	34 - 35.5	NP	NP	NP	42	SM	SILTY SAND
☆	CR49 B2	14 - 15.5	NP	NP	NP	19	SM	SILTY SAND
⊙	CR49 B2	24 - 25.5	NP	NP	NP	15	SM	SILTY SAND
⊞	CR49 B2	34 - 35.5	NP	NP	NP	17	SM	SILTY SAND
○	CR49 B3	24 - 25	NP	NP	NP	18	SM	SILTY SAND
△	CR49 B3	34 - 35	NP	NP	NP	17	SM	SILTY SAND
⊗	CR49 B3	39 - 40.5	NP	NP	NP	32	SM	SILTY SAND
⊕	CR49 B4	9 - 10.5	NP	NP	NP	13	SM	SILTY SAND
□	CR49 B4	29 - 30.5	NP	NP	NP	35	SM	SILTY SAND
⊗	CR49 B4	34 - 35	27	17	10	72	CL	LEAN CLAY with SAND
⊕	CR49 B4	39 - 40.5	56	30	26	93	MH	SILTSTONE
☆	HWY76 B1	14 - 15	33	15	18	91	CL	LEAN CLAY
⊞	HWY76 B1	34 - 35	53	18	35	96	CH	CLAYSTONE
■	HWY76 B2	9 - 10	NP	NP	NP	66	ML	SANDY SILT
◇	HWY76 B2	19 - 20	35	15	20	95	CL	LEAN CLAY
◇	HWY76 B2	39 - 40	35	16	19	97	CL	CLAYSTONE
×	HWY76 B3	14 - 15	29	15	14	96	CL	LEAN CLAY
⊠	HWY76 B3	24 - 25	NP	NP	NP	92	ML	SILTSTONE

PROJECT: High Plains to CIG 5C Expansion Project

SITE: I-76 and WCR 49
Weld County, CO

Terracon
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Greeley, CO

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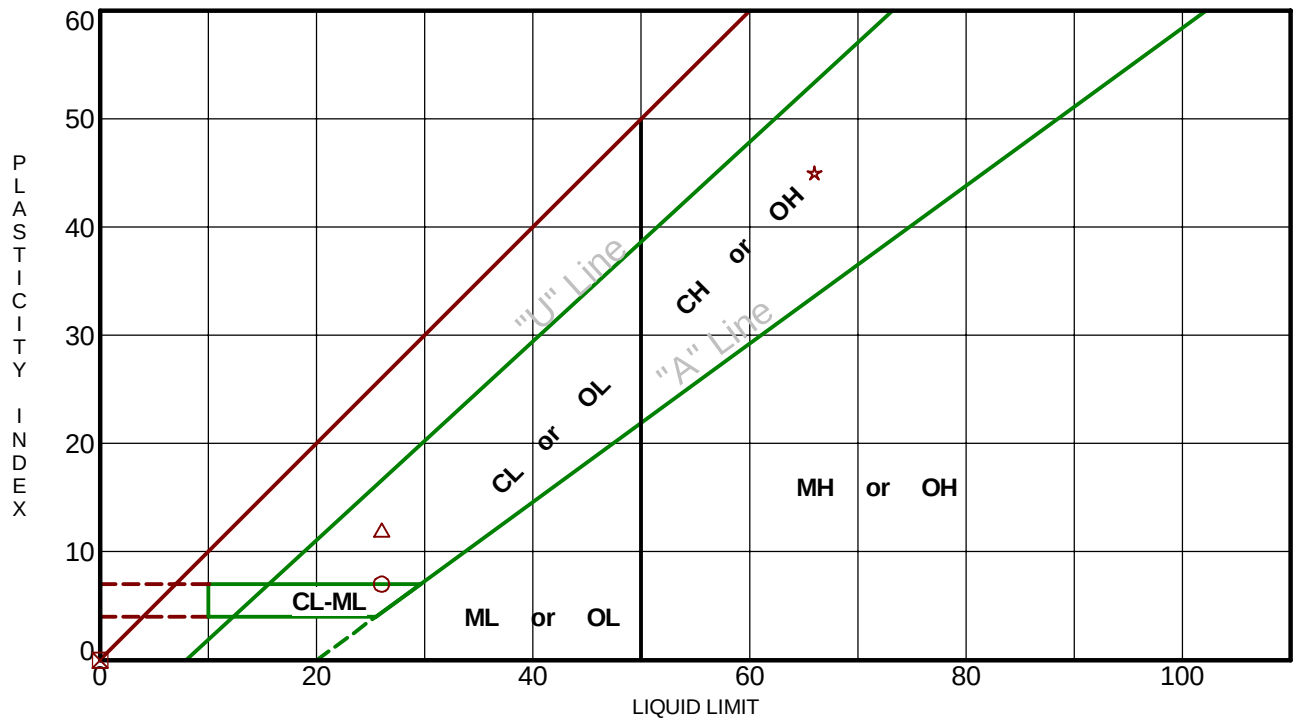
CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
○	HWY76 B3	34 - 35	26	19	7	89	CL-ML	CLAYSTONE/SILTSTONE
☒	HWY76 B4	9 - 10	NP	NP	NP	15	SM	SILTY SAND
△	HWY76 B4	19 - 20	26	14	12	95	CL	LEAN CLAY
☆	HWY76 B4	39 - 40	66	21	45	98	CH	CLAYSTONE

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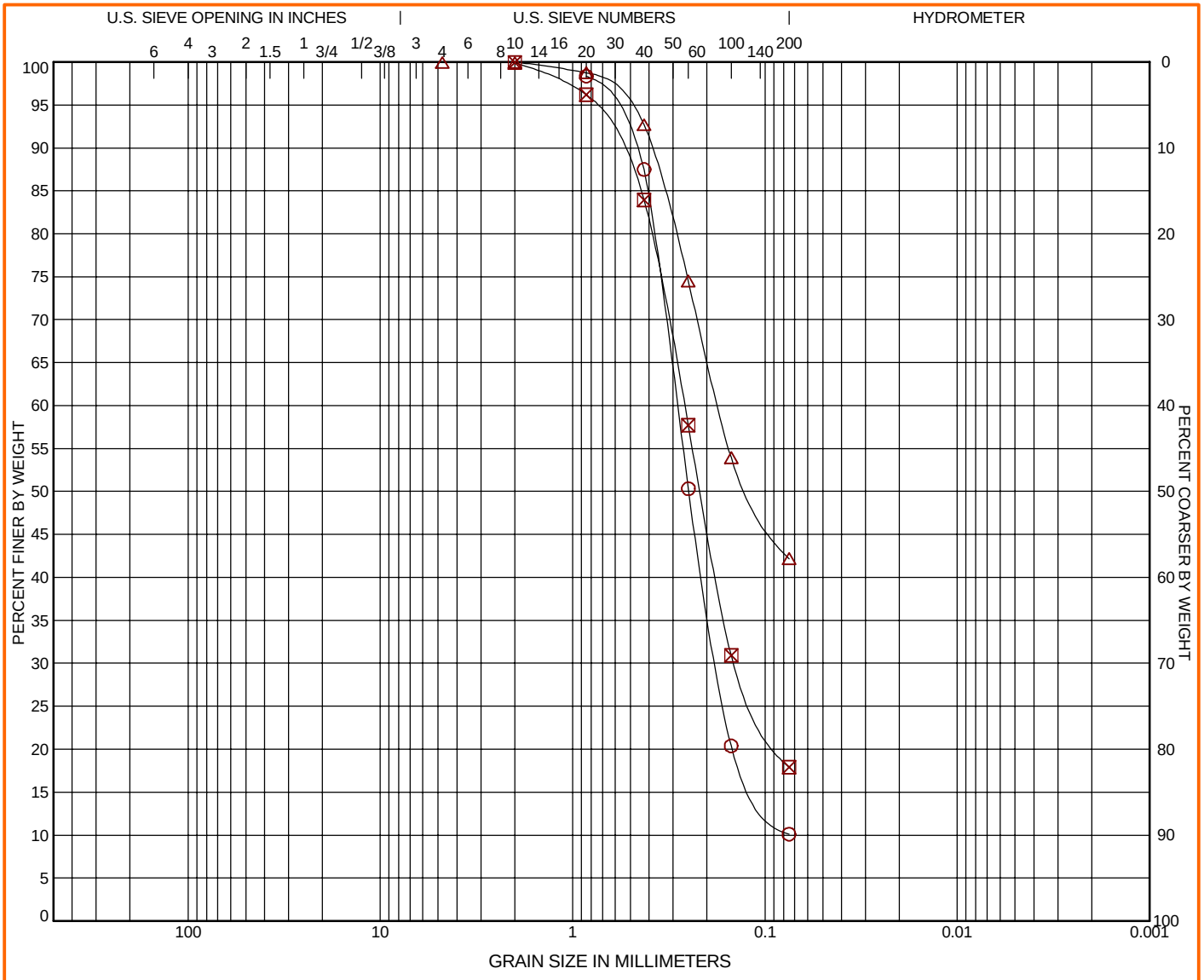
GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
○	CR49 B1	9 - 10			88.3		10.1		SP-SM
☒	CR49 B1	19 - 20			82.0		17.9		SM
△	CR49 B1	34 - 35.5			57.8		42.2		SM

GRAIN SIZE	○	☒	△
D_{60}	0.287	0.262	0.174
D_{30}	0.177	0.143	
D_{10}			

COEFFICIENTS	○	☒	△
C_C	1.46		
C_U	3.85		

○ Sieve	○ % Finer	☒ Sieve	☒ % Finer	△ Sieve	△ % Finer
#20	98.36	#10	99.91	#4	99.94
#40	87.48	#20	96.2	#10	99.94
#60	50.32	#40	83.93	#20	98.74
#100	20.38	#60	57.7	#40	92.7
#200	10.1	#100	30.92	#60	74.49
		#200	17.92	#100	53.94
				#200	42.17

SOIL DESCRIPTION	
○	POORLY GRADED SAND with SILT (SP-SM)
☒	SILTY SAND (SM)
△	SILTY SAND (SM)

REMARKS	
○	
☒	
△	

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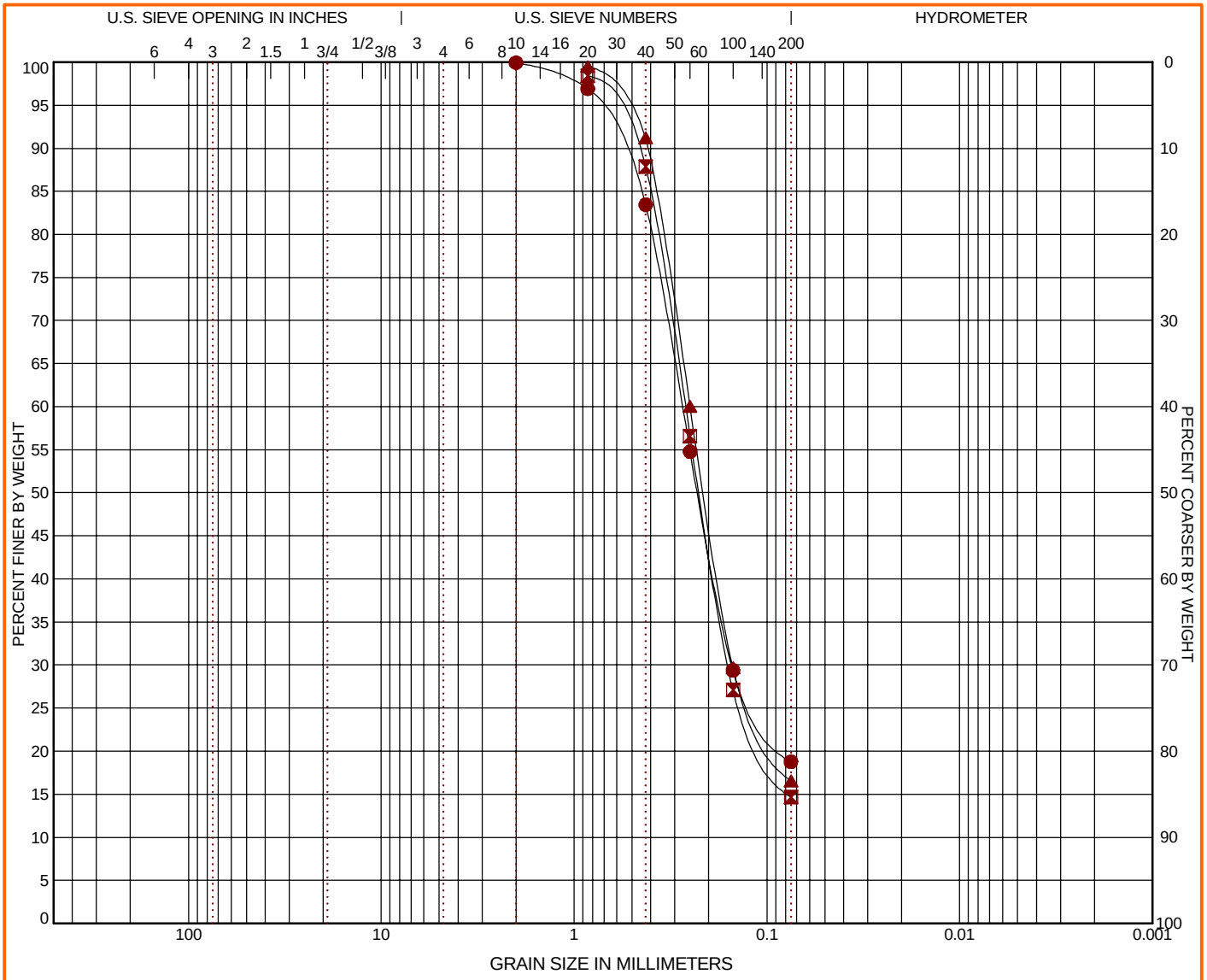

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	CR49 B2	14 - 15.5			81.2		18.8		SM
⊠	CR49 B2	24 - 25.5			83.8		14.6		SM
▲	CR49 B2	34 - 35.5			82.9		16.6		SM

GRAIN SIZE	●	⊠	▲
D_{60}	0.275	0.265	0.25
D_{30}	0.152	0.158	0.151
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#10	99.94	#20	98.41	#20	99.5
#20	96.92	#40	87.89	#40	91.19
#40	83.45	#60	56.57	#60	60.02
#60	54.78	#100	27.08	#100	29.67
#100	29.37	#200	14.64	#200	16.56
#200	18.77				

SOIL DESCRIPTION	
●	SILTY SAND (SM)
⊠	SILTY SAND (SM)
▲	SILTY SAND (SM)

REMARKS	
●	
⊠	
▲	

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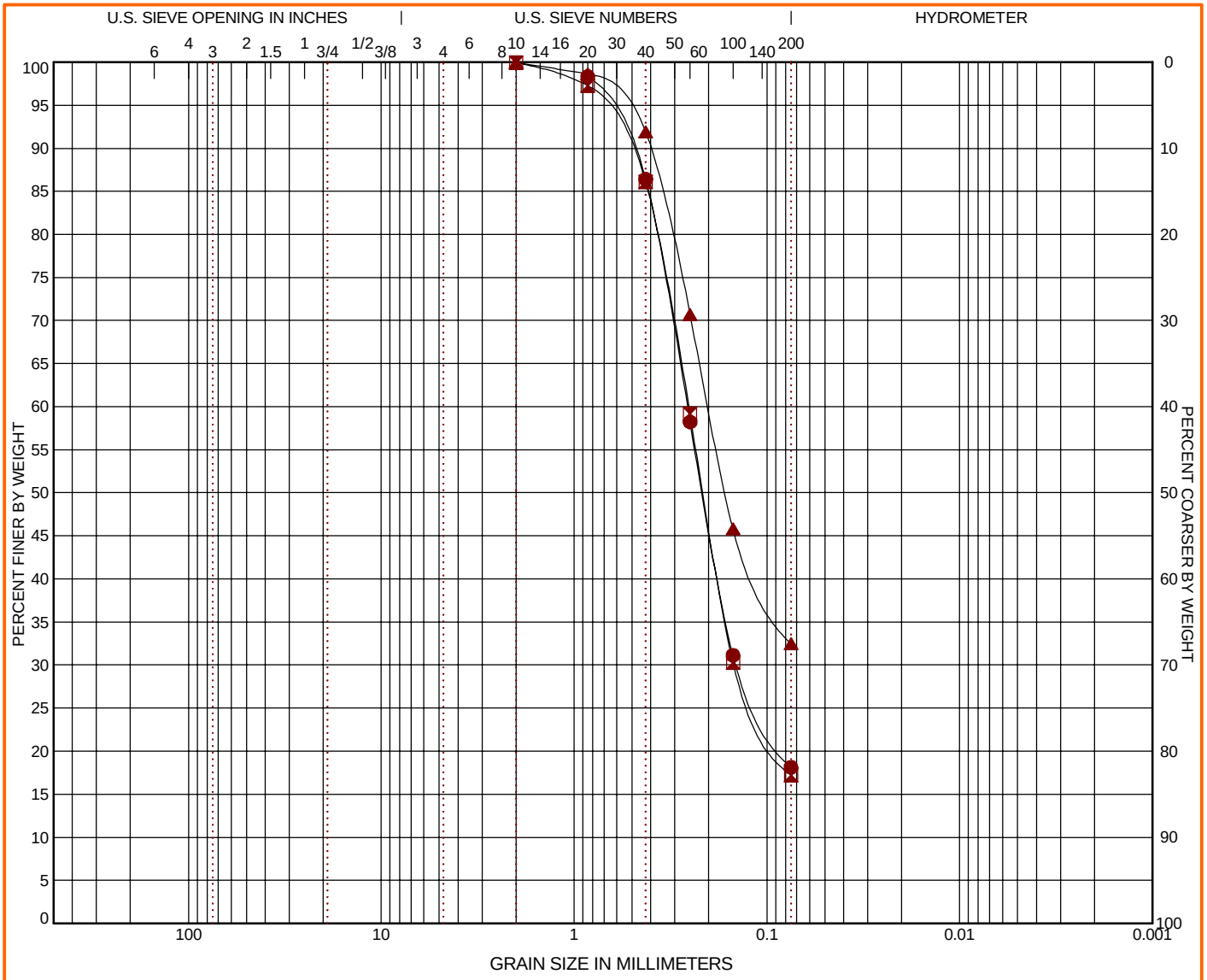

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	CR49 B3	24 - 25			80.2		18.1		SM
⊠	CR49 B3	34 - 35			82.7		17.2		SM
▲	CR49 B3	39 - 40.5			67.5		32.5		SM

GRAIN SIZE	●	⊠	▲
D_{60}	0.259	0.254	0.201
D_{30}	0.141	0.148	
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#20	98.33	#10	99.94	#10	99.95
#40	86.41	#20	97.28	#20	98.62
#60	58.22	#40	86.1	#40	91.92
#100	31.12	#60	59.15	#60	70.71
#200	18.13	#100	30.3	#100	45.79
		#200	17.22	#200	32.47

SOIL DESCRIPTION	
●	SILTY SAND (SM)
⊠	SILTY SAND (SM)
▲	SILTY SAND (SM)

REMARKS	
●	
⊠	
▲	

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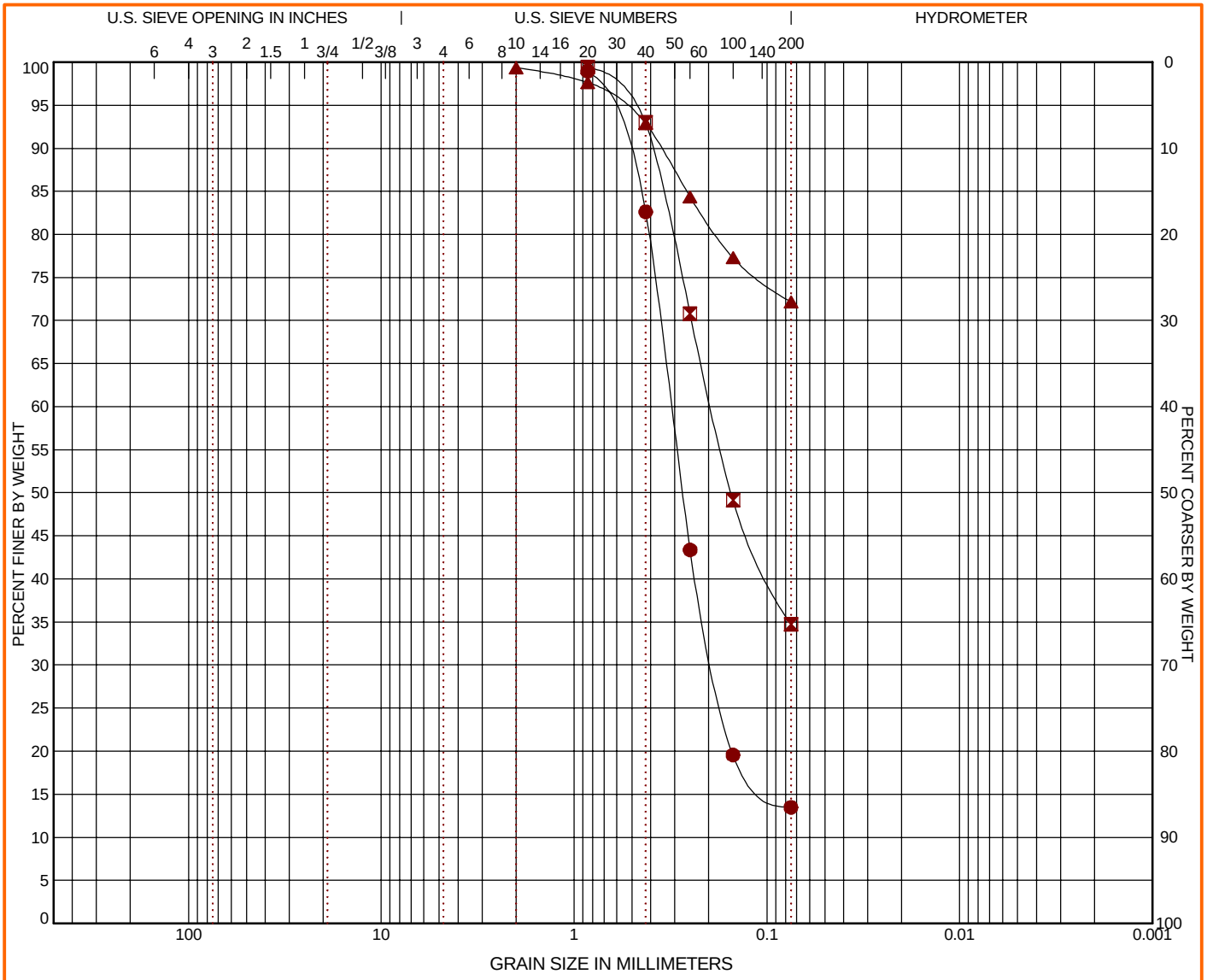

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	CR49 B4	9 - 10.5			85.5		13.5		SM
⊠	CR49 B4	29 - 30.5			64.7		34.7		SM
▲	CR49 B4	34 - 35			27.2		72.1		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.313	0.194	
D_{30}	0.188		
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#20	98.95	#20	99.41	#10	99.35
#40	82.62	#40	93.0	#20	97.63
#60	43.36	#60	70.78	#40	92.87
#100	19.55	#100	49.15	#60	84.36
#200	13.47	#200	34.7	#100	77.29
				#200	72.15

SOIL DESCRIPTION	
●	SILTY SAND (SM)
⊠	SILTY SAND (SM)
▲	LEAN CLAY with SAND (CL)

REMARKS	
●	
⊠	
▲	

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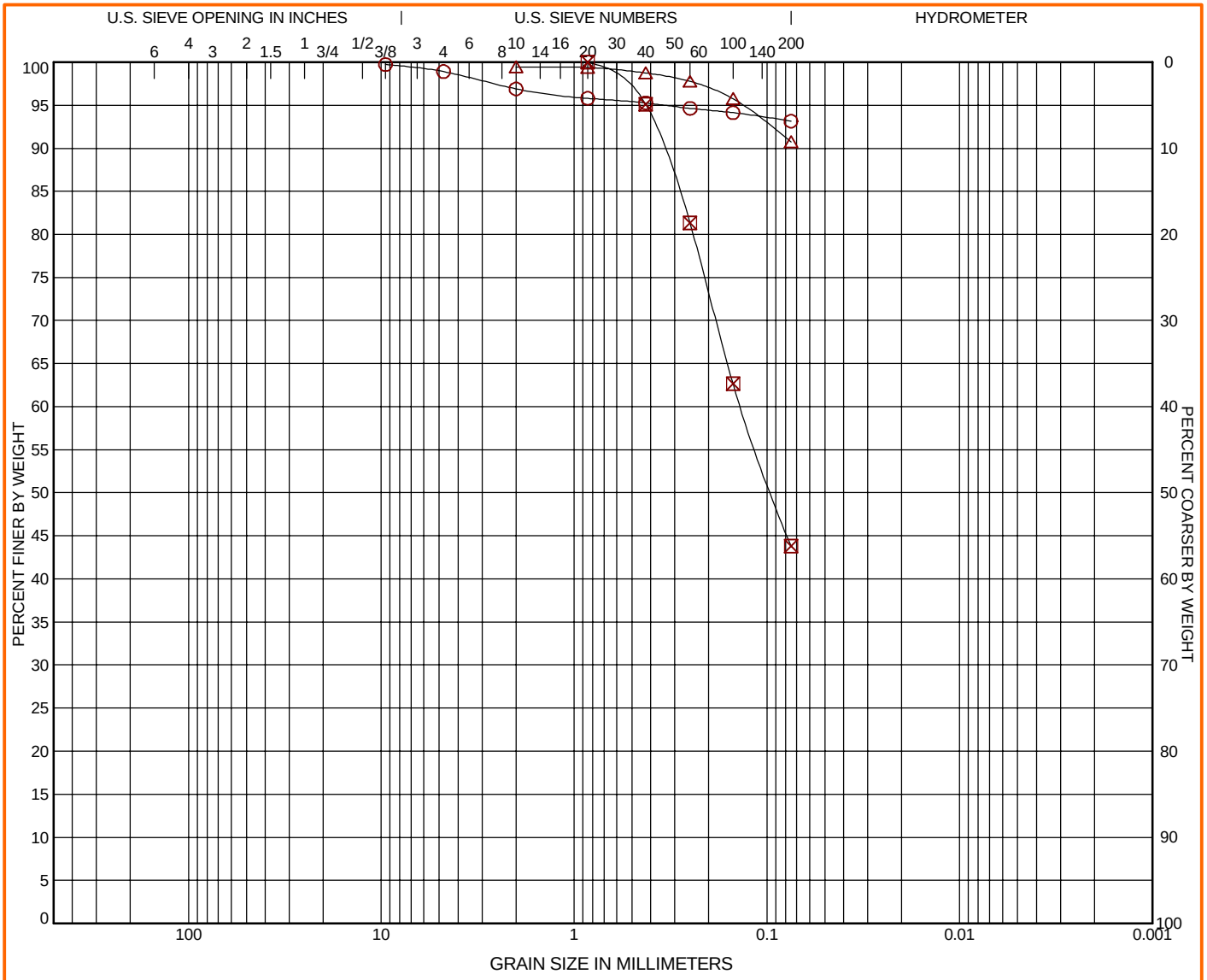

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
○	CR49 B4	39 - 40.5		0.8	5.8		93.1		MH
⊠	HWY76 B1	4 - 5			56.2		43.8		
△	HWY76 B1	14 - 15			8.7		90.8		CL

GRAIN SIZE	○	⊠	△
D_{60}		0.136	
D_{30}			
D_{10}			

COEFFICIENTS	○	⊠	△
C_C			
C_U			

○		⊠		△	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	99.72	#20	99.97	#10	99.45
#4	98.9	#40	95.14	#20	99.39
#10	96.89	#60	81.31	#40	98.75
#20	95.8	#100	62.68	#60	97.77
#40	95.27	#200	43.8	#100	95.76
#60	94.63			#200	90.75
#100	94.14				
#200	93.15				

SOIL DESCRIPTION	
○	SILTSTONE (MH)
⊠	
△	LEAN CLAY (CL)

REMARKS	
○	
⊠	
△	

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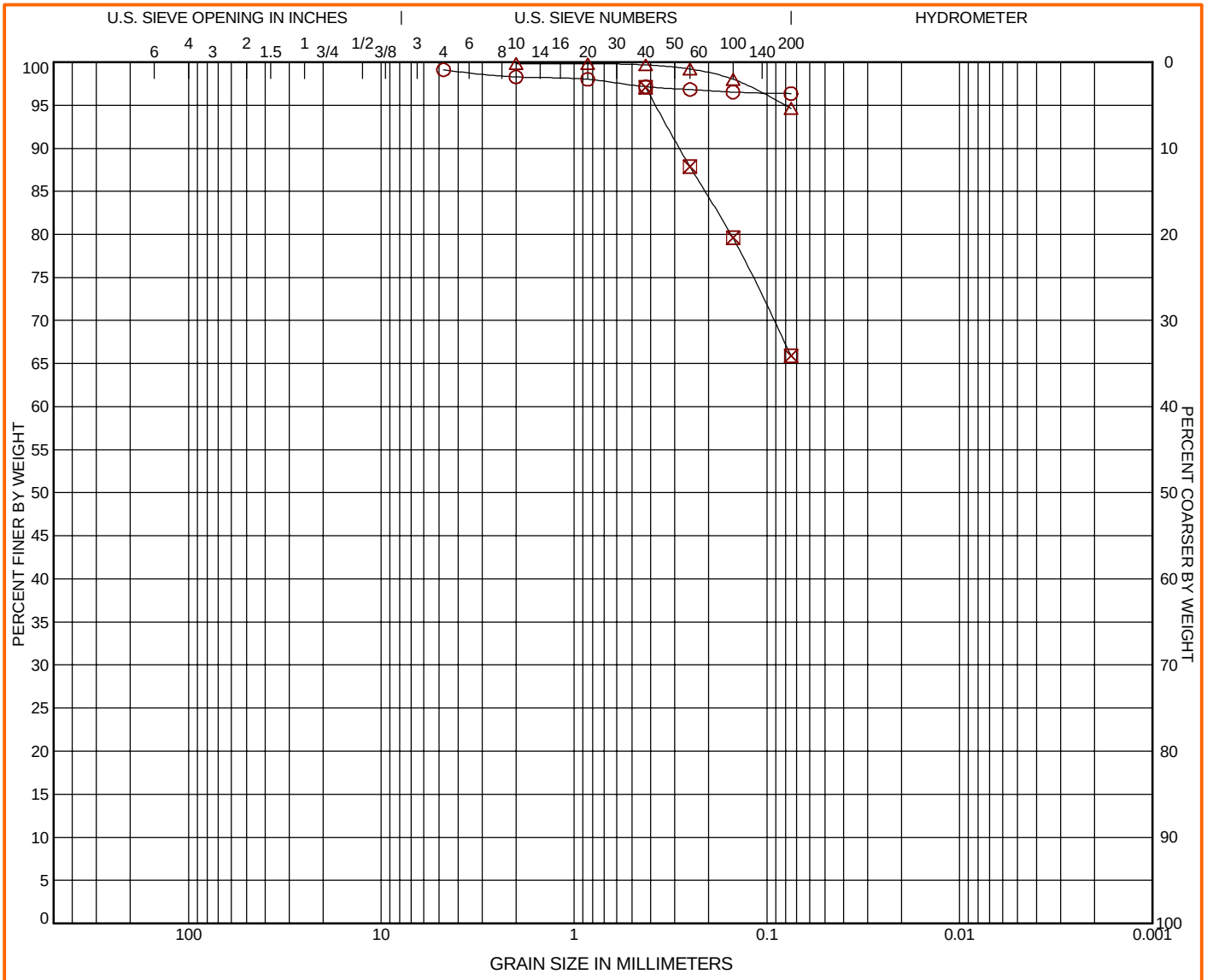

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
○	HWY76 B1	34 - 35			2.8		96.3		CH
☒	HWY76 B2	9 - 10			31.2		65.9		ML
△	HWY76 B2	19 - 20			5.2		94.6		CL

GRAIN SIZE	○	☒	△
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	○	☒	△
C_C			
C_U			

○		☒		△	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4	99.11	#40	97.06	#10	99.84
#10	98.28	#60	87.84	#20	99.81
#20	98.01	#100	79.59	#40	99.68
#40	97.15	#200	65.87	#60	99.2
#60	96.82			#100	98.02
#100	96.52			#200	94.63
#200	96.35				

SOIL DESCRIPTION	
○	CLAYSTONE (CH)
☒	SANDY SILT (ML)
△	LEAN CLAY (CL)

REMARKS	
○	
☒	
△	

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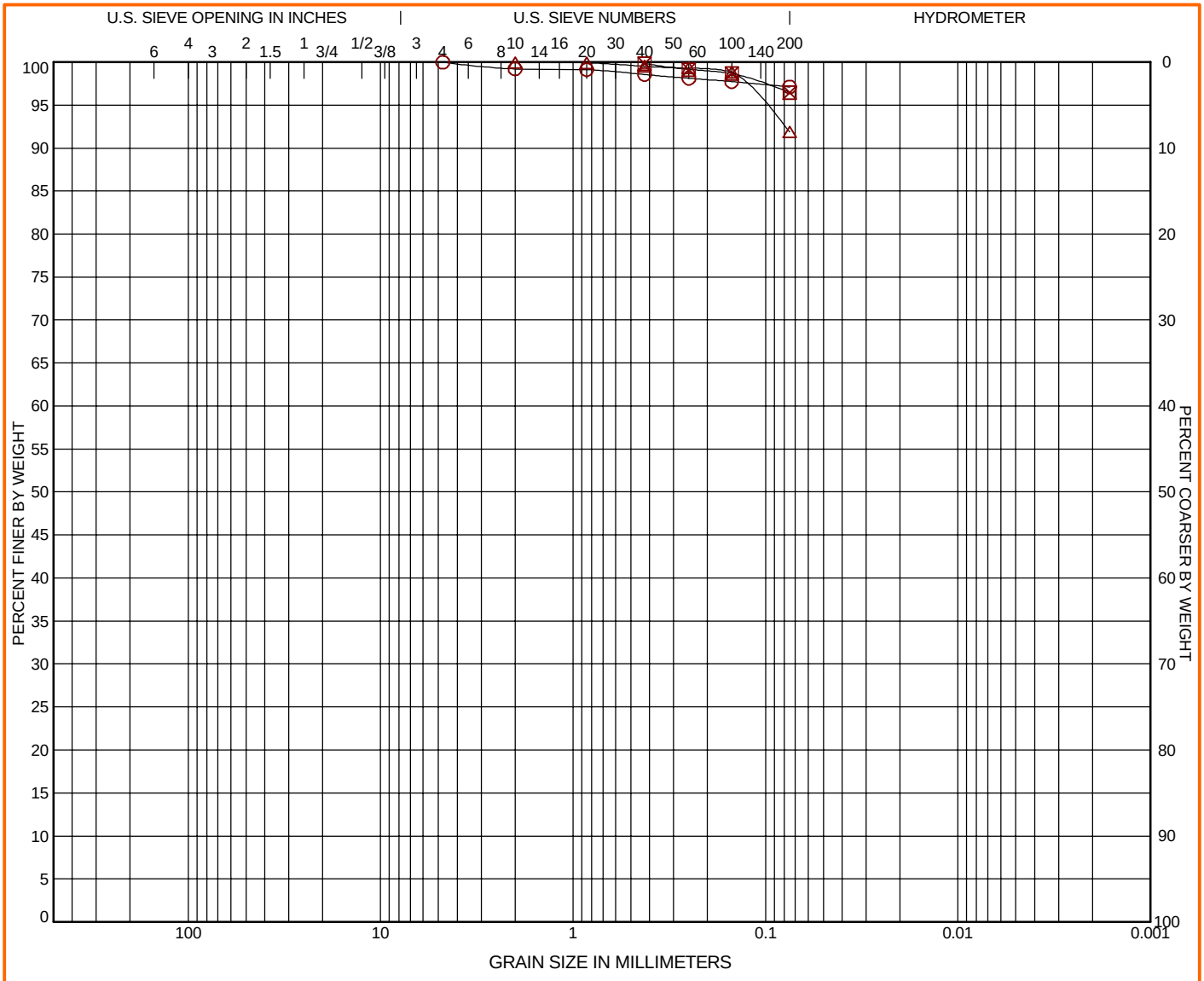

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
○	HWY76 B2	39 - 40			2.9		97.1		CL
☒	HWY76 B3	14 - 15			3.4		96.5		CL
△	HWY76 B3	24 - 25			8.1		91.9		ML

GRAIN SIZE	○	☒	△
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	○	☒	△
C_C			
C_U			

○		☒		△	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4	99.97	#40	99.83	#10	99.94
#10	99.2	#60	99.14	#20	99.91
#20	99.11	#100	98.66	#40	99.5
#40	98.55	#200	96.46	#60	99.31
#60	98.11			#100	98.84
#100	97.73			#200	91.88
#200	97.11				

SOIL DESCRIPTION	
○	CLAYSTONE (CL)
☒	LEAN CLAY (CL)
△	SILTSTONE (ML)

REMARKS	
○	
☒	
△	

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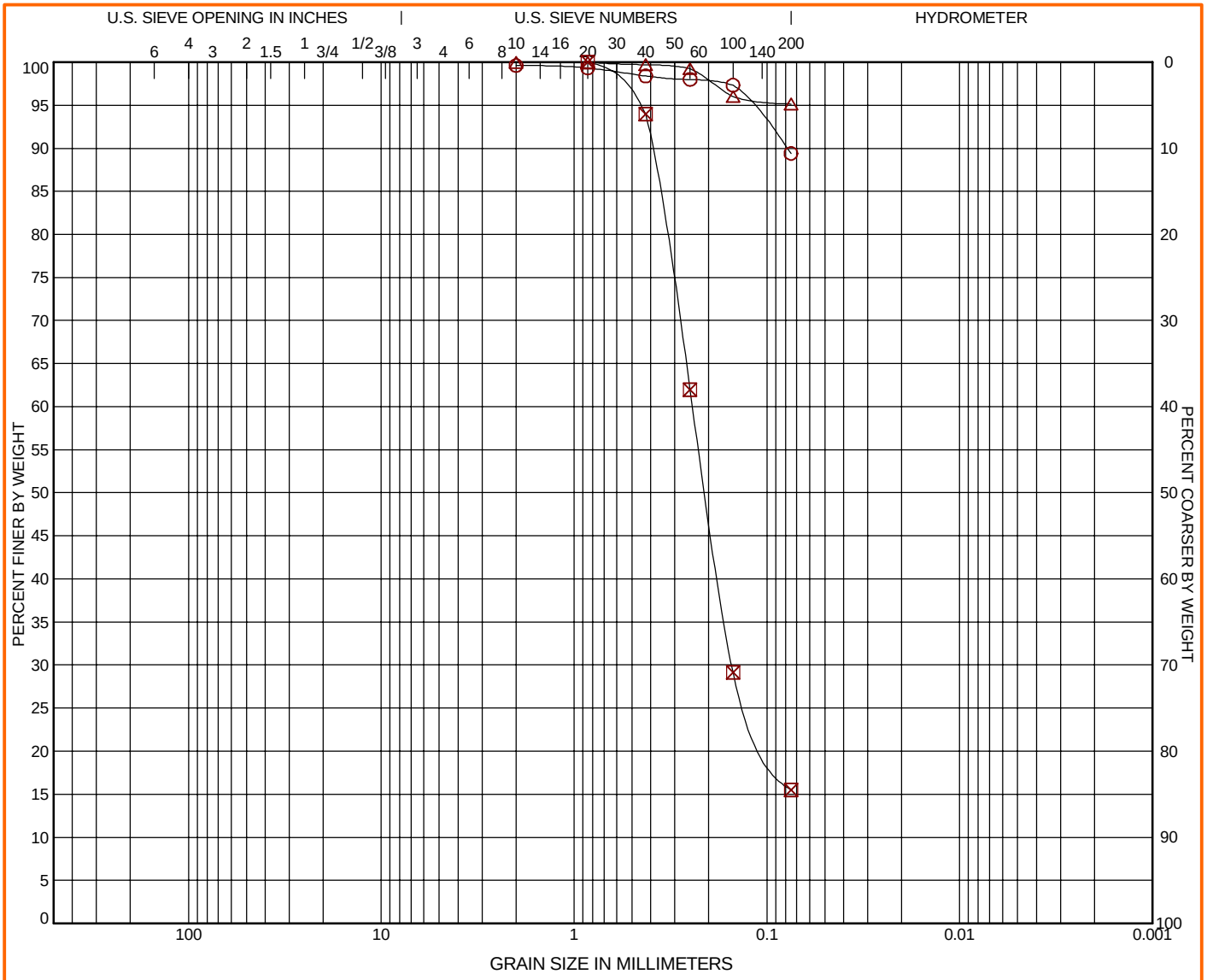

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
○	HWY76 B3	34 - 35			10.2		89.4		CL-ML
☒	HWY76 B4	9 - 10			84.5		15.5		SM
△	HWY76 B4	19 - 20			4.8		95.1		CL

GRAIN SIZE	○	☒	△
D_{60}		0.242	
D_{30}		0.152	
D_{10}			

COEFFICIENTS	○	☒	△
C_C			
C_U			

○		☒		△	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#10	99.61	#20	99.97	#10	99.96
#20	99.32	#40	93.94	#20	99.96
#40	98.39	#60	62.0	#40	99.71
#60	98.0	#100	29.14	#60	99.24
#100	97.32	#200	15.47	#100	96.0
#200	89.4			#200	95.13

SOIL DESCRIPTION	
○	CLAYSTONE/SILTSTONE (CL-ML)
☒	SILTY SAND (SM)
△	LEAN CLAY (CL)

REMARKS	
○	
☒	
△	

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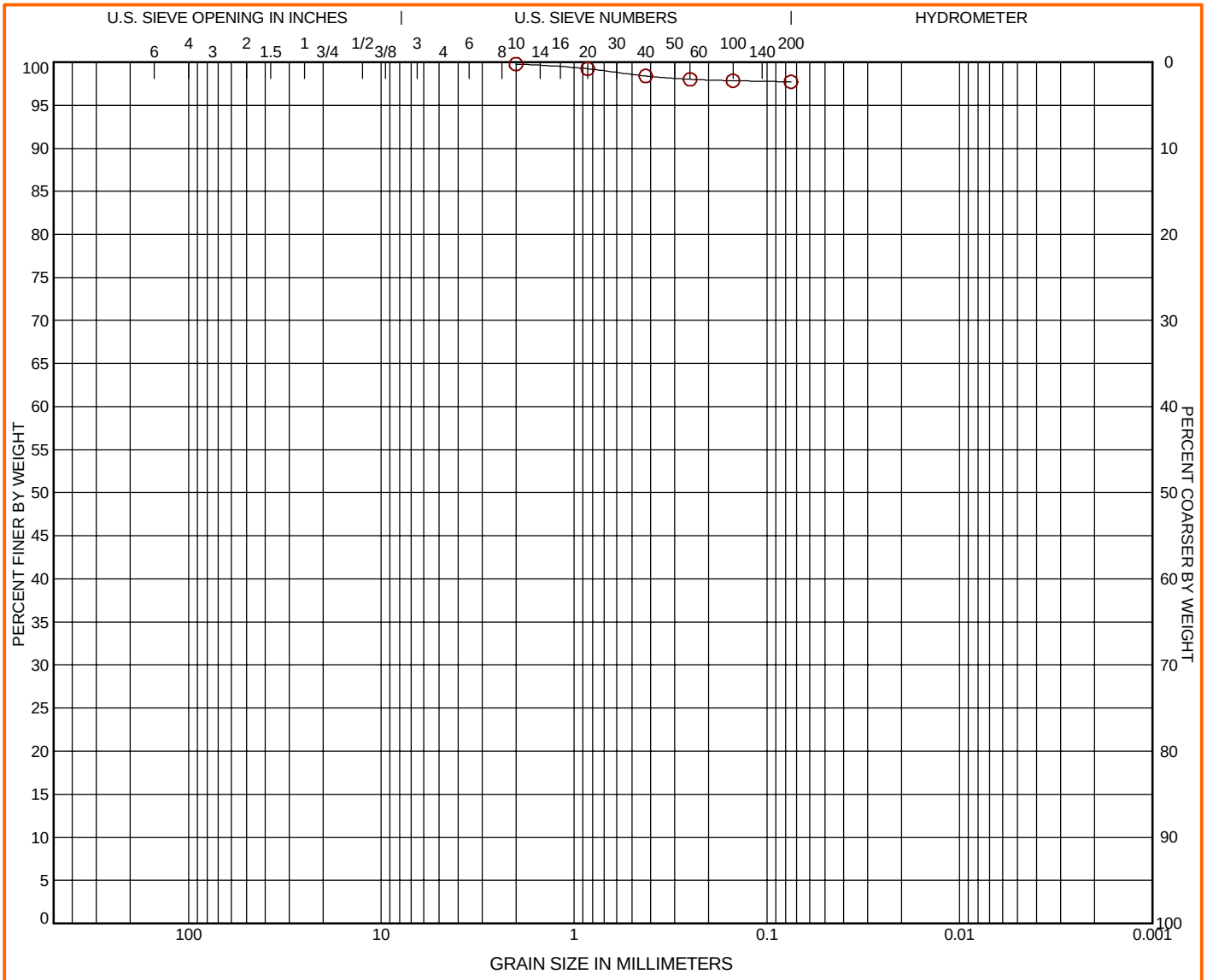
GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
○	HWY76 B4	39 - 40			2.1		97.7		CH

GRAIN SIZE			
	○		
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS			
	○		
C_C			
C_U			

○					
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#10	99.78				
#20	99.23				
#40	98.39				
#60	98.01				
#100	97.85				
#200	97.72				

SOIL DESCRIPTION	
○	CLAYSTONE (CH) (CH)

REMARKS
○

PROJECT: High Plains to CIG 5C Expansion Project

SITE: I-76 and WCR 49
Weld County, CO

Terracon
1289 1st Ave
Greeley, CO

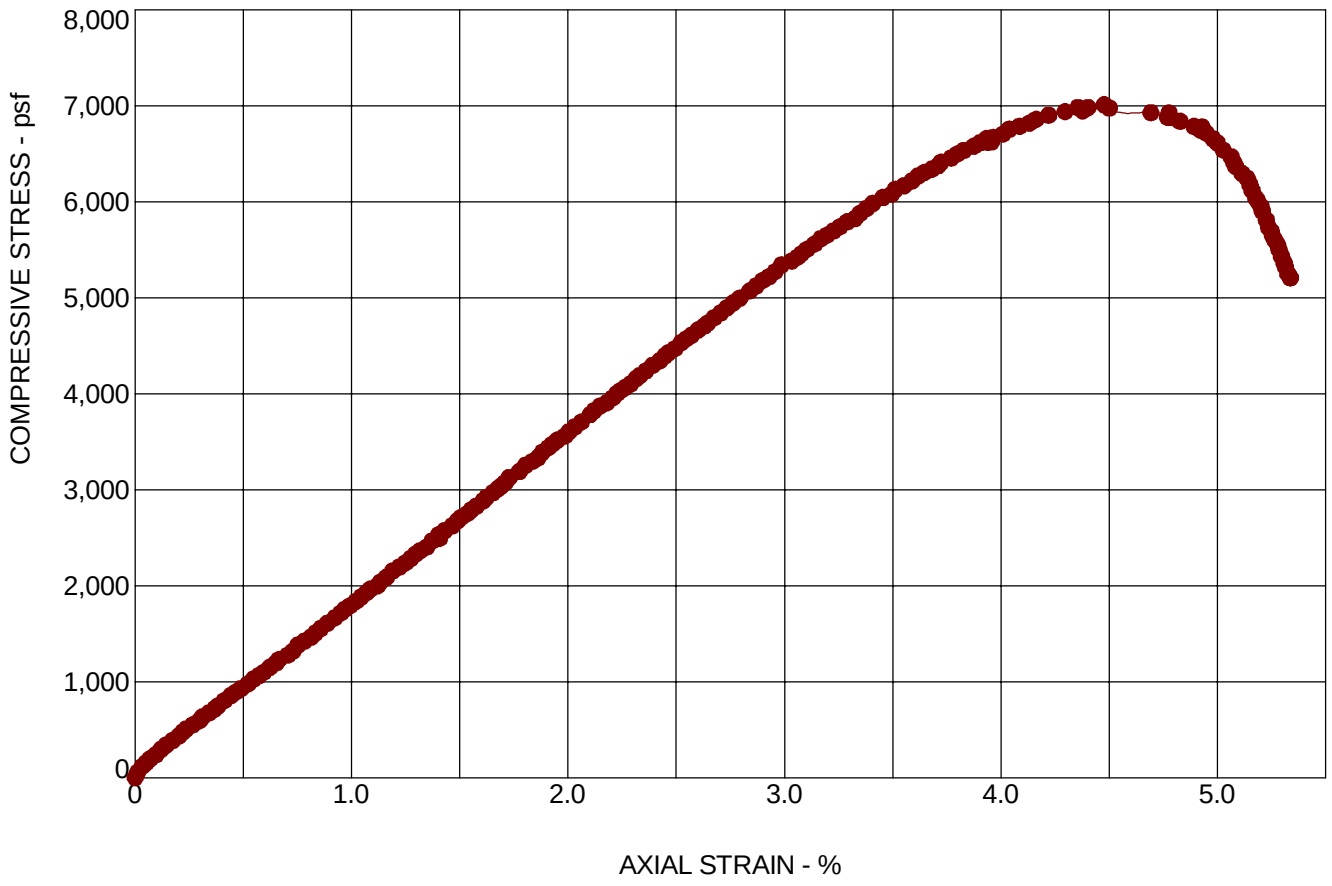
PROJECT NUMBER: 21185077

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

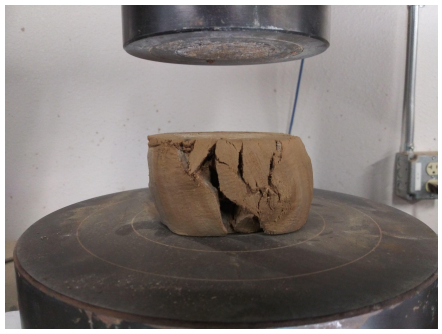
LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 21185077 HIGH PLAINS TO CI.GPJ TERRACON_DATATEMPLATE.GDT 12/24/18

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	21
Dry Density:	pcf	106
Diameter:	in.	1.93
Height:	in.	3.96
Height / Diameter Ratio:		2.06
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	4.48
Unconfined Compressive Strength	(psf)	7008
Undrained Shear Strength:	(psf)	3504
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: CR49 B4 @ 34 - 35 feet

DESCRIPTION: LEAN CLAY with SAND(CL)

LL	PL	PI	Percent < #200 Sieve
27	17	10	72

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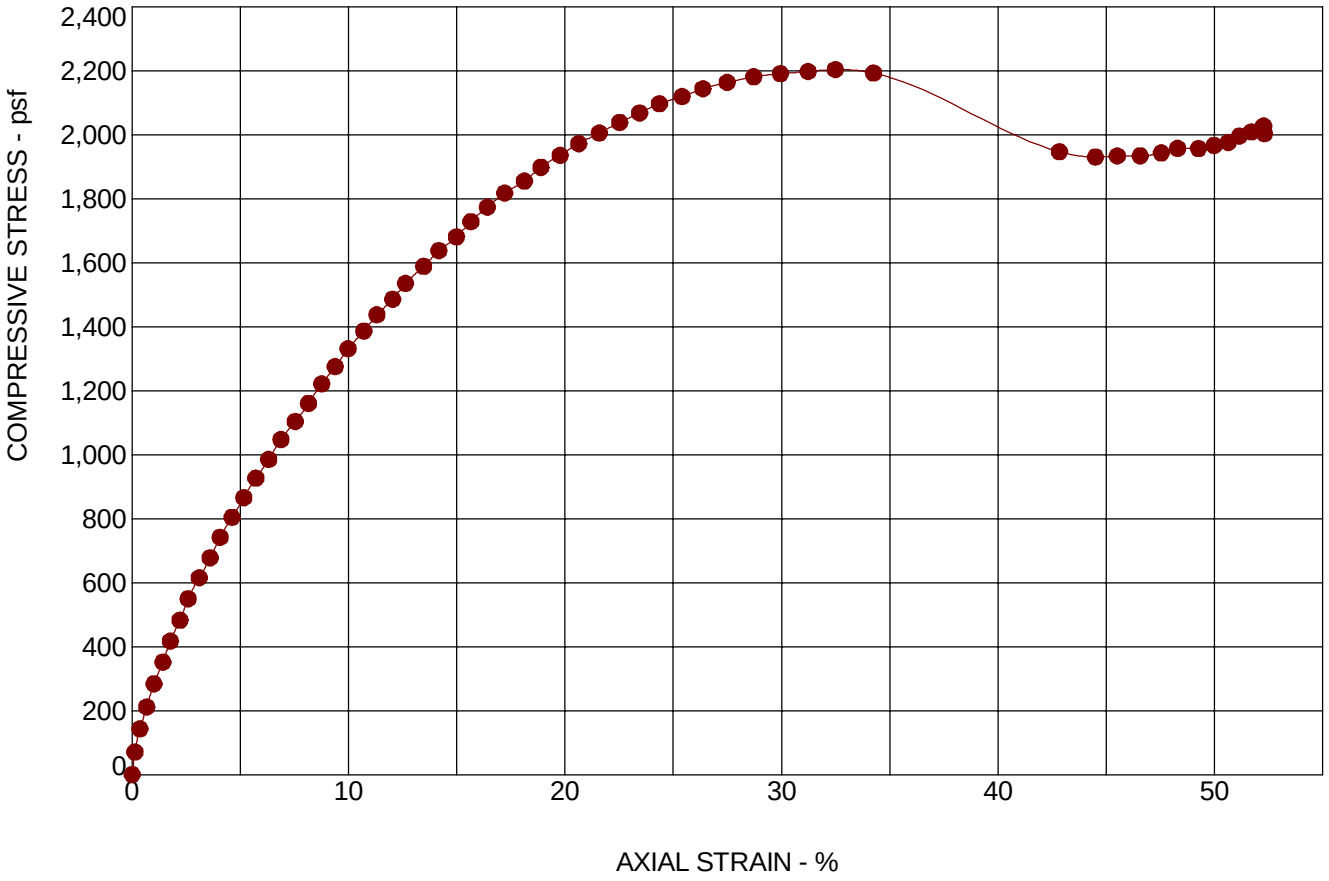
Vernal, UT

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH

SPECIMEN TEST DATA

Moisture Content:	%	18
Dry Density:	pcf	108
Diameter:	in.	1.92
Height:	in.	4.02
Height / Diameter Ratio:		2.09
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	15.00
Unconfined Compressive Strength	(psf)	1681
Undrained Shear Strength:	(psf)	841
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B1 @ 14 - 15 feet

DESCRIPTION: LEAN CLAY(CL)

LL	PL	PI	Percent < #200 Sieve
33	15	18	91

PROJECT: High Plains to CIG 5C Expansion Project

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Greeley, CO

PROJECT NUMBER: 21185077

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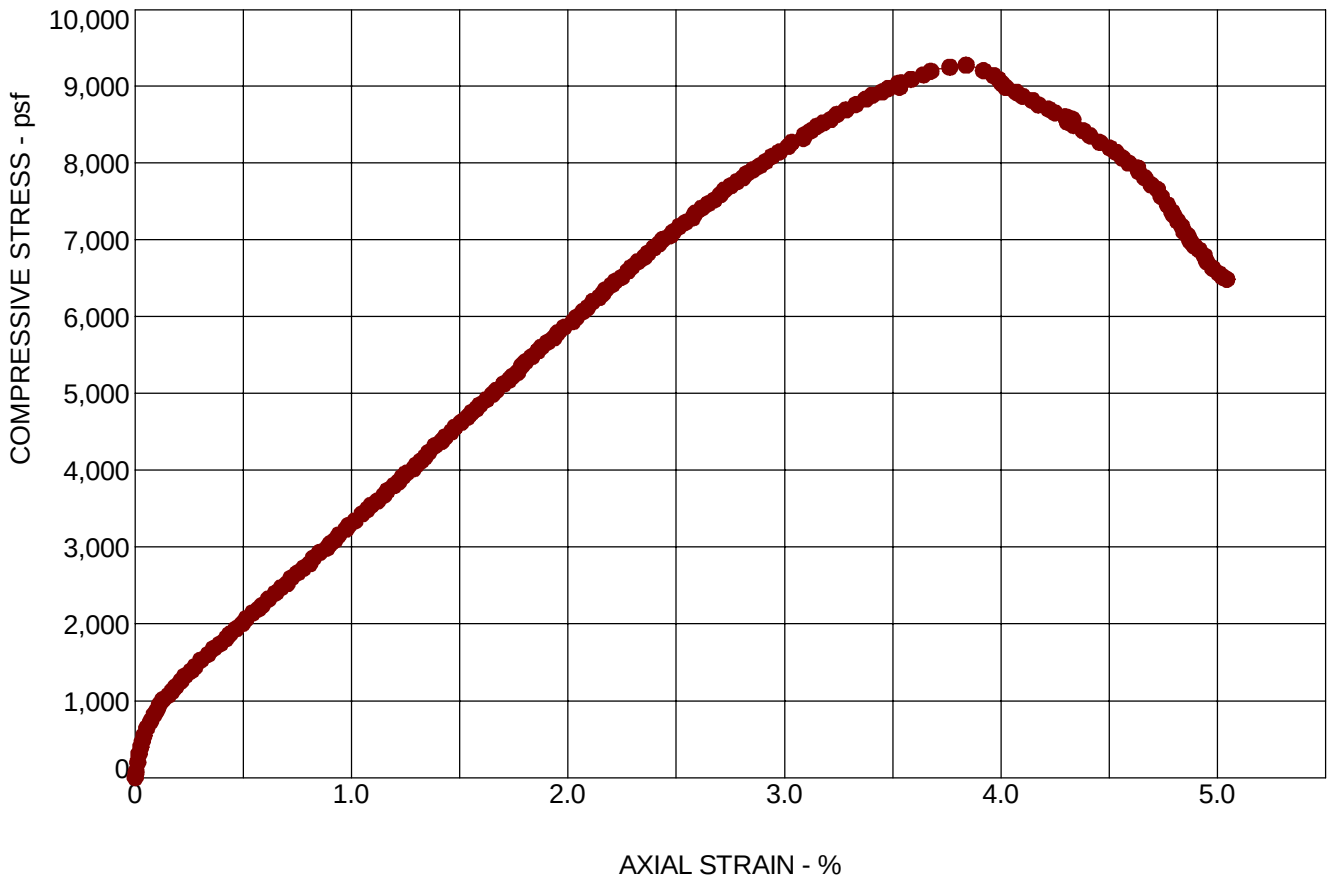
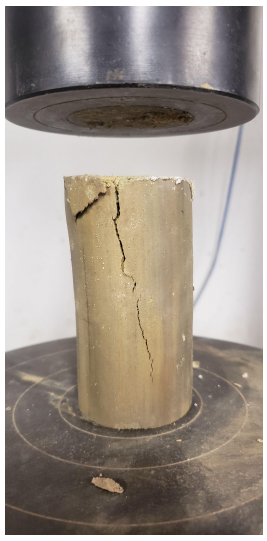
Vernal, UT

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	14
Dry Density:	pcf	14
Diameter:	in.	1.93
Height:	in.	4.00
Height / Diameter Ratio:		2.08
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	3.84
Unconfined Compressive Strength	(psf)	9276
Undrained Shear Strength:	(psf)	4638
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B1 @ 24 - 25 feet

DESCRIPTION: CLAYSTONE (CH)

LL	PL	PI	Percent < #200 Sieve

PROJECT: High Plains to CIG 5C Expansion Project

SITE: I-76 and WCR 49
Weld County, CO

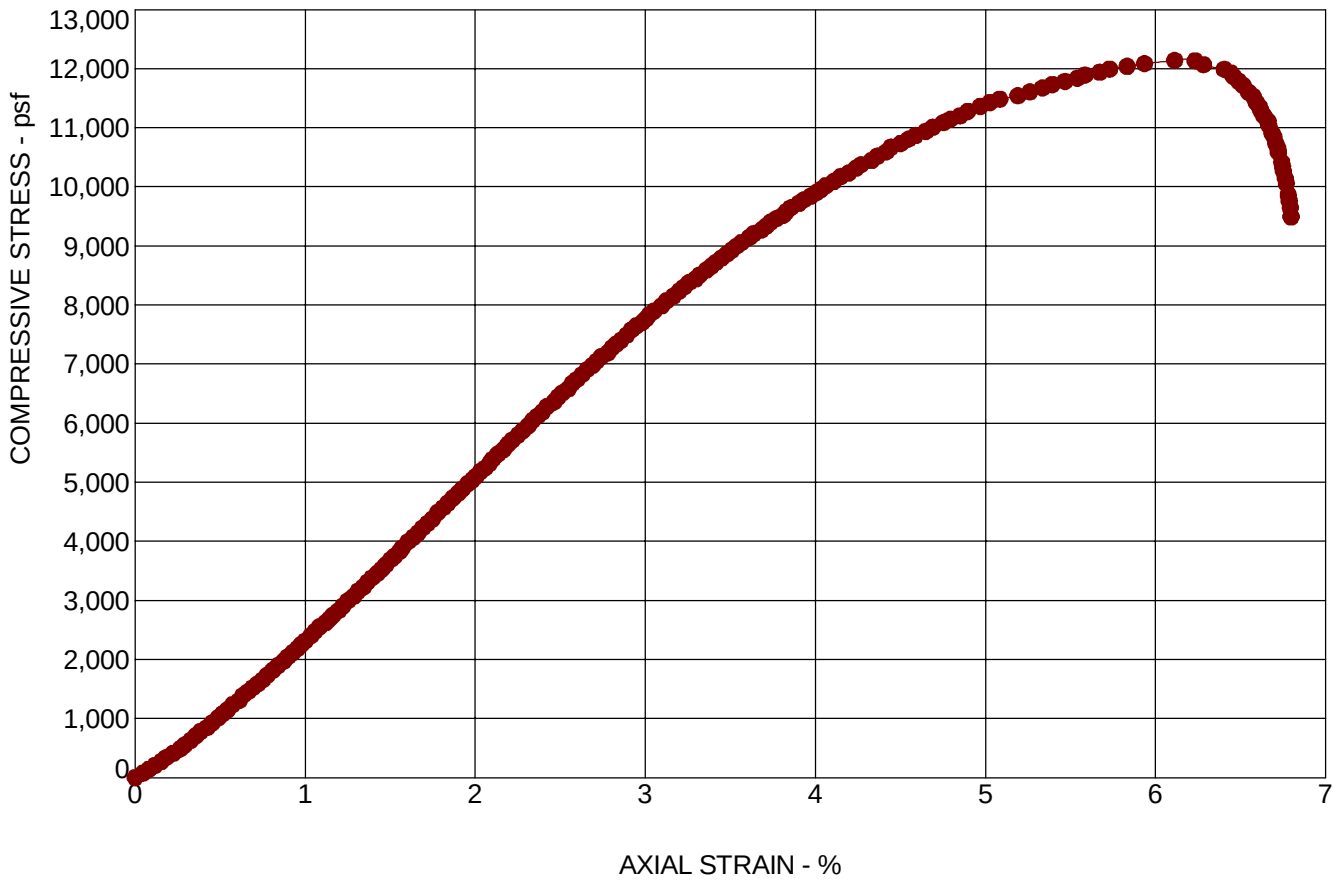
Terracon
1289 1st Ave
Greeley, CO

PROJECT NUMBER: 21185077

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH

SPECIMEN TEST DATA

Moisture Content:	%	21
Dry Density:	pcf	108
Diameter:	in.	1.93
Height:	in.	4.06
Height / Diameter Ratio:		2.11
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	6.11
Unconfined Compressive Strength	(psf)	12140
Undrained Shear Strength:	(psf)	6070
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B1 @ 34 - 35 feet

DESCRIPTION: CLAYSTONE (CH)

LL	PL	PI	Percent < #200 Sieve
53	18	35	96

PROJECT: High Plains to CIG 5C Expansion Project

SITE: I-76 and WCR 49
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Terracon
1289 1st Ave
Greeley, CO

PROJECT NUMBER: 21185077

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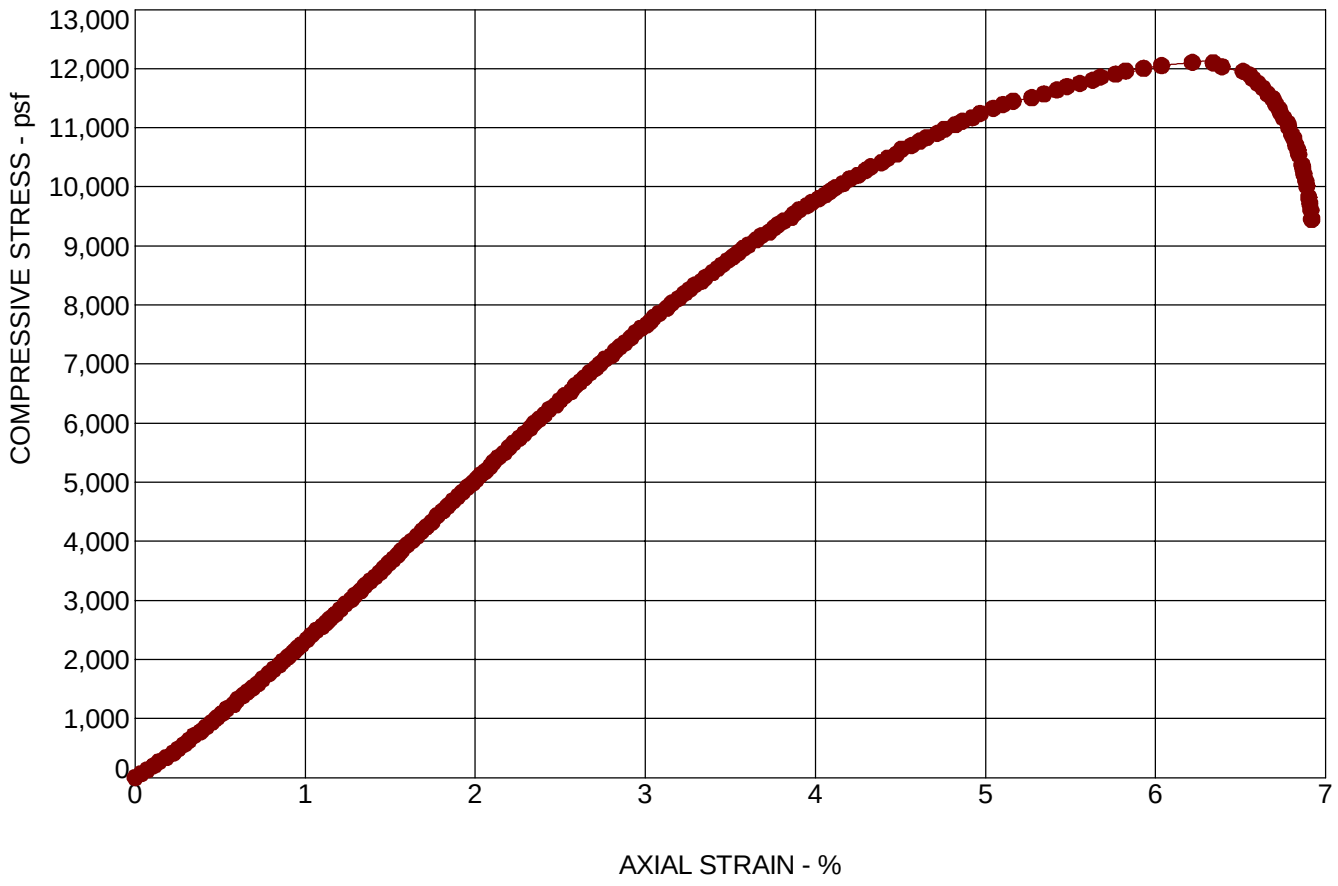
Vernal, UT

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH

SPECIMEN TEST DATA

Moisture Content:	%	66
Dry Density:	pcf	77
Diameter:	in.	1.92
Height:	in.	3.96
Height / Diameter Ratio:		2.06
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	6.22
Unconfined Compressive Strength	(psf)	12105
Undrained Shear Strength:	(psf)	6053
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B2 @ 19 - 20 feet

DESCRIPTION: LEAN CLAY(CL)

LL	PL	PI	Percent < #200 Sieve
35	15	20	95

PROJECT: High Plains to CIG 5C Expansion Project

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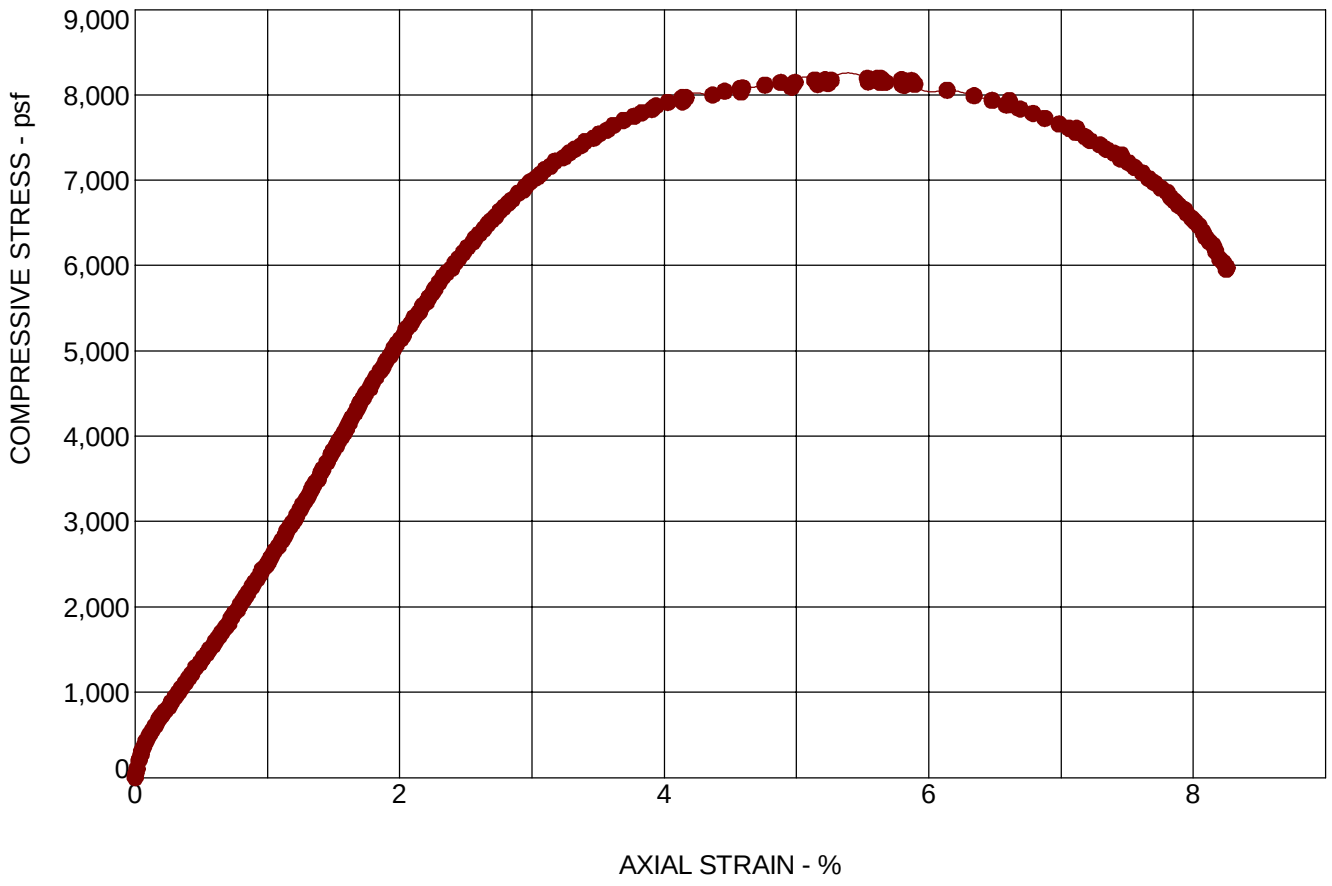
Greeley, CO

PROJECT NUMBER: 21185077

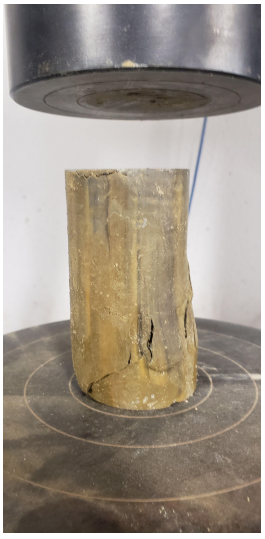
CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	15
Dry Density:	pcf	113
Diameter:	in.	1.94
Height:	in.	3.89
Height / Diameter Ratio:		2.01
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	5.54
Unconfined Compressive Strength	(psf)	8195
Undrained Shear Strength:	(psf)	4097
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B2 @ 29 - 30 feet

DESCRIPTION: CLAYSTONE (CL)

LL	PL	PI	Percent < #200 Sieve

PROJECT: High Plains to CIG 5C Expansion Project

SITE: I-76 and WCR 49
Weld County, CO

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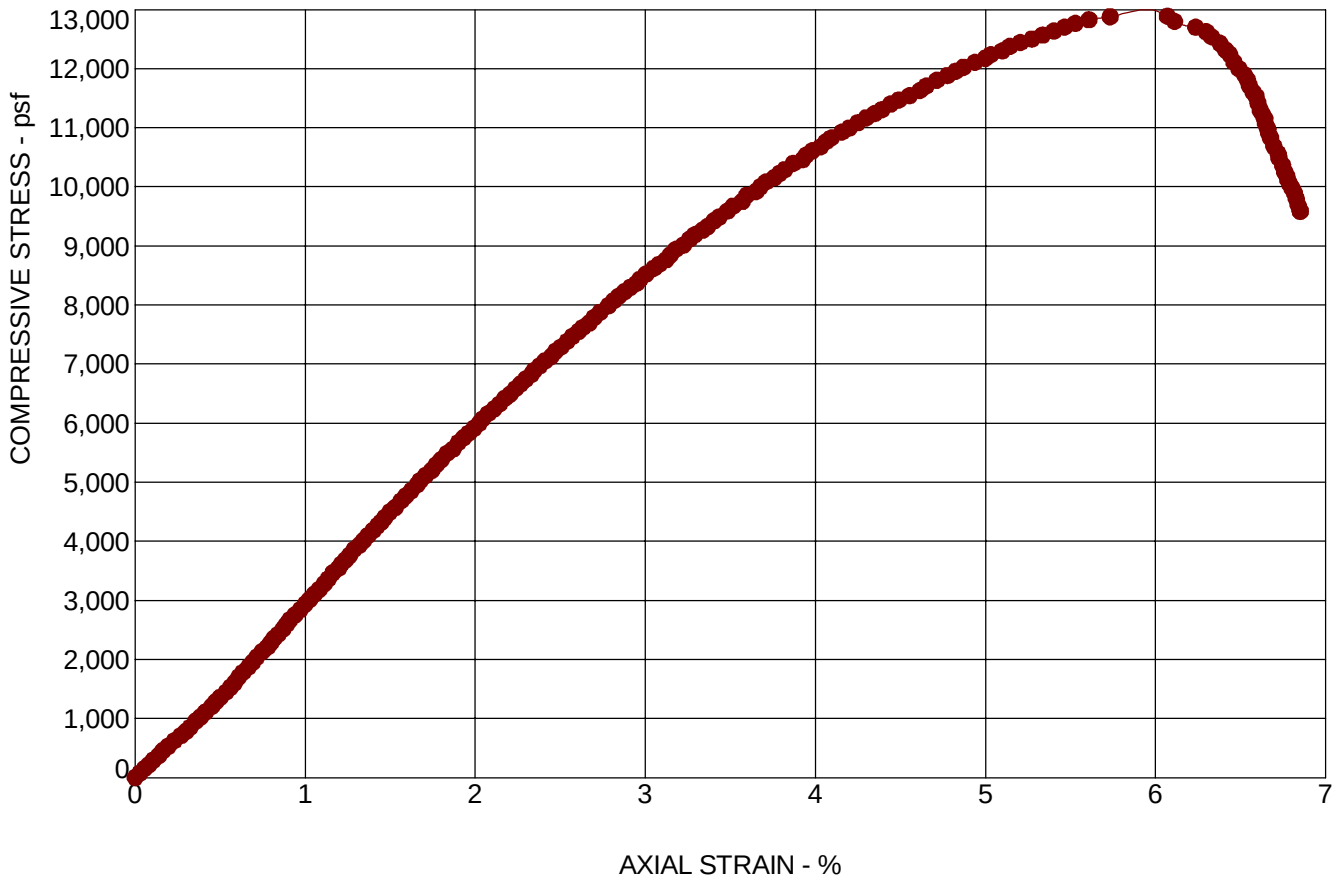
1289 1st Ave
Greeley, CO

PROJECT NUMBER: 21185077

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH

SPECIMEN TEST DATA

Moisture Content:	%	13
Dry Density:	pcf	118
Diameter:	in.	1.93
Height:	in.	3.73
Height / Diameter Ratio:		1.93
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	6.07
Unconfined Compressive Strength	(psf)	12888
Undrained Shear Strength:	(psf)	6444
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B2 @ 39 - 40 feet

DESCRIPTION: CLAYSTONE (CL)

LL	PL	PI	Percent < #200 Sieve
35	16	19	97

PROJECT: High Plains to CIG 5C Expansion Project

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Weld County, CO

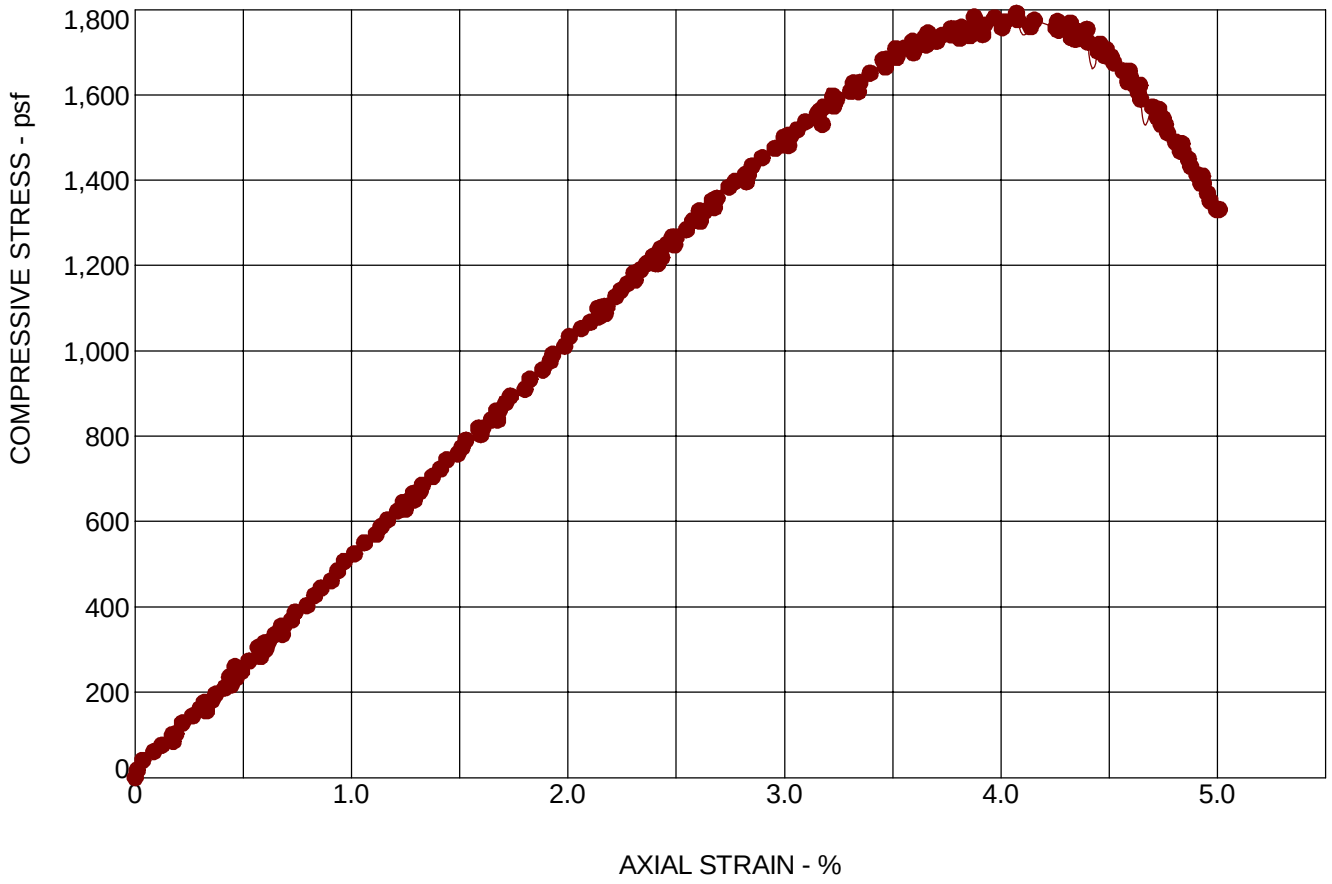
Terracon
1289 1st Ave
Greeley, CO

PROJECT NUMBER: 21185077

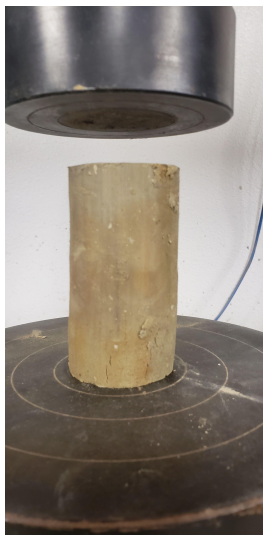
CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	20
Dry Density:	pcf	107
Diameter:	in.	1.93
Height:	in.	3.91
Height / Diameter Ratio:		2.03
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	4.07
Unconfined Compressive Strength	(psf)	1791
Undrained Shear Strength:	(psf)	896
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B3 @ 24 - 25 feet

DESCRIPTION: SILTSTONE (ML)

LL	PL	PI	Percent < #200 Sieve
NP	NP	NP	92

PROJECT: High Plains to CIG 5C Expansion Project

SITE: I-76 and WCR 49
Weld County, CO

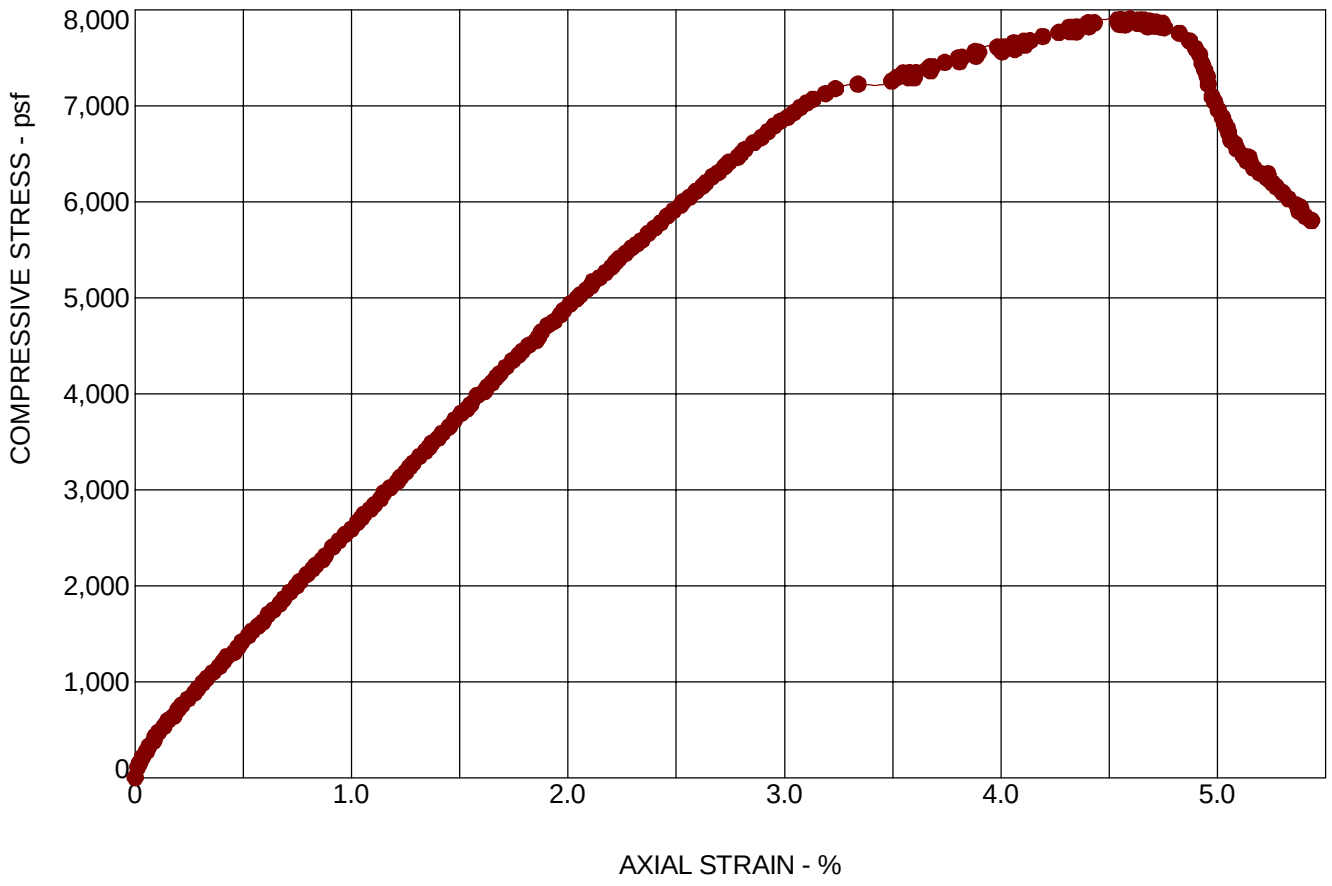
Terracon
1289 1st Ave
Greeley, CO

PROJECT NUMBER: 21185077

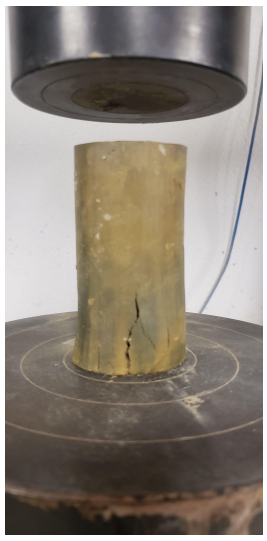
CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	16
Dry Density:	pcf	116
Diameter:	in.	1.93
Height:	in.	3.99
Height / Diameter Ratio:		2.07
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	4.60
Unconfined Compressive Strength	(psf)	7902
Undrained Shear Strength:	(psf)	3951
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B3 @ 34 - 35 feet

DESCRIPTION: CLAYSTONE/SILTSTONE (CL-ML)

LL	PL	PI	Percent < #200 Sieve
26	19	7	89

PROJECT: High Plains to CIG 5C Expansion Project

SITE: I-76 and WCR 49
Weld County, CO

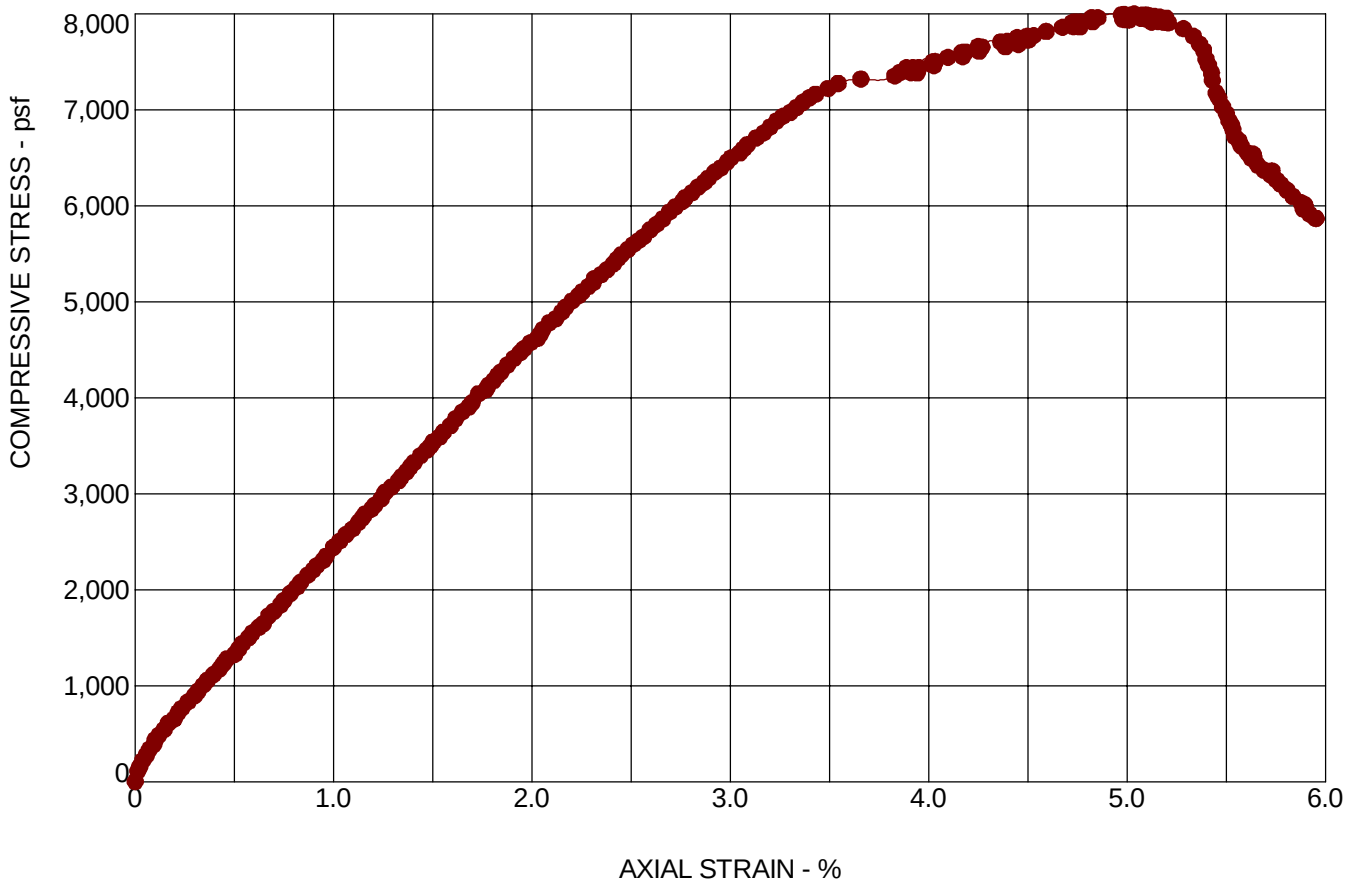
Terracon
1289 1st Ave
Greeley, CO

PROJECT NUMBER: 21185077

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH

SPECIMEN TEST DATA

Moisture Content:	%	27
Dry Density:	pcf	100
Diameter:	in.	1.91
Height:	in.	3.65
Height / Diameter Ratio:		1.91
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	5.04
Unconfined Compressive Strength	(psf)	7996
Undrained Shear Strength:	(psf)	3998
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B4 @ 19 - 20 feet

DESCRIPTION: LEAN CLAY(CL)

LL	PL	PI	Percent < #200 Sieve
26	14	12	95

PROJECT: High Plains to CIG 5C Expansion Project

SITE: I-76 and WCR 49
Weld County, CO

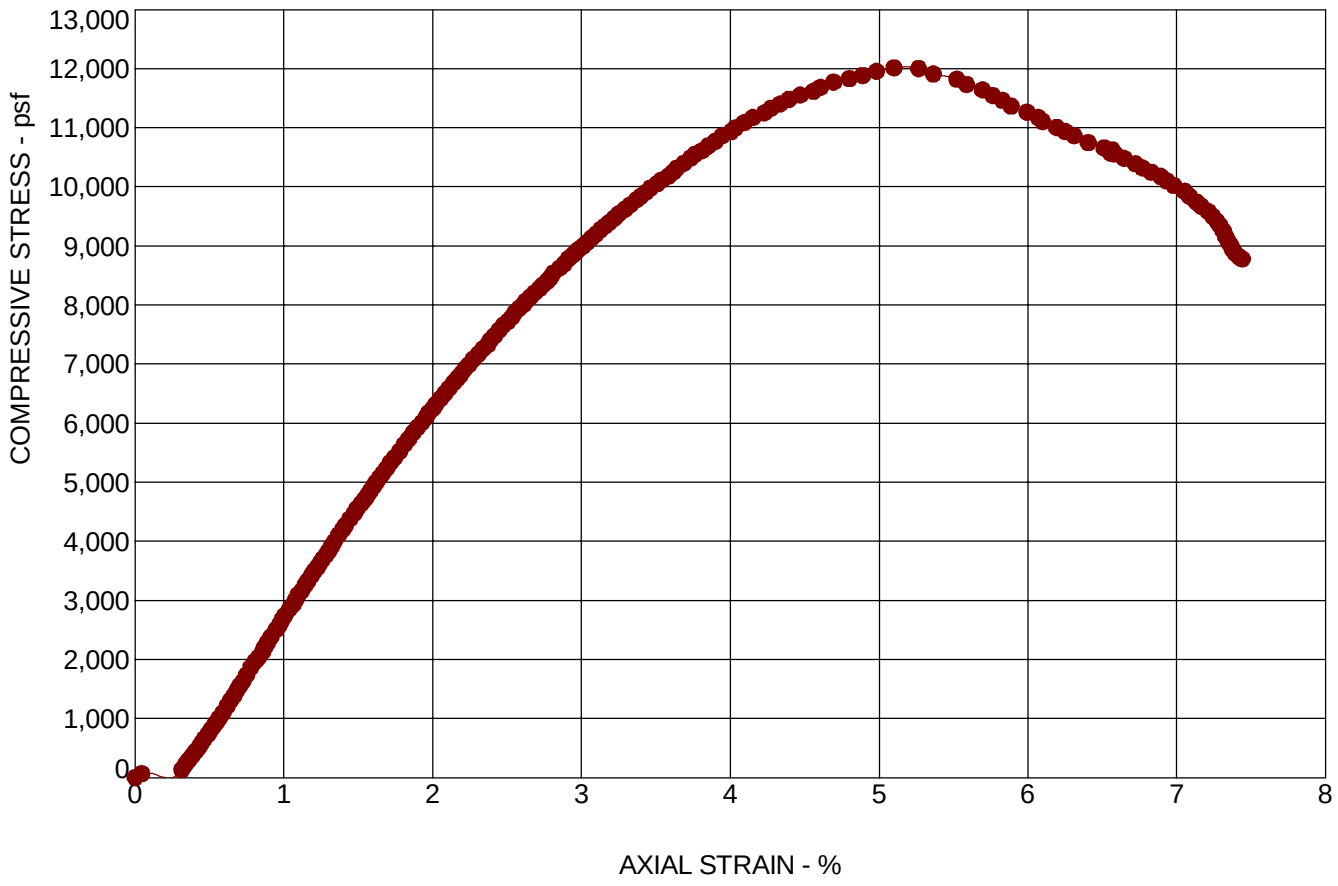
Terracon
1289 1st Ave
Greeley, CO

PROJECT NUMBER: 21185077

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH

SPECIMEN TEST DATA

Moisture Content:	%	18
Dry Density:	pcf	114
Diameter:	in.	1.92
Height:	in.	3.94
Height / Diameter Ratio:		2.05
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	5.10
Unconfined Compressive Strength	(psf)	12014
Undrained Shear Strength:	(psf)	6007
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B4 @ 29 - 30 feet

DESCRIPTION: CLAYSTONE (CH)

LL	PL	PI	Percent < #200 Sieve

PROJECT: High Plains to CIG 5C Expansion Project

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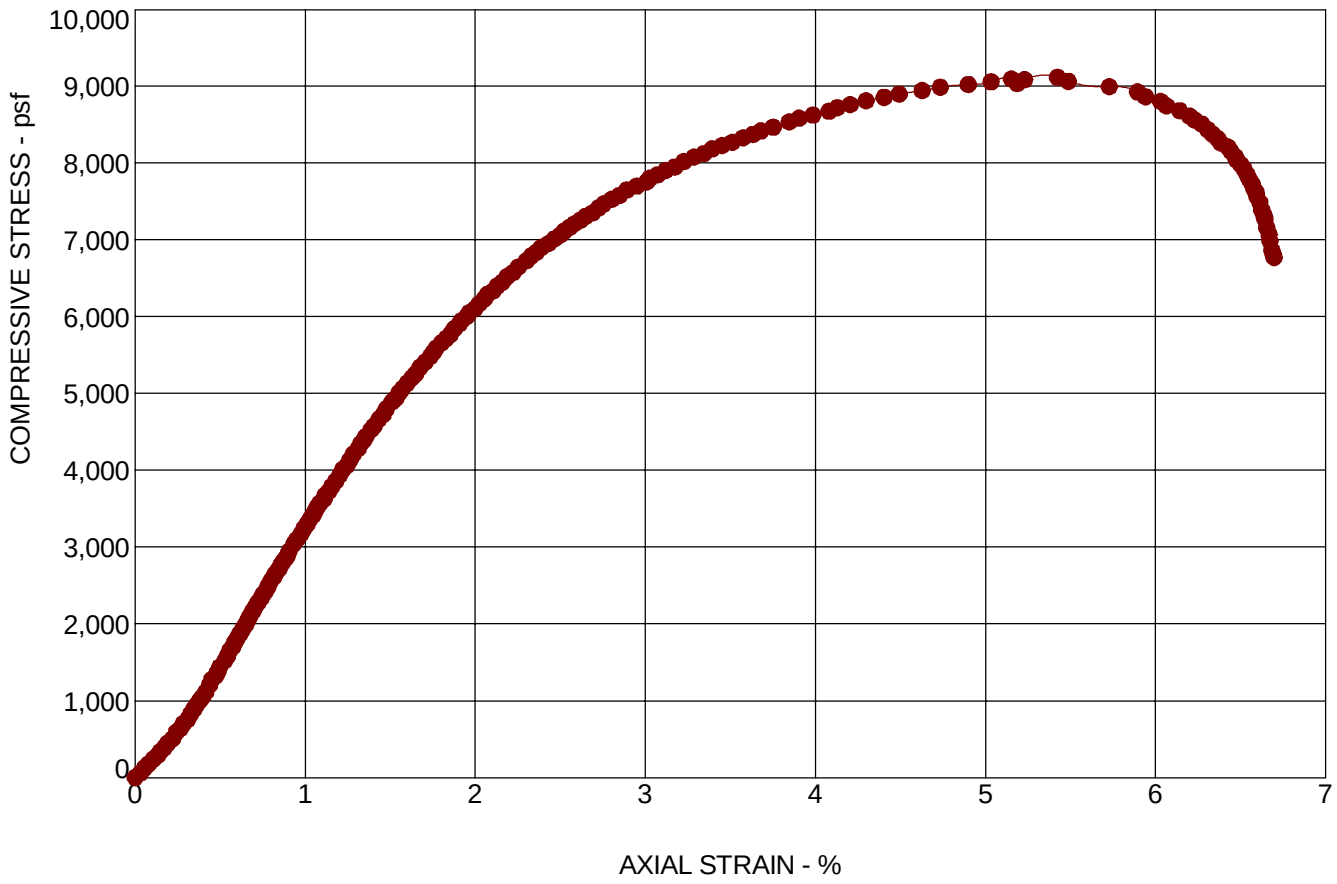
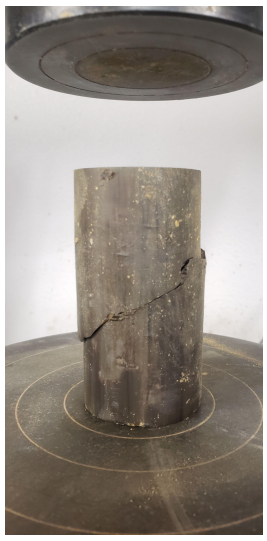
UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	23
Dry Density:	pcf	102
Diameter:	in.	1.94
Height:	in.	3.93
Height / Diameter Ratio:		2.03
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	5.42
Unconfined Compressive Strength	(psf)	9117
Undrained Shear Strength:	(psf)	4559
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: HWY76 B4 @ 39 - 40 feet

DESCRIPTION: CLAYSTONE (CH)

LL	PL	PI	Percent < #200 Sieve
66	21	45	98

PROJECT: High Plains to CIG 5C Expansion Project

SITE: I-76 and WCR 49
Weld County, CO

Terracon
1289 1st Ave
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PROJECT NUMBER: 21185077

CLIENT: Uintah Engineering and Land Surveying, Inc.
Vernal, UT

CHEMICAL LABORATORY TEST REPORT

Project Number: 21185077
Service Date: 12/14/18
Report Date: 12/17/18
Task:

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

Client

Uintah Engineering and Land Surveying Inc

Project

High Plains to CIG 5C Expansion Project

Sample Submitted By: Terracon (21) **Date Received:** 12/13/2018 **Lab No.: 18-1518**

Results of Corrosion Analysis

Sample Number	CR 49	CR 49
Sample Location	B-2	B-4
Sample Depth (ft.)	19.0	29.0
pH Analysis, AWWA 4500 H	8.25	8.84
Water Soluble Sulfate (SO4), ASTM C 1580 (mg/kg)	226	35
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	45	30
Red-Ox, AWWA 2580, (mV)	+677	+684
Total Salts, AWWA 2520 B, (mg/kg)	144	117
Resistivity, ASTM G 57, (ohm-cm)	12610	7178

Analyzed By: Trisha Campo
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: 21185077
Service Date: 12/19/18
Report Date: 12/20/18
Task:

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

Client

Uintah Engineering and Land Surveying Inc

Project

High Plains to CIG 5C Expansion Project

Sample Submitted By: Terracon (21) **Date Received:** 12/18/2018 **Lab No.: 18-1540**

Results of Corrosion Analysis

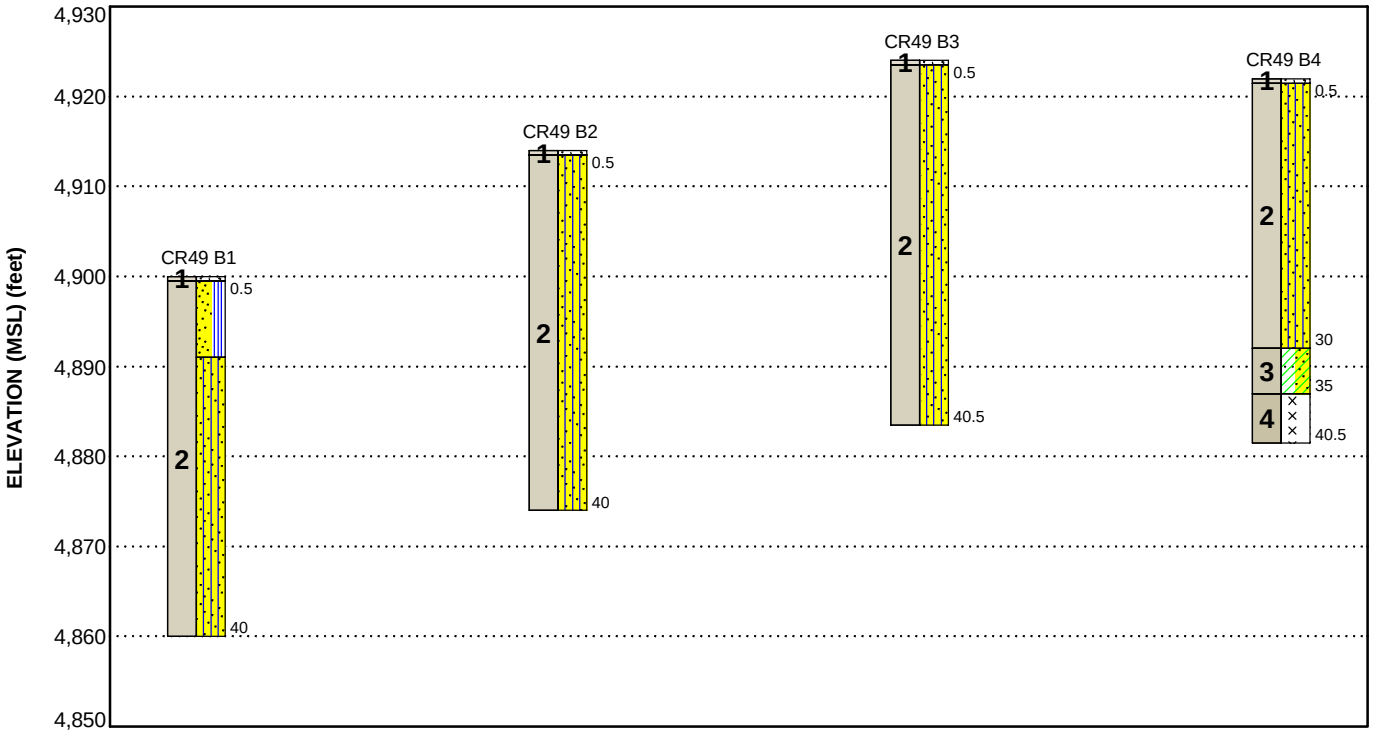
Sample Number	I-76	I-76
Sample Location	B-1	B-4
Sample Depth (ft.)	29.0	14.0
pH Analysis, AWWA 4500 H	8.17	8.54
Water Soluble Sulfate (SO4), ASTM C 1580 (mg/kg)	1428	182
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	52	50
Red-Ox, AWWA 2580, (mV)	+686	+686
Total Salts, AWWA 2520 B, (mg/kg)	3786	529
Resistivity, ASTM G 57, (ohm-cm)	572	1746

Analyzed By:

Trisha Campo
Chemist

GEOMODEL

High Plains to CIG 5C Expansion Project ■ Weld County, CO
12/28/2018 ■ Terracon Project No. 21185077



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

LEGEND

- Topsoil
- Poorly-graded Sand ith Silt
- Silty Sand
- Lean Clay with Sand
- Siltstone Bedrock

Model Layer	Layer Name	General Description
1	**Topsoil**	Topsoil, lightly vegetated
2	**Sand**	Sand with varying amounts of silt, loose to medium dense
3	**Clay**	Lean clay with varying amounts of sand, medium stiff to very stiff
4	**Siltstone**	Siltstone, weathered to very hard
5	**Claystone**	Claystone, firm to very hard
6	**Cemented Claystone**	Cemented claystone, very hard

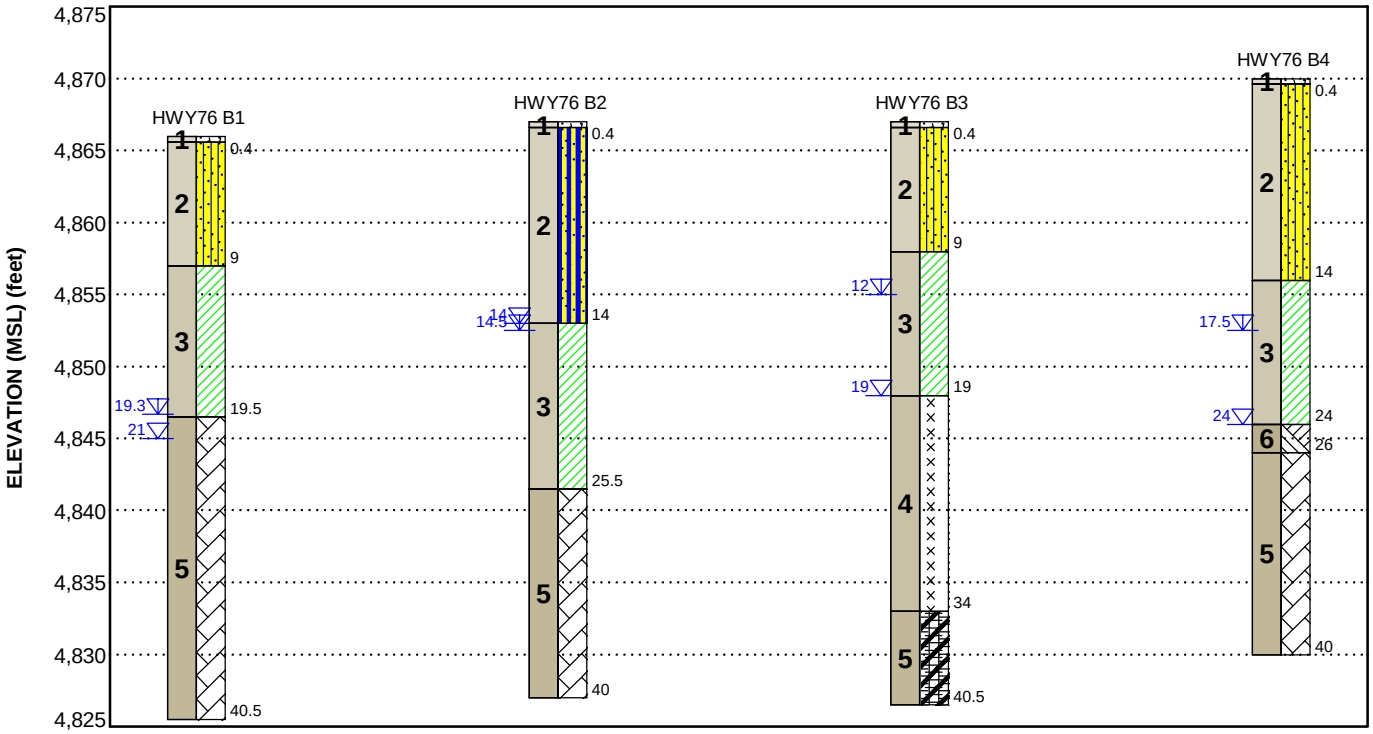
NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.

- First Water Observation
- Second Water Observation
- Final Water Observation

Groundwater levels are temporal. The 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.

GEOMODEL

High Plains to CIG 5C Expansion Project ■ Weld County, CO
12/28/2018 ■ Terracon Project No. 21185077



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	**Topsoil**	Topsoil, lightly vegetated
2	**Sand**	Sand with varying amounts of silt, loose to medium dense
3	**Clay**	Lean clay with varying amounts of sand, medium stiff to very stiff
4	**Siltstone**	Siltstone, weathered to very hard
5	**Claystone**	Claystone, firm to very hard
6	**Cemented Claystone**	Cemented claystone, very hard

LEGEND

- Topsoil
- Lean Clay
- Sandy Silt
- Claystone/Siltstone
- Silty Sand
- Claystone Bedrock
- Siltstone Bedrock
- Cemented Claystone

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.

- First Water Observation
- Second Water Observation
- Final Water Observation

Groundwater levels are temporal. The 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.

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

High Plains to CIG 5C Expansion Project ■ Hudson, CO

December 28, 2018 ■ Terracon Project No. 21185077

SAMPLING	WATER LEVEL	FIELD TESTS
Modified California Ring Sampler Standard Penetration Test	**Water Initially Encountered** **Water Level After a Specified Period of Time** **Water Level After a Specified Period of Time** Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**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 CLASSIFICATION

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

LOCATION AND ELEVATION NOTES

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

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance				BEDROCK		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (psf)**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3	< 30	< 20	Weathered
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4	30 - 49	20 - 29	Firm
Medium Dense	10 - 29	19 - 58	Medium Stiff	1,000 to 2,000	4 - 8	5 - 9	50 - 89	30 - 49	Medium Hard
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18	90 - 119	50 - 79	Hard
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42	> 119	>79	Very Hard
			Hard	> 8,000	> 30	> 42			

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

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.

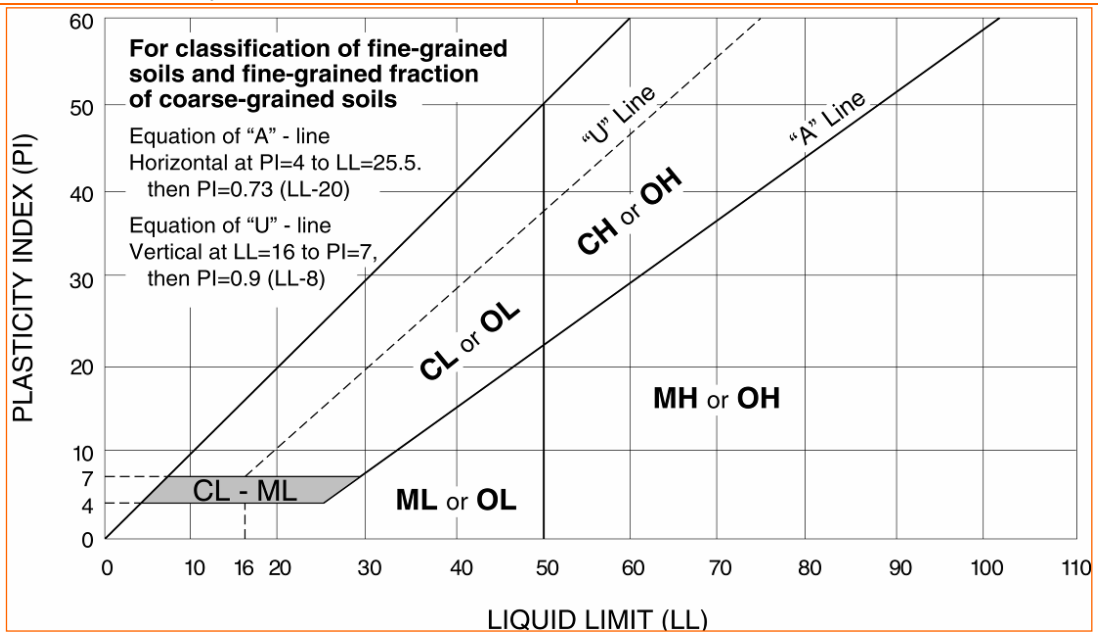
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[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.



WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

General

8. For each planned HDD crossing, provide an HDD assessment which includes a description of:

a. the likelihood of success for each drill;
b. any subsurface conditions that were identified as a result of geotechnical investigations that may increase the risk of HDD complications (e.g., unplanned inadvertent returns, drill hole collapse, contamination); and
c. the measures that would be implemented to minimize these risks.

Response:

a. In its response to General Question 7, CIG has provided the Golder Technical Memo dated March 18, 2019. Section 3 of that memo concluded that the HDD feasibility for the I-76 and Weld County ("WCR") 49 crossings are identified as good.

b. Section 1.0 of the Golder Technical Memo identified a potential for hydrolock of the pipe that could occur at the I-76 crossing. However, this risk can be mitigated. Further, the memo stated that the potential for inadvertent drilling return is low to moderate. As for the WCR 49 HDD, the memo identified a risk of drill hole collapse associated with the elevation difference of the start and end of the drill. Note that the risk of inadvertent drilling fluid return for the WCR 49 HDD is identified as low.

c. Mitigation measures that could be implemented in the case of hydolock at the I-76 HDD include a slow rate of advancement of the pipeline, maintenance of fluid circulation, and stopping advancement when pressure increases to allow for pressure dissipation. If hydrolock occurs, a percussive hammer can be used to loosen the pipe.

   In the case of the risk of hole collapse as identified as a risk for the WCR 49 HDD, techniques such as minimization of the lag time between hole completion and pullback, maintenance of drilling fluid circulation, and modification of drilling fluid properties to stabilize the hole will assist in minimizing the hole collapse risk.

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Response prepared by or under the supervision of:

Claudia Leal
Project Manager
303-914-4626

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

General

9. For each HDD crossing, describe the potential for hydrofracture and inadvertent return using the U.S. Army Corps of Engineers' Delft method (or an equivalent method) for crossings through unconsolidated material, and/or a qualitative analysis for an inadvertent return through bedrock utilizing rock quality designation values obtained from bedrock cores.

Response:

In Section 2.1 and 2.2 of the Golder Technical Memo dated March 18, 2019, which is provided in the response to General Question 7, the risk of hydrofacture and inadvertent return of drilling fluid is analyzed for the two HDD crossings using the US Army Corps of Engineers Delft Method. As identified in Section 3.0, the risk of inadvertent returns for the I-76 is identified as low to moderate and is identified as low for the WCR 49 crossing.

Response prepared by or under the supervision of:

Claudia Leal
Project Manager
303-914-4626

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Resource Report 1

2. Table 1-2 includes 3.1 acres for aboveground facilities' access roads for both construction and operation. Confirm there would be no temporary access roads used during construction of aboveground facilities, and this acreage is correct.

Updated Response:

On March 8, 2019 CIG provided a response to the informal request for information on Resource Report 1 Question 2. CIG is supplementing its prior response with the following information regarding the Project.

Table 8-3 submitted in CIG's March 8th response showed only access roads associated with above-ground facilities. As such the updated table was different from Table 8-3 provided by CIG in the original application which incorporated access roads associated with above- and below-ground facilities. Below is the revised Table 8-3 that includes both above- and below-ground facilities. CIG notes that the permanent High Five Meter Station Access Road A (0.2 acre) was changed to temporary, and the permanent High Five Meter Station Access Road B (0.03 acre) was added. CIG is also providing a revised Table 1-2 that shows a reduction of 0.2 acre of access roads for operation due to changing High Five Meter Station Access Road A from permanent to temporary.

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Table 8-3
Access Roads Proposed for Use During Construction and Operation

Facility	Temporary/Permanent/Existing	Approximate Acres of Impact
Kiowa Lateral		
Access Road A	Temporary (Existing)	13.5
Access Road B	Temporary (Proposed)	1.9
Access Road C	Temporary (Proposed)	2.2
Access Road D	Temporary (Existing)	1.3
Access Road E	Temporary (Proposed)	0.9
Access Road F	Temporary (Proposed)	1.0
High Five Lateral		
N/A	N/A	N/A
High Five Meter Station		
Access Road A	Temporary (Proposed)	0.2
Access Road B	Permanent (Proposed)	0.03
Prairie Hound Meter Station		
Access Road A	Permanent (Proposed)	1.1
Access Road B	Permanent (Proposed)	0.2
Access Road C	Permanent (Proposed)	0.2
Access Road D	Permanent (Proposed)	0.3
Lancaster/Kiowa Tie-In		
Access Road A	Permanent (Existing)	1.0
Lancaster/High Five Tie-In		
Access Road A	Permanent (Proposed)	0.1
Fort Lupton Contractor Yard		
Access Road A	Existing	1.2
	TOTAL	**25.33**

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Table 1-2
Project Land Requirements

Facility	Construction (acres)[a]	Operation (acres)
Pipeline Facilities		
Kiowa Lateral	104.4 [a]	44.5
High Five Lateral	7.7 [a]	4.3
Access Roads	20.8	0.0
Subtotal	**132.9**	**48.8**
Aboveground Facilities		
Prairie Hound Meter Station	1.9 [a]	0.9
High Five Meter Station	2.3 [a]	0.9
Lancaster/Kiowa Tie-In	3.0 [a]	0.1
Lancaster/High Five Tie-In	1.3 [a]	0.2
Access Roads	3.1 [b]	2.9
Subtotal	**11.6**	**5.0**
Contractor Yards		
Fort Lupton Contractor Yard	12.7	N/A
Access Roads	1.2	N/A
Subtotal	**13.9**	**N/A**
TOTAL	**158.4**	**53.8**

[a]Construction acres include operation acres
[b]Construction acres include operation acres entirely. See Table 8-3 for additional detail.

Response prepared by or under the supervision of:

Mike Bonar
Environmental Project Manager
719-520-4817

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Resource Report 1

7. For section 1.4.4 and table 1-2, provide information on maximum depth of disturbance for both HDD and boring.

Response:

The Environmental Report states that CIG planned to conduct road crossings using HDD technology for Weld County Road ("WCR") 49 and I-76, and proposed to have the options of crossing the 3 wetland areas using HDD technology or open cutting the wetlands. Since submitting the Environmental Report, CIG has decided to cross the 3 wetland areas implementing open cut methodology. Thus, the only remaining HDD crossings will occur at WDR 49 and I-76.

Based on the Golder Technical Memo dated March 18, 2019, being provided in CIG's response to General Question 7, the maximum depth of disturbance for the WCR 49 HDD is approximately elevation 4,872 feet, or approximately 52 feet below ground surface ("BGS"). The geotechnical borings in this location extend to the approximate elevation of 4,874 feet.

The maximum depth of disturbance for the I-76 HDD is approximately 4,840 feet or approximately 29 feet BGS. The geotechnical borings extend to the approximate elevation of 4,826 feet.

Response prepared by or under the supervision of:

Claudia Leal
Project Manager
303-914-4626

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Resource Report 1

8. For features where Colorado Interstate Gas has identified several potential crossing methods, clarify if Colorado Interstate Gas's proposed workspaces would be sufficient for any selected method or provide revised alignment sheets and a revised discussion of impacts, as appropriate.

Response:

As stated in its response to Resource Report 1 Question 7, the Environmental Report states that CIG proposed the options of crossing the 3 wetland areas by either HDD or Open Cut technologies. Since submitting the original Environmental Report, CIG has committed to implementing the open cut methodology for the three wetland crossings. As such, CIG has reviewed the size and location of all of the temporary workspaces associated with the road and wetland that include crossings the HDD crossings of Weld County Road ("WCR") 49 and Interstate 76, the core crossing of WCR 59, and the open cut crossings of the wetlands that the temporary workspaces identified on the alignment sheets are adequate to perform these crossings.

Response prepared by or under the supervision of:

Claudia Leal
Project Manager
303-914-4626

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Resource Report 4

7. The treatment plan needs a discussion on consultation with tribes, agencies, and other interested parties as appropriate for treatment of historic properties that may be affected by the proposed Project. File the revised plan.

Response:

Please see Attachment 4 behind this response for the revised treatment plan.

Response prepared by or under the supervision of:

Mike Bonar
Environmental Project Manager
719-520-4817

Metcalf Archaeological Consultants, Inc.

Beyond Compliance Archaeology *Est. 1980*

DISCOVERY PLAN AND TREATMENT PLAN:
KINDER MORGAN CIG HIGH PLAINS KIOWA LATERAL EXPANSION PROJECT, WELD COUNTY, COLORADO

Principal Investigator
Anne McKibbin

Prepared for

Golder Associates
44 Union Boulevard, Suite 300
Lakewood, Colorado 80228

Prepared by
Metcalf Archaeological Consultants, Inc.
11495 West 8th Ave, Suite 104
Lakewood, Colorado 80215

December 2018, revised March 2019

For Official Use Only: Disclosure of Site Locations Prohibited (43 CFR 7.18)

DISCOVERY PLAN

Metcalf has presented a discovery and treatment plan for the proposed KM Kiowa Lateral Pipeline Expansion Project in its report (Anderson and Roberts 2018) recently submitted for review to the Colorado SHPO and the FERC. The FERC has requested revision of the plan to include a procedural element addressing how discoveries will be handled, including roles and responsibilities of those involved in the discovery and the management thereof (see Procedures below).

Upon the discovery of cultural materials during monitoring, the first priority will be to insure that no further damage is done to the cultural remains. Construction will be halted in the immediate vicinity of the location of the cultural materials. During this time, Metcalf will assess the immediate needs for test excavations, other recording, and possible alterations to the construction plan. If necessary, further construction activity in the immediate area will be halted, limited, or altered in order to protect the find. This may affect some or all aspects of the remaining construction including pipe stringing, bending, welding, lowering in, backfilling, right-of-way re-contouring, and reclamation. Monitoring of these activities by Metcalf personnel will be considered in order to insure that further damage does not occur. In rare circumstances, it may be prudent or necessary to close a portion of the right-of-way to all construction traffic while further archaeological investigations are performed. Close communication will be maintained with Kinder Morgan and the construction contractor so that all parties clearly understand any limits or constraints on the continued construction.

If testing is deemed necessary, it will continue at each locality until enough information has been recovered to allow site eligibility to be determined and formulation of recommendations regarding any further work. If cultural materials are found to be significant and are such that the site should be considered eligible, then testing will continue until sufficient information has been recovered to prepare a data recovery plan, if that point hasn't been reached by the initial testing for eligibility. For all excavations, priority will be given to those that must be completed prior to continued construction. It may be possible to postpone testing until later in the construction process or after construction is completed if the find is not further threatened. Pipeline reroutes or boring under the resources are additional alternatives that may be considered on a case-by-case basis.

All references herein to "archaeologist" or "archaeological team" will be to an archaeologist listed on a State of Colorado Archaeological Permit in the principal investigator or project archaeologist category, or a team led by the same.

PROCEDURES

If at any time during construction, including pre-construction field activities and post-construction reclamation, anyone involved in the project finds what is or may be historic or prehistoric archaeological remains of any type, or human remains, this will be considered a discovery and will be investigated according to the procedural flowchart shown in Figure 1. This includes any cultural resources or human remains that may be found by a monitoring archaeologist, if present at the time. (Metcalf has made recommendations for right-of-way

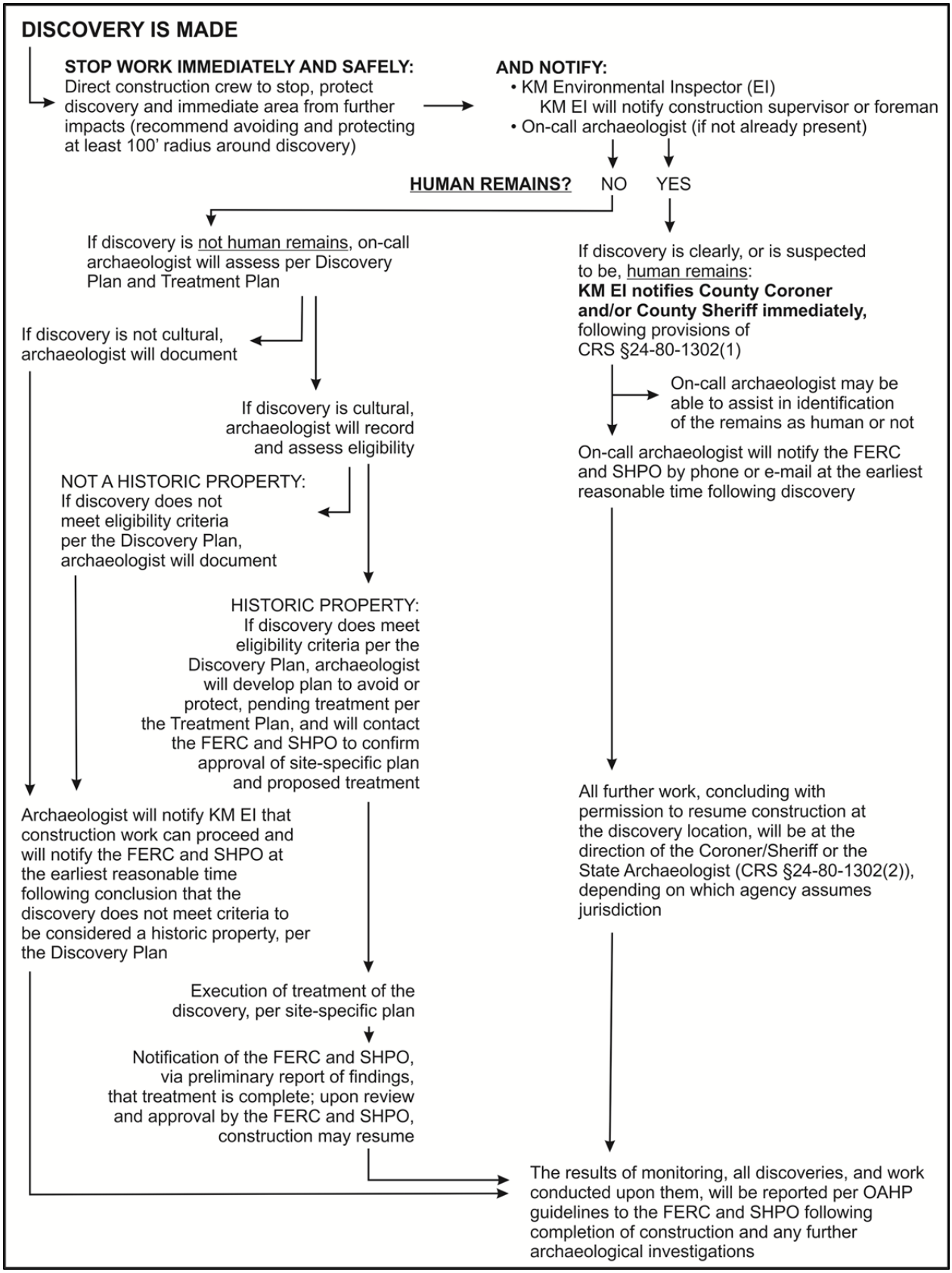


Figure 1. Schematic decision-making tree for cultural resource discoveries.

construction monitoring and open trench inspection for certain portions of the project area as described in its report [Anderson and Roberts 2018:42-45]).

The procedural flow-chart presented in Figure 1 shows the decision-making and notification process Metcalf recommends in the case of a cultural resource or human remains discovery on the project. This is based on substantial experience with similar FERC-jurisdictional pipeline projects and follows several basic sequential steps. In the event that the discovery involves human remains, the notification and investigation process is statutorily determined by Colorado's Unmarked Human Graves law, CRS §24-80-1301-1305, as described in more detail in the Unanticipated Discoveries Plan for this undertaking (under separate cover).

First, any construction work at the location of the discovery, including the work that may have exposed the discovery, must stop safely and immediately, and steps taken to protect what has been exposed from further disturbance. If the discovery is found by a monitoring archaeologist, the archaeologist will ask the construction operator(s) to stop work either via direct communication on-the-spot with the operator or his or her swamper, or by communicating with the construction supervisor, if that person is on site.

The initial notification of the discovery and the stoppage of work at the location is to Kinder Morgan's Environmental Inspector (KM EI), or someone of equivalent authority at KM's direction. If there is no archaeologist at the location, the on-call archaeologist will be notified at the same time by the KM EI.

The first assessment to be made is whether the discovery consists of or includes human remains. The on-call archaeologist may be able to assist in this determination. If human remains are suspected or known to be present, the KM EI will immediately notify the Weld County Sheriff and/or the Weld County Coroner, as required by state law. As soon as is reasonably possible (same day, or next working day if on a weekend or holiday), the on-call archaeologist will contact the SHPO and the FERC by phone or e-mail to notify them of the situation.

If human remains are present, the discovery falls under the jurisdiction of the County until such time as it determines whether the discovery is of forensic interest. If it is, then the County retains jurisdiction. If it is not, jurisdiction is turned over the State Archaeologist. One or the other of those agencies retains jurisdiction, control, and authority over the find until resolution or completion of any investigations, consultation, exhumation, or other treatment is completed. At that time, the agency presumably will then allow work to resume in the discovery location.

If the discovery is cultural and does not contain human remains, the on-call archaeologist will begin a several-step assessment process. First, the archaeologist will confirm whether the discovery is cultural, or a natural or recent phenomenon. If it is cultural, the archaeologist will record the discovery and conduct any necessary evaluative work, such as test excavations, to provide sufficient information to support a recommendation regarding National Register eligibility. This will follow methods and strategies and evaluation criteria provided below in the section entitled Evaluation Criteria for Discoveries.

Importantly, this discovery plan and treatment plan applies to discoveries that can be *anticipated* or reasonably expected based on the results of the Class III inventory and broader experience in the region. If cultural materials are found that are of a type, extent, age, or nature that is truly different and unusual, or unique, and thus could be considered *unanticipated*, then this discovery and treatment plan, beyond the very initial steps of assessing what has been found, will not apply. Instead, all work at the location will stop, the unanticipated discovery will be protected from further impacts, and the project archaeologist will notify the FERC and the SHPO immediately (same day or next business day if on a weekend or holiday) to begin consultation on treatment. Construction work at the location will not resume until directed to do so by the FERC. Please see the accompanying Unanticipated Discoveries Plan for this project.

If the anticipated discovery meets the evaluation criteria to be considered a historic property (a resource eligible for the National Register), the archaeologist will work with the KM EI and others as appropriate to develop a site-specific plan for treating the discovery as mitigation to the adverse effect resulting from the construction activity which exposed the cultural materials. This will proceed according to the Treatment Plan detailed below. The archaeologist will contact and discuss this plan with the SHPO and the FERC prior to proceeding with any surface disturbing work at the historic property. At this time, the archaeologist will also provide any additional information or documentation requested by either the SHPO or the FERC.

The site-specific plan may include a recommendation to leave the discovery alone and to allow construction to proceed if the nature of the discovery and the sediment context in which it is preserved is stable enough and at sufficient depth below surface that further impacts are not anticipated. This is discussed in the report (Anderson and Roberts 2018:46). Postponing testing at certain locations until after construction is partially or fully complete is a strategy commonly implemented by Metcalf, with FERC and SHPO approval, on pipeline projects where open trench inspection will occur. It is applied primarily as a safety consideration, keeping archaeologists out of the construction zone and away from the open trench to the extent possible, and to reduce the disruption to the construction process as much as is reasonably feasible. It is recommended only in circumstances where cultural materials are exposed in the wall of the pipeline trench, those materials are at least 30 cm (1 ft) below the right-of-way surface, where the deposits are stable and well-consolidated, and risk of trench wall sloughing is minimal. Under these conditions, the damage to the discovered resource is already done, and if these conditions exist, it is very unlikely that further damage will be done as construction continues. It is never applied in the case of discovery of human remains or suspected human remains. The discovery is shot in with GPS (post-processed to sub-meter accuracy) taking several shots to adequately map the extent of the exposure in the trench wall, and then pipe laying and backfilling are allowed to occur. The archaeologists return to the location following backfilling and conduct test excavations to further expose and assess the discovery. Monitoring of some or all of the construction steps following discovery may be warranted to assure the integrity of the discovery remains.

At each point in the decision-making process just outlined, the archaeologist will maintain contact with the KM EI, the SHPO, and the FERC to inform them of decisions being made concerning discoveries, their National Register assessments, and proposed further work, all of which will follow the Evaluation Criteria and Treatment Plan.

If a historic property discovery is made that then proceeds to data recovery excavation, the archaeologist will provide the FERC and the SHPO a preliminary summary of work performed and results no more than two weeks after close of field work, at which time it is anticipated that the FERC can release the discovery location back to KM for continuing construction, if construction has been postponed at the location.

Finally, a final report to the FERC of all results of archaeological monitoring will be prepared following close of all field work.

Consultation with parties other than SHPO, including tribes, is not recommended at this time. There has been no response from any tribe expressing interest or concern in resources that might be affected by the project. Given that, and unless something unusual or unanticipated is found, or if something is found for which direct tribal affiliation may be established, or if a future response to the initial inquiries to tribes presents a different circumstance or specific request, Metcalf recommends that tribal consultation conducted to date is sufficient. To Metcalf's knowledge, no other consultation parties have been involved, nor does Metcalf recommend the need to consult beyond that with the SHPO.

The Discovery Plan and Treatment Plan are prepared based on all reasonably expected types of cultural materials that may be found during construction. These are expected to be archaeological in nature, either historic or prehistoric in age, and located in subsurface contexts at varying depths. If something is found that, in the professional judgment of the on-call archaeologist and his or her team, cannot be reasonably assessed or treated according to the procedures just outlined, the archaeologist will notify the KM EI of this situation, and then begin consultation with the FERC and the SHPO about how to proceed. While this is ongoing, and until a resolution is reached for how to move forward, the discovery will be protected from any further impact, which may include a more prolonged cessation of construction activity at its location.

EVALUATION CRITERIA FOR DISCOVERIES

Given the context of proposed monitoring areas and the previously recorded sites in the vicinity, the most likely resources are prehistoric camps. These resources will first be evaluated for integrity and then against the National Register eligibility criteria (36 CFR §60.4). The most likely applicable criterion is "d," yielding information important in the study of prehistory. Evaluation under this criterion is done against a backdrop of an established research context that sets out research domains (study units) or questions considered important for a specific area (see Treatment Plan for Prehistoric Sites section, below).

To be considered suitable for evaluation beyond initial testing, discoveries, must, at a minimum, have integrity, be datable, and should retain evidence of function and subsistence activity. The evaluation of integrity will take into consideration the degree of modern impacts as well as those that have occurred in the past. The use of bulk soil samples for radiometric dates or the use of temporally diagnostic materials as the primary chronological control will only be considered as a last resort and only for materials significant, exclusive of their age, given the

imprecise and/or general nature of these dating techniques. There must be an indication that the cultural materials are in contexts that can be reasonably expected to allow segregation of multiple occupations or components if present. Small, low-density artifact scatters and/or features will be considered for further work only under certain circumstances. They will not be subject to further evaluation beyond descriptive recordation unless they first clearly possess the qualities of integrity, and they meet one or several of the following conditions: 1) preserve sufficient data to allow basic functional interpretation and represent a chronological period and function that is relatively poorly understood in the region; 2) have an indication of discrete occupations or components of differing ages; 3) can be radiometrically dated using charcoal samples of sufficient size to preclude extended count or accelerator processing; or 4) contain unusual or uncommon features, artifacts, or assemblages.

Several typical archaeological manifestations will not be subject to further evaluation. These include isolated simple hearths lacking in associated cultural materials or lacking an associated intact cultural surface, scatters of fire-cracked rock without evidence of associated features or materials, scatters of chipped stone debitage or bone debris in contexts lacking chronological control, and strata of cultural materials that clearly rest on an unconformable geomorphologic contact (buried erosional surface). Exceptions to these include isolated hearth features that can be reliably dated in geomorphologic contexts that suggest either great antiquity, or in contexts where chronologic control may have implications for site interpretation elsewhere in the immediate vicinity or region; and isolated features of uncommon morphology. The collection and processing of radiocarbon samples for materials or features that are not associated with a larger, significant archaeological context will not be considered.

TREATMENT PLAN FOR PREHISTORIC SITES

Monitoring of selected depositional environments is proposed for major drainage crossings and along the stabilized dune fields of the South Platte River Basin. This inspection is proposed because of the potential for buried prehistoric sites in alluvial and aeolian depositional settings. A generalized treatment plan, drawn from experience with similar projects, is presented here to cover a broad range of expected prehistoric resources that might be encountered during monitoring. Sufficient information was collected during the survey phase of this project to anticipate that some prehistoric resources may be discovered during construction. Rather than treating these expected resources as discoveries under 36 CFR §800.13, they are covered under this treatment plan.

Research Design

Theoretically, Metcalf orients its archaeological research with human-environment relationship models that attempt to explain how prehistoric hunter-gatherers organized themselves across the landscape and obtained resources essential to existence. Binford (1980) provides a useful framework for understanding the continuum of organizational strategies that hunter-gatherers employ in different environmental settings. Issues of resource homogeneity and residential mobility influence what subsistence strategies people pursue and what physical remains are left behind to represent the subsistence activities undertaken at a site. Optimal foraging theory provides an alternative approach to understanding human subsistence strategies by beginning with the assumption that humans would prefer to maximize energy gain and

minimize energy output in their pursuit of food and other resources. Models have been formulated to deal with such aspects of foraging as diet choice, foraging location, and foraging time, etc. (Bettinger 1991:84). These optimize food type selection, foraging location (or "patch") selection, and time spent traveling between and foraging within patches according to energy (and time) gains and expenditures (Bettinger 1991:84-92).

An "optimal" approach can be applied to the organization of technology as well (Torrence 1989b), although, as Torrence suggests, tool manufacture and use, as well as subsistence strategies in general, may be more closely aligned with the reduction of risk than the preservation of energy. In this view, energy is not a limited quantity, per se, but the circumstances (temporal and spatial) of its availability can be – wherein lies the risk that must be ameliorated in some fashion. Subsistence strategies are really risk-management schemes in which technology is employed to solve particular problems, usually the prevention of resource loss (Torrence 1989a:4; 1989b:58-62). Potential problems with the use of optimization theory in the study of technology include those shared with other avenues of research, such as the "oversimplification of complex behaviors" and the need for "clear, reproducible definitions of data categories," as well as problems unique to stone tools (Jochim 1989:107). Researchers must recognize "that not all stone tool technologies will be sensitive indicators of all, or most, complex aspects of human behavior" and that ultimately, "Stone tools…cannot, however, be isolated from other evidence of prehistoric human behavior" (Jochim 1989:107, 111).

Unfortunately, archaeologists do not recover "activities", "strategies", or "human-environmental relationships" from excavated sites. They find only the physical remains – the tools, the features, the refuse, the structures, the burials, etc. These remains are used to interpret past behaviors using inferential arguments that link contemporary knowledge and observations with the archaeological materials (Binford 1983). The systemic context of each artifact must be considered in its analysis: How was the artifact made? How was it used? Why was it discarded? Why was it reused? Natural and cultural post-depositional forces may also affect the archaeological remains and must be accounted for in the interpretation process (Schiffer 1972). The methods employed in the analysis of the artifacts are multidimensional, classifying each artifact according to several different domains of human behavior, maximizing our understanding of the context(s) in which it was made, used, and discarded.

Research Topics

The goal of data recovery is to gain some understanding of the activities undertaken by the sites' inhabitants; to place those activities (where possible) in the contexts of their cultural and natural environments; and to chronicle meaningful cultural change – as inferred and measured from the recovered archaeological materials and the natural setting of the sites themselves. Potential research topics are described below. Table 1 provides an outline of the types of materials likely to be encountered at a prehistoric site, the analyses they undergo, and the research topics to which they relate. Because stone artifacts are usually the most commonly encountered material in prehistoric sites and form the vast majority of artifacts, substantial attention is given to their analysis and interpretation in this treatment plan. Ultimately, however, it is the information these artifacts reveal about overall site function, rather than the artifacts themselves, that is most important.

Paleoenvironment/Seasonality: Reconstruction of the prehistoric climate and environment of the project area is important to understanding many aspects of the prehistoric occupations. A reconstruction pursued through pollen, faunal, soil, and geomorphological analyses can potentially shed light on such issues as seasonality, settlement, and subsistence. Of particular interest is determining what the landscape was like during site occupations(s) and why the occupants were attracted to these locations.

Cultural Chronology: Establishing and adding to regional cultural chronologies is an important goal. Chronologies provide a framework to which sites can be added or compared, enhancing our understanding of prehistoric lifeways in a given area. Charcoal and bone samples for radiocarbon dating, diagnostic projectile points, artifact assemblages, and soil stratigraphy can all provide indications of the age of the cultural deposits. The most recent and valuable synthesis of the prehistoric chronology of the study area is Gilmore et al. (1999).

Table 1. Archaeological Data, Analyses, and Research Topics

DATA SOURCE	TYPE OF ANALYSIS	RESEARCH TOPIC
Chipped stone flaking debris	Technological	• Lithic technology • Site function • Intrasite spatial variability • Cultural change
	Source area	• Settlement patterns • Cultural change
Stone tools	Technological/functional	• Lithic technology • Site function • Intrasite spatial variability • Subsistence
	Typological	• Chronology • Culture change
	Source area	• Settlement patterns • Culture change
Features	Morphology	• Site function • Intrasite spatial variability
	Contents	• Subsistence • Seasonality • Culture change
	Radiocarbon assay	• Chronology
Faunal remains	Species identification	• Subsistence
	Evidence of butchering/processing	• Subsistence • Settlement patterns • Site function • Intrasite spatial variability
	Age estimation	• Seasonality

DATA SOURCE	TYPE OF ANALYSIS	RESEARCH TOPIC
Floral remains	Species identification	• Subsistence • Site function • Intrasite spatial variability • Seasonality • Paleoenvironment/climate
Soils	Pedology	• Paleoenvironment/climate
	Sediment analysis	• Chronology
	Site formation processes	• Site preservation • Site destruction

Subsistence/Settlement: Knowledge of the materials used and the foods consumed by a site's occupants and the way a site fits into the structure of nomadic life ascribed to prehistoric hunter-gatherers by Binford (1980) can also be used to understand the site's function. Floral, faunal, and technological data can provide direct indications of the resources exploited as well as season of use.

Site Function: Interpretation of the recovered and analyzed lithic, faunal, and floral remains can provide clues about the site function(s) or range of activities engaged in by the prehistoric occupants during a given period. Determining site function is basic to studies of regional subsistence, settlement patterns, and culture change.

Lithic Sources and Technology: Stone artifacts are the most commonly encountered type of cultural remains at prehistoric sites. Data resulting from a detailed analysis of lithic assemblages can be used to address the subjects of site function, chronology, technology, intrasite variability, culture change, and the procurement of lithic raw materials.

Data Recovery Excavation

Prehistoric sites whose significance lies in their archaeological potential are generally treated by means of data recovery excavations in order to recover the data that causes them to be significant, and thus mitigate adverse affect resulting impacts to the site. Should significant cultural materials be found during monitoring, data recovery excavations may be appropriate.

Data recovery will involve excavation of blocks of one square meter excavation units. The research design identifies the activity area as the critical cultural unit and the focus of data recovery. Activity areas are best explored in block excavations of sufficient extent to recover a reasonable sample of materials so that activities can be identified, and the distribution of artifacts and, by inference, individual activities, can be understood within the context of the larger activity area. These block excavations are estimated to be from about 20 sq m in size to over 100 sq m depending on the nature and extent of the cultural materials.

Data recovery excavations will be conducted within a grid system established at each site. Excavation will proceed as 1 sq m excavation units, each designated by a grid coordinate. Excavation will proceed in 10 cm levels, which, like those in the test pits, will be oriented either

with the ground surface or will be horizontal, depending on the nature of the sediment units that make up the site matrix. Excavation levels will follow natural or cultural levels where possible, but this is not expected to be viable on most sites. Excavation in thinner 5 cm levels will be considered only where this allows resolution of separate cultural levels that would otherwise be blurred by 10 cm excavation levels.

All excavated matrix will be screened through ¼" mesh hardware cloth, with the exception of samples noted below. Vertical control will be maintained from a site-wide vertical datum, which will be used to correct local datums to the same "zero" elevation. A constant volume (5 liters) sample of fill from each excavation level will be saved for fine screening (1/16") to recover artifacts that would otherwise escape detection through ¼" mesh. These samples will be dry screened on-site if possible, but may be water-screened at a suitable location at the project area, or returned to the lab for screening. All materials that do not pass through the fine screen will be sorted in the laboratory regardless of the method or location of screening.

All artifacts will be collected and provenienced to the site, excavation unit, and level. Chipped stone debitage and bone debris will be bagged together by provenience and catalogued. Tools will be bagged and catalogued individually. If tools are found in situ, they will be point plotted. No specific effort will be made to point plot all tools or other classes of artifacts unless some unique characteristic of the assemblage indicates that such detail will be informative.

Features are anticipated to consist of hearths, other basin features, structures, and burned rock clusters or middens. These will be treated by first exposing their lateral extent, then mapping and photographing the feature. For basin features, fill will be removed from half of the basin. It will be excavated in 10 cm levels if of sufficient depth. Feature fill will be screened through ¼" mesh and a five liter constant volume sample will be recovered for 1/16" screening. Samples, such as flotation, pollen, charcoal, and bulk soil for radiocarbon will be taken as appropriate. Once half the feature has been emptied, the feature will be profiled and photographed. If the profile reveals cultural or natural strata within the feature fill, they will be followed in the excavation of the second half. Otherwise, excavation will proceed in the same fashion. Samples will not be duplicated unless the original samples are found to be inadequate. A final map and photographs will be taken when excavation is complete. If pollen samples are recovered from the feature, control samples will be taken from the occupation surface nearby. Structures will not be treated significantly differently, except to segregate inside and outside proveniences. Collection of flotation, pollen and radiocarbon samples will be considered if appropriate. Burned rock features will be exposed, mapped, and photographed. To the extent that a sediment matrix from among the rocks can be segregated, it will be treated as a separate provenience, and sampled accordingly.

The lateral extent of excavations will terminate when activity areas have been adequately sampled, further excavation is likely to yield only redundant information, or there is no indication of additional significant information in the unexcavated contexts. The depth of the excavation will be limited by the depth of cultural materials, although excavation of one or several units into sediments underlying the cultural materials, although excavation of one or several units into sediments underlying the cultural level(s) will be considered if there is important sedimentological or geoarchaeological information to be recovered.

All artifacts recovered during excavation will be bagged, labeled, and entered onto a catalogue in the field. Ground stone artifacts will be collected and packaged in anticipation of pollen and starch analysis. Chipped stone tools, and possibly certain ground stone implements, will be packaged in anticipation of possible blood residue analysis. All samples recovered during excavation will be appropriately bagged or packaged, labeled, and entered onto a sample log in the field.

Record keeping will include level notes kept by the excavators, daily notes at each site kept by the site's crew chief, and daily project notes kept by the project manager. Features will be individually recorded on feature forms. Scaled maps and profiles will be made where appropriate and photographs will be taken as work progresses, focusing on specific findings and on the excavation in general. All sites that undergo data recovery excavation will be instrument mapped.

Analysis

All collected cultural materials will undergo analysis. The goals of all analysis are to derive as much information as possible about the activities that produced the artifact assemblage, to place artifacts that typically provide some chronological information in context with other datable materials, to describe the technology of the artifact manufacturing process, and to examine raw materials for use of exotic material types. Chipped stone debitage, chipped stone tools, and ground stone tools will be analyzed by Metcalf. Other specialists may analyze ceramics, historic artifacts, and bone. Beta Analytic will process radiocarbon samples. Macrobotanical, pollen, and starch analyses will be outsourced to regional experts. Metcalf's geomorphology expert will do geoarchaeological investigations.

Reporting

A Treatment Report for the project will be prepared when all archaeological investigations are complete. It will follow the guidelines of FERC, and those of the Colorado OAHP. The report will describe the results of the investigations and discuss how they contribute to identified research topics of the area. A preliminary Management Summary report will be submitted within 30 days of the close of fieldwork. These two documents will be separate reporting efforts unless the results of further investigations are negative or exceptionally simple, in which case one report will serve both purposes.

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COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Resource Report 6

3. Provide a table that identifies areas of steep slopes that would be crossed by the Project. Include the following in the table:

a. start milepost of steep slope crossing;
b. end milepost of steep slope crossing; and
c. range of slope for each crossing location (i.e., 15%-30% slopes, 30%-50% slopes, 50-70% slopes, and greater than 70%).

Include a discussion of where susceptibility to slope failure may exist and describe any methods that Colorado Interstate Gas would use to mitigate and restore these areas; as well as any special measures that Colorado Interstate Gas would employ to stabilize these slopes prior to revegetation.

Response:

The table below identifies areas of steep slopes that would be crossed by the Project. The table identifies that eleven areas will be crossed by the Kiowa Lateral. The High Five Lateral does not have terrain with steep slopes greater than 15%.

Summary of Slopes		
Begin Station	End Station	Slope Range (percent)
Kiowa Lateral		
17+59	17+73	15-30
19+59	19+71	15-30
19+97	19+99	15-30
21+60	21+67	15-30
289+79	289+88	15-30
455+55	455+78	15-30
457+76	458+06	30-50
458+96	459+43	30-50
468+00	470+17	30-50
471+68	471+70	50-70
471+73	471+76	50-70

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

A desktop review of Colorado's publicly available on-line landslide database was completed and no mapped landslides are inventoried along the proposed pipeline right-of-way. Areas of steep slopes as summarized in the Summary of Slopes table above. These areas are typically localized and less than 50-feet in length, which suggests that they are not are particularly susceptible to any type of slope failure.

Examples of slope stability mitigation options that may be utilized on this project include re-grading the ROW surface to improve site conditions, modifying local surface drainage, conveyance of sub-surface drainage, modified ROW backfill materials, removal of unstable soil and replacement with engineered performance materials, ground surface erosion protection, slope breakers (water bars), and trench breakers. Temporary surface erosion protection measures may be implemented until vegetation has taken hold and may include erosion control matting, coir/jute cloth, straw/hay bales, coir breakers, and hydro-seeding.

Response prepared by or under the supervision of:

Mike Bonar
Environmental Project Manager
719-520-4817

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Resource Report 7

1. Colorado Interstate Gas states in section 7.6 “for all areas, including prime farmland, ditch line only topsoiling is the suggested method.” Clarify if Colorado Interstate Gas would conduct topsoil segregation in areas designated prime farmland (and whether this would include areas designated unique farmland or farmland of statewide or local importance) even if these areas are not in unsaturated wetlands or in agricultural use.

Updated Response:

On March 8, 2019 CIG provided a response to the informal request for information on Resource Report 7 Question 1. CIG is supplementing its prior response with the following information regarding the Project.

CIG will utilize the ditch line only method in areas designated as prime farmland. CIG would place a barrier between subsoil and topsoil within these areas to minimize mixing. In addition, CIG is providing a revised Reclamation Plan as Attachment 5 and the Reclamation Plan Deviations from FERC Standard Procedures as Attachment 6 behind this response. Specifications that differ from FERC Guideline are shown underlined and in italics.

Response prepared by or under the supervision of:

Mike Bonar
Environmental Project Manager
719-520-4817

Reclamation Plan

Colorado Interstate Gas Company

High Plains Kiowa Lateral Expansion Project
Weld County, Colorado

Colorado Interstate Gas Company, L.L.C.
a Kinder Morgan company

March 2019

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1.0 Introduction

Reclamation of the Colorado Interstate Gas Company (CIG) High Plains Kiowa Lateral Expansion Project (Project) right-of-way must overcome difficulties resulting from soil conditions and harsh weather typical of the eastern plains of Colorado. While CIG will follow FERC's 2013 Upland Erosion Control, Revegetation, and Maintenance Plan (FERC Plan) and FERC's 2013 Wetland and Waterbody Construction and Mitigation Procedures (FERC Procedures), a site-specific reclamation plan is also important for successful revegetation of the Project's disturbed areas.

Specifications included in this Reclamation Plan are intended to supplement the general FERC guidelines, which will remain in effect for this project, but the specifications in the Reclamation Plan will supersede those guidelines where they are contradictory. *Specifications that differ from the FERC guidelines are indicated in underlined italics.*

CIG, through its pipeline contractor, will have overall responsibility for the reclamation effort. CIG will require the pipeline contractor to subcontract the revegetation effort to a qualified revegetation contractor with local experience. All seedbed preparation after topsoil replacement will be performed by the revegetation contractor, who will be responsible for any discing, seeding, application of fertilizer and/or manure, mulching, crimping, etc.

2.0 Soil Management

2.1 Clearing, Grading, Topsoiling

Unless otherwise specified, the right-of-way width will be 85 feet. Exceptions include a right-of-way width of 75 feet in wetland areas and right-of-way widths greater than 85 feet in specified extra work areas.

In shrubby or brushy areas, the right-of-way will be mowed with a bush hog or similar implement before any grading or topsoil removal is performed.

In areas where the ground is naturally level, the working and spoil sides of the right-of-way will not be cut or graded. To eliminate uneven soils around the base of plants, and to provide a smooth working surface, skimming with a maintainer (moving no more than two inches of topsoil) may be performed with the concurrence of the environmental inspector (EI). The intention is to leave the topsoil, with its bank of native seeds and roots, as undisturbed as possible.

In naturally level areas, topsoil will be separated up to 12 inches in depth along the ditch line only. Topsoil from the ditch line will be placed immediately next to the ditch line on the working side and will be leveled and compacted in a lift located under the skids and the string of pipe. If soil conditions become pulverized or powdered out by construction vehicles to a depth of six inches or greater, and the pulverized soils are being lost off the right-of-way from wind or mixed with subsoils,

The EI will direct CIG to change operations and begin salvaging topsoil from the working side as further described below.

Where right-of-way grading is necessary, topsoil will be segregated as specified by the Environmental Inspector in consultation with the Chief Inspector.

Separation of salvaged topsoil and subsoil will be maintained throughout all construction activities. A physical barrier will be placed between topsoil and subsoil piles to prevent mixing of the soils after grading has occurred.

Segregated topsoil may not be used for padding the pipe.

Segregated topsoil in wind prone areas may be sprayed with water or an approved tacifier to form a crust to minimize soil losses due to windblown transport of topsoil.

2.2 Contouring, Decompaction, Topsoil Replacement

Cleanup operations should commence immediately following backfill. The right-of-way will be restored to its natural contours. *If compaction has occurred on the working side or other parts of the right-of-way, it should be ripped to a depth no greater than 12 inches.* In places where topsoil has been segregated, compacted subsoil will be ripped before replacing the topsoil.

Final grading, decompaction, topsoil replacement, and installation of permanent erosion control structures must be completed within 20 days of backfill.

If trees or other forms of natural woody debris are going to be replaced on the right-of-way, they will be stockpiled. After seeding has been completed, debris will be placed back on the right-of-way.

2.3 Rock

Where necessary, surface rock will be removed from the trench or right-of-way and stockpiled along the edge of the work areas. During cleanup, salvaged surface rock will be spread to blend with off-right-of-way areas, to conceal the corridor from adjacent undisturbed areas and to act as a mulch to minimize erosion. If spreading rock over the right-of-way will prevent the safe operation and maintenance of the pipeline, it will be removed and properly disposed. Rock may be stockpiled on the right-of-way edge near existing roads to keep the public from driving on the right-of-way.

Rock excavated from the trench may be used to backfill the trench only to the top of the existing bedrock profile. Rock that is not returned to the trench should be considered construction debris, unless it is approved for use as mulch (in areas with surface rock), or for some other use on the construction work areas by the landowner or land managing agency.

2.4 Cropland and Irrigated Pasture or Hayland

Ditch line topsoiling, rather than full right-of-way topsoiling, will be used on cropland and irrigated pasture or hayland, including Prime Farmland. This is a variance to the FERC plan, and is suggested as a way to eliminate as much soil handling as possible, minimizing mixing, loss, and wind erosion.

If rutting exceeds 6 inches in depth, significantly increasing the chance of topsoil mixing with subsoils, work will continue, and the rutted area will be covered with at least an adequate volume of new topsoil to replace mixed soils and subsoils. This topsoil will be purchased in the immediate vicinity. This is another variance from the FERC Plan. This variance would allow for continuation of construction during inclement weather at the cost of supplying new topsoil. This departure from the FERC Plan will not apply to rangeland.

Topsoil and subsoil will be tested by an EI for compaction at regular intervals with a penetrometer or other appropriate device. Compaction on the right-of-way should approximate the compaction level in adjacent undisturbed areas. Severely compacted agricultural land will be plowed with a paraplow or other deep tillage implement. Where topsoil has been segregated, the subsoil will be plowed before replacing the topsoil.

Excess rock will be removed from at least the top 12 inches of soil in all actively cultivated or rotated croplands and pastures, hayfields, and residential areas, as well as other areas at the landowner's request. The size, density, and distribution of rock on the right-of-way should be similar to adjacent areas not disturbed by construction.

Trench breakers will be installed in the trench on both sides of irrigation ditches to prevent channeling of irrigation water along the trench.

In irrigated pasture, after the pipe is placed in the ditch, the following criteria must be used for backfilling and compaction:

- Granular material will be placed on both sides of the pipe up to approximately the top of the pipe.
- Granular material will be water-settled by jetting or directing high pressure nozzles at the material to insure it is "washed" around the bottom half of the pipe.
- Backfill material (18 to 24 inches measured from top of pipe) will be placed in the ditch and leveled to allow compaction equipment to operate. Water will be added to the backfill material as necessary to achieve optimum compaction. The compaction equipment may be "wacker" packers, flat vibratory plates that are stand alone or mounted on a backhoe, or "sheepsfoot" rollers (either vibratory or non-vibratory). Extra care must be taken to avoid direct contact of the pipe with backfilling, leveling, or compacting equipment. The "aim" density is 92 to 95 percent.
- Additional lifts must be limited to a maximum of 12 inches. If compaction is not acceptable, the lifts will be reduced to eight inches.

- Topsoil will be restored, and the right-of-way leveled to blend topographically with the adjacent undisturbed fields. Irrigation will be restored over the right-of-way.

3.0 Seeding

3.1 Seeding Dates

The NRCS-recommended seeding window for the Project areas is from November 1 to May 15 for the native grass mix (Table 2) and November 1 to April 30 for the native grass (sand) mix (Table 3). *However, CIG plans to seed whenever the cleanup is complete, even if it is not in the recommended seeding season. This will permit establishment of at least some seed and does not relieve CIG of its responsibility to achieve acceptable reclamation after construction. CIG will mulch all areas seeded outside the recommended season, at mulch rates described below for seeded areas.* This determination will need to be made on a site-specific basis. For example, if the cleanup reclamation happens very late in the season during muddy or frozen soil conditions, CIG will be able to do no more than temporary stabilization in the form of temporary erosion control structures and mulch. Final decompaction and grading would likely wait until the following spring with seeding to follow. However, this situation is not expected on this project.

3.2 Seedbed Preparation

Decompaction of the right-of-way (ripping) will generally be performed by the cleanup crew. The seeding crew, however, may encounter surface compaction resulting from the use of a driving lane after cleanup, or due to surface crusting of soils after rain. There may also be clods left by ripping. The revegetation contractor will be equipped with discs or other tillage implements to deal with these conditions. To provide optimal conditions for drill seeding, soils are to be decompacted but firm to a depth of three to four inches.

Unnecessary discing should be avoided, since it is desirable to leave as much natural vegetation intact as possible.

3.3 Drilling and Broadcasting

Drill seeding is the preferred method and will be used whenever possible. The drill should be a reclamation-type drill, equipped with depth bands and with seedbox agitators and monitors capable of handling mixes of native seed species. One-half inch planting depth will be standard, with 6 to 10-inch drill spacing.

Seed may be broadcast rather than drilled in terrain where drilling is unsafe or impractical. Seed must be broadcast at double the drilling rate. Hand-operated or mechanically-powered cyclone type broadcasters should be used. Broadcast seed should be lightly covered or pressed into the

soil with a cultipacker, roller, or sheep's-foot. Where such implements cannot be practically used, seeds are to be incorporated with a chain drag or by hand raking.

3.4 Seed Mixes

All seed used will be certified unless certified seed is not available from any source. All seed tags will be provided to the reclamation EI. Seed mix categories to be used on the Project are listed by milepost in Table 1. Seed mix categories and seeding rates are detailed in Tables 2 through 4.

Table 1 - Seed Mixes to be used on the Project[1]

Starting Milepost	Ending Milepost	Distance (miles)	Site Characterization	Map Unit Symbol	Seed Mix
High Five Lateral					
0	0.021	0.021	Loamy Sand	73	Mix 2
0.021	0.053	0.032	Loamy Sand	44	Mix 2
0.053	0.094	0.041	Loamy Sand	73	Mix 2
0.094	0.072	0.629	Sand	69	Mix 2
Kiowa Lateral					
0	0.347	0.347	Sand	70	Mix 2
0.347	0.415	0.068	Sand	69	Mix 2
0.415	0.449	0.033	Sand	70	Mix 2
0.449	0.647	0.198	Sand	69	Mix 2
0.647	0.882	0.235	Sand	49	Mix 2
0.882	1.250	0.368	Loamy Sand	45	Mix 2
1.250	1.448	0.197	Loamy Sand	35	Mix 2
1.448	1.685	0.237	Sand	70	Mix 2
1.685	1.870	0.184	Sand	49	Mix 2
1.870	2.228	0.358	Sand	70	Mix 2
2.228	2.441	0.214	Sand	49	Mix 2
2.441	2.530	0.089	Sand	70	Mix 2
2.530	2.916	0.386	Sand	49	Mix 2
2.916	3.433	0.517	Loamy Sand	44	Mix 2
3.433	3.543	0.110	Loamy Sand	72	Mix 2
3.543	3.731	0.187	Sand	70	Mix 2
3.731	4.283	0.553	Sand	49	Mix 2
4.283	4.475	0.192	Loamy Sand	44	Mix 2
4.475	4.639	0.163	Sand	49	Mix 2
4.639	4.735	0.096	Sand	70	Mix 2
4.735	5.126	0.391	Sand	49	Mix 2
5.126	5.253	0.127	Sand	70	Mix 2
5.253	5.257	0.004	Sand	49	Mix 2
5.257	5.989	0.732	Sand	70	Mix 2
5.989	6.060	0.070	Sand	49	Mix 2
6.060	6.855	0.796	Sand	70	Mix 2

6.855	6.995	0.140	Loamy Sand	35	Mix 2
6.995	7.126	0.131	Sand	49	Mix 2
7.126	8.903	1.777	Sand	70	Mix 2
8.903	8.963	0.060	Sand	10	Mix 2
8.963	9.163	0.200	Loam	25	Mix 1
[1] No seed mix required if area is agriculture, unless landowner specifies.					

Irrigated hay land and irrigated pasture will likely be seeded with mixes stipulated by the landowners or will be seeded by the landowners themselves. If there are no such stipulations, Mix 3 will be used.

In actively cultivated cropland, seeding is not required unless requested by the landowner. Industrial lands, by definition, have been fully disturbed by previous activities to the point that no vegetation exists. Therefore, no seeding will be performed in these areas.

Table 2

Seed Mix 1

Native Grass Seed Mix, Weld County (Greeley NRCS Field Office)

Mix based on Range Seeding (550) specifications for soil textures other than Sand or Loamy Sand

Variety	Species	Seeding Rate (drilled PLS lbs/acre)	% of Species in Mix
El Reno	Sideoats Grama *	1.35	30
Arriba	Western Wheatgrass *	2.00	25
Lodorm	Green Needlegrass *	1.00	20
Hachita	Blue Grama *	0.23	15
Blackwell	Switchgrass	0.25	10
	Total	**4.83**	**100%**

* required grasses in mix

*****Mix must be seeded with a Native Grass Drill**

Options for Variety if the specified variety is in short supply, etc.

Niner	Sideoats Grama
Barton	Western Wheatgrass
Lovington	Blue Grama
Nebraska 28	Switchgrass

Recommend addition or substitution (up to 10%) of one of the following Forb or Legume Species:

Variety	Species	PLS RATE PER ACRE
Ladak or Ranger	Alfalfa	Up to 0.5
Native	Winterfat	"
Native	Fourwing Saltbush	"
Native	Purple Prairieclover	"
Native	American Vetch	"

Table 3

Seed Mix 2

Native Grass Seed Mix (sands) Weld County (Greeley NRCS Field Office)

Mix based on Range Seeding (550) specifications for Sand or Loamy Sand soil textures

Variety	Species	Seeding Rate (drilled PLS lbs/acre)	% of Species in Mix
Goshen	Prairie Sandreed *	1.05	30
Woodward	Sand Bluestem *	1.60	20
El Reno	Sideoats Grama *	0.90	20
Arriba	Western Wheatgrass	1.20	15
Blackwell	Switchgrass *	0.25	10
Cheyenne	Yellow Indiangrass*	0.25	5
	Total	**4.20**	**100%**

* required grasses in mix

*****Mix must be seeded with a Native Grass Drill**

Options for Variety if the specified variety is in short supply, etc.

Niner	Sideoats Grama
Holt	Yellow Indiangrass
Nebraska 28	Switchgrass
Barton	Western Wheatgrass

Recommend addition or substitution (up to 10%) of one of the following Forb or Legume Species:

Variety	Species	PLS RATE PER ACRE
Ladak or Ranger	Alfalfa	Up to 0.5
Native	Winterfat	"
Native	Fourwing Saltbush	"
Native	Purple Prairieclover	"
Native	American Vetch	"

Table 4
Seed Mix 3
Introduced/Native Grass Seed Mix Weld County (Greeley NRCS Field Office)

Mix based on NRCS Pasture & Hayland Planting (512) specifications Not for use on Sand or Loamy Sand soil textures

Variety	Species	Seeding Rate (drilled PLS lbs/acre)	% of Species in Mix
Luna	Pubescent Wheatgrass	2.70	30
Oahe	Intermediate Wheatgrass	2.00	20
Lincoln	Smooth Bromegrass	0.65	10
El Reno	Sideoats Grama	1.13	25
Barton	Western Wheatgrass	1.20	15
	Total	**7.68**	**100%**

Seeding Dates: November 1 to April 30
(Irrigated Sites - may also be seeded August 15 to September 15)
*****Recommend seeding with a Native Grass Drill**

Options for Variety if the specified variety is in short supply, etc.

Greenleaf	Pubescent Wheatgrass
Rush	Intermediate Wheatgrass
Manchar	Smooth Bromegrass
Niner	Sideoats Grama
Arriba	Western Wheatgrass

Recommend addition or substitution (up to 10%) of one of the following Forb or Legume Species:

Variety	Species	PLS RATE PER ACRE
Ladak or Ranger	Alfalfa	Up to 0.5
Native	Winterfat	"
Native	Fourwing Saltbush	"
Native	Purple Prairieclover	"
Native	American Vetch	"

Certified, blue-tagged seed shall be supplied where a named variety is specified. Vendor shall indicate on the bid whether certified or common seed is being offered, as well as the origin of the seed. The blue tags which are removed to mix the seed shall be given to the revegetation contractor and the EI; in addition, mix tags showing the weighted averages of the ingredients shall be attached to each bag. As the bags are used, the crew will save the mix tags and turn them over to the EI.

4.0 Mulch

Mulch will be applied on all slopes over five percent (except in actively cultivated cropland) concurrent with or immediately after seeding. The mulch to be used will be certified weed-free straw or hay.

Mulch will be spread uniformly to cover at least 75 percent of the ground surface at a rate of *1.5 tons/acre. The rate of 1.5 tons/acre is a slight variance to the standard. However, in our experience 1.5 tons/acre does give at least a 75 percent ground cover, providing equal protection to the resource. A rate of two tons/acre or more, tends to form a matted thatch that does not crimp easily; 1.5 tons/acre does crimp well, and so provides a greater protection to the resource. This rate has been confirmed with the NRCS (Communication, June 2012)*

Mulch will be crimped into the soil with a Finn crimper or similar implement.

CIG will mulch all areas seeded outside the recommended season, including level ground. In other words, all areas seeded before November 1.

5.0 Wetlands and Riparian Areas

Reclamation guidelines specified in FERC's Wetland and Waterbody Construction and Mitigation Procedures (Environmental Report, Appendix B) will be implemented in the construction right-of-way within the Project's one wetland area. Areas of predominantly hydrophilic vegetation will be allowed to revegetate naturally.

5.1 Seeding

Wetlands, or riparian areas with predominantly upland vegetation will be seeded with the mixes called for in Table 1 for those areas.

Areas with standing water or predominantly hydrophilic vegetation will be allowed to revegetate naturally; that is, they will not be seeded.

5.2 Trees and Shrubs

Unless blading is required to create a safe working area, the contractor will limit pulling of tree stumps and grading to directly over the trench line. If possible, on the rest of the right-of-way, trees and shrubs will be cut just above ground level, leaving existing root systems in place. Small woody and herbaceous vegetation may also be mowed or crushed to clear the right-of-way.

6.0 Monitoring

CIG's effort to reclaim areas disturbed during construction will be evaluated annually over a period of approximately three years or until CIG has received concurrence from all involved agencies that reclamation has been considered successful. CIG intends to begin monitoring in the summer of 2019, the first growing season following construction. If plant density and cover are insufficient, seeding efforts will continue until revegetation is successful. Noxious weed monitoring will occur

annually, and then as needed, to comply with state and federal law after successful reclamation.

Revegetation shall be considered successful if, upon visual survey, the density and cover of non-nuisance vegetation is similar to that of adjacent undisturbed areas. If revegetation is a success, a final inspection will be made in the third year following reclamation.

7.0 References

FERC Office of Pipeline Regulation. 2013. Upland Erosion Control, Revegetation, and Maintenance Plan.

FERC Office of Pipeline Regulation. 2013. Wetland and Waterbody Construction and Mitigation Procedures.

CIG. 2012. High Plains 2013 Expansion Project, Resource Report 3.

Reclamation Plan Deviations from FERC Standard Procedures		
FERC Plan & Procedures Text	**CIG Proposed Alternative Methods**	**Explanation for Differing from FERC Requirements**
Section 2.0 – Soil Management		
IV.A.2. The construction right-of-way width for a project shall not exceed 75 feet or that described in the FERC application unless otherwise modified by a FERC Order. However, in limited, non-wetland areas, this construction right-of-way width may be expanded by up to 25 feet without Director approval to accommodate full construction right-of-way topsoil segregation and to ensure safe construction where topographic conditions (e.g., side-slopes) or soil limitations require it. Twenty-five feet of extra construction right-of-way width may also be used in limited, non-wetland or non-forested areas for truck turn-arounds where no reasonable alternative access exists.	*Unless otherwise specified, the right-of-way width will be 85 feet. Exceptions include a right-of-way width of 75 feet in wetland areas and right-of-way widths greater than 85 feet in specified extra work areas.*	*CIG is asking for a wider workspace due to a number of site constraints that will be encountered during construction including sandy soils, foreign line crossings, and public road crossings. Construction in sandy soils will likely require trenches with angled side slopes due to the unstable nature of sandy soils, which will require additional ROW width for spoil storage. Further, working around foreign pipelines and utility lines, some of which parallel the proposed ROWs for some length, will require additional workspace for soils, materials, and equipment storage to ensure protection of these foreign facilities. Lastly, the ROWs cross a number of public roads as well as farm paths and oil field roads, all of which will require additional workspace for soil, material, and equipment storage in order to maintain access along these roads as necessary.*
IV.B.1. Unless the landowner or land management agency specifically approves otherwise, prevent the mixing of topsoil with subsoil by stripping topsoil from either the full work area or from the trench and subsoil storage area (ditch plus spoil side method) in: a. cultivated or rotated croplands, and managed pastures; b. residential areas; c. hayfields; and	*In areas where the ground is naturally level, the working and spoil sides of the right-of-way will not be cut or graded. To eliminate uneven soils around the base of plants, and to provide a smooth working surface, skimming with a maintainer (moving no more than two inches of topsoil) may be performed with the concurrence of*	*Its CIG intent that by minimizing topsoil disturbances the native seed bank and root structure will stay intact and as undisturbed as possible. Keeping the native seed bank in place will allow for quicker revegetation after construction. Minimizing the disturbance to the root stock will also minimize wind and water erosion while also allowing for quicker revegetation after construction.*

Reclamation Plan Deviations from FERC Standard Procedures		
FERC Plan & Procedures Text	**CIG Proposed Alternative Methods**	**Explanation for Differing from FERC Requirements**
d. other areas at the landowner's or land managing agency's request.	*the environmental inspector (EI). The intention is to leave the topsoil, with its bank of native seeds and roots, as undisturbed as possible.*	
IV.B.3. Where topsoil segregation is required, the project sponsor must: a. segregate at least 12 inches of topsoil in deep soils (more than 12 inches of topsoil); and b. make every effort to segregate the entire topsoil layer in soils with less than 12 inches of topsoil.	*In naturally level areas, topsoil will be separated up to 12 inches in depth along the ditch line only. Topsoil from the ditch line will be placed immediately next to the ditch line on the working side and will be leveled and compacted in a lift located under the skids and the string of pipe. If soil conditions become pulverized or powdered out by construction vehicles to a depth of six inches or greater, and the pulverized soils are being lost off the right-of-way from wind or mixed with subsoils, The EI will direct CIG to change operations and begin salvaging topsoil from the working side as further described below.*	*As stated previously by retaining the native seedbank and the root structure CIG will minimize potential wind and water erosion and enhance post construction reclamation. However, if soil conditions warrant the EI will request that the topsoil be salvaged across the entire ROW as per the FERC Plan. Where right-of-way grading is necessary, topsoil will be segregated as specified by the Environmental Inspector in consultation with the Chief Inspector.*
V.A.4. Remove excess rock from at least the top 12 inches of soil in all cultivated or rotated cropland, managed pastures, hayfields, and residential areas, as well as other areas at the landowner's request. The size, density, and	Where necessary, surface rock will be removed from the trench or right-of-way and stockpiled along the edge of the work areas. During	*The EI will determine if rock on the ROW is at a level greater that found in adjacent areas. If the amount of rock will hamper reclamation efforts the excess rock would be removed and either stockpiled at the landowners request or properly*

Reclamation Plan Deviations from FERC Standard Procedures		
FERC Plan & Procedures Text	**CIG Proposed Alternative Methods**	**Explanation for Differing from FERC Requirements**
distribution of rock on the construction work area shall be similar to adjacent areas not disturbed by construction. The landowner or land management agency may approve other provisions in writing. V.A.3. Rock excavated from the trench may be used to backfill the trench only to the top of the existing bedrock profile. Rock that is not returned to the trench shall be considered construction debris, unless approved for use as mulch or for some other use on the construction work areas by the landowner or land managing agency.	cleanup, salvaged surface rock will be spread to blend with off- right-of-way areas, to conceal the corridor from adjacent undisturbed areas and to act as a mulch to minimize erosion. If spreading rock over the right-of-way will prevent the safe operation and maintenance of the pipeline, *or if it will hamper successful reclamation*, it will be removed and properly disposed. Rock may be stockpiled on the right-of-way edge near existing roads *if directed by the EI and Chief Inspector and with landowner permission* to keep the public from driving on the right-of-way.	*disposed.*
IV.B.1. Unless the landowner or land management agency specifically approves otherwise, prevent the mixing of topsoil with subsoil by stripping topsoil from either the full work area or from the trench and subsoil storage area (ditch plus spoil side method) in: a. cultivated or rotated croplands, and managed pastures; b. residential areas; c. hayfields; and d. other areas at the landowner's or land managing agency's request.	*Ditch line topsoiling, rather than full right-of-way topsoiling, will be used on cropland and irrigated pasture or hayland, including Prime Farmland. This is a variance to the FERC plan, and is suggested as a way to eliminate as much soil handling as possible, minimizing mixing, loss, and wind erosion.*	*As stated previously by retaining the native seedbank and the root structure CIG will minimize potential wind and water erosion and enhance post construction reclamation. However, if soil conditions warrant the EI will request that the topsoil be salvaged across the entire ROW as per the FERC Plan.*

Reclamation Plan Deviations from FERC Standard Procedures		
FERC Plan & Procedures Text	**CIG Proposed Alternative Methods**	**Explanation for Differing from FERC Requirements**
II.B.9. Advising the Chief Construction Inspector when environmental conditions (such as wet weather or frozen soils) make it advisable to restrict or delay construction activities to avoid topsoil mixing or excessive compaction;	*If rutting exceeds 6 inches in depth, significantly increasing the chance of topsoil mixing with subsoils, work will continue, and the rutted area will be covered with at least an adequate volume of new topsoil to replace mixed soils and subsoils. This topsoil will be purchased in the immediate vicinity.* This is another variance from the FERC Plan. This variance would allow for continuation of construction during inclement weather at the cost of supplying new topsoil. This departure from the FERC Plan will not apply to rangeland.	*This variance would allow for continuation of construction during inclement weather at the cost of supplying new topsoil. This departure from the FERC Plan will not apply to rangeland.*
Section 3.0 - Seeding		
V.D.3.c. Perform seeding of permanent vegetation within the recommended seeding dates. If seeding cannot be done within those dates, use appropriate temporary erosion control measures discussed in section IV.F and perform seeding of permanent vegetation at the beginning of the next recommended seeding season. Dormant seeding or temporary seeding of annual species may also be used, if necessary, to establish cover, as approved by the Environmental Inspector. Lawns may be	The NRCS-recommended seeding window for the Project areas is from November 1 to May 15 for the native grass mix (Table 2) and November 1 to April 30 for the native grass (sand) mix (Table 3). *However, CIG plans to seed whenever the cleanup is complete, even if it is not in the recommended seeding season. This will permit*	*This variance will permit establishment of at least some vegetation to prevent wind or water erosion and however, the variance does not does not relieve CIG of its responsibility to achieve acceptable reclamation after construction. CIG will mulch all areas seeded outside the recommended season, at mulch rates described for seeded areas.*

Reclamation Plan Deviations from FERC Standard Procedures		
FERC Plan & Procedures Text	**CIG Proposed Alternative Methods**	**Explanation for Differing from FERC Requirements**
seeded on a schedule established with the landowner.	*establishment of at least some seed and does not relieve CIG of its responsibility to achieve acceptable reclamation after construction. CIG will mulch all areas seeded outside the recommended season, at mulch rates described below for seeded areas.* This determination will need to be made on a site-specific basis. For example, if the cleanup reclamation happens very late in the season during muddy or frozen soil conditions, CIG will be able to do no more than temporary stabilization in the form of temporary erosion control structures and mulch. Final decompaction and grading would likely wait until the following spring with seeding to follow. However, this situation is not expected on this project.	
Section 4.0 - Mulch		
IV.F.4.a. Apply mulch on all slopes (except in cultivated cropland) concurrent with or immediately after seeding, where necessary to stabilize the soil surface and to reduce wind and water erosion. Spread mulch uniformly over the	Mulch will be spread uniformly to cover at least 75 percent of the ground surface at a rate of *1.5 tons/acre. The rate of 1.5 tons/acre is a slight variance to the standard.*	*It has been CIGs experience that 1.5 tons/acre does give at least a 75 percent ground cover, providing equal protection to the resource. A rate of two tons/acre or more, tends to form a matted thatch that does not crimp easily; 1.5*

Reclamation Plan Deviations from FERC Standard Procedures		
FERC Plan & Procedures Text	**CIG Proposed Alternative Methods**	**Explanation for Differing from FERC Requirements**
area to cover at least 75 percent of the ground surface at a rate of 2 tons/acre of straw or its equivalent, unless the local soil conservation authority, landowner, or land managing agency approves otherwise in writing.	*However, in our experience 1.5 tons/acre does give at least a 75 percent ground cover, providing equal protection to the resource. A rate of two tons/acre or more, tends to form a matted thatch that does not crimp easily; 1.5 tons/acre does crimp well, and so provides a greater protection to the resource. This rate has been confirmed with the NRCS (Communication, June 2012)*	*tons/acre does crimp well, and so provides a greater protection to the resource. This rate has been confirmed with the NRCS (Communication, June 2012).*
IV.F.4.c. Mulch all disturbed upland areas (except cultivated cropland) before seeding if: (1) final grading and installation of permanent erosion control measures will not be completed in an area within 20 days after the trench in that area is backfilled (10 days in residential areas), as required in section V.A.1; or (2) construction or restoration activity is interrupted for extended periods, such as when seeding cannot be completed due to seeding period restrictions.	*CIG will mulch all areas seeded outside the recommended season,* including level ground. In other words, all areas seeded before November 1.	*As stated previously, this variance will permit establishment of at least some vegetation however, does not relieve CIG of its responsibility to achieve acceptable reclamation after construction. CIG will mulch all areas seeded outside the recommended season, at mulch rates described for seeded areas.*
IV.B.1 Unless landowner or land management agency specifically approve otherwise, prevent mixing of topsoil with subsoil by stripping topsoil from either the full work area of from the trench and subsoil storage area (Ditch plus spoil side	*CIG will place a physical barrier between subsoil and topsoil on the ROW in areas of croplands*	*Placement of a physical barrier will prevent the mixing of sub and topsoil in areas of croplands.*

Reclamation Plan Deviations from FERC Standard Procedures		
FERC Plan & Procedures Text	**CIG Proposed Alternative Methods**	**Explanation for Differing from FERC Requirements**
method0 in: Cultivated or rotated croplands and managed pastures. IV.B.4 Maintain separation of salvaged topsoil and subsoil throughout all construction activities.		

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Resource Report 7

2. Summarize the acres of each soil characteristic impact by facility and county (see example table below).

Updated Response:

On March 8, 2019 CIG provided a response to the informal request for information on Resource Report 7 Question 2. CIG is supplementing its prior response with the following information regarding the Project.

The table provided in the March 8th response included an error for the total acres impacted at 121.38. The total project land requirements are 120.6. The total has been revised to include acreages that are consistent with the application and rounded to the nearest tenth, not one hundredth. Note that the soils acreages affected by the project do not account for access roads (25.1 acres) or the Fort Lupton Contractor Yard (12.7 acres), which is a total of 37.8 acres. The total construction acreage of 158.4, as shown on Table 1-2 of the application, is derived by taking the total acres affected shown on the attached table (120.6 acres) plus the acres affected by the access roads and the contractor yard (37.8 acres).

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Acres of Soil Characteristics Affected by the Project[a,b,c]									
Total Acres in County	Important Farmlands[d]	Prime Farmland[e]	Hydric Soils[e]	Compaction Prone[f]	Highly Erodible		Revegetation Concerns[i]	Stony/ Rocky[j]	Shallow to Bedrock[k]
					Water[g]	Wind[h]			
Kiowa Lateral Pipeline									
107.4	42.6	0.0	3.7	0.0	0.0	102.2	60.4	0.0	0.0
High Five Pipeline									
9.0	6.5	0.0	0.0	0.0	0.0	9.0	6.2	0.0	0.0
Prairie Hound Meter Station									
1.9	0.0	0.0	0.0	0.0	0.0	1.9	1.9	0.0	0.0
High Five Meter Station									
2.3	1.3	0.0	0.0	0.0	0.0	2.3	2.3	0.0	0.0

[a] – The area affected includes the permanent pipeline right-of-way, temporary pipeline right-of-way, and additional temporary workspace. The soils data in the table does not include areas of open water.

[b] – The numbers in this table have been rounded for presentation purposes.

[c] – The values in each row do not add up to the total acreage for each county because soils may occur in more than one characteristic class or may not occur in any class listed in the table.

[d] – Important Farmlands are lands that the NRCS, along with other Federal, State, and local governmental organizations have inventoried for production of the Nation's food supply.

[e] – As designated by the NRCS. Prime farmland has been defined by the U.S. Department of Agriculture (USDA) as land with the best characteristics for producing food, fiber, and forage crops. The Kiowa Lateral crosses 5.9 acres considered to be prime farmland if it is irrigated, but it is not irrigated.

[f] – Includes soils in somewhat poor to very poor drainage classes with surface textures of sandy clay loam and finer.

[g] – Land in capability subclasses 4E through 8E and soils with an average slope greater than or equal to 9 percent.

[h] – Soils with a wind erodibility group (WEG) classification of 1 or 2.

[i] – Soils with a surface texture of sandy loam or coarser that are moderately well to excessively drained, and soils with an average slope greater than or equal to 9 percent.

[j] – This group includes soils with a cobbley, stony boulder, shaly, very gravelly, or extremely gravelly modifier to the textural class of the surface layer, with a surface layer that contains greater than 5 percent by weight stones larger than 3 inches, and/or with a layer in the subsoils that meets one of the preceding criteria.

[k] – Soils identified as containing bedrock at a depth of 5 feet or less from the surface, all of which is paralithic and rippable with standard construction equipment.

Response prepared by or under the supervision of:

Mike Bonar
Environmental Project Manager
719-520-4817

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Resource Report 7

3. With regard to the alternative measures to the FERC Upland Erosion Control, Revegetation, and Maintenance Plan (FERC Plan) described in section 7.6, address the following:

a. Colorado Interstate Gas proposes "topsoil salvage depth is specified as no less than 6 inches and no more than 12 inches, where topsoil is available." The FERC Plan (at section IV.B.3.b) states that a Project sponsor must "make every effort to segregate the entire topsoil layer in soils with less than 12 inches of topsoil". By salvaging "no less than 6 inches" during construction, Colorado Interstate Gas could mix topsoil and subsoil in areas where topsoil is less than 6 inches in thickness. Therefore, either confirm that Colorado Interstate Gas would adhere to the FERC Plan at section IV.B.3.b or provide additional justification on how the proposed alternative measure would provide equal or greater protection to topsoil resources.
b. Colorado Interstate Gas proposes that "if rutting exceeds 12 inches in depth…work would continue and the rutted area would be covered with an adequate volume of new topsoil to replace mixed soils and subsoils, such topsoil would be purchased in the immediate vicinity…this departure from the FERC Plan would not apply to rangelands or pasturelands." The Project workspace includes approximately 5.1 acres of agricultural land.

Clarify if and how this proposed alternative measure would apply to construction in agricultural land.

Updated Response:

On March 8, 2019 CIG provided a response to the informal request for information on Resource Report 7 Question 3. CIG is supplementing its prior response with the following information regarding the Project.

Proposed deviations from the FERC Plan and a justification for the change are provided in a table being submitted as Attachment 6 in CIG's updated response to Resource Report 7 Question 1.

Response prepared by or under the supervision of:

Mike Bonar
Environmental Project Manager
719-520-4817

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
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CIG High Plains Kiowa Lateral Expansion Project

Resource Report 7

4. Clearly specify each measure of Colorado Interstate Gas' Reclamation Plan that is not recommended or is unnecessary for the Project and indicate the alternative measure(s) that Colorado Interstate Gas would implement for each. For each alternative measure proposed, discuss how they would provide a level of protection to resources equal or better than our Plan.

Response:

CIG is proposing deviations from the FERC Plan and provides justification for the change in a table being submitted as Attachment 6 in CIG's updated response to Resource Report 7 Question 1.

Response prepared by or under the supervision of:
Mike Bonar
Environmental Project Manager
719-520-4817

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
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Resource Report 9

4. Clarify if there are additional noise sensitive areas (NSAs) within 0.5 mile of each proposed HDD site and if so, provide the distance and direction of each NSA.

Updated Response:

On March 8, 2019 CIG provided a response to the informal request for information on Resource Report 9 Question 4. CIG is supplementing its prior response with the following information regarding the Project.

CIG has determined that conducting HDD crossings of Streams 1 and 3 and Wetlands 1, 2, and 5 and County Road 59 are no longer necessary. All wetlands will be crossed using the open cut method and County Road 59 would be crossed utilizing a standard jack and bore method. Based on the revised crossing methods, there are no noise sensitive areas ("NSAs") within 0.5 miles of the two remaining HDDs. Please see Attachment 7 behind this response for the revised Table 6 from Appendix I. The noise modeling in the table reflects the original 5 HDDs even though CIG is proposing two HDDs. As a result, the predicted noise analysis at each of the ten NSAs is more conservative than what will likely be the outcome given that the noise being generated will be less with only two HDDs being undertaken.

Response prepared by or under the supervision of:

Claudia Leal
Project Manager
303-914-4626

Appendix I, Table 6 Revised. Modeled and Predicted Sound Pressure Levels at Boundary and Residential Receptors for the Project

Site[g]		Noise Modelling Data Based on 5 HDDs including the 3 Wetland Crossings										Data Based on 2 HDDs, Excluding the 3 Wetland Crossings		
		A- Weighted Sound Levels (dBA)												
		Baseline [a]		Without Mitigation				Predicted With Mitigation						
		L_{90}, Day	L_{90}, Night	Modeled [b]	Predicted[c] Day	Predicted[c] Night	Predicted[f] L_{dn}	Modeled [b]	Predicted[c] Day	Predicted[c] Night	Predicted[f] L_{dn}	Estimated HDD Duration	Nearest HDD Noise Source	Distance to Noise Source (miles)
Site 1	Morning	51	42	50	53	50	57	50	53	50	57	7-10 days		
	Afternoon	42			50		57		50		57			
Site 2	Morning	36	-	46	47	NA	NA	46	47	NA	NA	NA		
Site 3	Morning	37	40	40	41	43	49	40	41	43	49	NA		
	Afternoon	40			43		49		43		41			
Site 4	Morning	35	34	59	59	59	65	52	52	52	58	NA		
	Afternoon	33			59		65		52		50			
Site 5	Morning	34	-	47	47	NA	NA	47	47	NA	NA	NA		
Site 6	Continuous	46	40	63	63	63	69	61	61	61	67	7-10 days		
Site 7	Continuous	32	34	76	76	76	82	76	76	76	82	NA		
Site 8	Continuous	35	38	60	60	60	66	60	60	60	66	NA		
Residence 1 [d]		32	34	57	57	57	63	47	47	47	53	7-10 days	I 76 crossing	2
Residence 2 [e]		51	42	46	52	47	55	44	51	46	54	7-10 days	I 76 crossing	1.7
Residence 3 [d]		40	40	44	45	45	52	43	45	45	51	7-10 days	I 76 crossing	2.9
Residence 4 [d]		35	38	47	47	47	53	47	47	47	53	7-10 days	WCR 49 crossing	1.2
Residence 5 [d]		35	34	49	49	49	56	43	44	44	50	7-10 days	WCR 49 crossing	0.8
Residence 6 [d]		35	34	48	48	48	54	46	46	46	53	7-10 days	WCR 49 crossing	0.7
Residence 7 [e]		46	40	49	51	50	56	44	48	45	52	7-10 days	WCR 49 crossing	0.6
Residence 8 [d]		34	40	46	47	47	54	46	47	47	54	7-10 days	WCR 49 crossing	0.8
Residence 9 [d]		34	40	47	48	48	54	47	48	48	54	7-10 days	WCR 49 crossing	0.6
Residence 10 [d]		32	34	50	50	51	57	44	44	44	51	7-10 days	I 76 crossing	2.1

Source: Golder Associates Inc., 2018.

[a] Baseline was measured in October 2018 for all the monitoring sites.
[b] Modeled noise generated at proposed HDD locations calculated by the noise model Cadna A.
[c] Predicted impacts at the site were calculated by logarithmically adding the modeled impacts to the baseline measurements.
[d] Baseline from the closest monitoring locations used for residence locations values.
[e] Baseline from the monitoring location that best represents the residence location surroundings.
[f] The day-night average sound level:

$$L_{dn} = 10 \log \frac{15 \times 10^{\frac{L_d}{10}} + 9 \times 10^{\frac{L_n + 10}{10}}}{24}$$

[g] Site 1 is closest to I 76 and site 6 is closest to Weld County Road 49

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
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Resource Report 9

5. Provide a revised table 6 from appendix I as follows:

a. revise the calculation of the modeled noise due to HDD equipment and the predicted L_{dn}.[1] (including the modeled and baseline sound levels) to include the nighttime penalty for noise between the hours of 10 pm and 7 am;
b. provide the predicted sounds levels with and without mitigation measures (see question 7 below); and
c. include a column that specifies the estimated duration of drilling activities at each drill site.

[1] The Ldn, or the day-night average sound level, is the average noise level over a 24 hour period.

Response:

a. A revised Table 6 from Appendix I is being submitted as Attachment 7 in CIG's updated response to Resource Report 9 Question 4. The Ldn in revised Table 9-6 already includes the nighttime penalty in the calculations.
b. A revised Table 6 from Appendix I is being submitted as Attachment 7 in CIG's updated response to Resource Report 9 Question 4, which includes unmitigated and mitigated modeled results and predicted noise levels.
c. The estimated duration of drilling activities at each drill site is provided in the revised Table 6 from Appendix I, which is being submitted as Attachment 7 in CIG's updated response to Resource Report 9 Question 4. CIG notes that the data in revised Table 6 is based on crossing the three wetland areas and three roads using HDD technology. With CIG's decision to cross the wetlands using the open cut and crossing County Road 59 using a jack and bore method, there are no NSAs within 0.5 miles of the current HDD locations (Weld County Road 49 crossing and I-76 crossing).

Response prepared by or under the supervision of:

Claudia Leal
Project Manager
303-914-4626

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Resource Report 9

6. Clarify the specific mitigation measures that Colorado Interstate Gas commits to implement at HDD sites where noise from drilling activities in the revised table 6 above is greater than 55 A-weighted day-night averaged decibels.

Response:

Based on the revised crossing methods cross, the wetlands using the open cut methodology and to cross County Road 59 using a jack and bore method, there are no NSAs within 0.5 miles of the HDD locations (Weld County Road 49 crossing and I-76 crossing). As such, noise mitigation will not be required.

Response prepared by or under the supervision of:

Claudia Leal
Project Manager
303-914-4626

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Follow-up Question

1. Table 3-1, summary of habitat, state a total of 3.1 acres of wetlands/waterbodies would be impacted by the Project, however, the sum of surface waterbodies impacted listed in table 2-2 (0.05 acres) and the sum of wetland impacts listed in table 2-3 (1.91 acres) does not equal this amount. Rectify this apparent discrepancy.

Response:

Please see Attachment 8 behind this response for the revised Table 3-1 and Table 8-1 which corrects the discrepancy.

Response prepared by or under the supervision of:

Mike Bonar
Environmental Project Manager
719-520-4817

Table Error! No text of specified style in document.**-1**
Summary of Habitat Impacts (Acres)

Facility	Grasslands		Wetlands/Waterbodies		Agriculture		Developed Open Land		Project Total	
	Const. [a]	Op. [b]	Const. [a]	Op. [b]	Const. [a]	Op. [b]	Const. [a]	Op. [b]	Const. [a]	Op. [b]
Pipeline Facilities										
Kiowa Lateral	99.3	43.0	1.9	0.0	2.1	0.7	1.1	0.8	104.4	44.5
High Five Lateral	7.7	4.3	0.0	0.0	0.0	0.0	0.0	0.0	7.7	4.3
Access Roads	3.0	0.0	0.0	0.0	0.0	0.0	17.8	0.0	20.8	0.0
Pipeline Facilities Total	**110.0**	**47.3**	**1.9**	**0.0**	**2.1**	**0.7**	**18.9**	**0.8**	**132.9**	**48.8**
Aboveground Facilities										
Prairie Hound Meter Station	1.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.9
High Five Meter Station	2.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.9
Lancaster/Kiowa Tie-In	0.0	0.0	0.0	0.0	3.0	0.1	0.0	0.0	3.0	0.1
Lancaster/High Five Tie-in	1.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.2
Access Roads	2.0	2.0	0.0	0.0	0.0	0.0	1.1	1.1	3.1	3.1
Aboveground Facilities Total	**7.5**	**4.0**	**0.0**	**0.0**	**3.0**	**0.1**	**1.1**	**1.1**	**11.6**	**5.2**
Contractor Yard										
Fort Lupton Yard	9.4	0.0	0.0	0.0	0.0	0.0	3.3	0.0	12.7	0.0
Access Roads	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	1.2	0.0
Contractor Yard Total	**9.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**4.5**	**0.0**	**13.9**	**0.0**
PROJECT TOTAL	**126.9**	**51.3**	**1.9**	**0.0**	**5.1**	**0.8**	**24.5**	**1.9**	**158.4**	**54.0**

Note: The values in this table have been rounded for presentation purposes.
[a] Land affected during construction consists of temporary and permanent impacts.
[b] Land affected during operation consists only of permanent impacts.

Table 8-2
Summary of Land Use Impacts (Acres)

Facility	Grasslands		Wetlands/Waterbodies		Agriculture		Developed Open Land		Project Total	
	Const. [a]	Op. [b]	Const. [a]	Op. [b]	Const. [a]	Op. [b]	Const. [a]	Op. [b]	Const. [a]	Op. [b]
Pipeline Facilities										
Kiowa Lateral	99.3	43.0	1.9	0.0	2.1	0.7	1.1	0.8	104.4	44.5
High Five Lateral	7.7	4.3	0.0	0.0	0.0	0.0	0.0	0.0	7.7	4.3
Access Roads	3.0	0.0	0.0	0.0	0.0	0.0	17.8	0.0	20.8	0.0
Pipeline Facilities Total	**110.0**	**47.3**	**1.9**	**0.0**	**2.1**	**0.7**	**18.9**	**0.8**	**132.9**	**48.8**
Aboveground Facilities										
Prairie Hound Meter Station	1.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.9
High Five Meter Station	2.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.9
Lancaster/Kiowa Tie-In	0.0	0.0	0.0	0.0	3.0	0.1	0.0	0.0	3.0	0.1
Lancaster/High Five Tie-in	1.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.2
Access Roads	2.0	2.0	0.0	0.0	0.0	0.0	1.1	1.1	3.1	3.1
Aboveground Facilities Total	**7.5**	**4.0**	**0.0**	**0.0**	**3.0**	**0.1**	**1.1**	**1.1**	**11.6**	**5.2**
Contractor Yard										
Fort Lupton Yard	9.4	0.0	0.0	0.0	0.0	0.0	3.3	0.0	12.7	0.0
Access Roads	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	1.2	0.0
Contractor Yard Total	**9.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**4.5**	**0.0**	**13.9**	**0.0**
PROJECT TOTAL	**126.9**	**51.3**	**1.9**	**0.0**	**5.1**	**0.8**	**24.5**	**1.9**	**158.4**	**54.0**

Note: The values in this table have been rounded for presentation purposes.
[a] Land affected during construction consists of temporary and permanent impacts.
[b] Land affected during operation consists only of permanent impacts.

COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
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CIG High Plains Kiowa Lateral Expansion Project

Follow-up Question

2. Within the project survey area is the black-footed ferret habitat considered a federally endangered/state endangered?

Response:

For the proposed project survey area the habitat for the black-footed ferret is not considered to be federally endangered/state endangered. CIG is providing an updated threatened and endangered species potential habitat map (see attached Figure 3C in Appendix C) that removes references to the black-footed ferret habitat.

Response prepared by or under the supervision of:

Mike Bonar
Environmental Project Manager
719-520-4817

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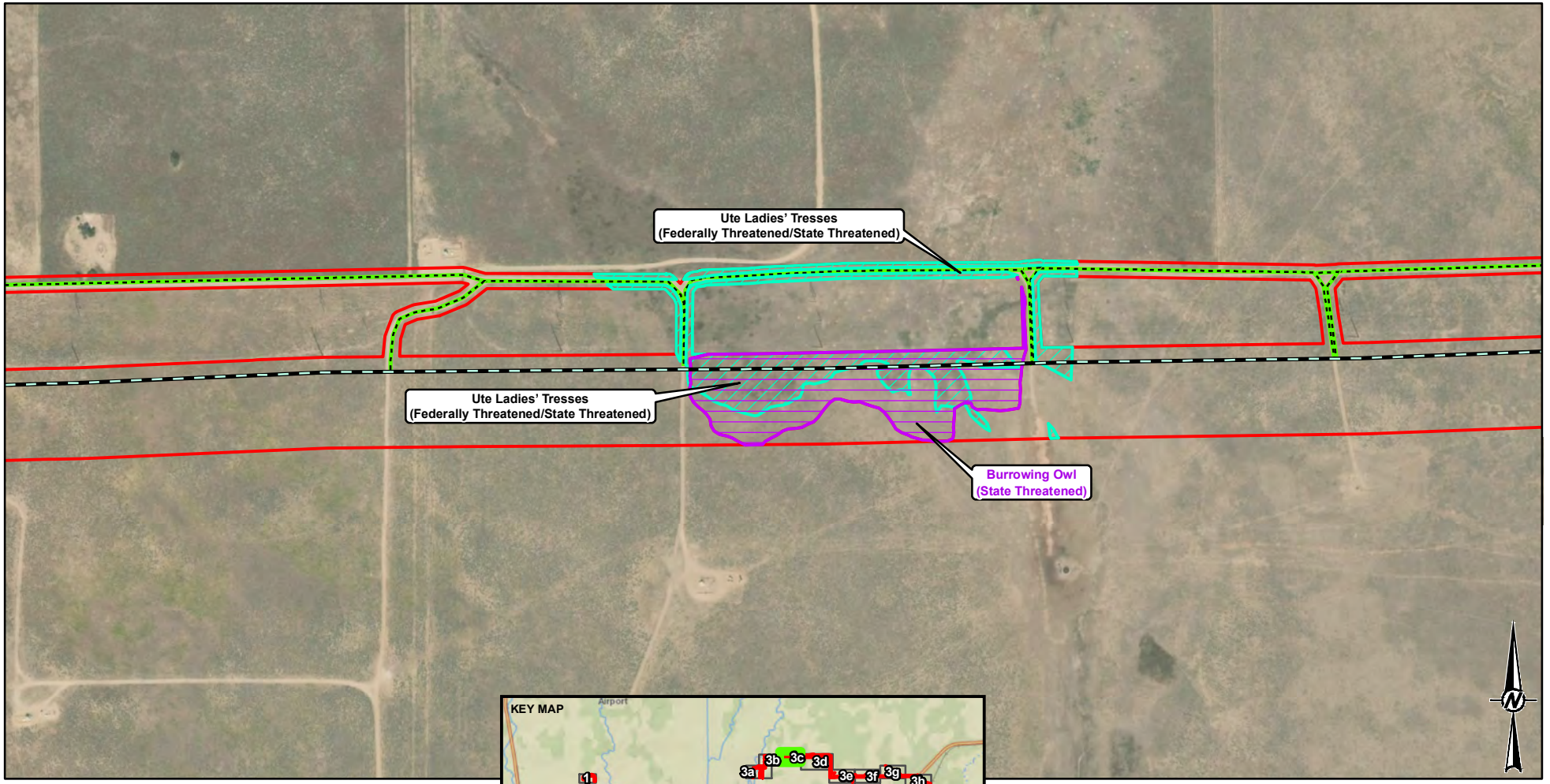

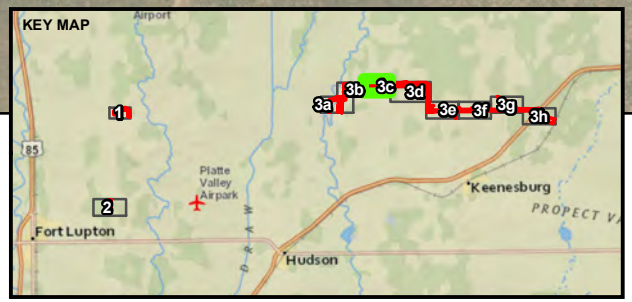

LEGEND

- SURVEY AREA (426.68 ACRES)
- PROPOSED KIOWA LATERAL PIPELINE (9.14 MILES)
- ACCESS ROAD

POTENTIAL HABITAT TYPE

- FEDERALLY THREATENED/STATE THREATENED
- STATE THREATENED

0 500 1,000
Feet

REFERENCE

1. AERIAL IMAGERY: ESRI BASEMAPS, DIGITAL GLOBE, 2017.
2. ENVIRONMENTAL DATA COLLECTED IN THE FIELD BY GOLDER ASSOCIATES, OCTOBER 2018.

CLIENT
KINDER MORGAN

CONSULTANT
GOLDER

YYYY-MM-DD	2018-11-14
DESIGNED	KJC
PREPARED	KJC
REVIEWED	MB
APPROVED	

PROJECT
CIG HIGH PLAINS KIOWA LATERAL TO LINE NO. 5C EXPANSION PROJECT FERC PERMITTING

DRAFT

TITLE
THREATENED AND ENDANGERED SPECIES POTENTIAL HABITAT MAP KIOWA LATERAL PIPELINE

PROJECT NO.
18108190

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COLORADO INTERSTATE GAS COMPANY, L.L.C.
Response to OEP Data Request
Dated February 21, 2019 in Docket No. CP19-56-000
CIG High Plains Kiowa Lateral Expansion Project

Follow-up Question

3. Please file a revised Unanticipated Discoveries Plan for Contaminated Media.

Response:

CIG included a Contaminated Media procedure discussion as a section in the Unanticipated Discoveries Plan. CIG has revised its plan and created a stand-alone plan referred to as the Unanticipated Discoveries Plan for Contaminated Media. Please see Attachment 9 behind this response for the plan.

Response prepared by or under the supervision of:

Mike Bonar
Environmental Project Manager
719-520-4817

UNANTICIPATED DISCOVERIES PLAN FOR

CONTAMINATED MEDIA

CIG High Plains Kiowa Lateral Expansion

Project Weld County, Colorado

Colorado Interstate Gas Company, L.L.C.
a Kinder Morgan company

Discovery of Contaminated Media

Indicators of possible contamination include, but are not limited to:

1. Buried drums or containers, rusted or in otherwise poor condition
2. Stained or otherwise discolored soil (in contrast to adjoining materials)
3. Spoil material containing debris other than obvious construction material
4. Chemical or hydrocarbon odors emanating from excavations
5. Oily residues
6. Visible sheen or other discoloration on groundwater
7. Structures such as pipelines (concrete, PVC or steel) or underground storage tanks

The EI and appropriate contractor personnel will be trained in hazard identification and worker protection and these topics will be discussed regularly in safety meetings. In the unlikely event that contamination is encountered, the following activities should take place:

1. Immediately cease construction activities within the area and notify the EI and Project Environmental Manager. Work in the immediate area will not resume until an assessment of the discovery has been completed and CIG has released the site. If safe to do so, the EI will take appropriate steps to mark (flag) off the area to identify the exclusion zone. Work in the immediate area will not resume until an assessment discovery has been completed.
2. If potentially contaminated groundwater or soil reaches (or has the potential to reach) surface waters, booms and/or absorbent materials shall be immediately deployed to contain and reduce downstream migration of the spilled material.
3. Upon notification, the Project Environmental Manager will perform or direct a hazard assessment to determine appropriate control measures to be implemented at the specific site. Activities may include sampling vapors, soil, sediments, groundwater, and/or wipe samples of materials.
4. If warranted by the assessment, the Project Environmental Manager will notify the Colorado Department of Public Health and Environment and any other appropriate federal, state, and local agencies.
5. CIG or the designated person(s) will make appropriate notifications to the Colorado Department of Public Health and Environment as necessary. Upon evaluation of the sampling results, additional notifications may be made to coordinate a work plan for measures to be implemented in the contaminated area to resume activities in a safe, environmentally compliant, and effective manner. Measures may include additional personal protective equipment, segregation of contaminated media, treatment or off-site disposal of contaminated media.
6. All identification/ characterization, handling, labeling, storage, manifesting, transportation, record keeping, and disposal of potentially contaminated materials shall be conducted in accordance with all applicable federal, state, and local regulations and guidance.

Project Contact List

Environmental Project Manager
Contact: Michael Bonar
Telephone: (719) 520-4817
Email: Michael_Bonar@kindermorgan.com
Address: Two North Nevada, Colorado Springs, CO 80903

Project Construction Manager
Contact: Claudia Leal
Telephone: (303) 914-4626
Email: Claudia_Leal@kindermorgan.com
Address: 370 Van Gordon Street, Lakewood, CO 80228

Environmental Inspector
Contact: To Be Determined
Telephone:
Email:
Address:

Colorado Department of Public Health and Environment, Environmental Spill Reporting
Contact: Not Applicable
Telephone: (877) 518-5608
Email:
Address: https://www.colorado.gov/pacific/cdphe/emergency-reporting-line

FERC Project Manager
Contact: Dawn Ramsey
Telephone: (202) 502-6856
Email: Dawn.Ramsey@ferc.gov
Address: 888 First St NE, Washington, DC 20426

Certificate of Service

I hereby certify that I have this day caused a copy of the foregoing documents to be served upon each person designated on the official service list compiled by the Commission's Secretary in this proceeding in accordance with the requirements of Section 385.2010 of the Federal Energy Regulatory Commission's Rules of Practice and Procedure.

Dated at Colorado Springs, Colorado as of this 20th day of March 2019.

/s/
Francisco Tarin

Two North Nevada Avenue
Colorado Springs, Colorado 80903
(719) 667-7517