Please add PCD file No. PPR2131

Design Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

_____ _____

Mark Volle, PE #48654 Date

Owner/Developer's Statement:

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

_____ _____

Jim Nikkel
Meridian Service Metropolitan District
11886 Stapleton Dr, Peyton, CO 80831 Date

El Paso County:

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

_____ _____

Jennifer Irvine, P.E. Date
County Engineer / ECM Administrator

Conditions:

El Paso County **July 13, 2021**
Planning & Community Development
2880 International Circle, Suite 110
Colorado Springs, CO 80910-3127

Revise to final drainage report

RE: Meridian Service Metropolitan District
Well Sites 5, 7 & 8
SDP Submittal – Drainage Report
Addresses
Well Site 5: 10511 Rainbow Bridge Drive
Well Site 7: 10810 Eastonville Road
Well Site 8: 11496 Eastonville Road

To Whom It May Concern:

The purpose of this drainage report is to satisfy requirements of the El Paso County Planning and Community Development division pertaining to the site development plan submittal for the project referenced above.

Property Description

The intention of the applicant is to construct three buildings (one at each well site) to house electrical gear.

The well sites are located as follows:
Well Site 5
Located off Rainbow Bridge Drive in Tract F of Meridian Ranch Filing 11A.

Well Site 7
Located in an easement (rec. # 214086535) off Eastonville Drive on EPC parks property. The Well Site is located south of the existing parking lot for the Falcon Regional Park.

Well Site 8
Located in an easement (rec. # 214086535) off Eastonville Drive on EPC parks property. The Well Site is located north of the Falcon Regional Park dog park.

Soils

Well Site 5:
Soils for this site are delineated as Stapleton sandy loam, 3 to 8 percent slopes and are characterized as Hydrologic Soil Group B (moderately low runoff potential when thoroughly wet). Soils were mapped using the NRCS Web Soil Survey. According to a geotechnical evaluation report by Vivid Engineering Group, dated 11/6/2020 and enclosed as Appendix D, site soils were comprised predominately of clayey sands underlain by silty and clayey sandstone of the Dawson formation. One exploratory bore within the project area was drilled to approximately 30 feet below the existing ground surface. The ground surface consists of gently sloping topography and was covered predominantly with grasses. A copy of NRCS Web Soil Survey is included in Appendix A.

Well Site 7:
Soils for this site are delineated as Columbine gravelly sandy loam, 0 to 3 percent slopes and are characterized as Hydrologic Soil Group A (low runoff potential when thoroughly wet). Soils were mapped using the NRCS Web Soil Survey. According to a geotechnical evaluation report by Vivid Engineering

Group, dated 11/6/2020, site soils were comprised predominately of silty sands underlain by weathered sandstone of the Dawson formation. One exploratory bore within the project area was drilled to approximately 30 feet below the existing ground surface. The ground surface consists of gently sloping topography and was covered predominantly with grasses. A copy of NRCS Web Soil Survey is included in Appendix A.

Well Site 8:
Soils for this site are delineated as Stapleton sandy loam, 3 to 8 percent slopes and are characterized as Hydrologic Soil Group B (moderately low runoff potential when thoroughly wet). Soils were mapped using the NRCS Web Soil Survey According to a geotechnical evaluation report by Vivid Engineering Group, dated 11/6/2020, site soils were comprised predominately of silty sands underlain by silty and clayey sandstone of the Dawson formation. One exploratory bore within the project area was drilled to approximately 30 feet below the existing ground surface. The ground surface consists of gently sloping topography and was covered predominantly with grasses. A copy of NRCS Web Soil Survey is included in Appendix A.

Flood Plain Statement

The Floodplain Insurance Rate Map (FIRM) for El Paso County (map number 08041C0552G, dated December 7, 2018) was reviewed to determine any potential floodplain delineation. A copy of the relevant portion of this FIRM panel can be found in Appendix B for each well site. As shown, the proposed well sites lie within Zone X, defined as areas outside the 100-year floodplain.

Drainage Criteria

This drainage analysis has been prepared in accordance with the current El Paso County Drainage Criteria Manual (Volumes 1 and 2). Volume 1 was established in 1991 with subsequent revisions in 1994. In 2002, the City of Colorado Springs Drainage Criteria Manual Volume 2 (DCMV2) was adopted as El Paso County's stormwater quality design criteria with Appendix I of the El Paso County's Engineering Criteria manual (ECM) to provide additions and revisions applicable to the County. In 2015, El Paso County adopted portions of the City of Colorado Springs Drainage Criteria Manual Volume 1 dated May 2014 including Chapter 6 and Section 3.2.1 of Chapter 13. In addition, the Urban Storm Drainage Criteria Manuals, Volumes 1-3 published by the Mile High Flood District (MHFD), formerly known as the Urban Drainage and Flood Control District and dated November 2010 with subsequent updates were used to prepare this drainage report.

Well Site 5 is located within the Bennet Ranch Drainage Basin (CHWS1200) and Well Sites 7 & 8 are located within the Geick Ranch Drainage Basin (CHMS0400). The well sites are owned and operated by MSMD.

Hydrologic Calculations

The hydrologic calculations were prepared following guidance from El Paso County Drainage Criteria Manual and resources from the MHFD (formerly known as UDFCD). Each well site is less than 100 acres, so the Rational Method is utilized as recommended in El Paso County Drainage Criteria Manual Volume 1. The Rational Method was used to determine estimated runoff peak discharges from storms between 2-year and 100-year storm recurrence intervals. Figure 6-5 IDF Curves are based on the rainfall depths for an elevation of 6,840 feet in the Colorado Springs area and were used for the hydrologic calculations. The 1-hr rainfall depths for each storm recurrence interval were obtained from Table 6-2 Rainfall Depths for Colorado Springs in the Drainage Criteria Manual Volume 1 Update.

Table 1 – 1-hr Rainfall Depths

2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1.19	1.50	1.75	2.00	2.25	2.52

Runoff coefficients were established based on Table 5-1 and Equation 5-2 of the El Paso County Drainage Criteria Manual Volume 1 Update. The percent impervious values for the site was calculated using the existing conditions for pre-development and proposed improvements for post-development. Calculations can be found in Appendix C.

The tables below contains the pre and post development estimated peak runoff rate in CFS for both the 10 year and 100-year storm events for each well site. Also included is the percent increase from pre to post development.

Runoff coefficients shall be based on CH6 table 6-6 of City DCMV1 2014 that was adopted by the County in 2015.

Per ECM 3.2.6.E and the adopted chapter 6, the design storms should be 5 yr and 100yr. Please update the report accordingly.

Table 2 - Well Site 5 Peak Runoff

	Pre Development	Post Development	Percent Increase
10-yr	1.64	1.67	1.72%
100-yr	3.31	3.34	1.02%

Table 3 - Well Site 7 Peak Runoff

	Pre-development	Post Development	Percent Increase
10-yr	1.08	1.13	4.17%
100-yr	2.19	2.24	2.45%

Table 4 - Well Site 8 Peak Runoff

	Pre-development	Post Development	Percent Increase
10-yr	1.32	1.40	6.28%
100-yr	2.66	2.76	3.68%

Please evaluate the 4 step process indicated in ECM Appendix I. The submitted site plan indicates that the total disturbance is more than 1 acre therefore please analyze/address stormwater quality for the sites and identify any exclusions that apply. Please also address detention. DPW stormwater will be a review agency on the subsequent submittal.

Conclusions

Because of the simplicity of the improvements, only the proposed drainage structures are proposed. It is anticipated that in the future, the area around the tank will be developed and at that time, a detailed drainage plan and associated infrastructure will be developed. If development occurs around the well sites, the drainage from the well sites will be redirected to drainage structures as part of that development.

Please provide drainage maps showing the existing and proposed conditions. Also provide basin descriptions that indicate the conveyance of the developed flow to a suitable outfall. If flow will be conveyed to an existing facility please discuss the facility and analyze whether the existing facility is designed to accept the sites developed flows. Please refer to DCMV1 CH4 for drainage report guidelines and provide the necessary drainage report information per criteria.

Respectfully,
JDS-Hydro Consultants, Inc.

Please indicate any previous approved drainage reports that have studied/analyzed the 3 sites. If some of sites have not been previously studied please state that in your narrative.

Mark Wolfe, P.E.

Enclosed

Appendix A – NCRS Soil Survey
Appendix B – FIRM Map
Appendix C – Drainage Calculations
Appendix D – Geotech Report

El Paso County Area, Colorado

83—Stapleton sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369z
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Stapleton and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stapleton

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 11 inches: sandy loam
Bw - 11 to 17 inches: gravelly sandy loam
C - 17 to 60 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R049XB215CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Pleasant
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Other soils
Percent of map unit: 1 percent
Hydric soil rating: No

Fluvaquentic haplaquolls
Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

El Paso County Area, Colorado

19—Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367p
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Columbine and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Columbine

Setting

Landform: Fans, flood plains, fan terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam
C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB215CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit: 1 percent

Landform: Depressions
Hydric soil rating: Yes

Other soils
Percent of map unit: 1 percent
Hydric soil rating: No

Fluvaquentic haplaquolls
Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

El Paso County Area, Colorado

83—Stapleton sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369z
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Stapleton and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stapleton

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 11 inches: sandy loam
Bw - 11 to 17 inches: gravelly sandy loam
C - 17 to 60 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R049XB215CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

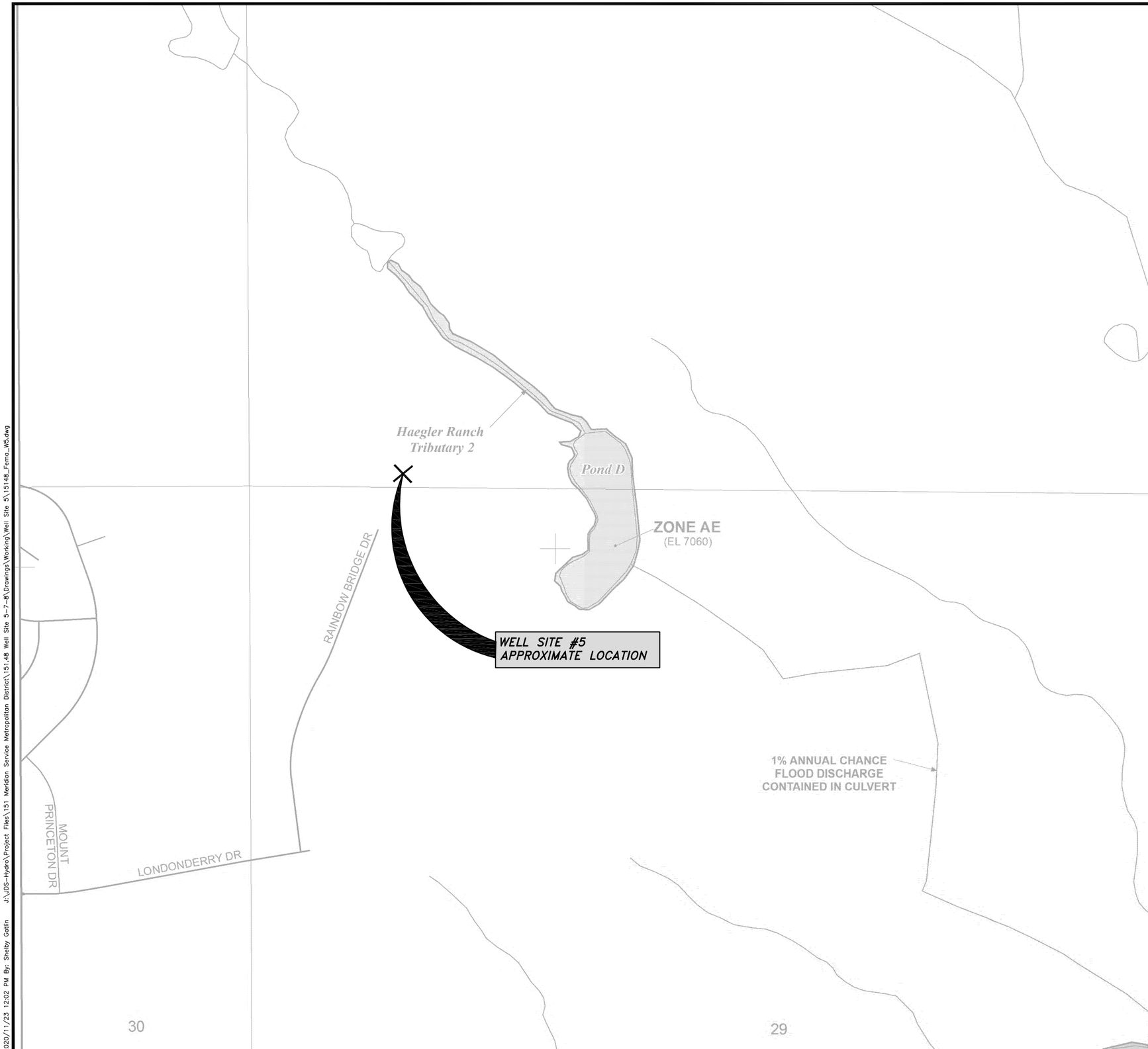
Pleasant
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Other soils
Percent of map unit: 1 percent
Hydric soil rating: No

Fluvaquentic haplaquolls
Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0552G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 552 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0552	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0552G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

JDS-HYDRO CONSULTANTS, INC.
5540 TECH CENTER DR., SUITE 100
COLORADO SPRINGS, COLORADO 80919
(719) 227-0072

MERIDIAN SERVICE METROPOLITAN DISTRICT

WELL SITE #5

FEMA FLOOD PLAIN MAP

REVISIONS

NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
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7				

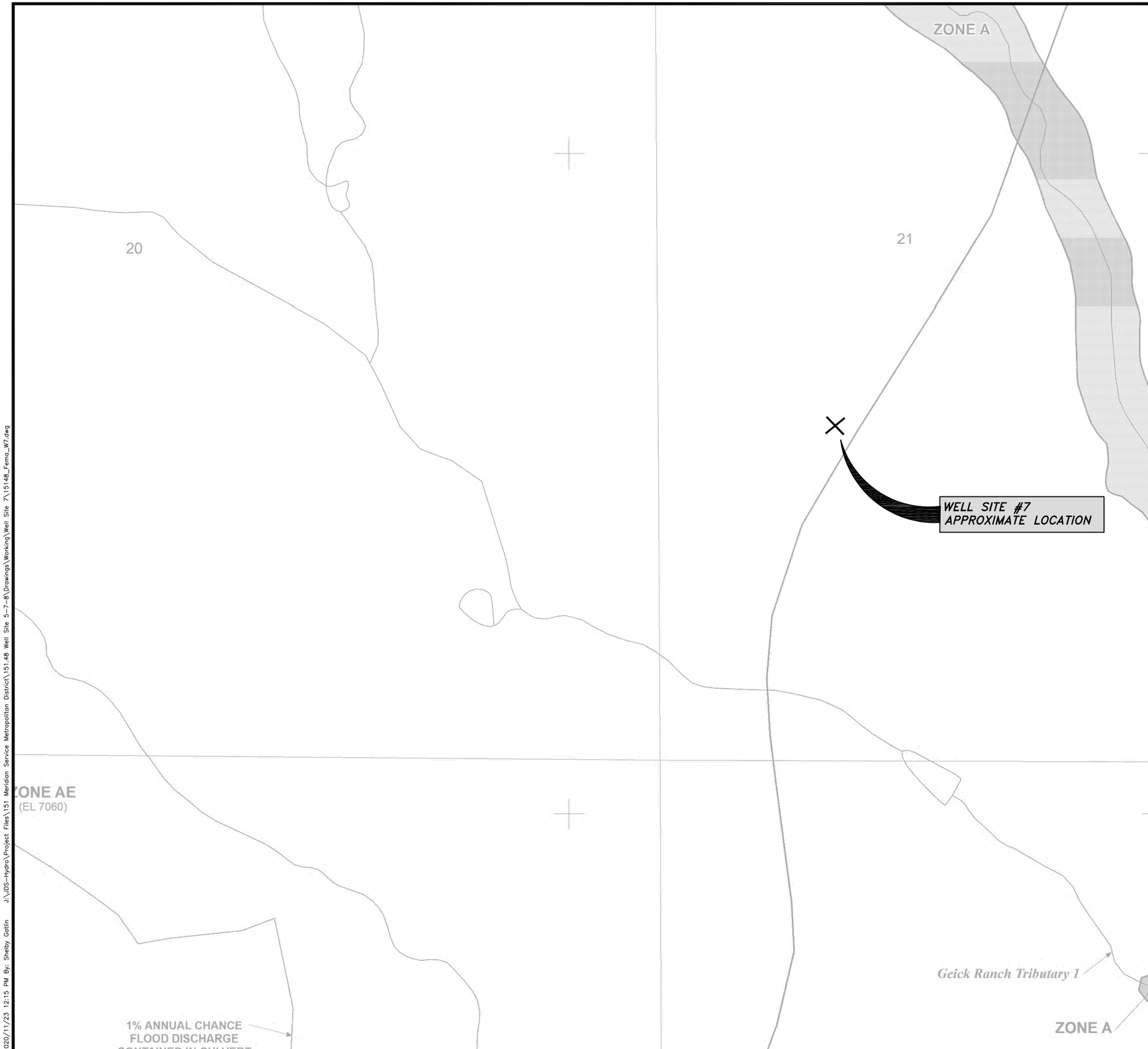
FOR CONSTRUCTION

Project No.: 151.48
Date: 10/12/20
Design: MTV
Drawn: SKG
Check: MLD

C5

SHEET ----OF

2020/11/23 12:02 PM By: Shelby Gatlin J:\JDS-Hydro\Project Files\151 Meridian Service Metropolitan District\151.48 Well Site 5-7-8\Drawings\Working\Well Site 5\15148_Fema_W5.dwg



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0552G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 552 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0552	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0552G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

JDS-HYDRO CONSULTANTS, INC.
5540 TECH CENTER DR., SUITE 100
COLORADO SPRINGS, COLORADO 80919
(719) 227-0072

MERIDIAN SERVICE METROPOLITAN DISTRICT

WELL SITE #7

FEMA FLOOD PLAIN MAPS

REVISIONS

NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
5				
6				
7				

FOR CONSTRUCTION

Project No.: 151.48
Date: 10/12/20
Design: MTV
Drawn: SKG
Check: MLD

C5

SHEET ----OF

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0552G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 552 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0552	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0552G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

JDS-HYDRO CONSULTANTS, INC.
5540 TECH CENTER DR., SUITE 100
COLORADO SPRINGS, COLORADO 80919
(719) 227-0072

MERIDIAN SERVICE METROPOLITAN DISTRICT

WELL SITE #8

FEMA FLOOD PLAIN MAP

REVISIONS

NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
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7				

FOR CONSTRUCTION

Project No.: 151.48
Date: 10/12/20
Design: MTV
Drawn: SKG
Check: MLD

C5

SHEET ----OF

2020/11/23 12:22 PM By: Shelby Gatlin I:\JDS-Hydro\Project Files\151 Meridian Service Metropolitan District\151.48 Well Site 5-7-8\Drawings\Working\Well Site 8\15148_WS8_Fema.dwg

Please use runoff coefficients from CH6 table 6-6 of City DCMV1 2014 that was adopted by the County in 2015.

https://library.municode.com/co/el_paso_county/codes/drainage_criteria_manual?nodeId=VO1UP

Drainage Calculations

	Roof area	Access Road - Agg base	Concrete	Site total	
Well Site 5	159	975	99	163,350	SF
Well Site 7	159	1861	0	108,000	
Well Site 8	159	3566	0	131,554	

Rational Method

Q=CiA

Q =	Peak runoff rate in CFS
C =	Runofff coefficient
i =	average rainfall intensity in in/hr
A =	drainage area in acres

Please provide calculation for how the runoff coefficients where determined

Well Site 5

Frequency	C pre-development (A&B soil classification)	C post-development	i	A
10 yr	0.25	0.254	1.75	3.75
100 yr	0.35	0.354	2.52	3.75

Q pre-development

10 yr	1.64	CFS
100 yr	3.31	CFS

Q post-development

10 yr	1.67	CFS
100 yr	3.34	CFS

Percent increase in Q

10 yr	1.72%
100 yr	1.02%

Well Site 7

Frequency	C pre-development (A&B soil classification)	C post-development	i	A
10 yr	0.25	0.26	1.75	2.48
100 yr	0.35	0.36	2.52	2.48

Q pre-development

10 yr	1.08	CFS
100 yr	2.19	CFS

Q post-development

10 yr	1.13	CFS
100 yr	2.24	CFS

Percent increase in Q

10 yr	4.17%
100 yr	2.45%

Well Site 8

Frequency	C pre-development (A&B soil classification)	C post-development	i	A
10 yr	0.25	0.27	1.75	3.02
100 yr	0.35	0.36	2.52	3.02

Q pre-development		
10 yr	1.32	CFS
100 yr	2.66	CFS
Q post-development		
10 yr	1.40	CFS
100 yr	2.76	CFS
Percent increase in Q		
10 yr	6.28%	
100 yr	3.68%	

11/6/2020

Geotechnical Evaluation Report

Meridian Service Metro District

Well Sites #5, #7, and #8

El Paso County, Colorado

VIVID Project No.: D20-2-341

VIVID Engineering Group

Report prepared for:

Mark Volle, PE
JDS-Hydro Consultants, Inc.
5540 Tech Center Drive, Suite 100
Colorado Springs, CO 80919
mvolle@jdshydro.com

GEOTECHNICAL EVALUATION REPORT
Meridian Service Metro District Well Sites #5, #7, and #8 Vaults
El Paso County, Colorado
VIVID Project No.: D20-2-341

Prepared by:

Mary Ray
Engineering Geologist

COLORADO REGISTERED
WILLIAM J. BARREIRE
32045
PROFESSIONAL ENGINEER
11/6/2020

William J. Barreire, P.E.
Senior Geotechnical Engineer

VIVID Engineering Group, Inc.
1053 Elkton Drive
Colorado Springs, CO 80907
(719) 896-4356
(719) 896-4357 fax

Table of Contents

1.0 INTRODUCTION

1.1 GENERAL

This report presents the results of a geotechnical investigation performed for the proposed Meridian Service Metro District Well Sites #5, #7, and #8 Vaults to be constructed at various locations northeast of Falcon, Colorado. An attached Vicinity Map (Figure 1) shows the general location of the project sites. Our investigation was performed for JDS-Hydro Consultants Inc. and was authorized by Mr. Mark Volle.

This report includes our recommendations relating to the geotechnical aspects of project design and construction. The conclusions and recommendations stated in this report are based upon the subsurface conditions found at the locations of our exploratory borings at the time our exploration was performed. They also are subject to the provisions stated in the report section titled **Additional Services & Limitations**. Our findings, conclusions, and recommendations should not be extrapolated to other areas or used for other projects without our prior review. Furthermore, they should not be used if the site has been altered, or if a prolonged period has elapsed since the date of the report, without VIVID's prior review to determine if they remain valid.

1.2 PROJECT DESCRIPTION

We understand the proposed project consists of the installation of a 10' tall pre-cast concrete vault to house piping connections at the Well Sites #5, #7 and #8 located at various sites northeast of Falcon, Colorado. Proposed Well Site #5 is located approximately 600 feet northeast of the intersection of Mount Harvard Drive and Rainbow Bridge Drive. Proposed Well Sites #7 and #8 are located west of Eastonville Road between Latigo Boulevard and Londonderry Drive.

No grading plans were available for our review when this report was prepared; however, we estimate general site grading will be limited to providing proper drainage away from the site improvements and preparing the foundation excavations for the vault. No structural loads were provided at the time this report was written. For the purposes of this report, we anticipate the vault structure will be relatively light. If the type of construction or actual structure loads vary significantly from those assumed above, VIVID should be notified in order to revise our recommendations, if required.

1.3 PURPOSE AND SCOPE

The purpose of our investigation was to explore and evaluate subsurface conditions at each well site and, based upon the conditions found, to develop recommendations relating to the geotechnical aspects of project design and construction. Our conclusions and recommendations in this report are based upon analysis of the data from our field exploration, laboratory tests, and our experience with similar soil and geologic conditions in the area.

VIVID's scope of services included:

- A visual reconnaissance to observe surface and geologic conditions at the project site and locating the exploratory boring;
- Notification of the Utility Notification Center of Colorado (UNCC)/Colorado 811 one-call service to identify underground utility lines at the boring location prior to our drilling;

- The drilling of one exploratory boring at each proposed well site location, selected based upon the proposed site layout, access, and location of existing structures and utilities;
- Laboratory testing of selected samples obtained during the field exploration to evaluate relevant physical and engineering properties of the soil;
- Evaluation and engineering analysis of the field and laboratory data collected to develop our geotechnical conclusions and recommendations; and
- Preparation of this report, which includes a description of the proposed project, a description of the surface and subsurface site conditions found during our investigation, our conclusions and recommendations as to foundation design and construction, and other related geotechnical issues, and appendices which summarize our field and laboratory investigations.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 FIELD EXPLORATION

A field exploration performed on October 15, 2020 included drilling one exploratory boring at each well site at the approximate locations indicated on the attached Boring Location Plan (Figure 2). The borings were advanced to a depth of approximately 29.5 feet below the existing ground surface.

The borings were advanced using a truck-mounted CME-45 drill rig equipped with 3-inch diameter, continuous-flight, solid-stem auger. Samples were taken with a standard split-spoon (SPT) sampler and California-type sampler (2.0-inch I.D./2.5-inch O.D.) and by bulk methods. Penetration tests were obtained at the various sample depths as well.

Appendix A to this report includes logs describing the subsurface conditions. The lines defining boundaries between soil and rock types on the logs are based upon drill behavior and interpolation between samples and are therefore approximate. Transition between soil and rock types may be abrupt or may be gradual.

2.2 GEOTECHNICAL LABORATORY TESTING

Laboratory tests were performed on selected soil samples to estimate their relative engineering properties. Tests were performed in general accordance with the following methods of ASTM or other recognized standards-setting bodies, and local practice:

- Description and Identification of Soils (Visual-Manual Procedure)
- Classification of Soils for Engineering Purposes
- Moisture Content and Unit Weight of Soils
- Sieve Analysis
- Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Results of the geotechnical laboratory tests are presented in the report text, where applicable, and included in Appendix B of this report. Selected test results are also shown on the boring logs in Appendix A.

2.3 ANALYTICAL LABORATORY TESTING

Analytical testing for soil corrosivity was performed on one select sample from each well site location and included the following tests:

- pH
- Resistivity
- Redox Potential
- Water-soluble Chlorides
- Sulfides
- Water-soluble Sulfate Content

Results of the analytical laboratory tests are included in Appendix C of this report.

3.0 SITE CONDITIONS

3.1 SURFACE

At the time of our exploration, Well Site #5 was located on the eastern edge of a subdivision with active site grading in progress directly east of the site. Rainbow Bridge Drive was directly west of the Well Site #5 with the ground surface sloping to the east. Well Sites #7 and #8 were located within Falcon Regional Park. Eastonville Road bordered Well Sites #7 and #8 to the east. The ground surface was relatively flat and sloped gently down towards the southeast.

3.2 GEOLOGY

Prior to drilling, the site geology was evaluated by reviewing available geologic information including the CGS Geologic Map of the Falcon Quadrangle, El Paso County Colorado (Morgan and White, 2012). Mapping indicates the surficial soils in the general area of the project site comprise predominantly Alluvium deposits of gravel, sand, silt, and clay underlain by sandstone and claystone bedrock of the Dawson Formation. The mapping is generally consistent with our explorations.

3.3 SEISMICITY

Based upon the geologic setting, subsurface soil conditions, and low seismic activity in this region, liquefaction is not expected to be a hazard at the site. Based on correlation of blow count data (N-values) from the boring advanced during this evaluation, the subsurface soil profile corresponds with Site Class C of the 2015 International Building Code (IBC). The intermediate design acceleration values from IBC are presented below.

Table 1
Design Acceleration for Short Periods

S_S	F_a
0.167	1.2

S_S = The mapped spectral accelerations for short periods (ATC Website, Accessed 10/26/2020)

F_a = Site coefficient from ATC Website, Accessed 10/26/2020

Table 2
Design Acceleration for 1-Second Period

S_1	F_V
0.057	1.7

S_1 = The mapped spectral accelerations for 1 second period (ATC Website, Accessed 10/26/2020)

F_v = Site coefficient from (ATC Website, Accessed 10/26/2020)

3.4 SUBSURFACE

VIVID explored the subsurface conditions by drilling, logging and sampling one exploratory boring at each well site location as shown on Figure 2. The borings were drilled at locations staked by JDS-Hydro to depths of approximately 29.5 feet below the existing ground surface. The general profile encountered in our boring consisted of:

Existing Fill

Existing fill materials comprised of clayey sand were encountered at Well Site #5 at the ground surface and extended to a depth of approximately 7.5 feet below the existing ground surface. The clayey sand was dark brown in color, moist, and field penetration testing (blow counts) indicated the soil to be medium dense.

Sand

Predominantly silty and clayey sand was encountered at the ground surface at Well Sites #7 and #8 and extended to depths of approximately 17 and 1.5 feet below the ground surface, respectively. The sand soils were light brown, grayish-brown, and olive in color, moist, and field penetration testing (blow counts) indicated the soil to be medium dense to loose, with the loose material being encountered near the groundwater at Well Site #7.

Bedrock

Silty and clayey sandstone bedrock of the Dawson Formation was encountered underlying the units described above at a depths of approximately 1.5 to 21 feet below the ground surface. The sandstone was generally olive, olive-brown, yellowish-brown in color, moist, and field penetration testing (blow counts) indicated the sandstone was hard to very hard. A weathered layer was encountered above the competent bedrock in the Well Site #7 boring at a depth of approximately 17 feet and extended to a depth of approximately 21 feet below the existing ground surface.

The boring logs in Appendix A should be reviewed for more detailed descriptions of the subsurface conditions at the boring location explored.

3.4.1 Groundwater

Groundwater was encountered in all three borings at the time of drilling at depths of approximately 14 to 29 feet below the ground surface. When checked one day after the time of drilling, groundwater was measured at depths of 12.5 to 24.5 feet below the ground surface. Groundwater was the shallowest at Well Site #5. Groundwater is anticipated to be a consideration for vault construction at Well Sites #5 and #7 depending on the time of year for construction and final vault depths. Soil moisture levels and groundwater levels commonly vary over time and space depending on seasonal precipitation, irrigation practices, land use, and runoff conditions. These conditions and the variations that they create often are not apparent at the time of field investigation. Accordingly, the soil moisture and groundwater data in this report pertain only to the locations and times at which exploration was performed. They can be extrapolated to other locations and times only with caution. It should also be noted that VIVID has not performed a hydrologic study to verify the seasonal high-water level.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 GEOTECHNICAL FEASIBILITY OF PROPOSED CONSTRUCTION

VIVID found no subsurface conditions during this investigation that would preclude construction of the vault essentially as planned, provided the recommendations in this report are incorporated into the design and construction of the project. Our recommendations for earthwork and foundations are discussed further in the following sections of the report.

The primary geotechnical issue associated with development of this project as proposed is the presence of groundwater near the proposed vault floor elevation at Well Site #5. Seasonal changes in groundwater conditions would indicate that construction (short-term) dewatering may be required. For the long-term solution one of the following options should be considered:

- A permanent dewatering system, or
- Designing the vault to resist buoyancy and hydrostatic pressures of the groundwater including an appropriate waterproofing system.

Vault foundation recommendations are described in more detail in Section 4.3.

4.2 CONSTRUCTION CONSIDERATIONS

4.2.1 General

All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations and other local, State or Federal guidelines.

4.2.2 Site Preparation and Grading

Initial site work should consist of completely removing all organic material and other deleterious materials from all areas to be filled and areas to be cut. All material should be removed for offsite disposal in accordance with local laws and regulations or, if appropriate, stockpiled in proposed non-structural areas for future use. Areas to receive fill should be evaluated by the geotechnical engineer prior to the placement of any fill materials.

After performing the required excavations and prior to the placement of structural elements and/or new fill, processing of the subgrade should be performed. This should include scarifying the exposed subgrade to a depth of at least 8 inches and compacting as recommended in Section 4.2.6 of this report. If bedrock is exposed at the planned excavation elevation, it should be scraped clean and relatively flat (bedrock should not be scarified). All fill materials should be placed on a horizontal plane and placed in loose lifts not to exceed 8 inches in thickness, unless otherwise accepted by the geotechnical engineer.

Although clay or claystone was not encountered in any of our borings, based on our experience, lenses are present within the Dawson Formation. If clay or claystone is encountered at the foundation subgrade elevations, it must be removed to expose natural sand or sandstone bedrock and replaced with moisture conditioned on-site sand or imported granular fill as described in Section 4.2.4 of this report and compacted to specification described in Table 3. **Vivid should observe excavations to evaluate if actual conditions are similar to that assumed based on our subsurface data.**

Due to groundwater levels, soft subgrade may be encountered at the base of the vault excavation. Use of stabilization rock can be used to stabilize areas that cannot otherwise be properly prepared for support of additional fill or structural elements. The optimal type and thickness of stabilization can only be evaluated when the conditions and magnitude of instability are exposed, but construction planning should address this need so it can be implemented when necessary.

4.2.3 Excavation Characteristics

Depending on the groundwater elevation at the time of construction, dewatering techniques may be required to perform construction activities. These techniques may include well-point and pump systems or diversionary techniques, such as trenches, sumps, and pumps.

All excavations must comply with applicable local, State and Federal safety regulations, and particularly with the excavation standards of the Occupational Safety and Health Administration (OSHA). Construction site safety, including excavation safety, is the sole responsibility of the Contractor as part of its overall responsibility for the means, methods and sequencing of construction operations. VIVID's recommendations for excavation support are intended for the Client's use in planning the project, and in no way relieve the Contractor of its responsibility to construct, support and maintain safe slopes. Under no circumstances should the following recommendations be interpreted to mean that VIVID is assuming responsibility for either construction site safety or the Contractor's activities.

We believe that the surficial sand soils on this site will classify as Type C materials and the sandstone bedrock will classify as Type B using OSHA criteria. OSHA requires that unsupported cuts be laid back to ratios no steeper than 1½:1 (horizontal to vertical) for Type C materials and no steeper than 1:1 for Type B. In general, we believe that these slope ratios for the soils provided above will be temporarily stable under unsaturated conditions. If groundwater seepage was to occur, flatter slopes may be appropriate. Please note that the actual determination of soil type and allowable sloping must be made in the field by an OSHA-qualified "competent person."

4.2.4 Structural Fill

Structural fill refers to material that is appropriate for placement beneath structural components, if necessary, as well as wall backfill. The native on-site granular (sand) materials are considered suitable for reuse as structural fill beneath the proposed vault structure and for use as wall backfill provided they are devoid of debris, organics, contamination, or other deleterious materials. Imported structural fill, if required, should consist of material meeting the requirements of a CDOT Class 1 Structure Backfill. A sample of any imported fill material should be submitted to our office for approval and testing at least 1 week prior to stockpiling at the site.

Structural fill should be moisture-treated and compacted according to the recommendations in Section 4.2.6 of this report. We recommend that a qualified representative of VIVID visit the site during excavation and during placement of the structural fill to verify the soils exposed in the excavations are consistent with those encountered during our subsurface exploration and that proper foundation subgrade preparation and placement is performed.

4.2.5 Utility Trench Backfill

Backfill material should be essentially free of plant matter, organic soil, debris, trash, other deleterious matter and rock particles larger than 4 inches. However, backfill material in the "pipe zone" (from the trench floor to 1 foot above the top of pipe) should not contain rock particles larger than 1 inch. Strictly observe any requirements specified by the utility agency for bedding and pipe-zone fill. In general, backfill above the pipe zone in utility trenches should be placed in lifts of 6 to 8 inches, and compacted using power equipment designed for trench work. Backfill in the pipe zone should be placed in lifts of 8 inches or less and compacted with hand-held equipment.

4.2.6 Compaction Requirements

Fill materials should be placed in horizontal lifts compatible with the type of compaction equipment being used, moisture conditioned, and compacted in accordance with the following criteria:

Table 3
Compaction Specifications

FILL LOCATION [1]	MATERIAL TYPE	PERCENT COMPACTION[2] (ASTM D 1557)	MOISTURE CONTENT
Subgrade Preparation (See Section 4.2.2.If bedrock exposed scrape clean to expose undisturbed bedrock surface)	On-site Soils	92 minimum	± 2 % of optimum
Below Foundations	On-site Granular Soils or Imported Structural Fill (CDOT Class 1 Structural Backfill)	92 minimum	± 2 % of optimum
Exterior Wall Backfill	On-site Granular Soils or Imported Structural Fill (CDOT Class 1 Structural Backfill)	92 minimum	± 2 % of optimum
Utility Trenches	On-site Soils	92 minimum	± 2 % of optimum

1) Where two or more "Fill Locations" coincide, the more stringent specification should be used.
2) In non-structural or landscaped areas, the compaction specification may be reduced to 90 percent.

Structural fill should be placed in level lifts not exceeding 8-inches in loose thickness and compacted to the specified percent compaction to produce a firm and unyielding surface. If field density tests indicate the required percent compaction has not been obtained, the fill material should be reconditioned as necessary and re-compacted to the required percent compaction before placing any additional material.

4.2.7 Construction in Wet or Cold Weather

During construction, grade the site such that surface water can drain readily away from the vault areas. Promptly pump out or otherwise remove any water that may accumulate in excavations or on subgrade

surfaces and allow these areas to dry before resuming construction. The use of berms, ditches and similar means may be used to prevent stormwater from entering the work area and to convey any water off site efficiently.

If earthwork is performed during the winter months when freezing is a factor, no grading fill, structural fill or other fill should be placed on frosted or frozen ground, nor should frozen material be placed as fill. Frozen ground should be allowed to thaw or be completely removed prior to placement of fill. A good practice is to cover the compacted fill with a "blanket" of loose fill to help prevent the compacted fill from freezing.

If the vault structures are erected during cold weather, foundations, concrete slabs-on-grade, or other concrete elements should not be constructed on frozen soil. Frozen soil should be completely removed from beneath the concrete elements, or thawed, scarified and recompacted. The amount of time passing between excavation or subgrade preparation and placing concrete should be minimized during freezing conditions to prevent the prepared soils from freezing. The use of blankets, soil cover or heating as required may be utilized to prevent the subgrade from freezing.

4.2.8 Construction Testing and Observation

Testing and construction observation should take place under the direction of VIVID to support that engineer's professional opinion as to whether the earthwork does or does not substantially conform to the recommendations in this report. Furthermore, the opinions and conclusions of a geotechnical report are based upon the interpretation of a limited amount of information obtained from the field exploration. It is therefore not uncommon to find that actual site conditions differ somewhat from those indicated in the report. The geotechnical engineer should remain involved throughout the project to evaluate such differing conditions as they appear, and to modify or add to the geotechnical recommendations, as necessary.

4.2.9 Surface Drainage

Surface drainage should be designed so that surface water will flow away from the buried vault and other improvements as rapidly as possible and not be allowed to stand or pond.

4.2.10 Permanent Cut and Fill Slopes

If required, permanent cut and fill slopes exposing the materials encountered in our borings are anticipated to be stable at slope ratios as steep as 3:1 (horizontal to vertical) under dry conditions. We believe that slope ratios of 4:1 or flatter are more reliable if subjected to wetting, and present less of a maintenance problem. New slopes should be revegetated as soon as possible after completion to reduce erosion problems.

4.3 VAULT SUPPORT RECOMMENDATIONS

As discussed in this report, we recommend vaults and shallow foundation elements, as required, be placed on a properly prepared subgrade soils or directly on undisturbed sandstone bedrock as described in Section 4.2.2 of this report. We recommend the vault foundation be designed and constructed in accordance with the following criteria:

- Vaults/foundations bearing directly on sandstone bedrock (Well-Site #5 and #8) may be designed for a maximum allowable bearing capacity of 4,000 pounds per square foot (psf).
- Vaults/foundations bearing upon a properly prepared subgrade (Well-Site #7) may be designed for a maximum allowable bearing capacity of 3,000 pounds per square foot (psf).
- If lenses of claystone are encountered at the foundation elevations, they must be removed to expose sandstone bedrock, and if needed, be replaced with moisture conditioned on-site sand and sandstone or imported granular fill as described in Section 4.2.4 of this report and compacted to specification described in Table 3.
- The vault foundation elements should have at least 36 inches of cover above the bottom of the foundation for frost protection or that required by the local building code, whichever is greater.
- The foundation subgrade and compacted structural fill should be protected from wetting and drying prior to and after concrete placement. Foundations should be backfilled as soon as practical after concrete placement.
- We estimate total movement for foundations will be less than 1 inch, with differential movement on the order of ½ to ¾ of the total movement.
- VIVID should observe excavations to evaluate if actual conditions are similar to that assumed based on our subsurface data. All fill should be tested as described herein.

4.4 LATERAL EARTH PRESSURES

Vault walls will be backfilled with soil on one side and will therefore be subjected to lateral earth pressures. The design and construction criteria presented below should be observed for earth retention systems (vault walls in this case) on this site with flat back slopes. Active and at-rest lateral earth pressures apply to the structural fill soils that are "retained" by the foundation walls. The sliding coefficient applies to the friction between the base of the foundation and the underlying soil. The following values were estimated assuming a moist unit weight of 125 pounds per cubic foot and an internal friction angle of 32 degrees for imported granular structural fill materials and internal friction angle of 30 degrees for on-site granular soils.

Table 4
Lateral "Equivalent Fluid" Earth Pressure Parameter Summary

Parameter	CDOT Class I Structure Backfill (Above Groundwater)	CDOT Class I Structure Backfill (Below Groundwater)[4]	On-Site Sand Soils (Above Groundwater)	On-site Sand Soils (Below Groundwater)[4]
At-Rest[1]	59 pcf	92 pcf	63 pcf	94 pcf
Active[2]	38 pcf	82 pcf	42 pcf	83 pcf
Passive[3]	407 pcf	204 pcf	375 pcf	188 pcf
Unfactored Coefficient of Sliding Friction[3]	0.62	0.62	0.58	0.58

Notes: 1. Retaining walls that are laterally supported (structurally restrained from rotation) can be expected to undergo only a slight amount of deflection. These walls should be designed for an "at-rest" lateral earth pressure.

2. Retaining structures which can deflect sufficiently to mobilize the full "active" earth pressure condition should be designed for an "active" lateral earth pressure.

3. Lateral loads may be resisted using these unfactored coefficients of sliding friction and unfactored passive earth pressures presented above. Because significant movement is required to fully mobilize passive earth pressure, we recommend a minimum factor of safety of 2 be applied for design purposes.

4. It should be noted that the hydrostatic water pressure (62.4 pcf) was already included in the pressure values for below groundwater condition.

4.5 CORROSIVITY AND CONCRETE

4.5.1 Corrosion Potential

Laboratory testing was completed to provide data regarding corrosivity of onsite soils. Our scope of services does not include corrosion engineering and, therefore, a detailed analysis of the corrosion test results is not included. A qualified corrosion engineer should be retained to review the test results and design protective systems that may be required.

Laboratory chloride concentration, sulfate concentration, sulfide concentration, pH, oxidation reduction potential, and electrical resistivity tests were performed on a sample of onsite materials obtained during our field investigation. The results of the tests are included in Appendix C to this report and are summarized below in Table 5.

Table 5
Summary of Laboratory Soil Corrosivity Testing

Boring No.	Sample Depth (ft)	Water Soluble Chloride (%)	pH	Redox Potential (mV)	Resistivity (ohm-cm)	Water Soluble Sulfate (%)	Sulfide Content
Well site #5	9	0.0005	7.2	340.0	3873	0.002	Negative
Well site #7	0-4	0.0008	6.8	340.9	6053	<0.001	Trace
Well site #8	7	0.0005	7.8	299.5	3821	0.002	Trace

Metal and concrete elements in contact with soil, whether part of a foundation system or part of a supported structure, are subject to degradation due to corrosion or chemical attack. Therefore, buried metal and concrete elements should be designed to resist corrosion and degradation based on accepted practices.

Based on the "10-point" method developed by the American Water Works Association (AWWA) in standard AWWA C105/A21.5, the corrosivity test results indicate that the onsite soils have low corrosive potential. We recommend that a corrosion engineer be consulted to recommend appropriate protective measures, if required.

4.5.2 Chemical Sulfate Susceptibility and Concrete Type

The degradation of concrete or cement grout can be caused by chemical agents in the soil or groundwater that react with concrete to either dissolve the cement paste or precipitate larger compounds within the concrete, causing cracking and flaking. The concentration of water-soluble sulfates in the soils is a good

indicator of the potential for chemical attack of concrete or cement grout. The American Concrete Institute (ACI) in their publication Guide to Durable Concrete (ACI 201.2R-08) provides guidelines for this assessment.

The concentration of water-soluble sulfates measured on subsurface materials submitted for testing represents a Class 0 exposure of sulfate attack on concrete exposed to the soils per CDOT Standard Specifications for Road and Bridge Construction, 2017, Section 601.04.

5.0 ADDITIONAL SERVICES & LIMITATIONS

5.1 ADDITIONAL SERVICES

Attached to this report is a document by the Geoprofessional Business Association (GBA) that summarizes limitations of geotechnical reports as well as additional services that are required to further confirm subgrade materials are consistent with that encountered at the specific boring locations presented in this report. This document should be read in its entirety before implementing design or construction activities. Examples of other services beyond completion of a geotechnical report are necessary or desirable to complete a project satisfactorily include:

- Review of design plans and specifications to verity that our recommendations were properly interpreted and implemented.
- Attendance at pre-bid and pre-construction meetings to highlight important items and clear up misunderstandings, ambiguities, or conflicts with design plans and specifications.
- Performance of construction observation and testing which allows verification that existing materials at locations beyond our borings are consistent with that presented in our report, construction is compliant with the requirements/recommendations, evaluation of changed conditions.

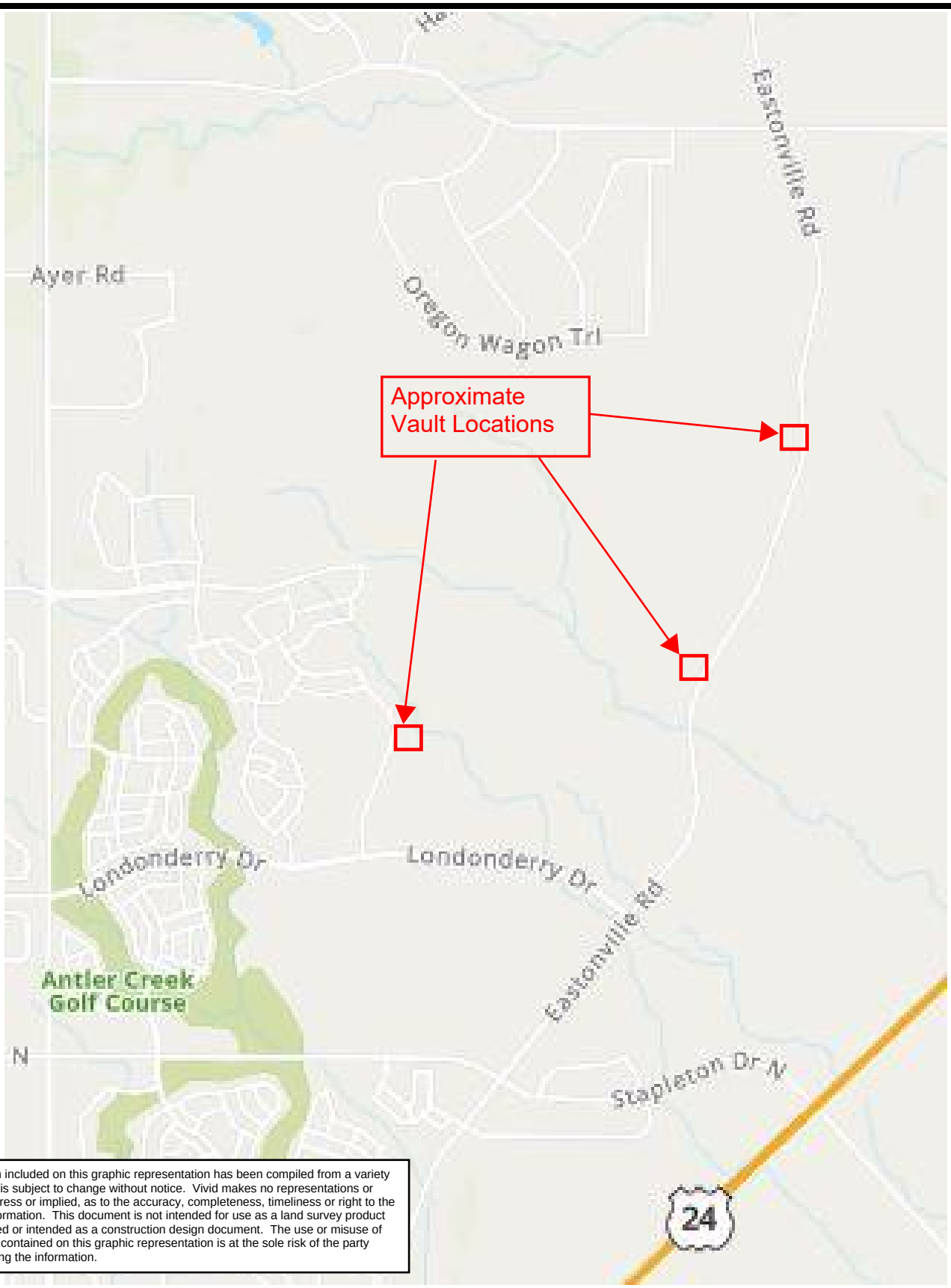
5.2 LIMITATIONS

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

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

The work performed was based on project information provided by Client. If Client does not retain VIVID to review any plans and specifications, including any revisions or modifications to the plans and specifications, VIVID assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, Client must obtain written approval from VIVID's engineer that such changes do not affect our recommendations. Failure to do so will vitiate VIVID's recommendations.

Figures



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Not to Scale. Base image obtained from www.mapquest.com, 2020

VIVID Engineering Group	Project No: D20-2-341	**VICINITY MAP**	Figure
	Date: October 6, 2020		**1**
	Drawn by: MBR	Meridian Service Metro District Well Sites #5, #7 and #8 Vaults El Paso County, Colorado	
	Reviewed by: WJB		

LEGEND

= APPROXIMATE LOCATION OF BORING

N

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Colorado Springs, Colorado 80907
719.896.4356

Project No: D20-2-341
Date: October 6, 2020
Drawn by: MBR
Reviewed by : WJB

BORING LOCATION PLAN - AERIAL

Meridian Service Metro District
Well Sites #5, #7, and #8
El Paso County, Colorado

Figure
2

Appendix A

Logs of Exploratory Borings

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Telephone: 719-896-4356
Fax: 719-896-4357

KEY TO SYMBOLS

CLIENT JDS Hydro Consultants, Inc.

PROJECT NAME Proposed MSMD Vaults

PROJECT NUMBER D20-2-341

PROJECT LOCATION El Paso County, Colorado

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

- FILL
- SANDSTONE
- SC: USCS Clayey Sand
- SM: USCS Silty Sand
- WEATHERED SANDSTONE

SAMPLER SYMBOLS

- Grab Sample
- 2" I.D. Modified California Sampler (MC)
- Standard Penetration Test (SPT)

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
MC - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
FINES- PERCENT PASSING NO. 200 SIEVE
UCS - UNCONFINED COMPRESSIVE STRENGTH

- Water Level at Time of Drilling, or as Shown
- Water Level at End of Drilling, or as Shown
- Water Level After 24 Hours, or as Shown

VIVID Engineering Group, Inc.
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Colorado Springs, CO 80907
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BORING NUMBER Well Site #5

CLIENT JDS-Hydro Consultants, Inc.
PROJECT NAME Proposed MSMD Vaults
PROJECT NUMBER D20-2-341
PROJECT LOCATION El Paso County, Colorado
DATE STARTED 10/15/20 **COMPLETED** 10/15/20
GROUND ELEVATION 7083.1 ft **HOLE SIZE** 3 inches
DRILLING CONTRACTOR Custom Auger Drilling (CME-45)
GROUND WATER LEVELS:
DRILLING METHOD 3" Solid Stem Auger
AT TIME OF DRILLING 21.00 ft / Elev 7062.10 ft
LOGGED BY M. Ray **CHECKED BY** B. Mustain
AT END OF DRILLING ---
NOTES
24hrs AFTER DRILLING 12.50 ft / Elev 7070.60 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0	GB				**Existing Fill** Clayey SAND, dark brown, moist, medium dense
5	SPT	3-3-7 (10)	MC = 9.6% LL = 25 PL = 16 Fines = 27.0%		
	MC	12-27			7.5 — 7075.6
10	MC	24-47	MC = 16.2% DD = 108.8 pcf LL = NP PL = NP		**Dawson Formation** Silty and Clayey SANDSTONE, olive-brown, yellowish-brown, moist, hard to very hard
15	MC	32-50	Fines = 40.0% Chloride = 0.0005%, pH = 7.2, Redox Potential = 340.0 mv, Resistivity = 3873 ohm.cm, Sulfate = 0.002%, Sulfide = Negative MC = 11.4% DD = 123.1 pcf LL = 29 PL = 21 Fines = 30.0%		-more clayey at approximately 11 feet below the existing ground surface. Approximate Bottom of Slab Elevation
20	MC	50/6"			
25	MC	50/4"			
	SPT	50/5"			29.4 — 7053.7

Bottom of borehole at 29.4 feet.

VIVID Engineering Group, Inc.
1053 Elkton Drive
Colorado Springs, CO 80907
Telephone: 719-896-4356
Fax: 719-896-4357

BORING NUMBER Well Site #7

CLIENT JDS-Hydro Consultants, Inc.
PROJECT NAME Proposed MSMD Vaults
PROJECT NUMBER D20-2-341
PROJECT LOCATION El Paso County, Colorado
DATE STARTED 10/15/20 **COMPLETED** 10/15/20
GROUND ELEVATION 7011.22 ft **HOLE SIZE** 3 inches
DRILLING CONTRACTOR Custom Auger Drilling (CME-45)
GROUND WATER LEVELS:
DRILLING METHOD 3" Solid Stem Auger
AT TIME OF DRILLING 14.00 ft / Elev 6997.22 ft
LOGGED BY M. Ray **CHECKED BY** B. Mustain
AT END OF DRILLING ---
NOTES
24hrs AFTER DRILLING 14.00 ft / Elev 6997.22 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	MATERIAL DESCRIPTION
0	GB		Chloride = 0.008%, pH = 6.8, Redox Potential = 340.9 mv, Resistivity = 6053 ohm.cm, Sulfate = <0.001%, Sulfide = Trace	Silty SAND, light brown, olive, slightly moist, medium dense
5	SPT	5-6-6 (12)	MC = 2.2% LL = NP PL = NP Fines = 22.0%	
	SPT	9-9-8 (17)	MC = 5.9% LL = NP PL = NP Fines = 11.0%	8.0 / 7003.2 — Well-Graded SAND with Silty SAND, olive, moist to wet, medium dense to loose
10	SPT	10-11-10 (21)	MC = 5.9% LL = NP PL = NP Fines = 14.0%	Approximate Bottom of Slab Elevation
15	SPT	2-2-3 (5)		-softer at approximately 14 feet below the existing ground surface.
				17.0 / 6994.2 — **Dawson Formation** Weathered SANDSTONE, olive, moist, medium hard
20	MC	14-29	MC = 12.2% DD = 122.5 pcf LL = 42 PL = 14 Fines = 38.0%	
				21.0 / 6990.2 — **Dawson Formation** Clayey SANDSTONE, olive, moist, very hard
25	MC	50/3"		
	MC	50/6"		29.5 / 6981.7

Bottom of borehole at 29.5 feet.

VIVID Engineering Group, Inc.
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BORING NUMBER Well Site #8

CLIENT JDS-Hydro Consultants, Inc.
PROJECT NAME Proposed MSMD Vaults
PROJECT NUMBER D20-2-341
PROJECT LOCATION El Paso County, Colorado
DATE STARTED 10/15/20 **COMPLETED** 10/15/20
GROUND ELEVATION 7045.86 ft **HOLE SIZE** 3 inches
DRILLING CONTRACTOR Custom Auger Drilling (CME-45)
GROUND WATER LEVELS:
DRILLING METHOD 3" Solid Stem Auger
AT TIME OF DRILLING 29.00 ft / Elev 7016.86 ft
LOGGED BY M. Ray **CHECKED BY** B. Mustain
AT END OF DRILLING ---
NOTES
AFTER DRILLING 24.50 ft / Elev 7021.36 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	MATERIAL DESCRIPTION
0				Silty SAND, grayish-brown, slightly moist
				1.5 — 7044.4
	GB			**Dawson Formation** Silty and Clayey SANDSTONE, coarse-grained, olive, yellowish-brown, moist
5	SPT	30-50	MC = 6.7% LL = 26 PL = 18 Fines = 18.0%	
	MC	41-50/5"	Chloride = 0.0005%, pH = 7.8, Redox Potential = 299.5 mv, Resistivity = 3821 ohm.cm, Sulfate = 0.002%, Sulfide = Trace	
10	MC	50/6"	MC = 6.5% LL = 29 PL = 19 Fines = 13.0%	Approximate Bottom of Slab Elevation
15	MC	31-50		
	MC	50/5"		
20	MC	38-50/3"		-finer grained and clayier at approximately 21 feet below the existing ground surface
25	MC	50/6"		
				29.5 — 7016.4

Bottom of borehole at 29.5 feet.

Appendix B

Geotechnical Laboratory Test Results

Vivid Engineering Group, Inc.
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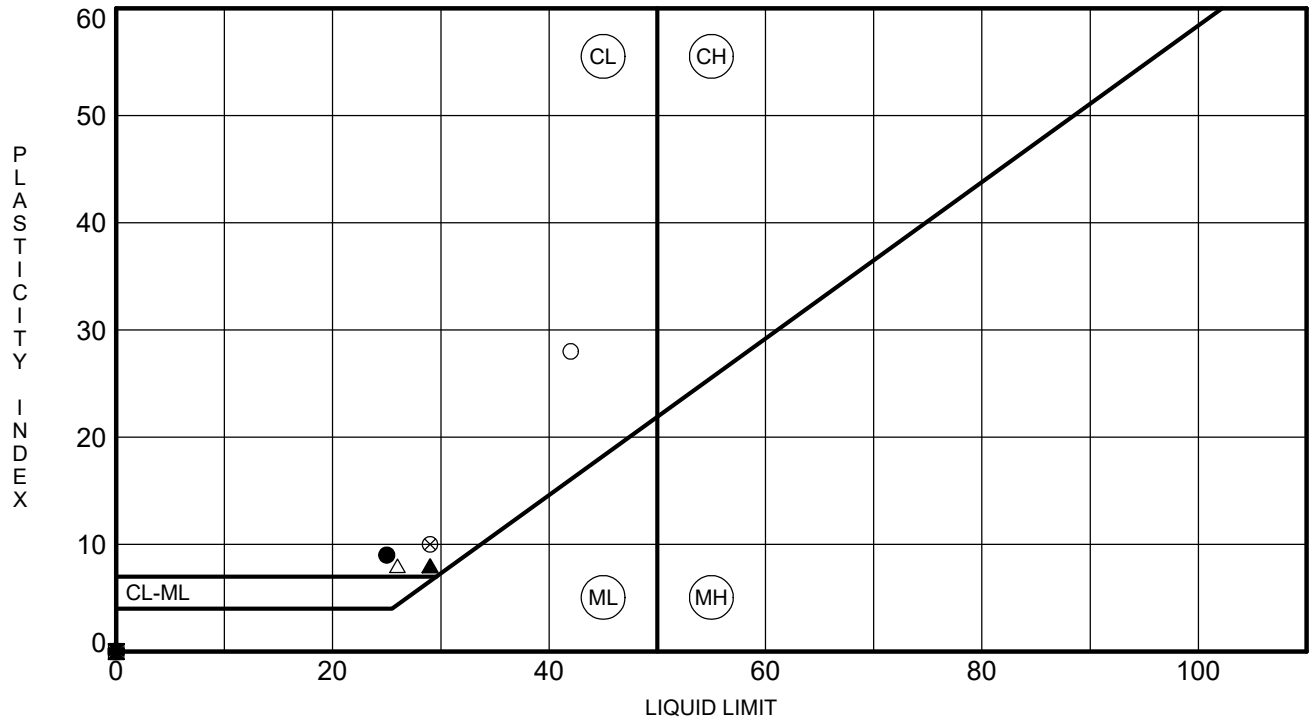
ATTERBERG LIMITS' RESULTS

CLIENT JDS Hydro Consultants, Inc.
PROJECT NAME Proposed MSMD Vaults
PROJECT NUMBER D20-2-341
PROJECT LOCATION El Paso County, Colorado



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**Well Site #5**	**4.0**	**25**	**16**	**9**	**27**	**CLAYEY SAND(SC)**
⊠	**Well Site #5**	**9.0**	**NP**	**NP**	**NP**	**40**	**SILTY SAND(SM)**
▲	**Well Site #5**	**14.0**	**29**	**21**	**8**	**30**	**CLAYEY SAND(SC)**
★	**Well Site #7**	**4.0**	**NP**	**NP**	**NP**	**22**	**SILTY SAND(SM)**
⊙	**Well Site #7**	**7.0**	**NP**	**NP**	**NP**	**11**	**WELL-GRADED SAND with SILT(SW-SM)**
✿	**Well Site #7**	**9.0**	**NP**	**NP**	**NP**	**14**	**SILTY SAND(SM)**
○	**Well Site #7**	**19.0**	**42**	**14**	**28**	**38**	**CLAYEY SAND(SC)**
△	**Well Site #8**	**4.0**	**26**	**18**	**8**	**18**	**CLAYEY SAND(SC)**
⊗	**Well Site #8**	**9.0**	**29**	**19**	**10**	**13**	**CLAYEY SAND(SC)**

Vivid Engineering Group, Inc.
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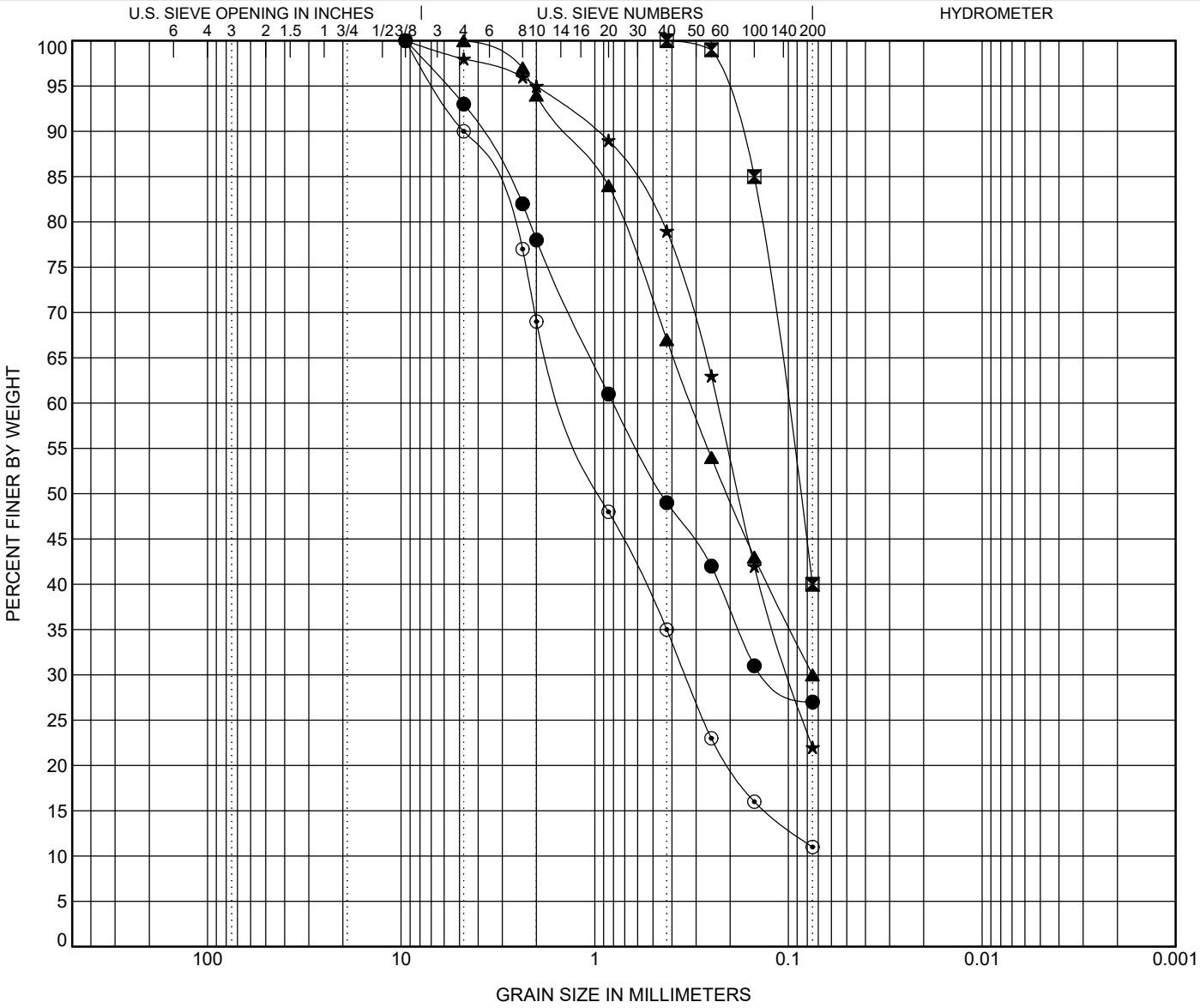
GRAIN SIZE DISTRIBUTION

CLIENT JDS Hydro Consultants, Inc.
PROJECT NAME Proposed MSMD Vaults
PROJECT NUMBER D20-2-341
PROJECT LOCATION El Paso County, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	Well Site #5	4.0	CLAYEY SAND(SC)	25	16	9		
⊠	Well Site #5	9.0	SILTY SAND(SM)	NP	NP	NP		
▲	Well Site #5	14.0	CLAYEY SAND(SC)	29	21	8		
★	Well Site #7	4.0	SILTY SAND(SM)	NP	NP	NP		
⊙	Well Site #7	7.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP	1.28	21.23

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	Well Site #5	4.0	9.5	0.802	0.126		7.0	66.0	27.0	
⊠	Well Site #5	9.0	0.425	0.102			0.0	60.0	40.0	
▲	Well Site #5	14.0	4.75	0.319	0.075		0.0	70.0	30.0	
★	Well Site #7	4.0	9.5	0.232	0.099		2.0	76.0	22.0	
⊙	Well Site #7	7.0	9.5	1.386	0.341		10.0	79.0	11.0	

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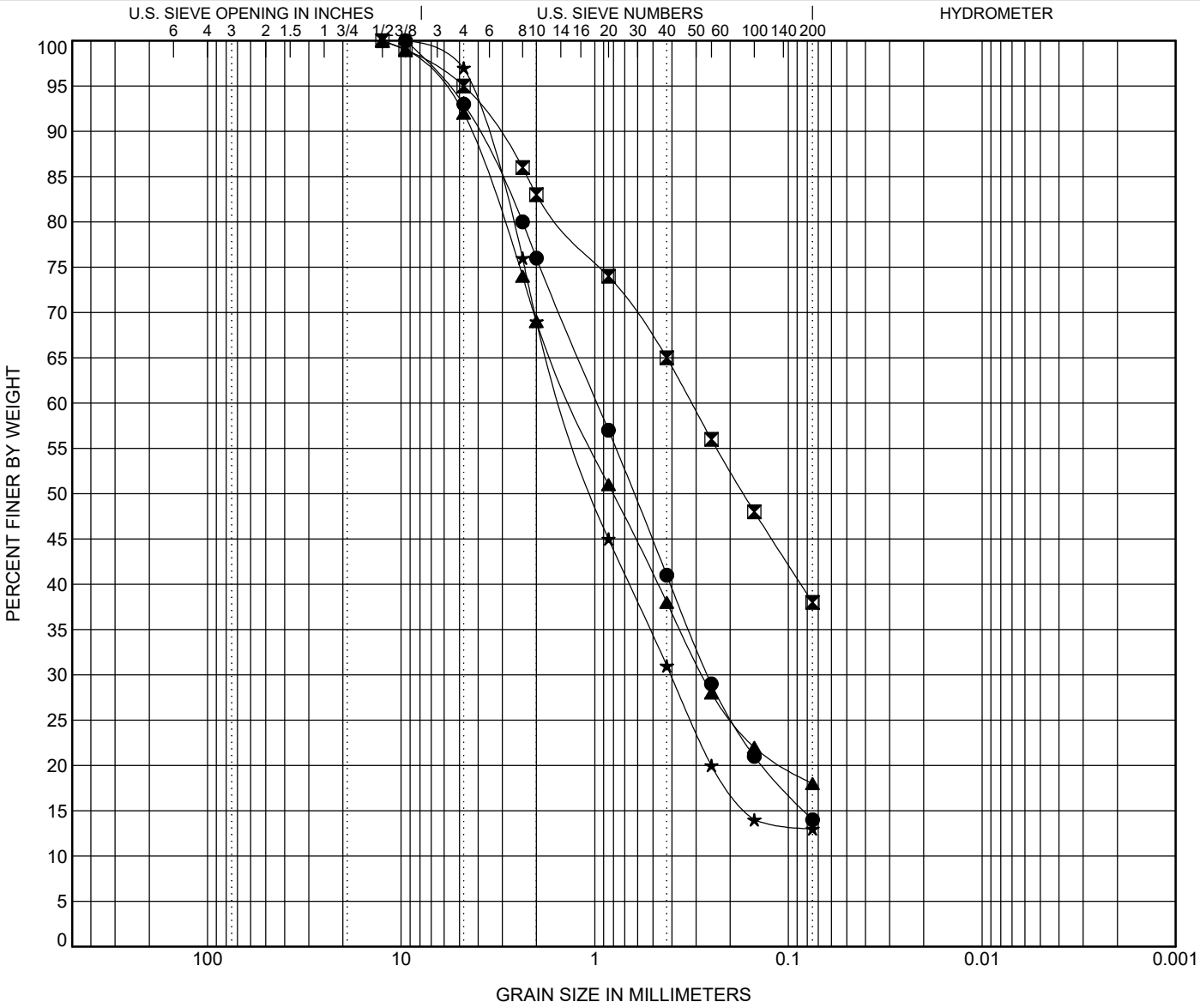
GRAIN SIZE DISTRIBUTION

CLIENT JDS Hydro Consultants, Inc.
PROJECT NAME Proposed MSMD Vaults
PROJECT NUMBER D20-2-341
PROJECT LOCATION El Paso County, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**Well Site #7**	**9.0**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
⊠	**Well Site #7**	**19.0**	**CLAYEY SAND(SC)**	**42**	**14**	**28**		
▲	**Well Site #8**	**4.0**	**CLAYEY SAND(SC)**	**26**	**18**	**8**		
★	**Well Site #8**	**9.0**	**CLAYEY SAND(SC)**	**29**	**19**	**10**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**Well Site #7**	**9.0**	**9.5**	**0.973**	**0.261**		**7.0**	**79.0**	**14.0**	
⊠	**Well Site #7**	**19.0**	**12.5**	**0.316**			**5.0**	**57.0**	**38.0**	
▲	**Well Site #8**	**4.0**	**12.5**	**1.304**	**0.278**		**8.0**	**74.0**	**18.0**	
★	**Well Site #8**	**9.0**	**9.5**	**1.451**	**0.405**		**3.0**	**84.0**	**13.0**	

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SUMMARY OF LABORATORY RESULTS

CLIENT JDS Hydro Consultants, Inc.

PROJECT NAME Proposed MSMD Vaults

PROJECT NUMBER D20-2-341

PROJECT LOCATION El Paso County, Colorado

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)		
Well Site #5	4.0	25	16	9	9.5	27	SC	9.6			
Well Site #5	9.0	NP	NP	NP	0.425	40	SM	16.2	108.8		
Well Site #5	14.0	29	21	8	4.75	30	SC	11.4	123.1		
Well Site #7	4.0	NP	NP	NP	9.5	22	SM	2.2			
Well Site #7	7.0	NP	NP	NP	9.5	11	SW-SM	5.9			
Well Site #7	9.0	NP	NP	NP	9.5	14	SM	5.9			
Well Site #7	19.0	42	14	28	12.5	38	SC	12.2	122.5		
Well Site #8	4.0	26	18	8	12.5	18	SC	6.7			
Well Site #8	9.0	29	19	10	9.5	13	SC	6.5			

Appendix C

Analytical Laboratory Test Results

Colorado Analytical LABORATORIES, INC.

Analytical Results

TASK NO: 201019033

Task No.: 201019033
Client PO:
Client Project: MSMD Vaults D20-2-341

Date Received: 10/19/20
Date Reported: 10/26/20
Matrix: Soil - Geotech

Customer Sample ID 5 @ 9ft
Lab Number: 201019033-01

Test	Result	Method
Chloride - Water Soluble	0.0005 %	AASHTO T291-91/ ASTM D4327
pH	7.2 units	AASHTO T289-91
Redox Potential	340.0 mv	ASTM D1498
Resistivity	3873 ohm.cm	AASHTO T288-91
Sulfate - Water Soluble	0.002 %	CDOT CP-L 2103 / ASTM D4327
Sulfide	Negative	AWWA C105

Customer Sample ID 7 @ 0-4ft
Lab Number: 201019033-02

Test	Result	Method
Chloride - Water Soluble	0.0008 %	AASHTO T291-91/ ASTM D4327
pH	6.8 units	AASHTO T289-91
Redox Potential	340.9 mv	ASTM D1498
Resistivity	6053 ohm.cm	AASHTO T288-91
Sulfate - Water Soluble	< 0.001 %	CDOT CP-L 2103 / ASTM D4327
Sulfide	Trace	AWWA C105

Abbreviations/ References:

AASHTO - American Association of State Highway and Transportation Officials.
ASTM - American Society for Testing and Materials.
ASA - American Society of Agronomy.
DIPRA - Ductile Iron Pipe Research Association Handbook of Ductile Iron Pipe.

DATA APPROVED FOR RELEASE BY

Colorado Analytical LABORATORIES, INC.

Analytical Results

TASK NO: 201019033

Task No.: 201019033
Client PO:
Client Project: MSMD Vaults D20-2-341

Date Received: 10/19/20
Date Reported: 10/26/20
Matrix: Soil - Geotech

Customer Sample ID 8 @ 7ft
Lab Number: 201019033-03

Test	Result	Method
Chloride - Water Soluble	0.0005 %	AASHTO T291-91/ ASTM D4327
pH	7.8 units	AASHTO T289-91
Redox Potential	299.5 mv	ASTM D1498
Resistivity	3821 ohm.cm	AASHTO T288-91
Sulfate - Water Soluble	0.002 %	CDOT CP-L 2103 / ASTM D4327
Sulfide	Trace	AWWA C105

Abbreviations/ References:

AASHTO - American Association of State Highway and Transportation Officials.
ASTM - American Society for Testing and Materials.
ASA - American Society of Agronomy.
DIPRA - Ductile Iron Pipe Research Association Handbook of Ductile Iron Pipe

DATA APPROVED FOR RELEASE BY

Appendix D

Site Photos

DRILLING WELL SITE #5- LOOKING SOUTHEAST

DRILLING WELL SITE #7 - LOOKING SOUTHWEST

VIVID Engineering Group	Project No: D20-2-341	**SITE PHOTOS**	FIGURE
	Date: 10/19/2020	Meridian Service Metro District	**D-1**
	Drawn by: MBR	Well Sites #5, #7, #8	
	Reviewed by: WJB	El Paso County, Colorado	

DRILLING WELL SITE #8- LOOKING NORTHWEST

VIVID Engineering Group	Project No: D20-2-341	**SITE PHOTOS**	FIGURE
	Date: 10/19/2020	Meridian Service Metro District	**D-2**
	Drawn by: MBR	Well Sites #5, #7, #8	
	Reviewed by: WJB	El Paso County, Colorado	

Appendix E

Important Information About This Geotechnical Engineering Report

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

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

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation*.

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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e-mail: info@geoprofessional.org www.geoprofessional.org