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Rev. 2 (9/11/19)

Geology and Soils Evaluation Report

Proposed Grandwood Subdivision

NE of Higby Road and Fairplay Drive

El Paso County, Colorado

VIVID Project No.: D18-2-175

PCD File No. SP195

VIVID Engineering Group

January 19, 2019
Revision 1- April 1, 2019
Revision 2- September 11, 2019

Report prepared for:

Bill Herebic
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Monument, Colorado 80132
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GEOLOGY AND SOILS EVALUATION REPORT
Proposed Grandwood Subdivision
NE of Higby Road and Fairplay Drive
El Paso County, Colorado
VIVID Project No. D18-2-175

Prepared by:

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9-11-19

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1.0 INTRODUCTION

1.1 General

This report presents the results of a geology and soils evaluation report performed for the proposed Grandwood Subdivision to be constructed northeast of Higby Road and Fairplay Drive in El Paso County, Colorado. An attached Vicinity Map (Figure 1) shows the general location of the project. Our evaluation was performed for Grandwood Enterprises, LLC, and was authorized by Mr. Bill Herebic. **This report was revised from its original version dated January 19, 2019 which was a combined Geology & Soils and Wastewater report per Section 8.4.9 (B) (2) of the Land Development Code. This updated report includes only the Geology and Soils report conclusions (section 3.0) based on the County's request to provide separate Geology, Soils, and Wastewater reports.**

1.2 Project Description

The proposed project includes the development of a 151-acre parcel into a residential subdivision. 48 lots are planned, that will be approximately 2.5 acres in size. The property has no current improvements and is in a generally native condition. The development will include construction of access roadways and utilities. Residential lots will require individual water well and septic systems. A preliminary site layout is shown on Figure 2, attached to this report.

1.3 Purpose and Scope

The purpose of this evaluation was to evaluate the site geology and potential geologic hazards for the proposed development. This report is part of the submittal of the Preliminary Development Plan for this proposed subdivision to El Paso County.

VIVID's scope of services included:

- A visual reconnaissance to observe surface and geologic conditions at the project site and locating the exploratory borings and test pit sites;
- Notification of the Utility Notification Center of Colorado (UNCC)/Colorado 811 to identify underground utility lines at the boring locations prior to our drilling;
- The drilling of seven exploratory borings (including percolation testing) and excavation of three test pits for tactile evaluation of the soils. These exploration were performed on 20 percent of the proposed lots at currently accessible locations across the proposed development area;
- Laboratory testing of selected samples obtained during the field exploration to evaluate relevant physical, geologic, and engineering properties of the soil; 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, geologic and geotechnical research and mapping for evaluation of challenges or hazards that may impact the development.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration

A field exploration performed on December 20, 2018 included the drilling of seven exploratory borings (including percolation testing), and excavation of three test pits for tactile evaluation of the soils at the locations presented on Figure 2 – Exploration Location Plan. This exploration and some of the basic information are presented in Table 1, below.

Table 1
Summary of Subsurface Exploration

Boring Designation	Approximate Boring Depth [feet, below ground surface]	Approximate Depth to Groundwater [feet, below ground surface]	Approximate Depth to Weathered Bedrock [feet, below ground surface]	Approximate Depth to Competent Bedrock [feet, below ground surface]
B-1	25.0	23.0	None Encountered	None Encountered
B-2	14.5	None Encountered	4.0	12.0
B-3	25.0	19.0	None Encountered	None Encountered
B-4	20.0	17.0	-	12.0
B-5	14.5	None Encountered	8.0	None Encountered
B-6	25.0	19.0	25.0	None Encountered
B-7	20.0	14.0	14.0	None Encountered
TP-1	10.0	None Encountered	None Encountered	None Encountered
TP-2	10.0	None Encountered	None Encountered	None Encountered
TP-3	10.0	None Encountered	None Encountered	None Encountered

Borings were performed with a truck-mounted CME-45 drill rig equipped with 4-inch outside diameter, continuous-flight, solid-stem auger. Samples were taken with a 2.5-inch O.D./2.0-inch I.D., California-type sampler, standard penetration (SPT) sampler, and by bulk methods. Penetration tests were obtained at the various sample depths as well.

Test pits were performed with a rubber-tire backhoe. Tactile observation/evaluation of the soils exposed was performed during excavation. Bulk samples of the soils were obtained for laboratory testing purposes.

Appendix A to this report includes logs of the borings and test pits 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 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
- Sieve Analysis of Fine and Coarse Aggregates
- Liquid Limit, Plastic Limit, and Plasticity Index
- Swell/Settlement

Results of the laboratory tests are included in Appendix B of this report. Selected test results are also shown on the boring logs in Appendix A.

3.0 GEOLOGY AND SOILS

3.1 Site Description

The site is 151 acres and is currently covered with native grasses, trees, and shrubs. The parcel is a generally mild south and west sloping parcel with two shallow alluvial valleys separated by sandstone topographic highs. The site is bounded on the north, east and west by existing residential subdivisions. Higby Road borders the south.

3.2 Geologic Reconnaissance

A visual geologic reconnaissance of the site was performed by Mr. Jim Frohbieter, Professional Geologist, with J&K Geological Services. This reconnaissance was supported by the field drilling and test pit explorations, as well as geologic mapping and information from the following sources:

- CGS Geologic Map of the Monument Quadrangle, El Paso County, Colorado by Jon P. Thorson and Richard F. Madole, 2003
- Soil Survey of El Paso County Area, Colorado Soil Conservation Service, USDA, 1979
- El Paso County, Colorado: Potential Geologic Hazards and Surficial Deposits, Environmental and Engineering Maps and Tables for Land Use (Colorado Springs Quadrangle 1961), Charles S. Robinson and Associates, Inc. Cochran, D.M. (1977)
- Review of Available Geologic Hazard Studies in the surrounding area

Geologic maps are presented as Figures 3a-Regional Geology Map and Figure 3b-Site Specific Geology Map, attached to this report. An NRCS Soil Survey Map and associated Soil Descriptions are presented as Figures 4a, and 4b. A USGS Topographic Map is attached as Figure 5.

3.3 Site Stratigraphy (Figure 3b)

Based on information available, two geologic units are identified on the site which may be described as follows:

Qsw Holocene and Pleistocene Aged Sheet Washed Deposits (water deposited soil):	The alluvial sheet washed deposits encountered on and adjacent to the site are generally associated with the late Pleistocene and Holocene Ages. The material is typically brown to light brown to tan. This unit is very lensatic, consisting of poorly sorted sand, silty to clayey sand with minor amounts of fine gravel. The unit consists chiefly of material derived and transported from the surrounding uplands of valley side slopes by sheet flow, but also includes sediments deposited by concentrated runoff from rills and minor gullies. Unit Qsw exists primarily in sheets and wedges in the shallow valleys encountered on this site.
TKd Dawson Formation	The Upper Dawson Formation (TKd) is Upper Cretaceous to Eocene in age, and is divided into five facies in this area of El Paso County Colorado. The project site is mapped as the fourth facies (TKd4) on the CGS Geologic Map of the Monument Quadrangle, El Paso County, Colorado, (by Jon P. Thornson and Richard F. Madole, 2003).

This unit (TKd4) is typically made up of very thick to massive, cross bedded, light colored arkoses, and arkosic pebbly conglomeratic sandstones. These sandstones are generally white to light tan in color, fine to course grained, cross bedded and are poorly cemented and friable. Clay content is quite variable and the expansion potential ranges from low to very high depending on the amount of clay content in the lenses.

Facies Unit 4 is generally permeable, well drained and has good foundation characteristics. Excavation may be difficult, even though the sandstone is friable and is easily eroded on exposed slopes.

3.4 Engineering Geology and Mitigation of Geologic Hazards

No geologic hazards were found that would preclude the proposed development as planned. The following presents a list of geologic hazards, their applicability to this site, and the typical mitigation techniques.

Expansive/Settlement Prone Soil

Neither expansive nor settlement prone soils and bedrock were encountered during this investigation, and are not anticipated to be a significant or widespread hazard for this development. However, it should be noted that expansive clay or clayey sandstone is not uncommon within the Dawson Formation. This condition, if it exists, should be evaluated at the time of final geotechnical investigations for each specific residence. Expansive soils can be mitigated through typical engineering approaches including removal of expansive layers, over-excavation and treatment or replacement, or use of deep foundations.

Erodible Soils

Soils with a sandy matrix, such as that encountered underlying the site, are susceptible to erosion when exposed. These concerns are normally addressed in an erosion control plan during construction and a long-term seeding/landscape plan that is typical for this type of development.

Corrosive Soils

The site may be underlain by soil or bedrock materials that may contain corrosive minerals. Corrosive minerals can have detrimental effects on concrete and buried metals if not identified prior to design and properly mitigated. The potential for corrosive minerals is addressed in a site specific geotechnical investigation report.

Mine Subsidence

This project is outside of the any areas of know mining and mine subsidence.

Slope Stability

The Dawson Formation and moderate to gentle slopes on this site are not considered to be prone to slope instability an there are no published geologic maps that indicate these issues exist on this site.

Flooding Potential

As shown on Figure 6, the project site is outside of mapped flood plain areas. Based on the mapping and our site observations flooding is not considered to be a hazard for this development. However, surface runoff water from the surrounding area is currently being directed into historical 1st order drainage features that cross the project site. These historical surface water flows must not be interrupted or blocked by new construction of the proposed streets, homes, or driveways.

Seismicity

The major structural feature of this region is the Rampart Range Fault System which is located approximately 5 miles west of the site along the Front Range. There is evidence of movement during the past 2 million years along this fault zone. The Rampart Range Fault is considered to be active by the Colorado Geologic Survey. This area, as is the case with most of central Colorado, is subject to a degree of risk due to seismic activity. The Colorado Geologic Survey considers the El Paso County area to be in Seismic Risk Zone 2A. Pikes Peak Regional Building Department has adopted the International Building Code. Refer to the currently approved building codes for current design and construction practices.

Radiation

The primary radiation hazard associated with soil and bedrock commonly found in the El Paso County area is Radon gas. The higher concentrations of radon gas normally occur in residential structures that have been sealed to prevent exchange of outside air. Buildup of Radon gas can usually be mitigated by providing frequent exchange of air within the structure and by sealing joints and cracks that are located adjacent to the subsoil. Radon can be evaluated and mitigated utilizing common local construction practices if radon is found to exist during site specific geotechnical investigations.

Groundwater

Groundwater was encountered in five of the preliminary profile borings ranging in depth from 14 to 23 feet below the existing ground surface. The depth of groundwater is presented in Table 1 of this report, and on the individual boring and test pit logs presented in Appendix A. Although the ground water encountered during the preliminary investigation was relatively deep, shallower groundwater and smaller seeps are not uncommon as perched water above the bedrock, or in more permeable lenses within the Dawson Formation. If this condition is encountered during site specific geotechnical investigations for individual lots, it should be mitigated with cut-off or foundation drains that are common local design and construction techniques.

Conclusion

It is our opinion that the project site exhibits no geologic hazards that pose a significant risk to the proposed project or adjacent properties that cannot be mitigated through proper land usage planning, foundation design, engineering design, and/or construction practice. Recommendations regarding mitigation of the identified potential hazards are addressed in the site-specific geotechnical investigation report, or through the use of current building design codes.

3.5 Economic Mineral Resources

According *to El Paso County Aggregate Resource Evaluation Map*, the project site is not mapped with any viable aggregate deposits. The site is mapped as a "poor" for coal resources and "fair" for oil, according to the *Evaluation of Mineral and Mineral Fuel Potential of El Paso, State Mineral Lands.*

3.6 On-site Detention Ponds

Given the soils encountered in the various borings and test pits performed on the site, we do not anticipate soil conditions that would result in foundation or slope instability for the proposed detention ponds planned at the locations shown on Figure 3b. We understand the maximum height of embankments will be on the order of 14 feet (west pond), and 20 feet (east pond) as measured from the crest of the embankment to the lowest point at the embankment toe.

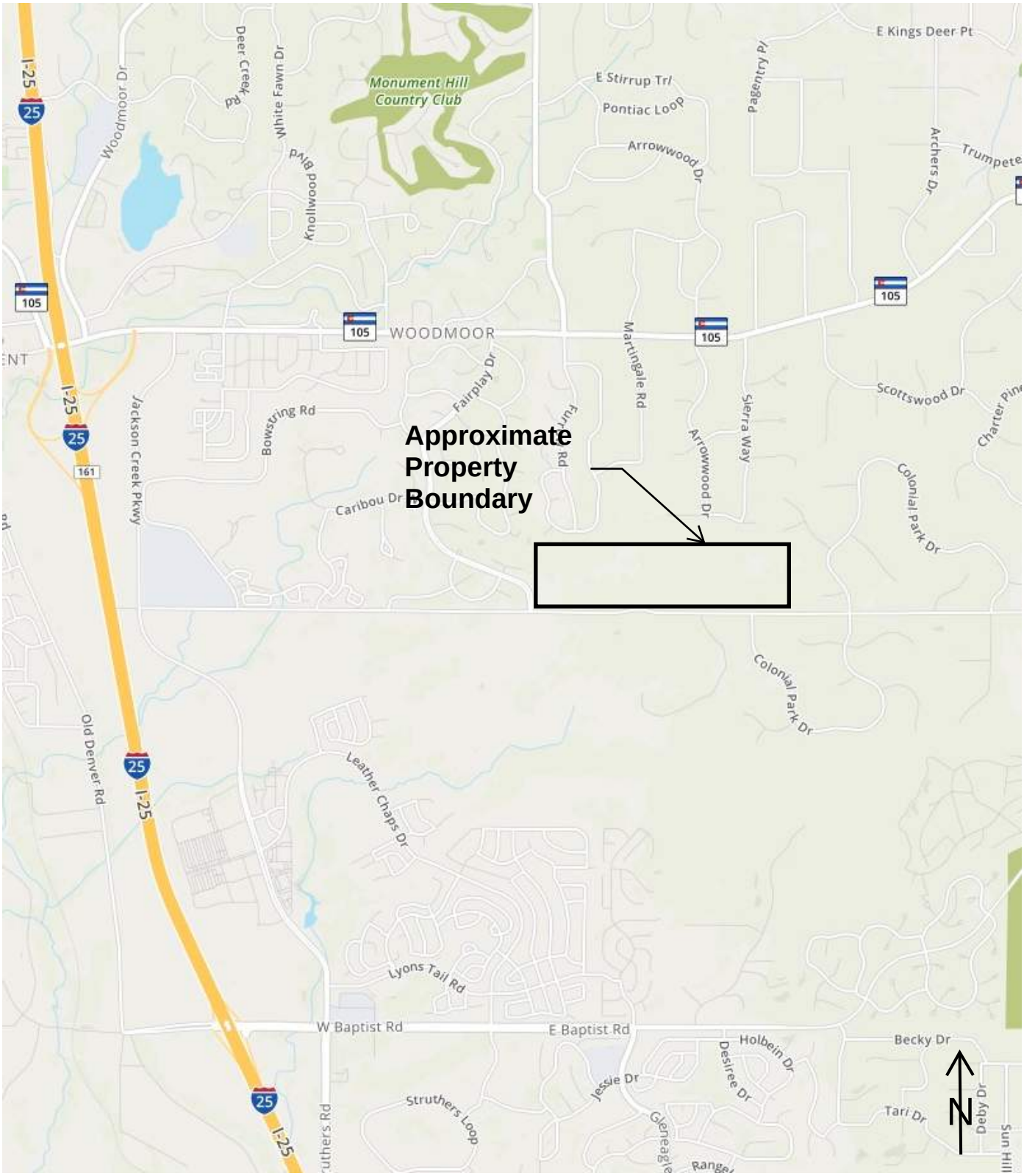
Foundation preparation will require removal of organic material and soft/wet surficial soils (anticipated to be relatively shallow) below new embankment for the ponds. In the event that deeper, wet soils are encountered, stabilization in the form of pushing angular rock into the subgrade may required to create a more stable foundation and slope stability condition. The size of rock, depth, and area extent of such mitigation would be determined by the geotechnical engineer at the time the conditions are fully exposed.

The granular soils encountered would also be a good material for re-use as embankment fill and would provide adequate stability for the anticipated detention durations with slopes of 3:1 or shallower (as currently designed) to achieve required factors of safety for global stability. Topsoil and seeding to establish adequate growth on the new embankments will required for erosion protection. While the soils encountered are granular in nature which is good for stability, they also have appreciable fines to prevent water from readily seeping into and through the new embankment. We recommend the foundation soils below embankment and new embankment fill be compacted to minimum 95% of the maximum laboratory dry density per ASTM D698 "Standard Proctor". In lieu of achieving this compaction requirement, unstable foundation soils shall be stabilized as discussed above and subject to proof roll to determine adequate stability per the geotechnical engineer.

4.0 LIMITATIONS

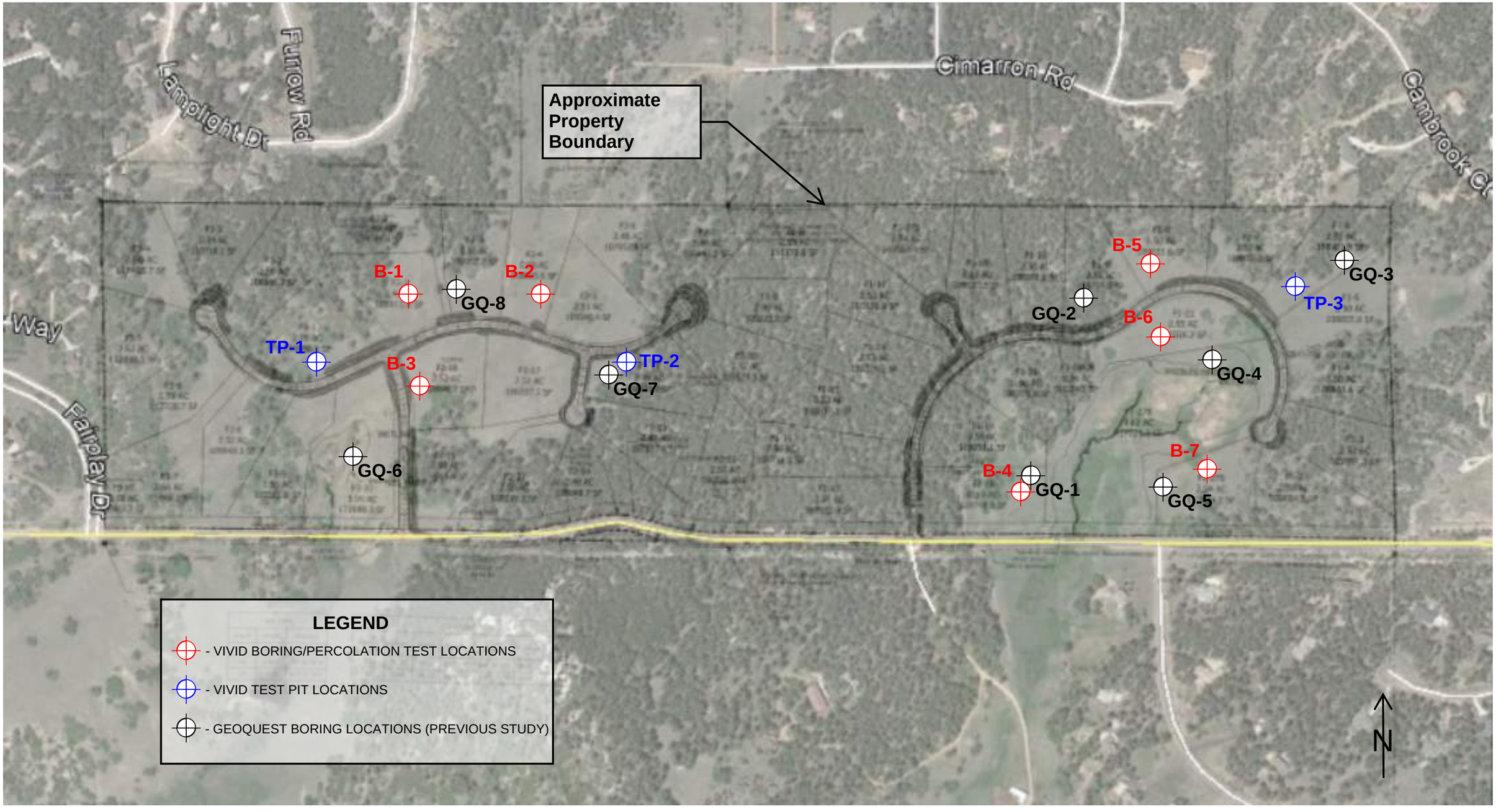
This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of VIVID's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on 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.



Not to Scale. Base image obtained from www.mapquest.com, 2019

VIVID Engineering Group	Project No: D18-2-175	VICINITY MAP	Figure
	Date: 1/15/19		1
	Drawn by: WJB	Grandwood Subdivision El Paso County, Colorado	
	Reviewed by: BTM		



Not to Scale. Base image dated 06/09/2017 and obtained from Google Earth, 2019.

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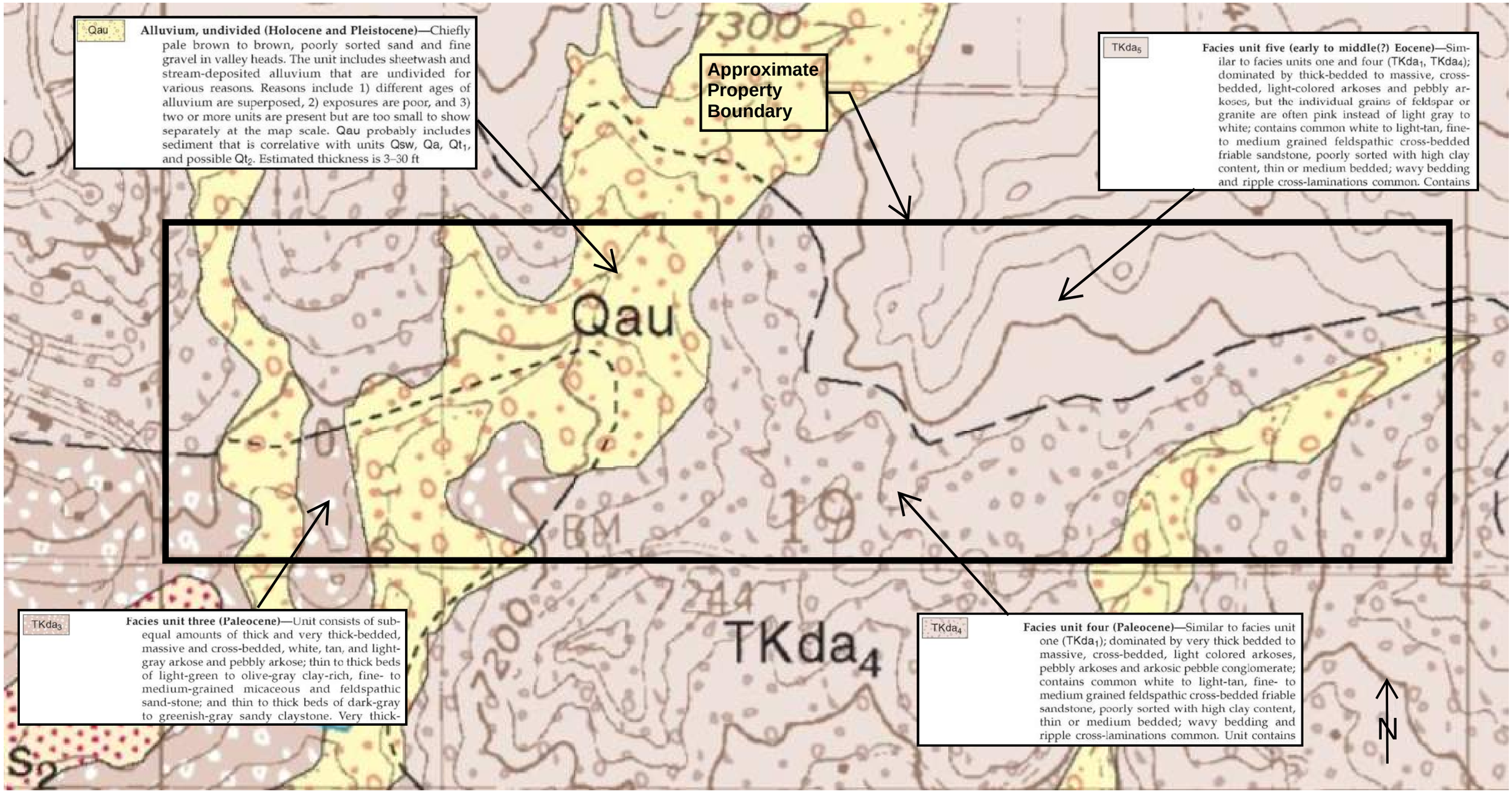
EXPLORATION LOCATION PLAN

Grandwood Subdivision
El Paso County, Colorado

Figure
2



Not to Scale. Base image from https://ngmdb.usgs.gov/Prodesc/proddesc_76327.htm (Geologic Map of the Monument Quadrangle, El Paso County, Colorado, 2003)

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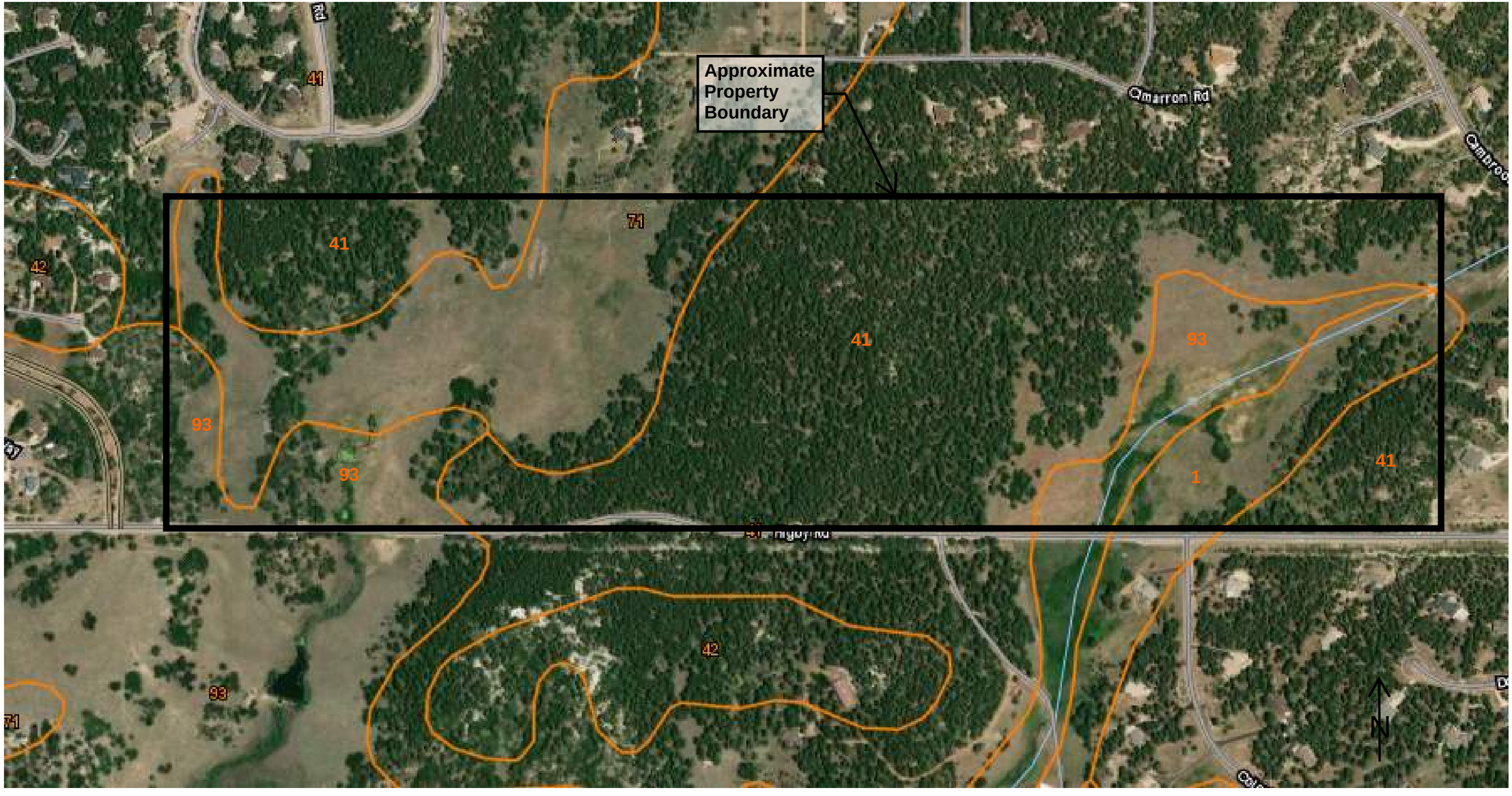
REGIONAL GEOLOGY MAP

Grandwood Subdivision
El Paso County, Colorado

Figure
3a



Not to Scale. Base image from https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

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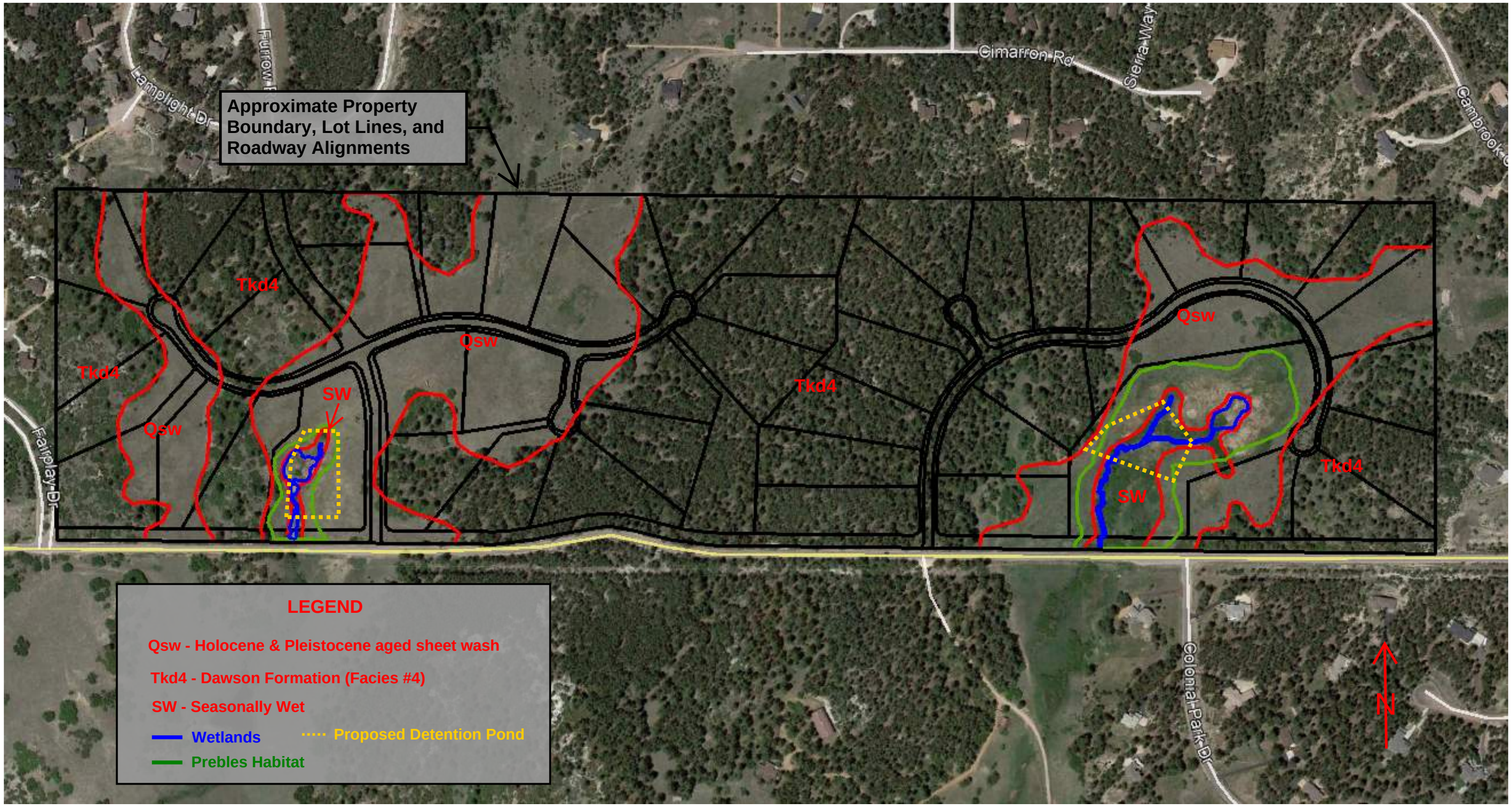
NRCS SOIL SURVEY MAP

Grandwood Subdivision
El Paso County, Colorado

Figure
4a



Not to Scale. Base image dated 06/09/2017 and obtained from Google Earth, 2019.
Site-specific Geology Mapping by Jim Frohbieter, Professional Geologist

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SITE-SPECIFIC GEOLOGY MAP

Grandwood Subdivision
El Paso County, Colorado

Figure
3b

El Paso County Area, Colorado

1—Alamosa loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3670
Elevation: 7,200 to 7,700 feet
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition

Alamosa and similar soils: 85 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alamosa

Setting

Landform: Flood plains, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 6 inches: loam
Bt - 6 to 14 inches: clay loam
Btk - 14 to 33 inches: clay loam
Cg1 - 33 to 53 inches: sandy clay loam
Cg2 - 53 to 60 inches: sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Very slightly saline to strongly saline (2.0 to 16.0 mmhos/cm)
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: Mountain Meadow (R048AY241CO)
Hydric soil rating: Yes

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

El Paso County Area, Colorado

41—Kettle gravelly loamy sand, 8 to 40 percent slopes

Map Unit Setting

National map unit symbol: 368h
Elevation: 7,000 to 7,700 feet
Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 85 percent

Estimates are based on observations, descriptions, and transec mapunit.

Description of Kettle

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

E - 0 to 16 inches: gravelly loamy sand
Bt - 16 to 40 inches: gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 8 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): (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 storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

El Paso County Area, Colorado

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

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

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy Park (R048AY222CO)
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

El Paso County Area, Colorado

93—Tomah-Crowfoot complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 36bb
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Hills, alluvial fans
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Not to Scale. Base image from https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

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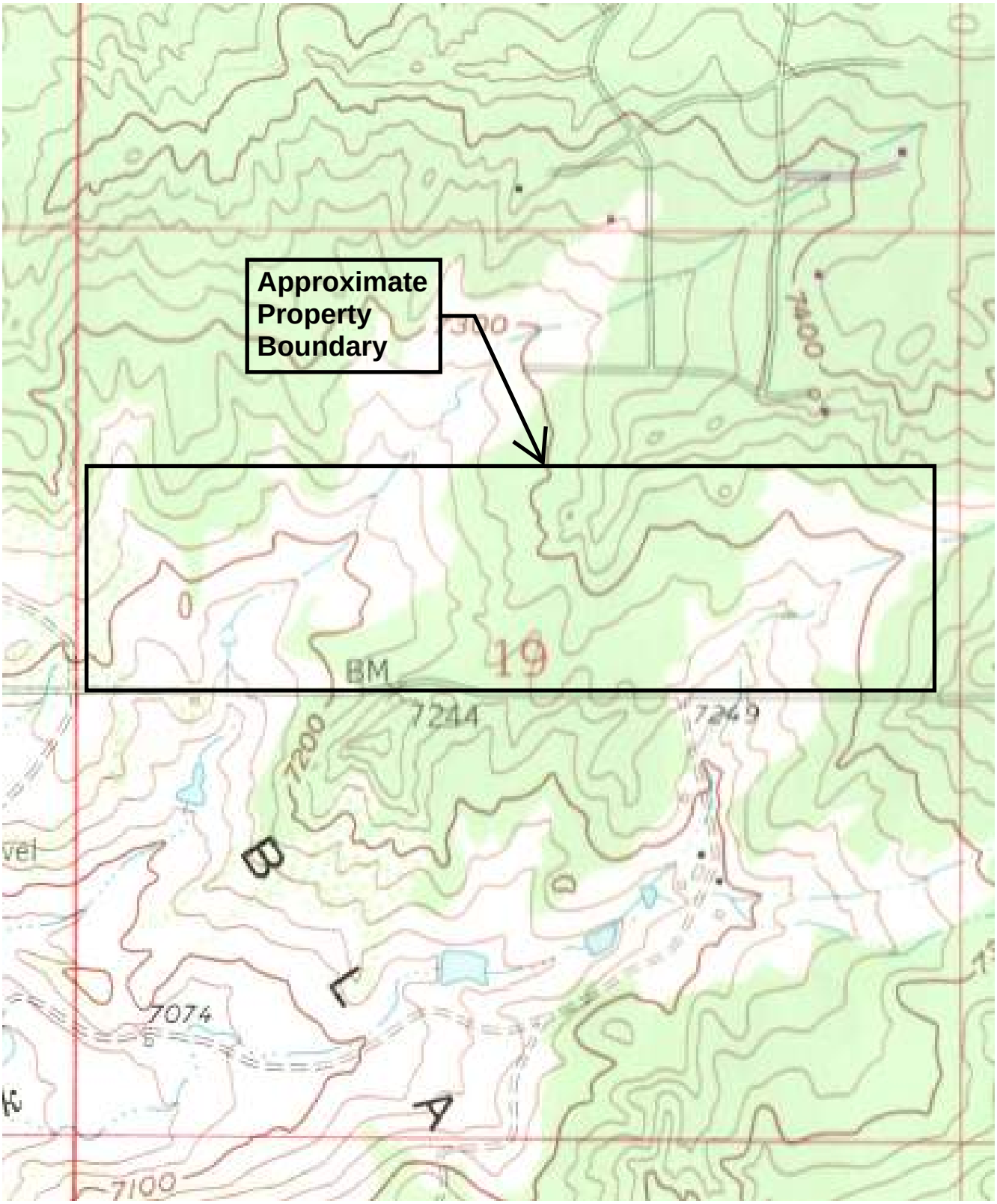
NRCS SOIL SURVEY MAP (Soil Descriptions)

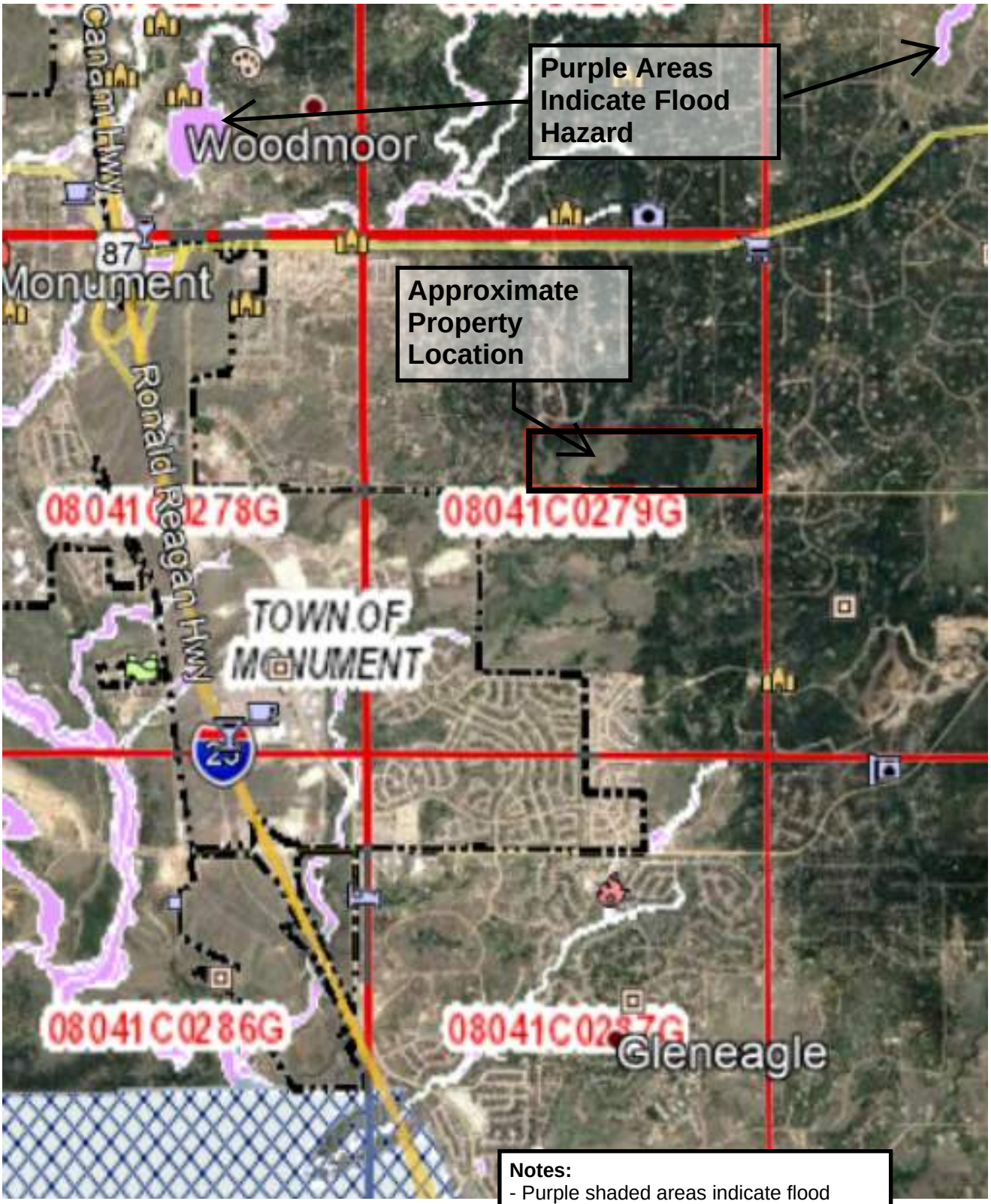
Grandwood Subdivision
El Paso County, Colorado

Figure
4b



Not to Scale. Base image obtained from USGS 7.5 Minute Quadrangle, 1961

VIVID Engineering Group	Project No: D18-2-175	TOPOGRAPHIC MAP	Figure
	Date: 1/15/19		5
	Drawn by: WJB	Grandwood Subdivision El Paso County, Colorado	
	Reviewed by: BTM		



Notes:
- Purple shaded areas indicate flood hazard risk
- Site has no mapped flood hazards

Not to Scale. Base image obtained from https://dsat.services.femadata.com/arcgis/rest/services/FEMA_R8/RiskMAP_ElPasoCounty_Colorado/MapServer/legend, 2019

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VIVID Engineering Group	Project No: D18-2-175	FLOOD HAZARD MAP	Figure
	Date: 1/15/19		6
	Drawn by: WJB	Grandwood Subdivision El Paso County, Colorado	
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Appendix A

Logs of Explorations

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BORING NUMBER B-1

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING 23.00 ft
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	4-5			Silty to Clayey SAND, tan, dry to wet (below about 23 feet), loose to medium dense, fine to coarse-grained. USDA Soil Type: 2, Structure Shape: GR, Structure Grade: 2
5	SPT	7-5			
10	SPT	3-5	MC = 8.2% LL = NP PL = NP Fines = 14.0%		
15	SPT	5-5			
20	SPT	4-4			
25	SPT	5-5	MC = 17.3% LL = NP PL = NP		(25.0) Bottom of borehole at 25.0 feet.

Note:
Average Percolation Rate = 18 min./in.
LTAR = 0.60 gal./s.f./day

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Colorado Springs, CO 80907
Telephone: 719-896-4356
Fax: 719-896-4357

BORING NUMBER B-2

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	9-8			Silty to Clayey SAND, tan to light brown, dry, loose to medium dense, fine to coarse-grained. USDA Soil Type: 2, Structure Shape: GR, Structure Grade: 2 (4.0)
5	SPT	7-15			**Dawson Formation** Weathered SANDSTONE with clayey zones, tan to light gray, dry to slightly moist, medium dense to very dense. USDA Soil Type: 3A, Structure Shape: 0, Structure Grade: 1
10	SPT	35-15/2"	MC = 10.6% LL = 43 PL = 26 Fines = 22.0%		(12.0)
	MC	50	MC= 17.0% Comp. = 0.7% Under 1ksf surcharge pressure		**Dawson Formation** CLAYSTONE, sandy, light gray, slightly moist, hard. USDA Soil Type: 4A, Structure Shape: 0, Structure Grade: 1 (14.5)

Bottom of borehole at 14.5 feet.

Note:
Average Percolation Rate = 23 min./in.
LTAR = 0.60 gal./s.f./day

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BORING NUMBER B-3

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
∇ **AT TIME OF DRILLING** 19.00 ft
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	9-8			Well Graded to Silty to Slightly Clayey SAND, dark brown to tan and pink, dry to wet (below about 19 feet), medium dense to loose. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
5	SPT	4-4	MC = 2.1% LL = NP PL = NP Fines = 11.4%		
10	SPT	5-4			
15	SPT	5-5	MC = 4.4% LL = NP PL = NP Fines = 7.8%		
20	SPT	3-3			∇
25	SPT	5-5			(25.0)

Bottom of borehole at 25.0 feet.

Note:
Average Percolation Rate = 5 min./in.
LTAR = 0.80 gal./s.f./day

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BORING NUMBER B-4

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
∇ **AT TIME OF DRILLING** 17.00 ft
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose
				1.0	Poorly Graded to Silty/Slightly Clayey SAND, brown to tan to pinkish-tan, dry, loose to medium dense, fine to coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
	SPT	5-5	MC = 2.8% LL = NP PL = NP Fines = 19.0%		
5	SPT	5-6			
10	SPT	2-3			
				12.0	**Dawson Formation** SANDSTONE with clayey zones, tan to light gray, dry to slightly moist, very dense to hard, fine to coarse-grained, poorly cemented. USDA Soil Type: 3A, Structure Shape: 0, Structure Grade: 1
15	SPT	35-15/1"	MC = 11.7% LL = NP PL = NP Fines = 15.0%		∇
	SPT	25-25/2"		19.7	

Bottom of borehole at 19.7 feet.

Note:
Average Percolation Rate = 5 min./in.
LTAR = 0.80 gal./s.f./day

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BORING NUMBER B-5

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
0				8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	2-3		Poorly Graded to Silty/Slightly Clayey SAND, brown to tan, slightly moist, loose. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
5	SPT	3-2		
				(8.0)
10	SPT	31-19/3"		**Dawson Formation** Weathered SANDSTONE, clean to slightly clayey, tan to pink, dry to slightly moist, dense to hard. USDA Soil Type: 3A, Structure Shape: 0, Structure Grade: 1
	SPT	50		(14.5)

Bottom of borehole at 14.5 feet.

Note:
Average Percolation Rate = 5 min./in.
LTAR = 0.80 gal./s.f./day

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BORING NUMBER B-6

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING 19.00 ft
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	3-3			Well Graded to Silty/Slightly Clayey SAND, tan to pinkish-tan, dry to wet (below about 19 feet), loose. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
5	SPT	3-2			
10	SPT	2-2	MC = 10.1% LL = 25 PL = 19 Fines = 21.0%		
15					
	SPT	3-4			
20	SPT	1-2			
25	SPT	4-35			(24.5) **Dawson Formation** Weathered SANDSTONE, clean to slightly clayey, tan, moist, very dense (25.0)

Bottom of borehole at 25.0 feet.

Note:
Average Percolation Rate = 7 min./in.
LTAR = 0.80 gal./s.f./day

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BORING NUMBER B-7

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Old Dirt Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING 14.00 ft
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	MATERIAL DESCRIPTION
0				8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose (1.0)
	SPT	4-6		Silty to Slightly Clayey SAND, tan with some iron-oxide staining, dry to slightly moist, loose to medium dense, fine-grained to about 6 feet then coarse-grained. USDA Soil Type: 2, Structure Shape: GR, Structure Grade: 2
5	SPT	6-5	MC = 6.4% LL = NP PL = NP Fines = 30.0%	
10	SPT	6-6		
				(14.0 ▽)
15	SPT	6-25	MC = 22.1% LL = 33 PL = 24 Fines = 54.0%	**Dawson Formation** Weathered SANDSTONE to CLAYSTONE, tan to gray, moist to very moist, very dense to hard, poorly cemented, fine to coarse-grained
	SPT	30-20/2"		(19.7)

Bottom of borehole at 19.7 feet.

Note:
Average Percolation Rate = 6 min./in.
LTAR = 0.60 gal./s.f./day

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TEST PIT NUMBER TP-1

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION ---
TEST PIT SIZE 60 X 120 inches
EXCAVATION CONTRACTOR Bush Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-Tire Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0				8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose
	GB		1.0	Poorly Graded SAND with silt, brown, dry, loose to medium dense, coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
			2.0	Silty to Clayey SAND, brown, dry to moist, medium dense, fine to coarse-grained. USDA Soil Type: 2, Structure Shape: GR, Structure Grade: 2
5	GB	MC = 2.9% LL = NP PL = NP Fines = 16.5%		
10	GB		10.0	

Bottom of test pit at 10.0 feet.

Note:
Average Percolation Rate = N/A
LTAR = 0.60 gal./s.f./day

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TEST PIT NUMBER TP-2

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION ---
TEST PIT SIZE 60 X 120 inches
EXCAVATION CONTRACTOR Bush Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-Tire Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0				8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose
			1.0	
	GB			Well Graded SAND with silt and clay, light brown, dry to slightly moist, loose to medium dense, fine to coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
			3.0	
				Well Graded SAND with silt and clay, tan, slightly moist, loose to medium dense. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
5	GB	MC = 5.7% LL = NP PL = NP Fines = 8.6%		
			6.5	
				Clayey SAND, brown, slightly moist, medium dense. USDA Soil Type: 2, Structure Shape: GR, Structure Grade: 2
	GB			
10			10.0	

Bottom of test pit at 10.0 feet.

Note:
Average Percolation Rate = N/A
LTAR = 0.60 gal./s.f./day

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TEST PIT NUMBER TP-3

CLIENT Herebic Homes
PROJECT NAME Grandwood Subdivision
PROJECT NUMBER D18-2-175
PROJECT LOCATION Higby Road, Monument, Colorado
DATE STARTED 12/20/18 **COMPLETED** 12/20/18
GROUND ELEVATION ---
TEST PIT SIZE 60 X 120 inches
EXCAVATION CONTRACTOR Bush Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-Tire Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY J. Frohbieter **CHECKED BY** W. Barreire
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0				8"-12" Topsoil - SAND, slightly clayey with organics, dark brown, dry, loose
			1.0	Poorly Graded SAND with clay, light brown, dry to slightly moist, loose to medium dense, fine to coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
	GB		2.0	Poorly Graded SAND with silt and clay, light brown, dry to slightly moist, loose to medium dense, fine to coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
			4.0	Poorly Graded SAND with clay, tan, dry to slightly moist, loose to medium dense, fine to coarse-grained. USDA Soil Type: 1, Structure Shape: N/A, Structure Grade: 0
5				
	GB	MC = 4.5% LL = NP PL = NP Fines = 11.6%		
10			10.0	

Bottom of test pit at 10.0 feet.

Note:
Average Percolation Rate = N/A
LTAR = 0.80 gal./s.f./day

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KEY TO SYMBOLS

CLIENT Herebic Homes

PROJECT NAME Grandwood Subdivision

PROJECT NUMBER D18-2-175

PROJECT LOCATION Higby Road, Monument, Colorado

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

- CLAYSTONE
- SANDSTONE
- SC: USCS Clayey Sand
- SC-SM: USCS Clayey Sand
- SM: USCS Silty Sand
- SP-SC: USCS Poorly-graded Sand with Clay
- SP-SM: USCS Poorly-graded Sand with Silt
- SW-SM: USCS Well-graded Sand with Silt
- TOPSOIL
- 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

∇ Water Level at Time Drilling, or as Shown

Appendix B

Laboratory Test Results

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SUMMARY OF LABORATORY RESULTS

CLIENT Herebic Homes **PROJECT NAME** Grandwood Subdivision

PROJECT NUMBER D18-2-175 **PROJECT LOCATION** Higby Road, Monument, Colorado

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)		
B-1	9.0	NP	NP	NP	19	14	SM	8.2			
B-1	24.0	NP	NP	NP				17.3			
B-2	9.0	43	26	17	9.5	22	SC	10.6			
B-3	4.0	NP	NP	NP	19	11	SW-SM	2.1			
B-3	14.0	NP	NP	NP	25	8	SW-SM	4.4			
B-4	2.0	NP	NP	NP	12.5	19	SM	2.8			
B-4	14.0	NP	NP	NP	9.5	15	SM	11.7			
B-6	9.0	25	19	6	19	21	SC-SM	10.1			
B-7	4.0	NP	NP	NP	12.5	30	SM	6.4			
B-7	14.0	33	24	9	9.5	54	ML	22.1			
TP-1	2.0	NP	NP	NP	25	17	SM	2.9			
TP-2	3.0	NP	NP	NP	12.5	9	SW-SM	5.7			
TP-3	4.0	NP	NP	NP	25	12	SP-SM	4.5			

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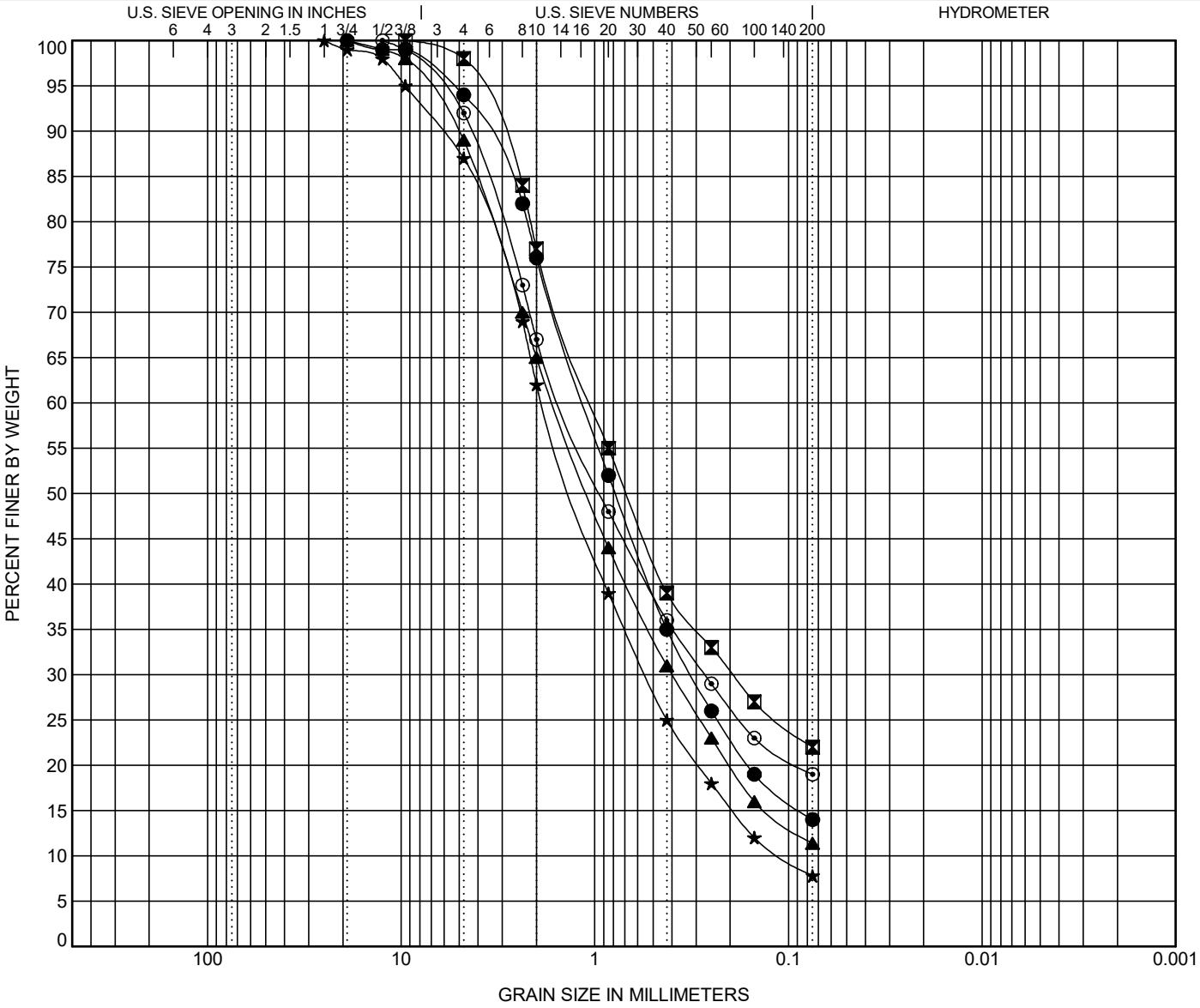
GRAIN SIZE DISTRIBUTION

CLIENT Herebic Homes **PROJECT NAME** Grandwood Subdivision

PROJECT NUMBER D18-2-175 **PROJECT LOCATION** Higby Road, Monument, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	B-1	9.0	SILTY SAND(SM)	NP	NP	NP		
⊠	B-2	9.0	CLAYEY SAND(SC)	43	26	17		
▲	B-3	4.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP	1.60	26.86
★	B-3	14.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP	1.48	17.22
⊙	B-4	2.0	SILTY SAND(SM)	NP	NP	NP		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-1	9.0	19	1.131	0.316		6.0	80.0	14.0	
⊠	B-2	9.0	9.5	1.032	0.194		2.0	76.0	22.0	
▲	B-3	4.0	19	1.631	0.398		11.0	77.6	11.4	
★	B-3	14.0	25	1.857	0.544	0.108	13.0	79.2	7.8	
⊙	B-4	2.0	12.5	1.459	0.27		8.0	73.0	19.0	

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GRAIN SIZE DISTRIBUTION

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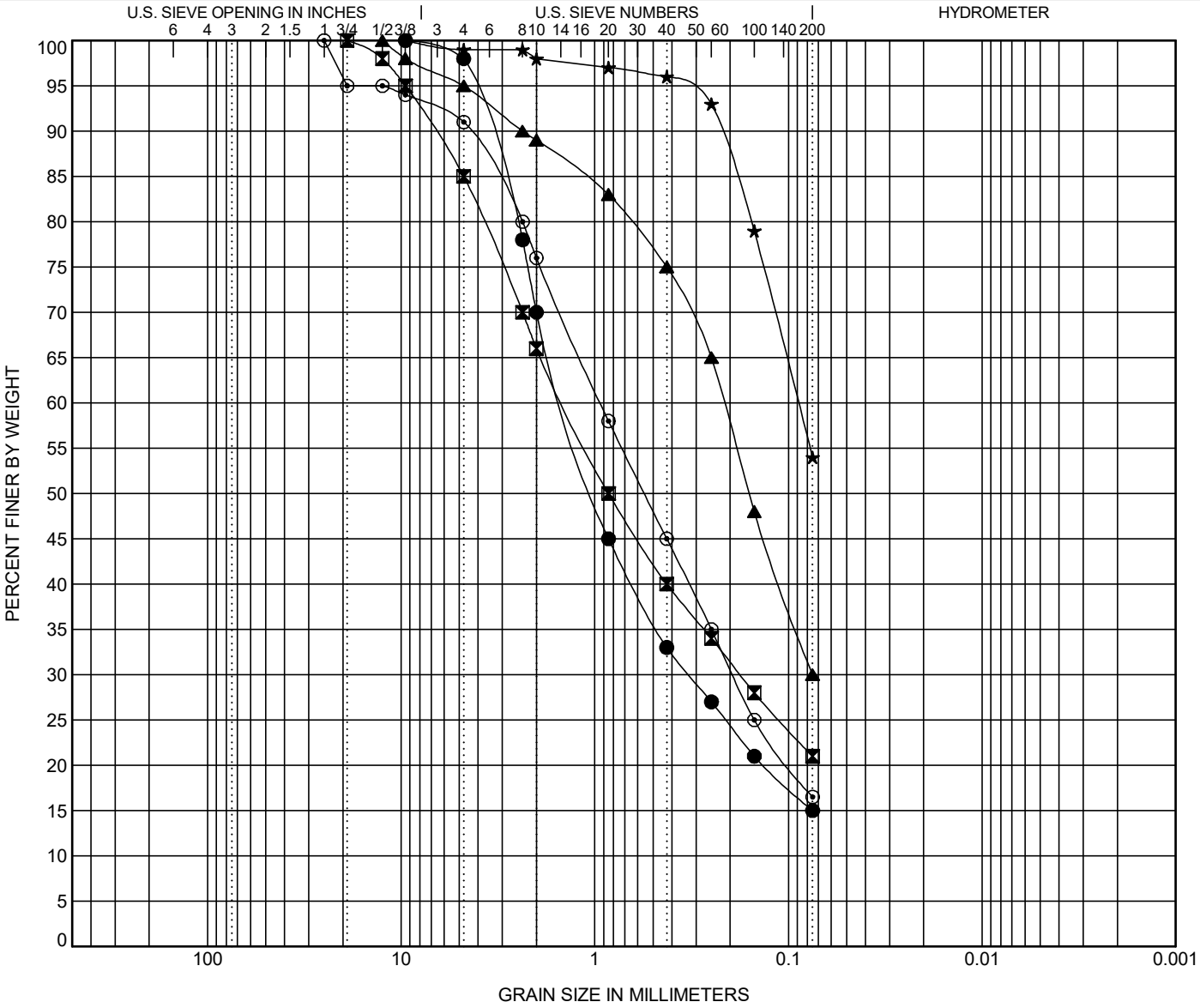
PROJECT NUMBER D18-2-175 **PROJECT LOCATION** Higby Road, Monument, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	B-4	14.0	SILTY SAND(SM)	NP	NP	NP		
⊠	B-6	9.0	SILTY, CLAYEY SAND with GRAVEL(SC-SM)	25	19	6		
▲	B-7	4.0	SILTY SAND(SM)	NP	NP	NP		
★	B-7	14.0	SANDY SILT(ML)	33	24	9		
⊙	TP-1	2.0	SILTY SAND(SM)	NP	NP	NP		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-4	14.0	9.5	1.42	0.326		2.0	83.0	15.0	
⊠	B-6	9.0	19	1.451	0.178		15.0	64.0	21.0	
▲	B-7	4.0	12.5	0.215	0.075		5.0	65.0	30.0	
★	B-7	14.0	9.5	0.089			1.0	45.0	54.0	
⊙	TP-1	2.0	25	0.935	0.194		9.0	74.5	16.5	

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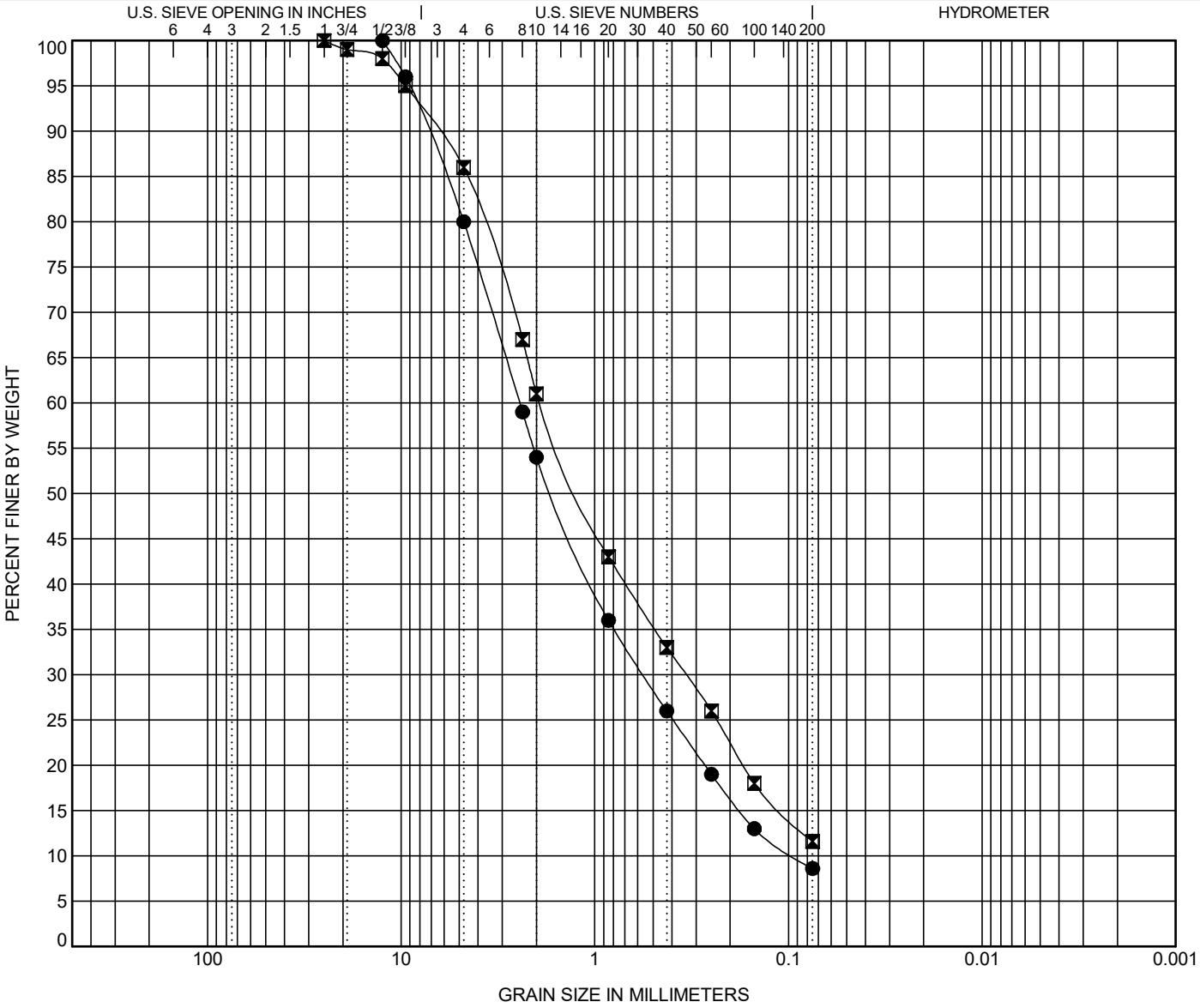
GRAIN SIZE DISTRIBUTION

CLIENT Herebic Homes **PROJECT NAME** Grandwood Subdivision

PROJECT NUMBER D18-2-175 **PROJECT LOCATION** Higby Road, Monument, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	TP-2	3.0	WELL-GRADED SAND with SILT and GRAVEL(SW-SM)	NP	NP	NP	1.38	26.09
⊠	TP-3	4.0	POORLY GRADED SAND with SILT(SP-SM)	NP	NP	NP	0.95	30.24

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-2	3.0	12.5	2.44	0.561	0.094	20.0	71.4	8.6	
⊠	TP-3	4.0	25	1.907	0.339		14.0	74.4	11.6	