Huddleston-Berry
Engineering & Testing, LLC

GEOTECHNICAL AND GEOLOGIC HAZARDS INVESTIGATION
WESTON ESTATES
FRUITA, COLORADO
PROJECT#00545-0077

VORTEX ENGINERING & ARCHITECTURE, INC.
861 ROOD AVENUE
GRAND JUNCTION, COLORADO 81501

JANUARY 16, 2023

Huddleston-Berry Engineering and Testing, LLC
2789 Riverside Parkway
Grand Junction, Colorado 81501

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

A geologic hazards and geotechnical investigation was conducted for the proposed Weston Estates Subdivision in Fruita, Colorado. The project location is shown on Figure 1 – Site Location Map. The purpose of the investigation was to evaluate the surface and subsurface conditions at the site with respect to geologic hazards, foundation design, pavement design, and earthwork for the proposed construction. This summary has been prepared to include the information required by civil engineers, structural engineers, and contractors involved in the project.

Subsurface Conditions (p. 2)

The subsurface investigation consisted of seven test pits, excavated on September 18th, 2008 and December 12th, 2022. The locations of the test pits are shown on Figure 2 – Site Plan. The test pits generally encountered loose/soft to medium dense/medium stiff sand, silt, and clay soils. Groundwater was encountered in four of the test pits at depths of between 7.0 and 9.5 feet. The native soils range from non-plastic to moderately plastic and slightly collapsible to slightly expansive.

Geologic Hazards and Constraints (p. 4)

The primary geologic hazard and constraint at this site is the presence of moisture sensitive soils. However, shallow groundwater may also impact the design and construction.

Summary of Foundation Recommendations

- *Foundation Type* – Spread Footings or Monolithic Structural Slabs (p. 4)
- *Structural Fill* – Minimum of 24-inches below foundations. The native soils may be reused as structural fill with approval from HBET on a lot-by-lot basis. Imported structural fill should consist of granular material approved by HBET. (p. 4)
- *Maximum Allowable Bearing Capacity* – 1,500 psf. (p. 5)
- *Subgrade Modulus* – 150 pci for approved native soils and 200 pci for approved imported granular fill. (p. 5)
- *Lateral Earth Pressure* – 45 pcf active. 65 pcf at-rest. (p. 6)

Summary of Pavement Recommendations (p. 7)

Internal Subdivision Roadways
EDLA = 20, Structural Number = 3.50

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Rigid Pavement	TOTAL
A	3.0	16.0			19.0
B	4.0	13.0			17.0
C	3.0	6.0	14.0		23.0
Full Depth RP		6.0		6.0	12.0

J Road

ESAL's = 412,000, Structural Number = 3.80

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
A	4.0	16.0			20.0
B	5.0	13.0			18.0
C	4.0	6.0	14.0		24.0
Rigid Pavement		6.0		8.0	14.0

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1.0 INTRODUCTION

As part of the continued development in Grand Junction and surrounding areas, the new Weston Estates Subdivision is proposed in Fruita, Colorado. As part of the development process, Huddleston-Berry Engineering and Testing, LLC (HBET) was retained by Vortex Engineering, Inc. to conduct a geologic hazards and geotechnical investigation at the site.

1.1 Scope

As discussed above, a geologic hazards and geotechnical investigation was conducted for the proposed Weston Estates Subdivision in Fruita, Colorado. The scope of the investigation included the following components:

- Conducting a subsurface investigation to evaluate the subsurface conditions at the site.
- Collecting soil samples and conducting laboratory testing to determine the engineering properties of the soils at the site.
- Providing recommendations for foundation type and subgrade preparation.
- Providing recommendations for bearing capacity.
- Providing recommendations for lateral earth pressure.
- Providing recommendations for drainage, grading, and general earthwork.
- Providing recommendations for pavements.
- Evaluating potential geologic hazards at the site.

The investigation and report were completed under the direction of a Colorado registered professional engineer in accordance with generally accepted geotechnical and geological engineering practices. This report has been prepared for the exclusive use of Vortex Engineering and the Owner.

1.2 Site Location and Description

The site encompasses approximately 28 acres at the northwest corner of the intersection of 19 Road and J Road in Fruita, Colorado. The project location is shown on Figure 1 – Site Location Map.

At the time of the investigation, an existing residence occupied the center and northern portion of the site. The remainder of the site was generally open and nearly level. Vegetation at the site was minimal and consisted primarily of tall grasses located next to an irrigation ditch running along the southern border of the property. The property was bordered to the north by J 2/10 Road, to the east by 19 Road, to the south by J Road, and to the west by existing residences.

1.3 Proposed Construction

The proposed subdivision is anticipated to include residential structures on approximately 100 lots, and utility and street pavement installation. The proposed structures are anticipated to be wood framed buildings constructed over reinforced concrete foundations.

2.0 GEOLOGIC SETTING

2.1 Soils

Soils data was obtained from the USDA Natural Resource Conservation Service Web Soil Survey. The data indicates that the soils at the site consist of Fruitland sandy clay loam, 0 to 2 percent slopes and Turley clay loam, 0 to 2 percent slopes. Soil survey data, including descriptions of the soil units, is included in Appendix A.

Residential construction in the soils at the site is described as not limited. The Fruitland and Turley soils are described as having a moderate potential for frost action, moderate risk of corrosion of uncoated steel, and low risk of corrosion of concrete.

2.2 Geology

According to the *Geologic Map of the Fruita Quadrangle, Mesa County, Colorado* (2009), the site is underlain by alluvial mudflow and fan valley fill deposits.

2.3 Groundwater

Groundwater was generally encountered in the test pits at depths ranging from 7.0 to 9.5 feet. However, groundwater was not encountered in Test Pits TP-2 or TP-3 at the time of the investigation.

3.0 FIELD INVESTIGATION

3.1 Subsurface Investigation

The initial subsurface investigations was conducted on September 18th, 2008 and consisted of four test pits. A subsequent subsurface investigation was conducted on December 12th, 2022 and consisted of three additional test pits. The test pits were excavated to depths of between 7.0 and 10.0 feet below the existing ground surface.

The locations of the test pits are shown on Figure 2 – Site Plan. The test pits were located in the field relative to existing site features. Typed test pit logs are included in Appendix B. Samples of the native soils were collected using hand drive samplers and bulk sampling methods at the locations shown on the logs.

As indicated on the logs, the subsurface conditions at the site were variable. Test pit, TP-1, conducted in the southeast area of the site, encountered 1.0 foot of topsoil above brown, dry, medium dense silt with sand to a depth of 3.0 feet. The silt was underlain by brown, moist to wet, soft to very soft lean clay with sand to the bottom of the excavation. Groundwater was encountered in TP-1 at a depth of 9.5 feet below the ground surface.

Test Pit, TP-2, conducted in the southwest portion of the site, encountered 1.0 foot of topsoil above brown, dry to moist, dense to loose silty sand to the bottom of the excavation. Groundwater was not encountered in TP-2 at the time of the excavation.

Test Pits, TP-3 and TP-4, conducted in the northeast area of the site, encountered 1.0 foot of topsoil above brown, dry to moist, medium dense silt with sand to depths of between 4.0 and 4.5 feet below the ground surface. The silt was underlain by brown to gray, moist, medium stiff to stiff lean clay to depths of between 7.0 and 7.5 feet. The lean clay was underlain by brown, moist to wet, very loose clayey sand to the bottoms of the excavations. Groundwater was not encountered in TP-3 but was encountered in TP-4 at a depth of 9.0 feet below the ground surface.

Test Pits TP-5, TP-6, and TP-7, conducted in the western area of the site, encountered 1.0 foot of topsoil above brown, moist to wet, medium stiff to soft lean clay with sand soils to the bottoms of the excavations. Groundwater was encountered in TP-5 and TP-7 at a depth of 7.0 feet, and in TP-6 at a depth of 7.5 feet at the time of the investigation.

3.2 Field Reconnaissance

The field reconnaissance included walking the site during the subsurface investigation. In general, the site was fairly level and no evidence of landslides, debris flows, rockfalls, etc. was observed.

4.0 LABORATORY TESTING

Selected native soil samples collected from the test pits were tested in the Huddleston-Berry Engineering and Testing LLC geotechnical laboratory for natural moisture and density, California Bearing Ratio (CBR), grain size analysis, maximum dry density and optimum moisture (Proctor), Atterberg limits, swell/consolidation, and soluble sulfates content. The laboratory testing results are included in Appendix C.

The laboratory testing results indicate that the native silt soils are slightly plastic. In addition, these materials were shown to be slightly expansive with approximately 0.2% expansion at 650 psf measured in the laboratory.

The native clay soils were indicated to be slightly to moderately plastic. In addition, the clay soils were shown to be slightly expansive with up to approximately 1.0% expansion at 1,500 psf measured during swell/consolidation testing.

The native sand soils were indicated to be non-plastic and are anticipated to be slightly collapsible. Water soluble sulfates were detected in the site soils in concentrations as high as 60 ppm.

5.0 GEOLOGIC INTERPRETATION

5.1 Geologic Hazards

The primary geologic hazard at the site is the presence of moisture sensitive soils.

5.2 Geologic Constraints

The primary geologic constraints to construction at the site is the presence of moisture sensitive soils. However, shallow groundwater may also impact any deep utility installation at this site.

5.3 Water Resources

No water supply wells were observed on the property. As discussed previously, shallow groundwater was encountered in the test pits at depths of between 7.0 and 9.5 feet. In general, with proper design and construction, the proposed construction is not anticipated to adversely impact surface water or groundwater.

5.4 Mineral Resources

Potential mineral resources in the Grand Valley generally include gravel, uranium ore, and commercial rock products such as flagstone. No significant gravel, uranium bearing bedrock, or other mineable bedrock units were encountered on the subject site at the time of the investigation, nor was any literary or cartographic information discovered that indicate the existence or potential existence of commercial quality mineral deposits.

6.0 CONCLUSIONS

Based upon the available data sources, field investigation, and nature of the proposed subdivision, HBET does not believe that there are any geologic conditions which should preclude subdivision of the site. However, the presence of moisture sensitive soils will likely impact the proposed construction.

7.0 RECOMMENDATIONS

7.1 Foundations

Based upon the results of the subsurface investigation, shallow foundations are recommended. Spread footings and monolithic (turndown) structural slabs are both appropriate alternatives. However, in order to provide a uniform bearing stratum and limit the potential for excessive differential movements, it is recommended that the foundations be constructed above a minimum of 24-inches of structural fill.

As discussed previously, the subsurface conditions at the site were variable and the native soils range from collapsible to expansive. Therefore, the soils should be evaluated on a lot-by-lot basis to determine if the native soils on an individual lot are suitable for reuse as structural fill. Imported structural fill should consist of a granular, non-expansive, non-free draining material approved by HBET.

For spread footing foundations, the footing areas may be trenched. However, for monolithic slab foundations, the structural fill should extend across the entire building pad area to a depth of 24-inches below the turndown edges. Structural fill should extend laterally beyond the edges of the foundations a distance equal to the thickness of structural fill for both foundation types.

Prior to placement of structural fill, it is recommended that the bottoms of the foundation excavations be scarified to a depth of 6 to 8-inches, moisture conditioned, and re-compacted to a minimum of 95% of the standard Proctor maximum dry density, within ±2% of the optimum moisture content as determined in accordance with ASTM D698. However, as discussed previously, soft / loose soils were encountered in the subsurface and this may make compaction of the subgrade difficult. It may be necessary to utilize geotextile and/or geogrid in conjunction with up to 30-inches of additional granular fill to stabilize the subgrade. HBET should be contacted to provide specific recommendations for subgrade stabilization depending upon the actual conditions encountered during construction.

Structural fill should be moisture conditioned, placed in maximum 8-inch loose lifts, and compacted to a minimum of 95% of the standard Proctor maximum dry density for fine grained soils or modified Proctor maximum dry density for coarse grained soils, within ±2% of the optimum moisture content as determined in accordance with ASTM D698 or D1557C, respectively. Structural fill should be extended to within 0.1-feet of the bottom of the foundation. No more than 0.1-feet of gravel should be placed below the footings or turndown edge as a leveling course.

For foundation building pads prepared as recommended with structural fill consisting of approved native soils or imported granular materials, a maximum allowable bearing capacity of 1,500 psf may be used. In addition, a modulus of subgrade reaction of 150 pci may be used for structural fill consisting of approved native soils and a modulus of 200 pci may be used for approved imported materials. Foundations subject to frost should be at least 24 inches below the finished grade.

As discussed previously, water soluble sulfates were detected in the site soils in concentrations as high as 60 ppm. These concentrations represent a negligible degree of potential sulfate attack on concrete exposed to these materials. However, water soluble sulfate concentrations can vary widely in Western Colorado. Therefore, at a minimum, Type I-II sulfate resistant cement is recommended for construction at this site.

7.2 Floor Slabs and Exterior Flatwork

In general, slabs-on-grade cannot develop sufficient loads to resist swelling of underlying clay soils and some movement of slabs-on-grade is possible where expansive clay soils are present in the subgrade. However, in order to limit the potential for movement of floor slabs, it is recommended that floor slabs be constructed above a minimum of 18-inches of structural fill will subgrade preparation and fill placement in accordance with the *Foundations* section of this report.

It is recommended that exterior flatwork be constructed above native soils, below the topsoil, that have been scarified to a depth of 9 to 12-inches, moisture conditioned, and compacted to a minimum of 95% of the standard Proctor maximum dry density, within ±2% of optimum moisture content as determined in accordance with ASTM D698. Slabs should not be tied into or otherwise connected to the foundations in any manner.

7.3 Lateral Earth Pressures

Stemwalls and/or retaining walls should be designed to resist lateral earth pressures. For backfill consisting of the native soils or imported granular, non-free draining, non-expansive material, we recommend that the walls be designed for an active equivalent fluid unit weight of 45 pcf in areas where no surcharge loads are present. An at-rest equivalent fluid unit weight of 65 pcf is recommended for braced walls. Lateral earth pressures should be increased as necessary to reflect any surcharge loading behind the walls.

7.4 Drainage

Due to the presence of moisture sensitive soils at the site, proper site grading is critical to the performance of the structures. In order to improve the long-term performance of the foundations and slabs-on-grade, grading around the structures should be designed to carry precipitation and runoff away from the structures. It is recommended that the finished ground surface drop at least twelve inches within the first ten feet away from the structures. Downspouts should empty beyond the backfill zone. It is recommended that landscaping within five feet of the structures include primarily desert plants with low water requirements. In addition, it is recommended that automatic irrigation within ten feet of foundations be minimized or controlled with automatic shut off valves.

As discussed previously, shallow groundwater was encountered in some of the test pits. Therefore, it is recommended that structures utilizing a structural floor and crawlspace include a perimeter foundation drain. Perimeter foundation drains should consist of prefabricated drain materials or perforated pipe and gravel systems with the flowline of the drain at least one foot below the bottoms of the foundations (at the highest point). Perimeter drains should slope at a minimum of 1.0% to daylight or to a sump. However, site specific drain recommendations can be developed by HBET, as necessary.

7.5 Excavations and Utilities

Excavations in the soils at the site may stand for short periods of time but should not be considered to be stable. Trenching and excavations should be sloped back, shored, or shielded for worker protection in accordance with applicable OSHA standards. The soils generally classify as Type C soil with regard to OSHA's *Construction Standards for Excavations*. For Type C soils, the maximum allowable slope in temporary cuts is 1.5H:1V.

As discussed previously, shallow groundwater and soft/loose soils were encountered in some of the test pits. Therefore, deep utility installation may be difficult at the site. It may be necessary to dewater deep utility trenches. In addition, it may be necessary to stabilize trench bottoms with geotextile and/or geogrid in conjunction with granular fill. However, HBET believes that if construction is conducted during the winter months or early spring (prior to the irrigation season), the impact on construction due to shallow groundwater and/or soft soils may be reduced.

7.6 Pavements

The proposed construction is anticipated to include asphalt paved internal subdivision roadways and improvements to J Road. As discussed previously, the pavement subgrade materials consist of sand, silt, and clay soils. However, the clay soils will be critical for pavement design. The design California Bearing Ratio (CBR) of the native clay soils was determined in the laboratory to be approximately 3.5. This corresponds to a Resilient Modulus of approximately 5,250 psi. However, the native soils were indicated to be moisture sensitive. Therefore, the minimum recommended Resilient Modulus of 3,000 psi was used for the design.

Based upon the subgrade conditions and anticipated traffic loading, asphalt and concrete pavement section alternatives were developed in accordance with AASHTO design procedures. ESAL calculations for J Road are included in Appendix D. The following minimum pavement section alternatives are recommended:

Internal Subdivision Roadways
EDLA = 20 Structural Number = 3.50

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
A	3.0	16.0			19.0
B	4.0	13.0			17.0
C	3.0	6.0	14.0		23.0
Rigid Pavement		6.0		6.0	12.0

J Road
ESAL's = 412,000, Structural Number = 3.80

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
A	4.0	16.0			20.0
B	5.0	13.0			18.0
C	4.0	6.0	14.0		24.0
Rigid Pavement		6.0		8.0	14.0

Prior to pavement placement, areas to be paved should be stripped of all topsoil, fill, or other unsuitable materials. It is recommended that the subgrade soils be scarified to a depth of 12-inches; moisture conditioned, and recompacted to a minimum of 95% of the standard Proctor maximum dry density, within ±2% of optimum moisture content as determined by AASHTO T-99. However, as discussed previously, soft/loose soil conditions were encountered at the site. It may be necessary to utilize geotextile and/or geogrid in conjunction with up to 30-inches of additional granular fill to stabilize the subgrade. HBET should be contacted to provide specific recommendations for subgrade stabilization depending upon the actual conditions encountered during construction.

Aggregate base course and subbase course should be placed in maximum 9-inch loose lifts, moisture conditioned, and compacted to a minimum of 95% and 93% of the maximum dry density, respectively, at -2% to +3% of optimum moisture content as determined by AASHTO T-180. In addition to density testing, base course should be proofrolled to verify subgrade stability.

It is recommended that Hot-Mix Asphaltic (HMA) pavement conform to CDOT grading SX or S specifications and consist of an approved 75 gyration Superpave method mix design. HMA pavement should be compacted to between 92% and 96% of the maximum theoretical density. An end point stress of 50 psi should be used. In addition, pavements should conform to local specifications.

The long-term performance of the pavements is dependent on positive drainage away from the pavements. Ditches, culverts, and inlet structures in the vicinity of paved areas must be maintained to prevent ponding of water on the pavement.

8.0 GENERAL

The recommendations included above are based upon the results of the subsurface investigation and on our local experience. These conclusions and recommendations are valid only for the proposed construction.

As discussed previously, the subsurface conditions encountered at the site were variable. However, the precise nature and extent of any subsurface variability may not become evident until construction. As a result, it is recommended that HBET provide construction materials testing and engineering oversight during the entire construction process.

It is important to note that the recommendations herein are intended to reduce the risk of structural movement and/or damage, to varying degrees, associated with volume change of the native soils. However, HBET cannot predict long-term changes in subsurface moisture conditions and/or the precise magnitude or extent of volume change. Where significant increases in shallow subsurface moisture occur due to poor grading, improper stormwater management, utility line failure, excess irrigation, or other cause, either during construction or the result of actions of the property owner, several inches of movement are possible. In addition, any failure to comply with the recommendations in this report releases Huddleston-Berry Engineering & Testing, LLC of any liability with regard to the structure performance.

Huddleston-Berry Engineering and Testing, LLC is pleased to be of service to your project. Please contact us if you have any questions or comments regarding the contents of this report.

Respectfully Submitted:
Huddleston-Berry Engineering and Testing, LLC

Michael A. Berry, P.E.
Vice President of Engineering

FIGURES

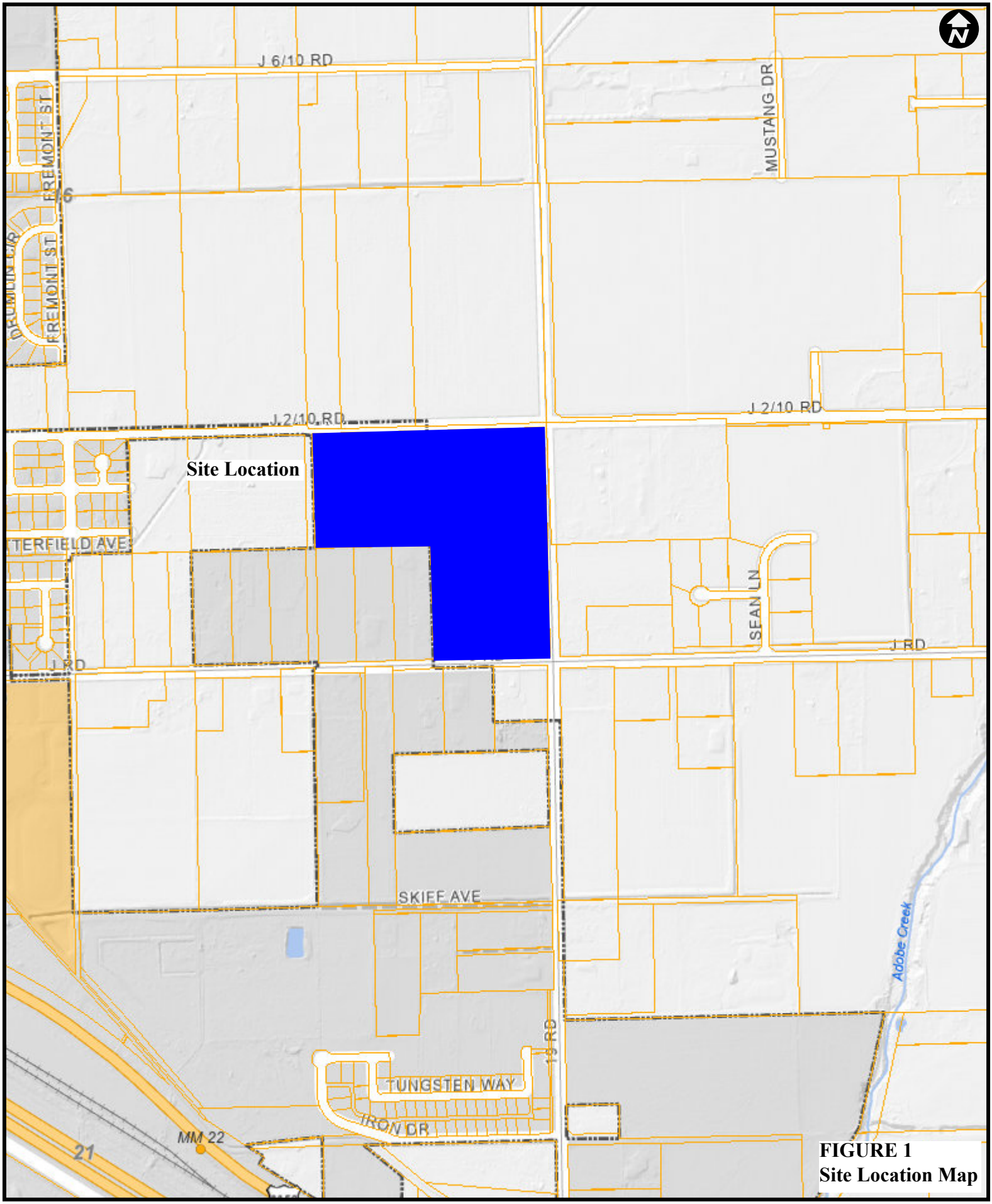

FIGURE 1
Site Location Map

Mesa County Map

0 0.05 0.1 0.2 mi
0 0.075 0.15 0.3 km

Print Date: September 22, 2022

Mesa County, Colorado
GIS/IT Department
gis.mesacounty.us

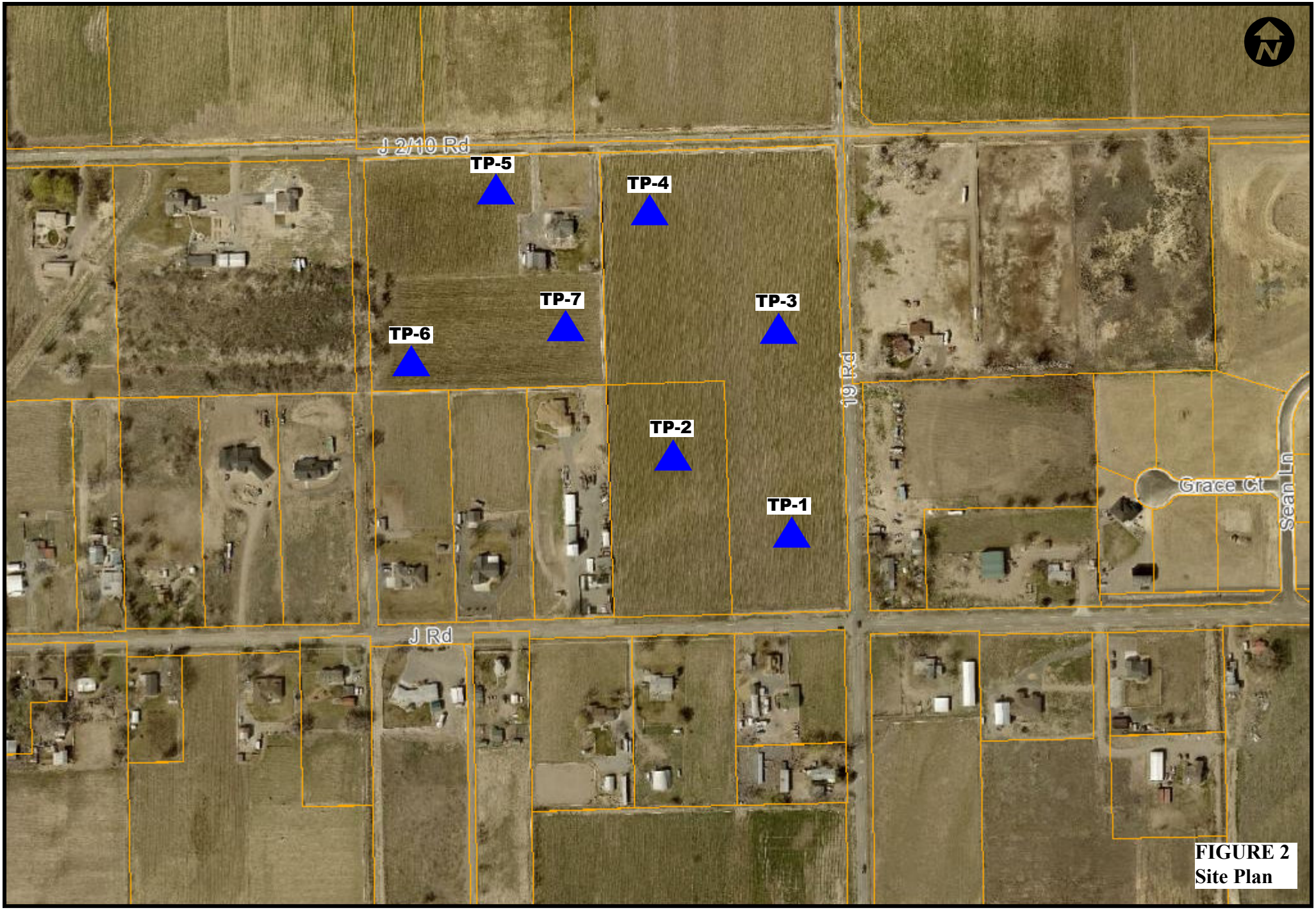

FIGURE 2
Site Plan

Mesa County Map

0 0.03 0.06 0.12 mi
0 0.035 0.07 0.14 km

Print Date: January 13, 2023

Mesa County, Colorado
GIS/IT Department
gis.mesacounty.us

APPENDIX A
Soil Survey Data

Map Scale: 1:2,280 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 12, Sep 2, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 24, 2020—Jul 8, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Rc	Fruitland sandy clay loam, 0 to 2 percent slopes	10.4	53.7%
Tr	Turley clay loam, 0 to 2 percent slopes	9.0	46.3%
Totals for Area of Interest		**19.3**	**100.0%**

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named, soils that are similar to the named components, and some minor components that differ in use and management from the major soils.

Most of the soils similar to the major components have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Some minor components, however, have properties and behavior characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Mesa County Area, Colorado

Rc—Fruitland sandy clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: k0d0
Elevation: 4,490 to 4,890 feet

Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Fruitland and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fruitland

Setting

Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Cretaceous source alluvium derived from sandstone and shale

Typical profile

Ap - 0 to 8 inches: sandy clay loam
C1 - 8 to 30 inches: gravelly sandy loam
C2 - 30 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.71 to 2.13 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: B
Ecological site: R034BY115UT - Desert Sandy Loam (Indian Ricegrass)
Hydric soil rating: No

Tr—Turley clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: k0d8
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 6 to 9 inches

Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Turley and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Turley

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Cretaceous slope alluvium derived from sandstone and shale

Typical profile

Ap - 0 to 10 inches: clay loam
C1 - 10 to 20 inches: fine sandy loam
C2 - 20 to 30 inches: clay loam
C3 - 30 to 60 inches: loam

Properties and qualities

Slope: 0 to 2 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): Moderately high (0.21 to 0.71 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 4 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 5e
Hydrologic Soil Group: C
Ecological site: R034BY106UT - Desert Loam (Shadscale)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 12, Sep 2, 2021

Dwellings and Small Commercial Buildings

Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, performance after construction, and maintenance. This table shows the degree and kind of soil limitations that affect dwellings and small commercial buildings.

The ratings in the table are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect building site development. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Dwellings are single-family houses of three stories or less. For dwellings without basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. For dwellings with basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet. The ratings for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Compressibility is inferred from the Unified classification. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Small commercial buildings are structures that are less than three stories high and do not have basements. The foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. The ratings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility (which is inferred from the Unified classification). The properties that affect the ease and amount of excavation include flooding, depth to a water table, ponding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Information in this table is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil between the surface and a depth of 5 to 7 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this table. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Report—Dwellings and Small Commercial Buildings

[Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The table shows only the top five limitations for any given soil. The soil may have additional limitations]

Dwellings and Small Commercial Buildings–Mesa County Area, Colorado							
Map symbol and soil name	Pct. of map unit	Dwellings without basements		Dwellings with basements		Small commercial buildings	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
Rc—Fruitland sandy clay loam, 0 to 2 percent slopes							
Fruitland	90	Not limited		Not limited		Not limited	
Tr—Turley clay loam, 0 to 2 percent slopes							
Turley	90	Not limited		Not limited		Not limited	

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 12, Sep 2, 2021

Soil Features

This table gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A *restrictive layer* is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. *Depth to top* is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage, or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (Ksat), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Report—Soil Features

Soil Features–Mesa County Area, Colorado									
Map symbol and soil name	Restrictive Layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
		Low-RV-High	*Range*		*Low-High*	*Low-High*			
		In	*In*		*In*	*In*			
Rc—Fruitland sandy clay loam, 0 to 2 percent slopes									
Fruitland		—	—		0	0	Moderate	Moderate	Low
Tr—Turley clay loam, 0 to 2 percent slopes									
Turley		—	—		0	0	Moderate	Moderate	Low

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 12, Sep 2, 2021

APPENDIX B
Typed Test Pit Logs

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

TEST PIT NUMBER TP-1

CLIENT Vortex Engineering
PROJECT NAME Weston Estates Subdivision
PROJECT NUMBER 00545-0077
PROJECT LOCATION Fruita, CO
DATE STARTED 9/18/08 **COMPLETED** 9/18/08
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
AT TIME OF EXCAVATION 9.5 ft
LOGGED BY AS **CHECKED BY** MAB
AT END OF EXCAVATION 9.5 ft
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		SILT with Sand and Organics (TOPSOIL), brown, dry										
		SILT with Sand (ML), brown, dry, medium dense	MC 1				90	5				
2.5		GB-1 Lab Classified	GB 08-1348					6	24	21	3	73
		Lean CLAY with Sand (CL), silty sand lenses, brown, moist to wet, soft to very soft	MC 2				100	21				
5.0		GB-2 Lab Classified	GB 2					25	23	11	12	76
7.5												
10.0												

Bottom of test pit at 10.0 feet.

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970-255-8005

TEST PIT NUMBER TP-2

CLIENT Vortex Engineering
PROJECT NAME Weston Estates Subdivision
PROJECT NUMBER 00545-0077
PROJECT LOCATION Fruita, CO
DATE STARTED 9/18/08 **COMPLETED** 9/18/08
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
AT TIME OF EXCAVATION dry
LOGGED BY AS **CHECKED BY** MAB
AT END OF EXCAVATION dry
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Silty SAND with Organics (TOPSOIL), brown, dry										
		Silty SAND (SM), brown, dry to moist, dense to loose										
2.5												
5.0			MC 1									
		GB-1 Lab Classified	GB 1					9	NP	NP	NP	28
7.5												
		Bottom of test pit at 8.0 feet.										

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TEST PIT NUMBER TP-3

CLIENT Vortex Engineering
PROJECT NAME Weston Estates Subdivision
PROJECT NUMBER 00545-0077
PROJECT LOCATION Fruita, CO
DATE STARTED 9/18/08 **COMPLETED** 9/18/08
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
AT TIME OF EXCAVATION dry
LOGGED BY AS **CHECKED BY** MAB
AT END OF EXCAVATION dry
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		SILT with Sand and Organics (TOPSOIL), brown, dry										
		SILT with Sand (ml), brown, dry to moist, medium dense										
2.5												
		Lean CLAY (CL), brown to gray, moist, medium stiff										
5.0			MC 1				-88	27				
		GB-1 Lab Classified	GB 1					25	48	22	26	99
7.5		Clayey SAND (sc), brown, moist, very loose										
		Bottom of test pit at 8.5 feet.										

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TEST PIT NUMBER TP-4

CLIENT Vortex Engineering
PROJECT NAME Weston Estates Subdivision
PROJECT NUMBER 00545-0077
PROJECT LOCATION Fruita, CO
DATE STARTED 9/18/08 **COMPLETED** 9/18/08
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
AT TIME OF EXCAVATION 9.0 ft
LOGGED BY AS **CHECKED BY** MAB
AT END OF EXCAVATION 9.0 ft
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		SILT with Sand and Organics (TOPSOIL), brown, dry										
		SILT with Sand (ml), brown, dry, medium dense										
2.5												
		Lean CLAY (cl), brown to gray, moist, stiff										
5.0												
		Clayey SAND (sc), brown, moist to wet, very loose										
7.5												
		Bottom of test pit at 9.0 feet.										

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TEST PIT NUMBER TP-5

CLIENT Vortex Engineering
PROJECT NAME Weston Estates Subdivision
PROJECT NUMBER 00545-0077
PROJECT LOCATION Fruita, CO
DATE STARTED 12/12/22 **COMPLETED** 12/12/22
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Trackh/Backhoe
AT TIME OF EXCAVATION 7.0 ft
LOGGED BY TC **CHECKED BY** MAB
AT END OF EXCAVATION 7.0 ft
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		SILT with Sand and Organics (TOPSOIL)										
		Lean CLAY with Sand (CL), brown, moist to wet, medium stiff to soft										
		GB-1: Lab Classified	GB 1					21	27	17	10	82
2.5												
5.0												
		Bottom of test pit at 7.0 feet.										

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970-255-8005

TEST PIT NUMBER TP-6

CLIENT Vortex Engineering
PROJECT NAME Weston Estates Subdivision
PROJECT NUMBER 00545-0077
PROJECT LOCATION Fruita, CO
DATE STARTED 12/12/22 **COMPLETED** 12/12/22
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Trackh/Backhoe
AT TIME OF EXCAVATION 7.5 ft
LOGGED BY TC **CHECKED BY** MAB
AT END OF EXCAVATION 7.5 ft
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		SILT with Sand and Organics (TOPSOIL)										
		Lean CLAY with Sand (cl), brown, moist to wet, medium stiff to soft										
2.5												
5.0												
7.5		Bottom of test pit at 7.5 feet.										

Huddleston-Berry Engineering & Testing, LLC
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TEST PIT NUMBER TP-7

CLIENT Vortex Engineering
PROJECT NAME Weston Estates Subdivision
PROJECT NUMBER 00545-0077
PROJECT LOCATION Fruita, CO
DATE STARTED 12/12/22 **COMPLETED** 12/1/12
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Trackh/Backhoe
AT TIME OF EXCAVATION 7.0 ft
LOGGED BY TC **CHECKED BY** MAB
AT END OF EXCAVATION 7.0 ft
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		SILT with Sand and Organics (TOPSOIL)										
		Lean CLAY with Sand (cl), brown, moist to wet, medium stiff to soft										
2.5												
5.0												
		Bottom of test pit at 7.0 feet.										

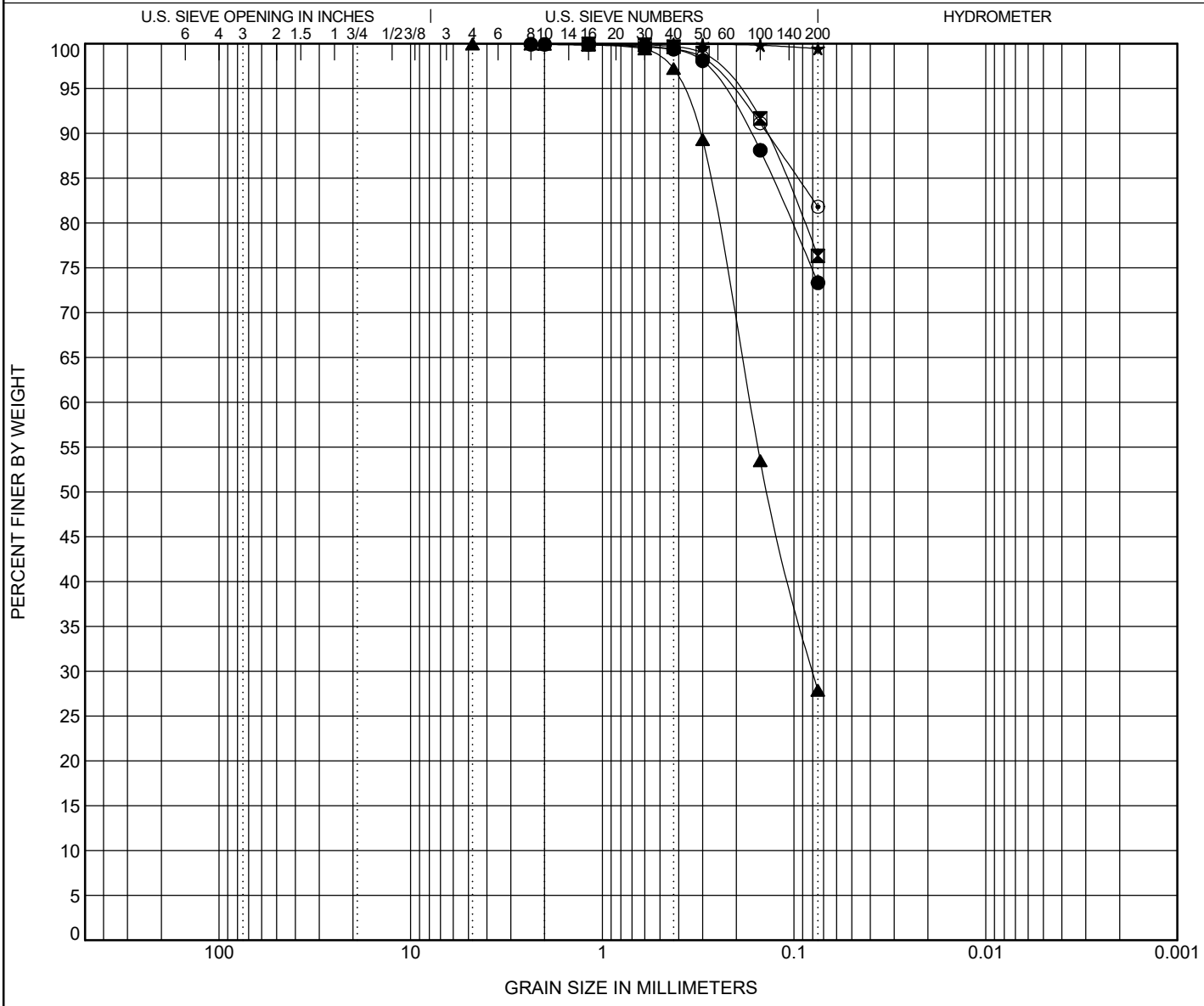
APPENDIX C
Laboratory Testing Results

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

GRAIN SIZE DISTRIBUTION

CLIENT Vortex Engineering **PROJECT NAME** Weston Estates Subdivision

PROJECT NUMBER 00545-0077 **PROJECT LOCATION** Fruita, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● TP1,GB1 09/18/08	SILT with SAND(ML)	24	21	3		
⊠ TP1,GB2 09/18/08	LEAN CLAY with SAND(CL)	23	11	12		
▲ TP2,GB1 09/18/08	SILTY SAND(SM)	NP	NP	NP		
★ TP3,GB1 09/18/08	LEAN CLAY(CL)	48	22	26		
⊙ TP5,GB1 12/12/22	LEAN CLAY with SAND(CL)	27	17	10		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP1,GB1 09/18/08	2.36					26.6	73.3	
⊠ TP1,GB2 09/18/08	1.18					23.6	76.3	
▲ TP2,GB1 09/18/08	4.75	0.17	0.079			72.1	27.9	
★ TP3,GB1 09/18/08	1.18					0.5	99.4	
⊙ TP5,GB1 12/12/22	1.18				0.0	18.2	81.8	

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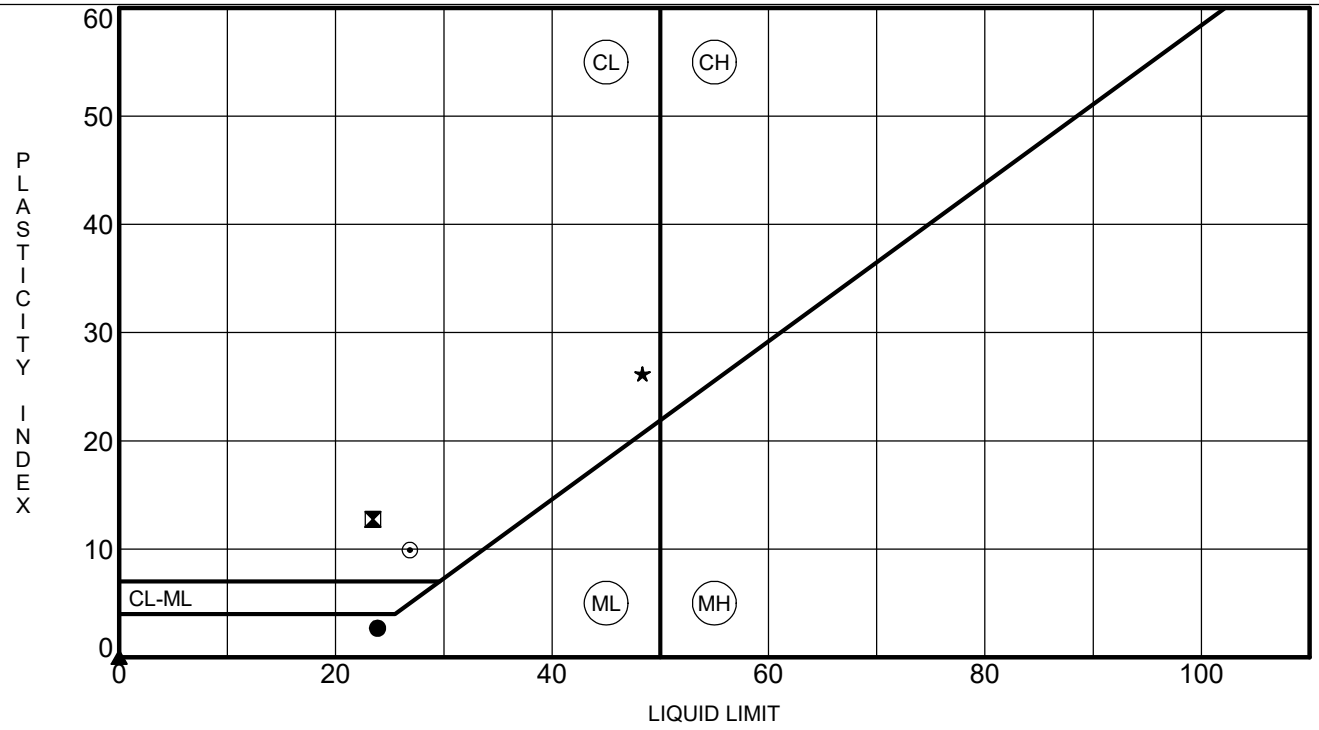
ATTERBERG LIMITS' RESULTS

CLIENT Vortex Engineering **PROJECT NAME** Weston Estates Subdivision

PROJECT NUMBER 00545-0077 **PROJECT LOCATION** Fruita, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	TP1,GB1	09/18/08	24	21	3	73	SILT with SAND(ML)
⧓	TP1,GB2	09/18/08	23	11	12	76	LEAN CLAY with SAND(CL)
▲	TP2,GB1	09/18/08	NP	NP	NP	28	SILTY SAND(SM)
★	TP3,GB1	09/18/08	48	22	26	99	LEAN CLAY(CL)
⊙	TP5,GB1	12/12/22	27	17	10	82	LEAN CLAY with SAND(CL)

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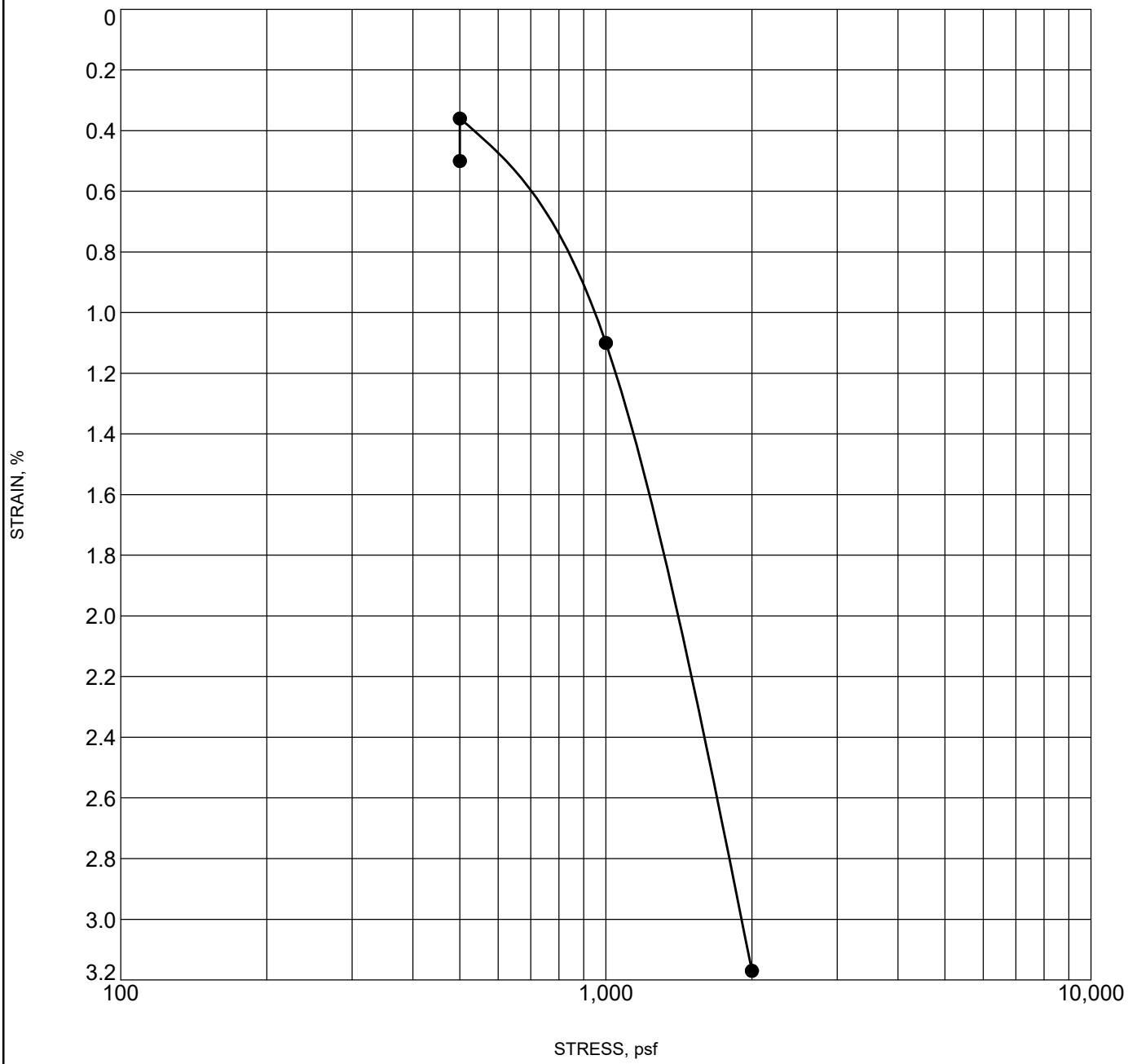
CONSOLIDATION TEST

CLIENT Vortex Engineering **PROJECT NAME** Weston Estates Subdivision

PROJECT NUMBER 00545-0077 **PROJECT LOCATION** Fruita, CO



Specimen Identification		Classification	γ_d	MC%
● **TP-1**	**1.5**		**90**	**5**

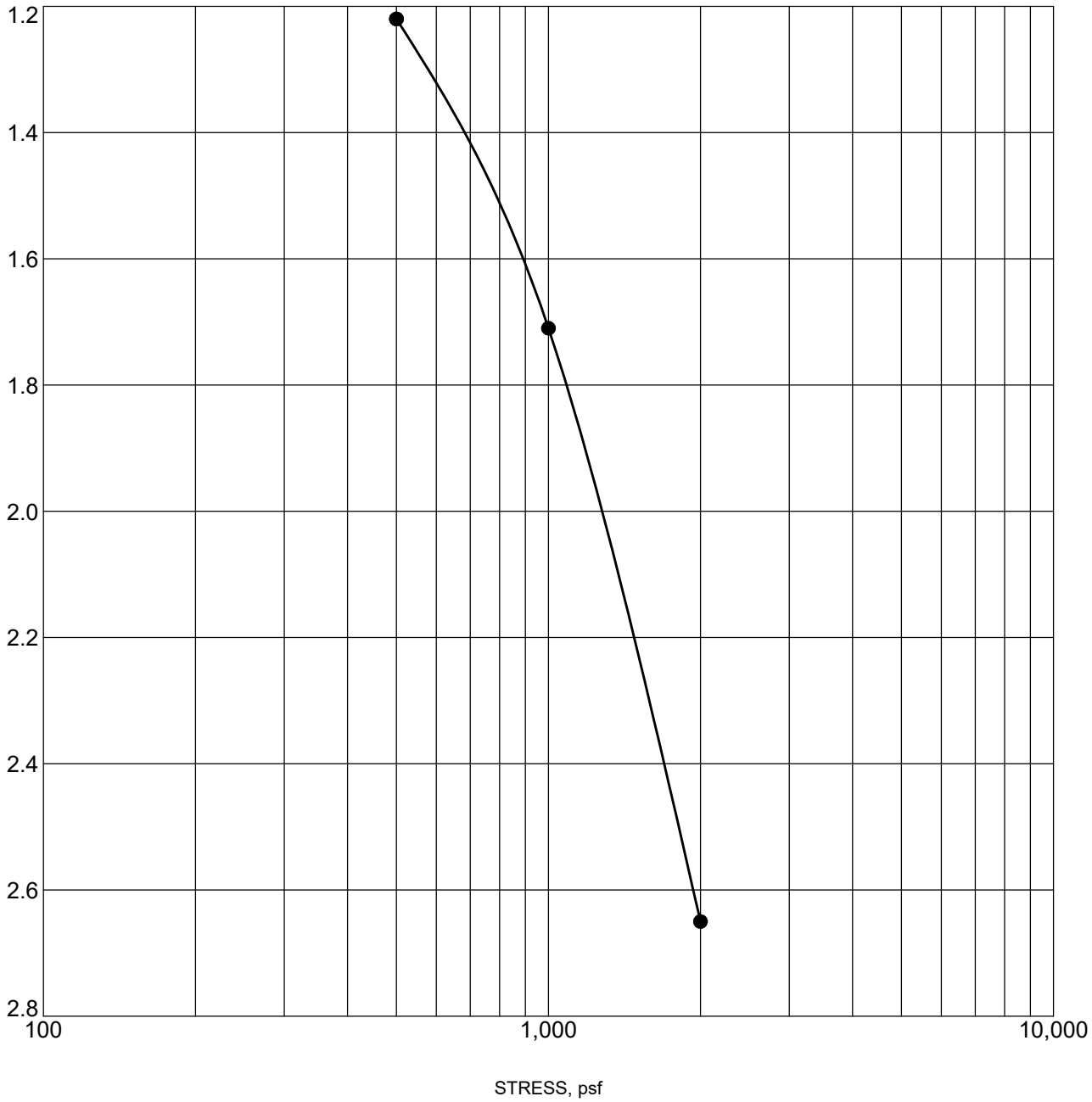
CONSOL STRAIN 00545-0077 WESTON ESTATES SUBDIVISION.GPJ GINT US LAB.GDT 9/22/22

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

CONSOLIDATION TEST

CLIENT Vortex Engineering **PROJECT NAME** Weston Estates Subdivision

PROJECT NUMBER 00545-0077 **PROJECT LOCATION** Fruita, CO



Specimen Identification		Classification	γ_d	MC%
● TP-1	4.0		100	21

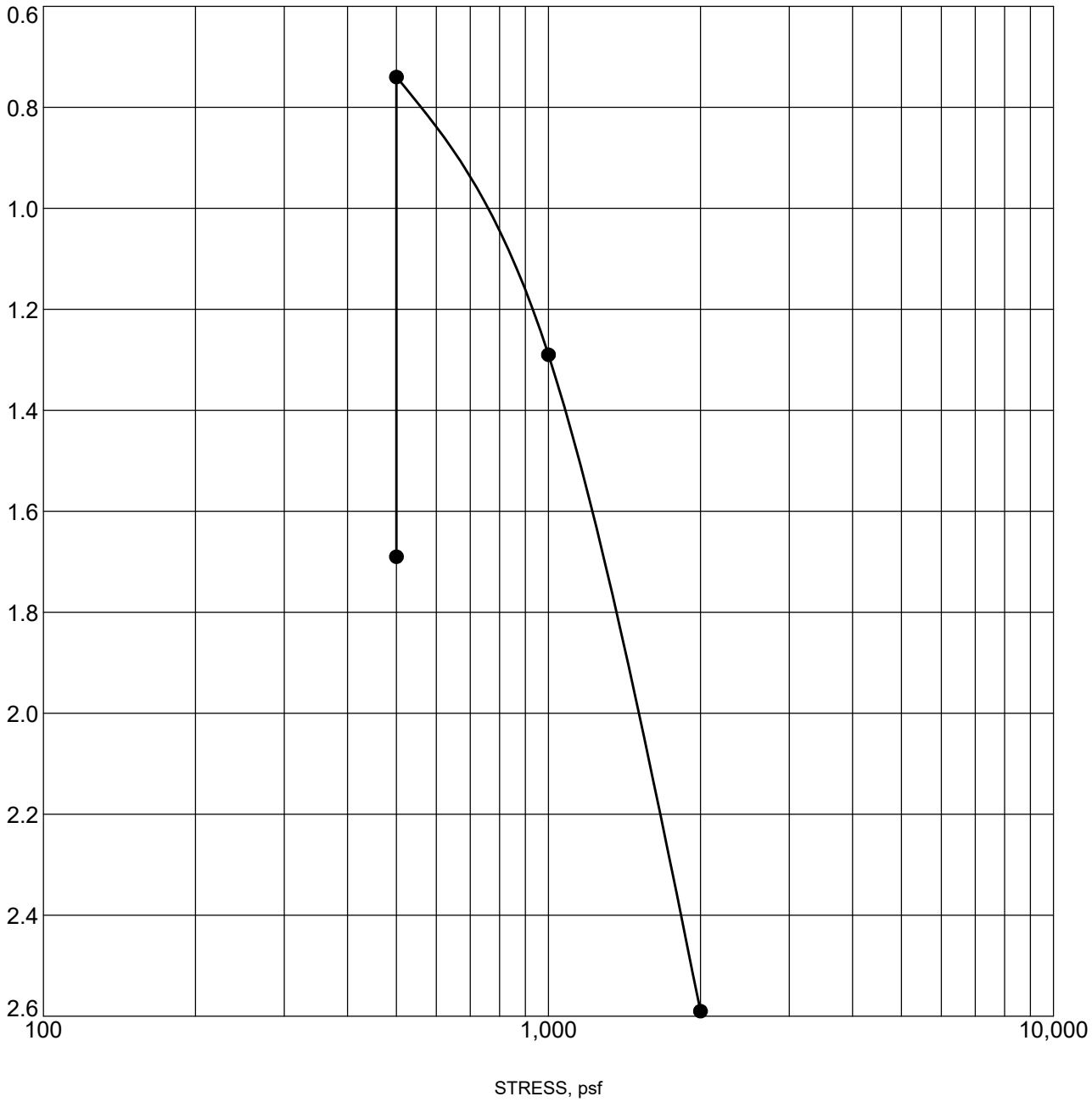
CONSOL STRAIN 00545-0077 WESTON ESTATES SUBDIVISION.GPJ GINT US LAB.GDT 9/22/22

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

CONSOLIDATION TEST

CLIENT Vortex Engineering **PROJECT NAME** Weston Estates Subdivision

PROJECT NUMBER 00545-0077 **PROJECT LOCATION** Fruita, CO



Specimen Identification		Classification	γ_d	MC%
● TP-3	5.0		-88	27

CONSOL STRAIN 00545-0077 WESTON ESTATES SUBDIVISION.GPJ GINT US LAB.GDT 9/22/22

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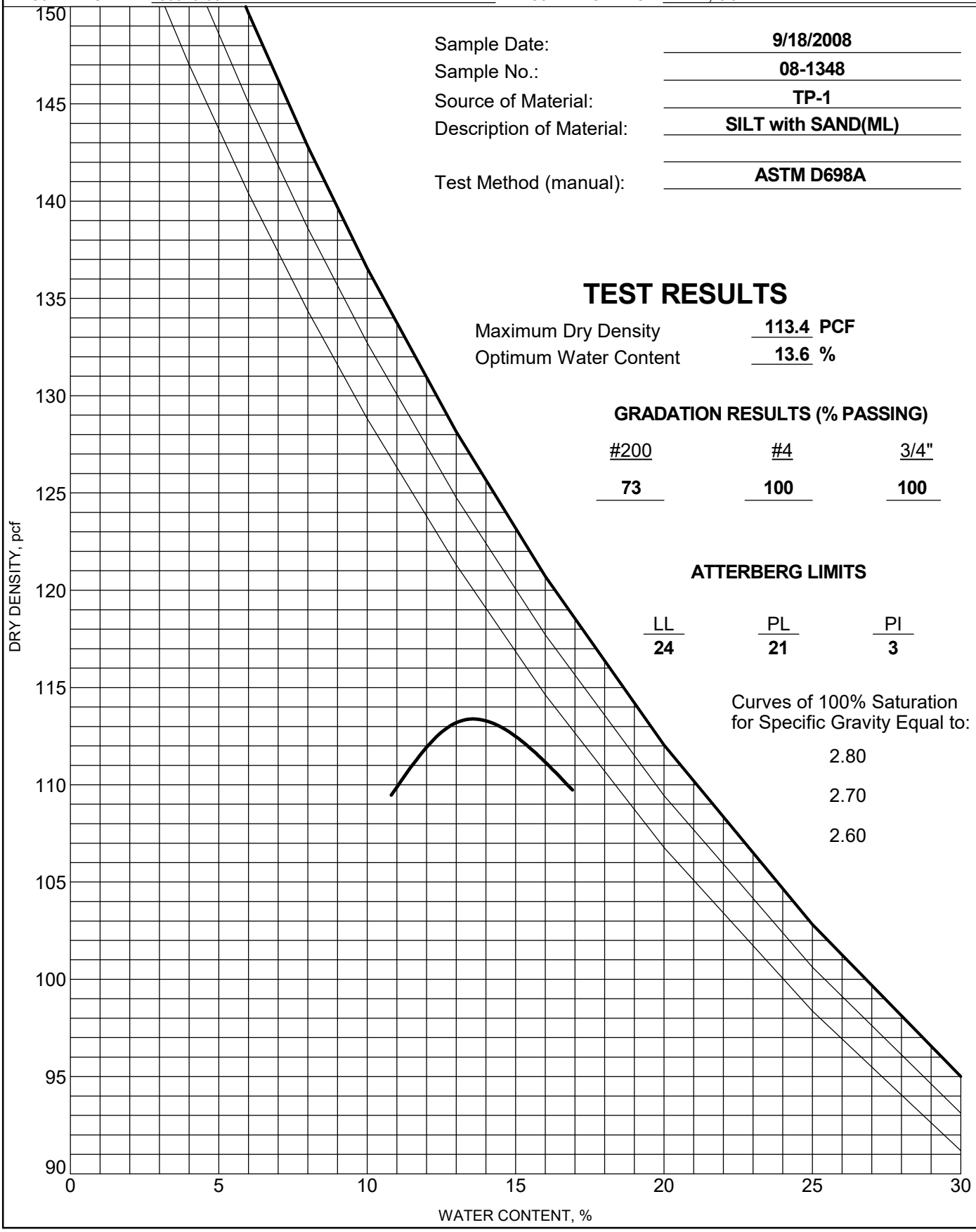
MOISTURE-DENSITY RELATIONSHIP

CLIENT Vortex Engineering **PROJECT NAME** Weston Estates Subdivision

PROJECT NUMBER 00545-0077 **PROJECT LOCATION** Fruita, CO



Sample Date: **9/18/2008**

Sample No.: **08-1348**

Source of Material: **TP-1**

Description of Material: **SILT with SAND(ML)**

Test Method (manual): **ASTM D698A**

TEST RESULTS

Maximum Dry Density **113.4** PCF

Optimum Water Content **13.6** %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
73	100	100

ATTERBERG LIMITS

LL	PL	PI
24	21	3

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

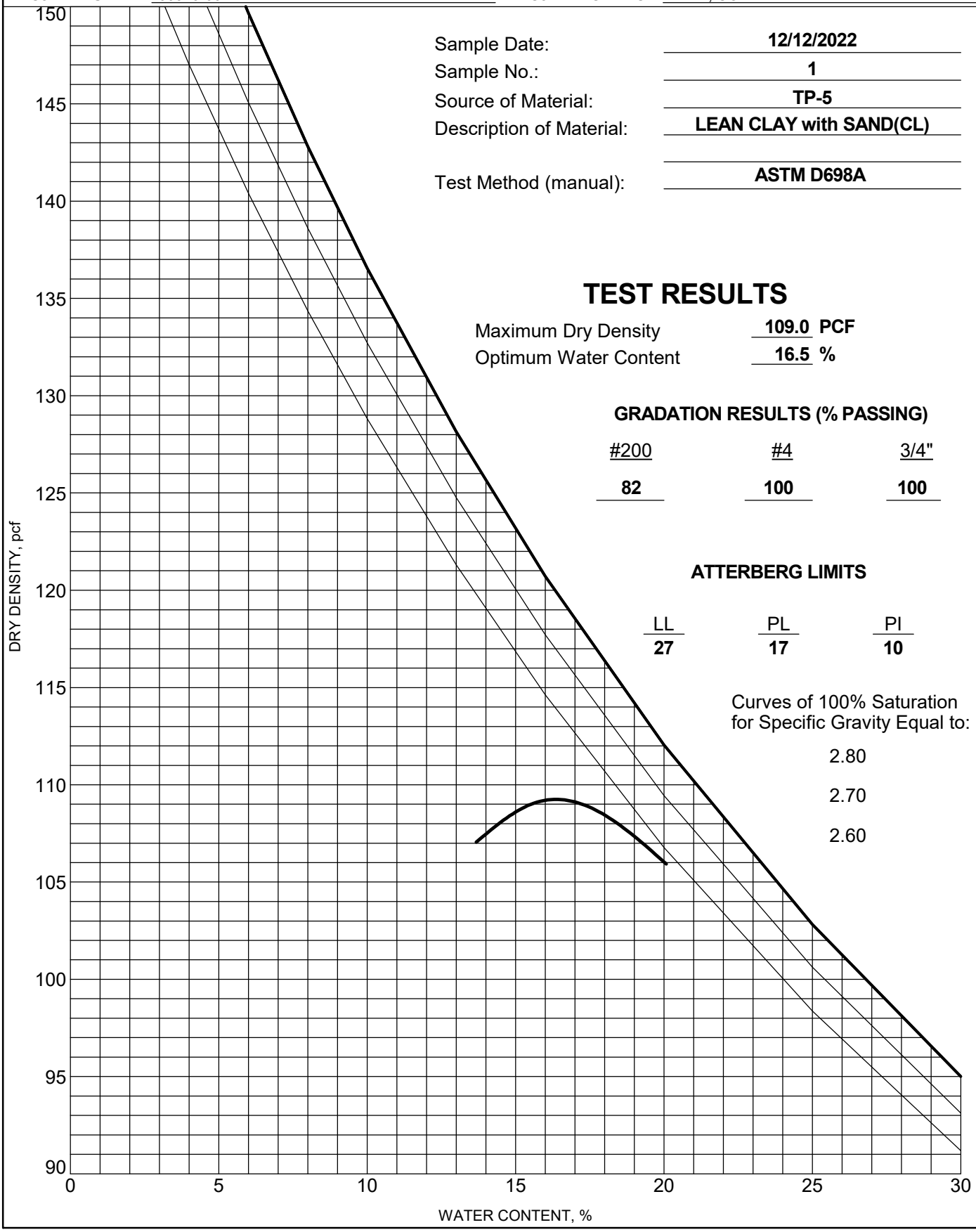
COMPACTION 00545-0077 WESTON ESTATES SUBDIVISION.GPJ GINT US LAB.GDT 1/16/23

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

MOISTURE-DENSITY RELATIONSHIP

CLIENT Vortex Engineering **PROJECT NAME** Weston Estates Subdivision

PROJECT NUMBER 00545-0077 **PROJECT LOCATION** Fruita, CO



Sample Date: **12/12/2022**

Sample No.: **1**

Source of Material: **TP-5**

Description of Material: **LEAN CLAY with SAND(CL)**

Test Method (manual): **ASTM D698A**

TEST RESULTS

Maximum Dry Density **109.0** PCF

Optimum Water Content **16.5** %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
82	100	100

ATTERBERG LIMITS

LL	PL	PI
27	17	10

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

COMPACTION 00545-0077 WESTON ESTATES SUBDIVISION.GPJ GINT US LAB.GDT 1/16/23

Huddleston-Berry
Engineering & Testing, LLC

CALIFORNIA BEARING RATIO
ASTM D1883

Project No.:	00545-0077		**Authorized By:**	Client	**Date:** 09/18/08
Project Name:	Weston Estates		**Sampled By:**	AS	**Date:** 09/18/08
Client Name:	Vortex Engineering		**Submitted By:**	AS	**Date:** 09/18/08
Sample Number:		**Location:** TP-1 GB-1	**Reviewed By:**	MAB	**Date:** 10/28/08

Compaction Method ASTM D698, Method A

Maximum Dry Density (pcf): 113.4

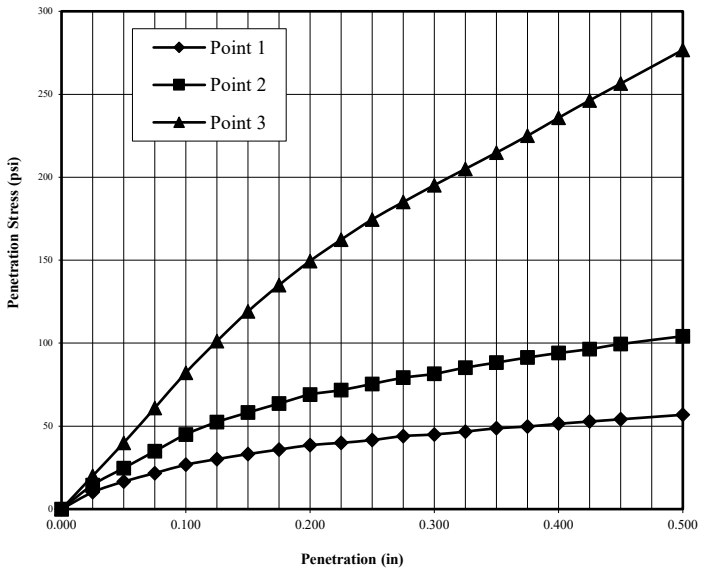
Opt. Moisture Content (%): 13.6

Sample Condition: Soaked

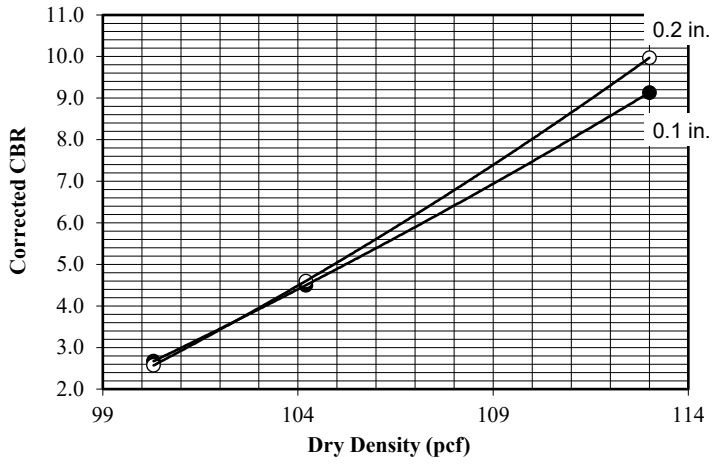
Remarks:

		Sample Data		
		Point 1	Point 2	Point 3
Blows per Compacted Lift:		15	25	56
Surcharge Weight (lbs):		10.0	10.0	10.0
Dry Density Before Soak (pcf):		100.3	104.2	113.0
Dry Density After Soak (pcf):		99.8	103.7	112.4
Moisture Content (%)	Bottom Pre-Test	12.9	13.0	12.1
	Top Pre-Test	12.4	12.6	12.2
	Top 1" After Test	21.2	21.6	19.4
	Average After Soak:	227.0	18.8	15.1
Percent Swell After Soak:		0.5	0.5	0.5

Load Pentration Curve(s)



Dry Density vs CBR



Penetration Data								
Point 1			Point 2			Point 3		
Dist. (in)	Load (lbs)	Stress (psi)	Dist. (in)	Load (lbs)	Stress (psi)	Dist. (in)	Load (lbs)	Stress (psi)
0.000	0	0	0.000	0	0	0.000	0	0
0.025	30	10	0.025	43	15	0.025	59	20
0.050	49	17	0.050	73	25	0.050	118	40
0.075	64	22	0.075	103	35	0.075	180	61
0.100	79	27	0.100	133	45	0.100	243	82
0.125	89	30	0.125	155	52	0.125	299	101
0.150	98	33	0.150	172	58	0.150	352	119
0.175	106	36	0.175	188	64	0.175	399	135
0.200	114	39	0.200	204	69	0.200	442	150
0.225	118	40	0.225	212	72	0.225	480	162
0.250	123	42	0.250	223	75	0.250	516	175
0.275	130	44	0.275	234	79	0.275	547	185
0.300	133	45	0.300	241	82	0.300	577	195
0.325	138	47	0.325	252	85	0.325	606	205
0.350	144	49	0.350	261	88	0.350	635	215
0.375	147	50	0.375	270	91	0.375	665	225
0.400	152	51	0.400	278	94	0.400	697	236
0.425	156	53	0.425	285	96	0.425	728	246
0.450	160	54	0.450	294	99	0.450	758	256
0.500	168	57	0.500	308	104	0.500	818	277

Corrected CBR @ 0.1"		
2.7	4.5	9.1
Corrected CBR @ 0.2"		
2.6	4.6	10.0

Penetration Distance Correction (in)		
0.000	0.000	0.000

Figure:

APPENDIX D
J Road ESAL Calculations

Huddleston-Berry
Engineering & Testing, LLC

ESAL CALCULATIONS

Project No.: 00545-0077
Project Name: Weston Estates
Client Name: Vortex Engineering
Completed By: MAB
Date: 9/22/2022
Current Year: 2022

GIVEN INFORMATION:

Source: Mesa County GIS

Year: 2022 **ADT:** 1777
Year: **ADT:**

ASSUMPTIONS:

Growth Rate (%): 4
Design Life (yr): 20
Truck Traffic (%): 6
Single Axle (%): 70
Combination (%): 30

DEFINED EQUIVALENCY FACTORS:

Automobiles Flexible: 0.003
Automobiles Rigid: 0.003
Single Unit Flexible: 0.249
Single Unit Rigid: 0.285
Combination Flexible: 1.087
Combination Rigid: 1.692

CALCULATIONS:

ADT at Beginning of Design Life
ADT: 1777

ADT at End of Design Life
ADT: 3894

ADT at Midpoint of Design Life
ADT: 2835.5

Breakdown of Vehicles Multiplied by Equivalency Factors for Flexible Pavemen

Automobiles: 8
Single Unit: 30
Combination: 56

Breakdown of Vehicles Multiplied by Equivalency Factors for Rigid Paveme

Automobiles: 8
Single Unit: 34
Combination: 87

Flexible Pavement ESAL's

ESAL's: 411720

Rigid Pavement ESAL's

ESAL's: 565020