Huddleston-Berry
Engineering & Testing, LLC

GEOTECHNICAL AND GEOLOGIC HAZARDS INVESTIGATION
HILLSIDE DRIVE IMPROVEMENTS
DELTA, COLORADO
PROJECT#01123-0006

CITY OF DELTA
640 W. 4TH STREET
DELTA, COLORADO 81416

JANUARY 24, 2023

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

TABLE OF CONTENTS

1.0 INTRODUCTION

As part of continued infrastructure improvements, the City of Delta proposes to reconstruct Hillside Drive between approximately E. 4th Street and E. 6th Street. As part of the design development process, Huddleston-Berry Engineering and Testing, LLC (HBET) was retained by the City of Delta 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 Hillside Drive improvements project in Delta, 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 excavations, subgrade preparation, and pavements.
- Evaluating potential geologic hazards at the site.

The investigation and report were completed by 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 the City of Delta.

1.2 Site Location and Description

The site includes Hillside Drive, between approximately E. 4th Street and E. 6th Street, in Delta, Colorado. The project location is shown on Figure 1 – Site Location Map.

At the time of the investigation, Hillside Drive consisted of one lane in each direction. The area included primarily residential properties. The general slope of the roadway was moderately down to the north.

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 site is underlain by Urban land. Soil survey data is included in Appendix A.

2.2 Geology

According to the *Geologic Map of the Delta Quadrangle, Delta and Montrose Counties, Colorado* (2008), most of Hillside Drive lies on landslide deposits. Alluvial deposits of the Uncompahgre River are mapped at the higher elevations east of Hillside Drive and at the lower elevations west of Hillside Drive.

2.3 Groundwater

Groundwater was only encountered in B-1 at a depth of 10.0 feet and in B-4 at a depth of 5.0 feet at the time of the investigation. However, based upon the soil types encountered and location of B-4 on the hillside, the shallow groundwater in B-4 is likely perched and not representative of a static groundwater elevation.

3.0 FIELD INVESTIGATION

3.1 Subsurface Investigation

The subsurface investigation was conducted on November 14th, 2019 and consisted of five geotechnical borings. The borings were drilled to depths of between 6.0 and 15.0 feet below the existing ground surface. Boring locations are shown on Figure 2 – Site Plan. Typed boring logs are included in Appendix B. Samples of the native soils were collected during Standard Penetration Testing (SPT) and using bulk sampling methods at the locations shown on the logs.

As shown on the logs, the subsurface conditions were variable. Boring B-1, conducted at the lower elevation at the north end of the project area, encountered 4-inches of asphalt pavement above granular base course to a depth of approximately 2.0 feet. Below the base course, brown, moist to wet, medium stiff to stiff sandy lean clay to lean clay with sand extended to a depth of 12.5 feet. The clay was underlain by brown, wet, dense sandy gravel and cobbles to the bottom of the boring. Groundwater was encountered in B-1 at a depth of 10.0 feet at the time of the investigation.

Borings B-2 and B-4, conducted along Hillside Drive as it climbed the hill, encountered 4 to 5-inches of asphalt pavement. In B-4, granular base course extended to a depth of approximately 3.0 feet. Below the asphalt in B-2 and below the base course in B-4, black to brown, loose to medium dense silty gravel with sand was encountered. The gravel extended to the bottom of B-2. In B-4, the gravel extended to a depth of 12.5 feet where shale bedrock was encountered. Groundwater was not encountered in B-2 but was encountered in B-4 at a depth of 5.0 feet at the time of the investigation.

Borings B-3 and B-5, conducted at the higher elevations in the southern and eastern portions of the site, encountered 4-inches of asphalt pavement. In B-5, granular base course extended to a depth of approximately 2.0 feet. Below the asphalt in B-3 and below the base course in B-5, tan, moist, dense to very dense sandy gravel and cobbles extended to the bottoms of the borings where auger refusal was encountered. Groundwater was not encountered in B-3 or B-5 at the time of the investigation.

4.0 LABORATORY TESTING

Selected native soil and bedrock samples collected from the borings were tested in the Huddleston-Berry Engineering and Testing LLC geotechnical laboratory for natural moisture content, grain size analysis, and Atterberg limits. The laboratory testing results are included in Appendix C.

The laboratory testing results indicate that the native clay soils are slightly to moderately plastic. In general, based upon the plasticity of the material, the native clay soils may have a slight potential for expansion.

The native silty gravel soils were indicated to be very slightly plastic. Based upon our experience with similar soils, the native silty gravel soils are anticipated to be slightly collapsible.

The shale bedrock at the site was indicated to be moderately plastic. Based upon the Atterberg limits of the material and upon our experience with the Mancos shale in Western Colorado, the shale bedrock at this site is anticipated to be slightly expansive.

5.0 GEOLOGIC INTERPRETATION

5.1 Geologic Hazards

As indicated previously, most of the roadway is mapped as being underlain by landslide deposits. Although no evidence of active movements was observed at the time of the investigation, shallow groundwater was encountered in B-4 and it is important to note that most mass earth movements are associated with excess moisture. As discussed previously, the observed groundwater at this location is likely perched. However, given that groundwater was not encountered in B-2, B-3, or B-5, the presence of shallow groundwater in B-4 raises some concerns regarding the long-term stability of the hillside.

In addition to the shallow groundwater in the hillside, moisture sensitive soils and bedrock are also present at the site.

5.2 Geologic Constraints

In general, the primary geologic constraint to construction at the site is the fact that most of the roadway is underlain by landslide deposits.

5.3 Water Resources

No water supply wells were observed in the project area. As discussed previously, shallow groundwater was encountered in some areas of the site. 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 western Colorado generally include gravel, uranium ore, and commercial rock products such as flagstone. As discussed previously, portions of the site are mapped as being underlain by gravels. In addition, gravels were encountered in the subsurface at the site. However, based upon the current land use at the site and surrounding properties, HBET does not believe that the gravels represent an economically recoverable resource.

6.0 CONCLUSIONS

Based upon the available data sources, field investigation, and nature of the proposed construction, HBET does not believe that there are any geologic conditions which should preclude construction at this site. However, pavements, utility installation, and/or earthwork may have to consider the impacts of moisture sensitive soils and/or bedrock. In addition, the presence of groundwater in B-4 raises concerns regarding the long-term stability of the hillside.

7.0 RECOMMENDATIONS

7.1 Corrosion of Concrete

Water soluble sulfates are common to the soils and bedrock in Western Colorado. Therefore, at a minimum, Type I-II sulfate resistant cement is recommended for this site.

7.2 Lateral Earth Pressures

Any 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 55 pcf in areas where no surcharge loads are present. Passive pressure should be ignored. Lateral earth pressures should be increased as necessary to reflect any surcharge loading behind the walls.

7.3 Excavations

Excavations in the soils at the site may stand for short periods of time but should not be considered to be stable. In general, the site soils 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. Subgrade Preparation.

7.4 Pavements

The proposed construction is anticipated to include new pavements along Hillside Drive and the new pavements may extend into portions of the intersecting streets. As discussed previously, the native pavement subgrade materials at the site range from clay soils to gravel and cobble soils. Where clays are present in the subgrade, HBET recommends the minimum Resilient Modulus of 3,000 psi be used. Where gravel and cobble soils are present in the subgrade, a Resilient Modulus of 4,500 psf may be used.

Traffic date provided to HBET suggest that the Average Daily Traffic (ADT) at the end of 2022 was approximately 3,500 vehicles. This corresponds to an estimated ESAL value of approximately 665,000 as indicated on the ESAL calculations included in Appendix D. Based upon the traffic loading and subgrade conditions, the following pavement section alternatives are recommended:

Clay Soils in Subgrade

ESAL's = 665,000; Structural Number = 4.10

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
A	4.0	18.0			22.0
B	5.0	14.0			19.0
C	4.0	6.0	16.0		30.0
Rigid Pavement		6.0		8.0	14.0

Gravel Soils in Subgrade

ESAL's = 665,000; Structural Number = 3.71

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
A	4.0	15.0			19.0
B	5.0	12.0			17.0
C	4.0	6.0	12.0		22.0
Rigid Pavement		6.0		8.0	14.0

The pavement section alternatives below can be reduced by incorporating a geogrid such as Haynes RX1100, Tensar TX5, Mirafi BXG110, or equivalent into the section. The geogrid reinforced alternatives are:

Clay Soils in Subgrade

ALTERNATIVE	PAVEMENT SECTION (Inches)			
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	Geogrid Location	TOTAL
A	4.0	11.0	Below base	15.0
B	5.0	8.0	Below base	13.0

Gravel Soils in Subgrade

ALTERNATIVE	PAVEMENT SECTION (Inches)			
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	Geogrid Location	TOTAL
A	4.0	8.0	Below base	12.0
B	5.0	6.0	Below base	11.0

Prior to new pavement placement, areas to be paved should be stripped of all topsoil, uncontrolled 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.

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. It is recommended that rigid pavements consist of CDOT Class P concrete or alternative approved by the Engineer. 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.

7.5 Additional Investigation

As discussed previously, shallow groundwater was encountered in B-4 which was conducted on the hillside and this raises concerns regarding the long-term stability of the hillside. In order to further evaluate the water at this location, HBET recommends that additional investigation be conducted during the construction. Specifically, HBET recommends that test pits be excavated in the vicinity of B-4 to determine the precise nature and extent of the water and to evaluate whether or not additional drainage measures are necessary to mitigate the water.

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 at the site were variable. However, the precise nature and extent of any subsurface variability may not become evident until construction. Therefore, it is recommended that a representative of HBET observe the foundation excavations prior to structural fill placement to verify that the subsurface conditions are consistent with those described herein. In addition, it is recommended that a representative of HBET test compaction of structural fill materials.

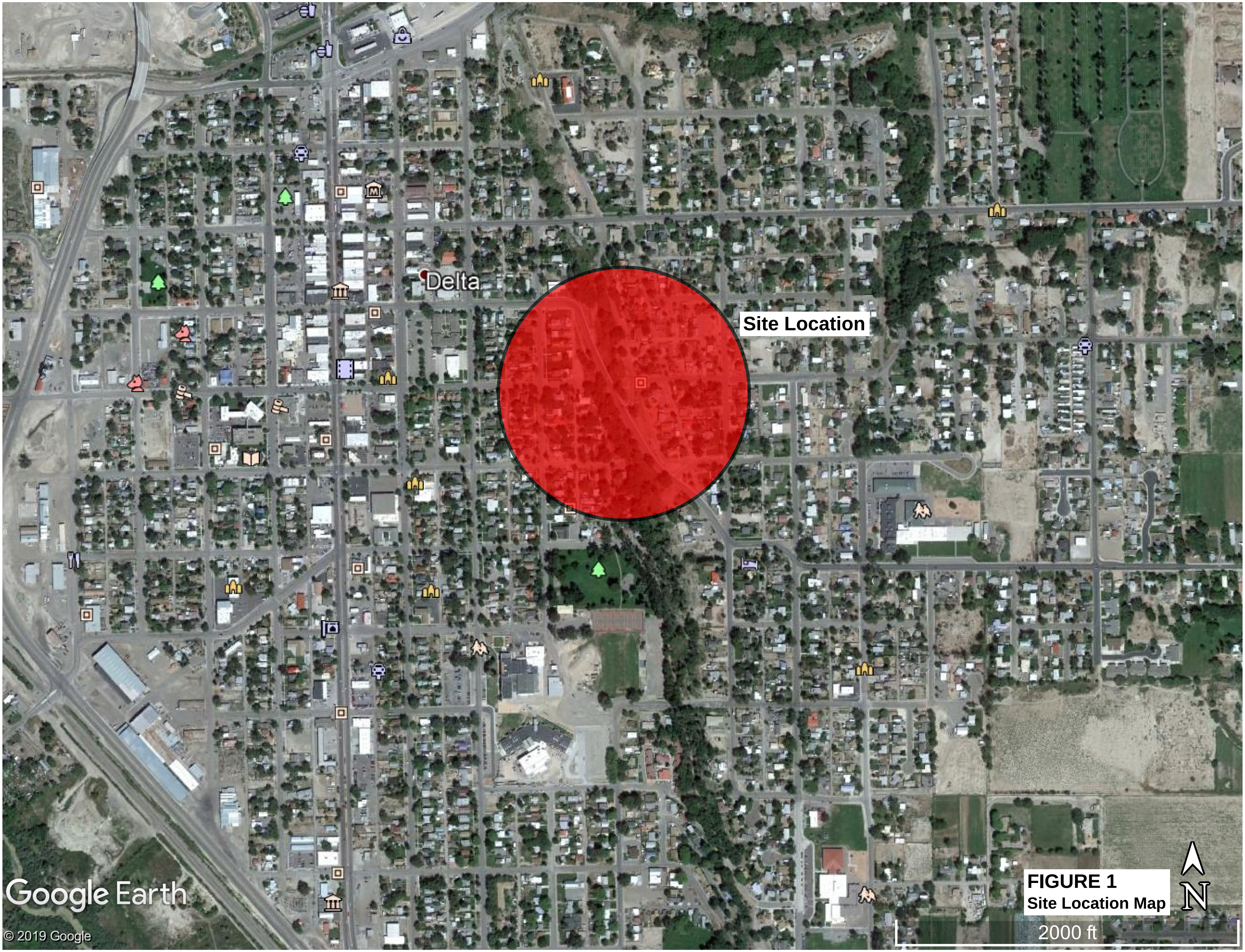
As discussed previously, moisture sensitive soils and bedrock were encountered at the site. The recommendations contained herein are designed to reduce the potential for excessive differential movements; however, HBET cannot predict long-term changes in subsurface moisture conditions and/or the precise magnitude or extent of volume change. ***Where significant increases in subsurface moisture occur due to poor grading, improper stormwater management, utility line failure, excess irrigation, or other cause, significant movements, including slope failures along the hillside, are possible***.

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



Delta
Site Location
Google Earth
© 2019 Google
FIGURE 1
Site Location Map
N
2000 ft

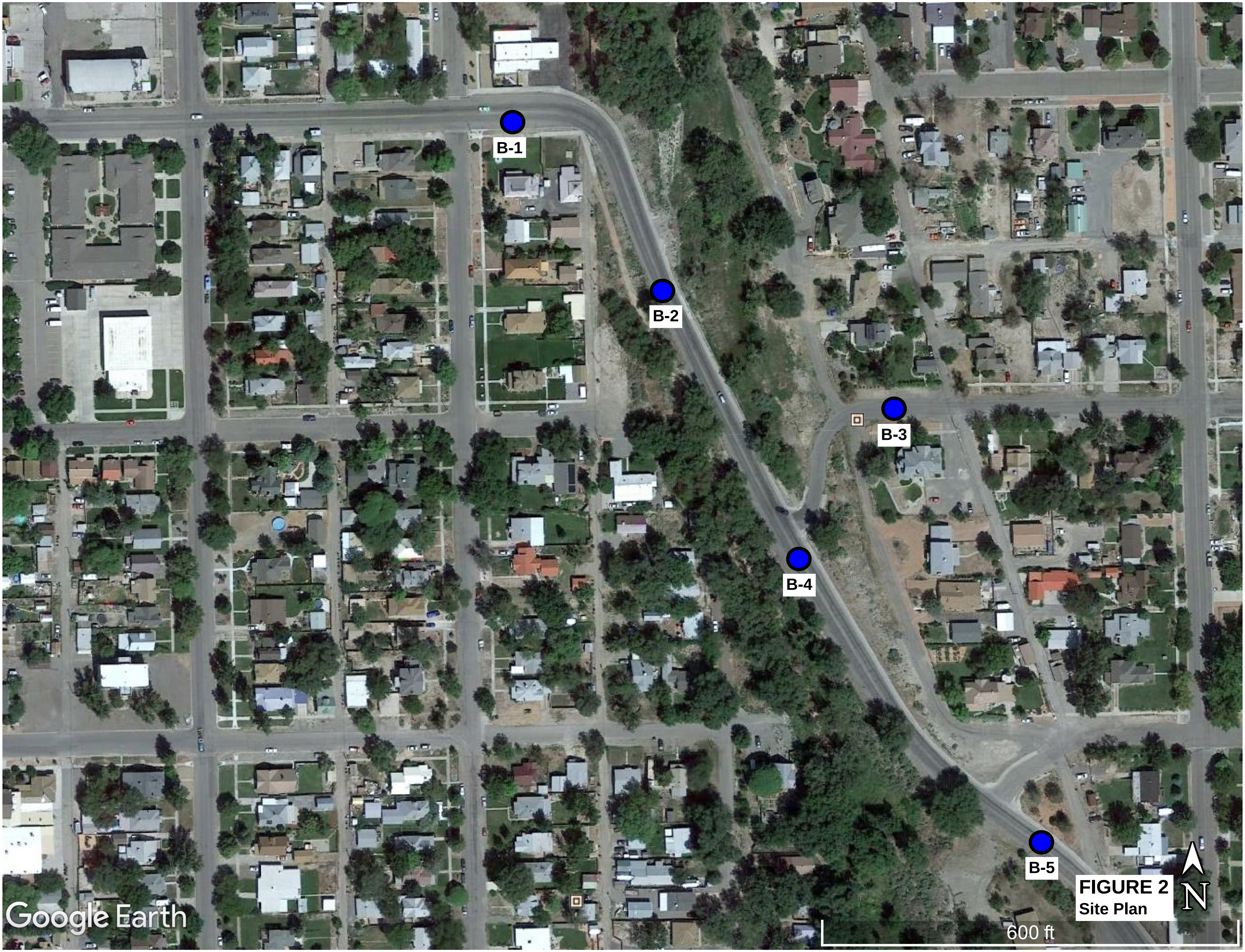
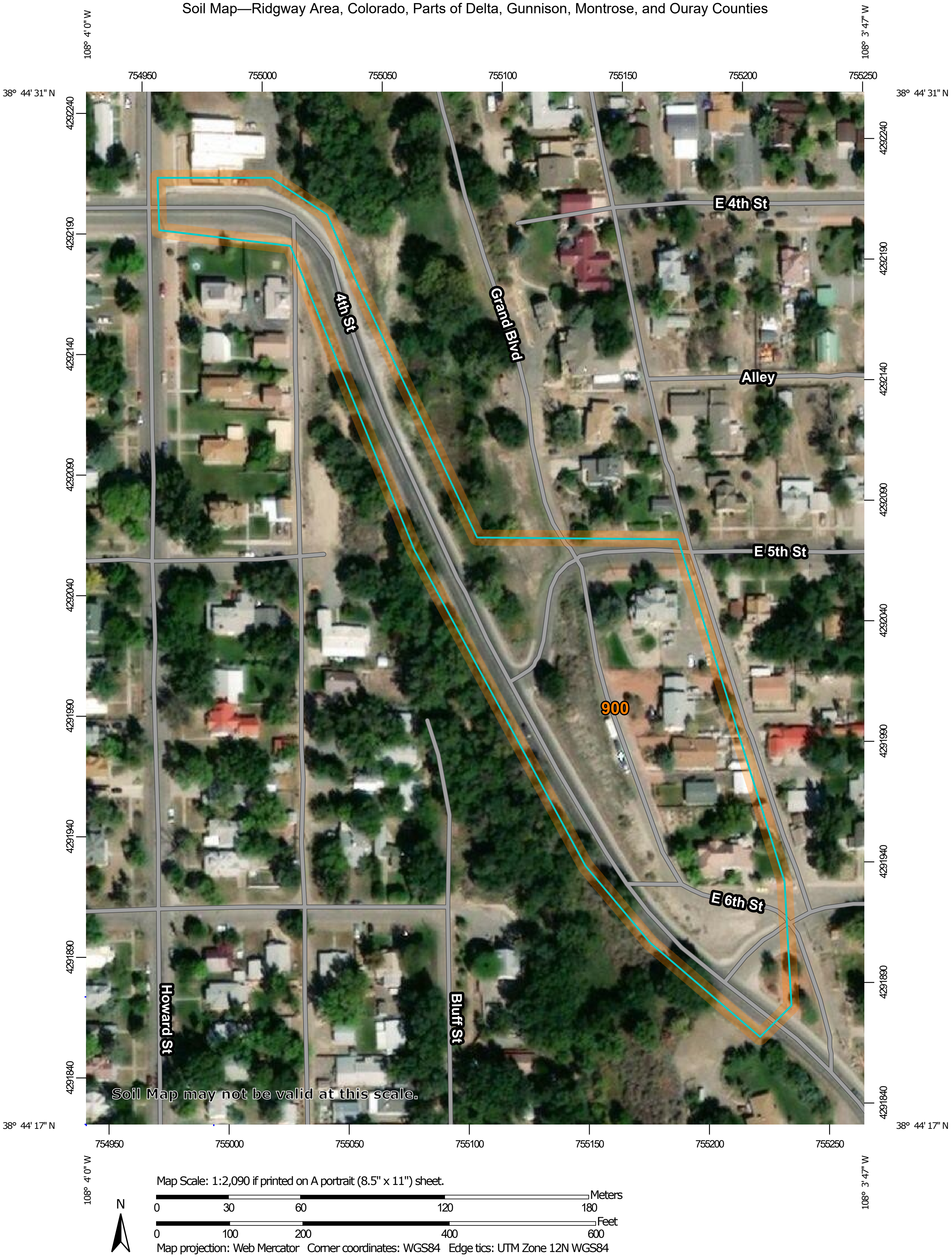


FIGURE 2
Site Plan

APPENDIX A
Soil Survey Data


108° 4' 0" W
108° 3' 47" W
754950
755000
755050
755100
755150
755200
755250
38° 44' 31" N
38° 44' 17" N
4292240
4292190
4292140
4292090
4292040
4291990
4291940
4291890
4291840
E 4th St
4th St
Grand Blvd
Alley
E 5th St
900
E 6th St
Howard St
Bluff St
Soil Map may not be valid at this scale.
Map Scale: 1:2,090 if printed on A portrait (8.5" x 11") sheet.
Meters
0 30 60 120 180
Feet
0 100 200 400 600
N
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: Ridgway Area, Colorado, Parts of Delta, Gunnison, Montrose, and Ouray Counties
Survey Area Data: Version 11, Sep 13, 2019

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

Date(s) aerial images were photographed: Dec 31, 2009—Jul 7, 2017

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
900	Urban land	5.3	100.0%
Totals for Area of Interest		**5.3**	**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

Ridgway Area, Colorado, Parts of Delta, Gunnison, Montrose, and Ouray Counties

900—Urban land

Map Unit Composition

Urban land: 100 percent

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

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): 8
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Data Source Information

Soil Survey Area: Ridgway Area, Colorado, Parts of Delta, Gunnison, Montrose, and Ouray Counties
Survey Area Data: Version 11, Sep 13, 2019

APPENDIX B
Typed Boring Logs

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-1

CLIENT Austin Civil Group
PROJECT NAME Hillside Drive
PROJECT NUMBER 00302-0050
PROJECT LOCATION Delta, CO
DATE STARTED 11/14/19 **COMPLETED** 11/14/19
GROUND ELEVATION **HOLE SIZE** 4-inches
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
∇ **AT TIME OF DRILLING** 10.0 ft
LOGGED BY CM **CHECKED BY** MAB
▼ **AT END OF DRILLING** 10.0 ft
NOTES
AFTER DRILLING ---

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		ASPHALT										
		Granular Base Course										
2.5		Sandy Lean CLAY (CL) to Lean CLAY with Sand (CL), brown, moist to wet, medium stiff to stiff *** Lab Classified SS1	SS 1	94	3-4-3 (7)			23	38	19	19	67
5.0												
7.5		*** Lab Classified SS2	SS 2	100	7-6-5 (11)			22	28	16	12	74
10.0	▼											
12.5		Sandy GRAVEL and COBBLES (gw), brown, wet, dense										
15.0			SS 3	53	24-23							
		Bottom of hole at 15.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-2

CLIENT Austin Civil Group
PROJECT NAME Hillside Drive
PROJECT NUMBER 00302-0050
PROJECT LOCATION Delta, CO
DATE STARTED 11/14/19 **COMPLETED** 11/14/19
GROUND ELEVATION **HOLE SIZE** 4-inches
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY CM **CHECKED BY** MAB
AT END OF DRILLING dry
NOTES
AFTER DRILLING ---

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		ASPHALT										
		Silty GRAVEL with Sand (GM), black to brown, moist, loose to medium dense										
2.5			SS 1	0	4-4-4 (8)							
5.0												
7.5			SS 2	89	7-6-10 (16)							
10.0												
12.5		*** Lab Classified SS3										
			SS 3	67	14-10-11-16 (21)			4	19	18	1	20
15.0		Bottom of hole at 15.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-3

CLIENT Austin Civil Group
PROJECT NAME Hillside Drive
PROJECT NUMBER 00302-0050
PROJECT LOCATION Delta, CO

DATE STARTED 11/14/19 **COMPLETED** 11/14/19
GROUND ELEVATION **HOLE SIZE** 4-inches
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY CM **CHECKED BY** MAB
AT END OF DRILLING dry
NOTES
AFTER DRILLING ---

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		ASPAHLT										
		Sandy GRAVEL and COBBLES (gw), tan, moist, dense to very dense										
2.5												
5.0			SS 1	72	20-20-24 (44)							
		*** Auger Rufusal										
		Bottom of hole at 6.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-4

CLIENT Austin Civil Group
PROJECT NAME Hillside Drive
PROJECT NUMBER 00302-0050
PROJECT LOCATION Delta, CO
DATE STARTED 11/14/19 **COMPLETED** 11/14/19
GROUND ELEVATION **HOLE SIZE** 4-inches
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
▽ **AT TIME OF DRILLING** 5.0 ft
LOGGED BY CM **CHECKED BY** MAB
▼ **AT END OF DRILLING** 5.0 ft
NOTES
AFTER DRILLING ---

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		ASPHALT										
		Granular Base Course										
2.5												
		Silty GRAVEL with Sand (gm), brown, moist, loose to medium dense	SS 1	22	5-4-3 (7)							
5.0	▼											
7.5			SS 2	0	4-3-2 (5)							
10.0												
12.5		SHALE, grey, soft to medium hard, highly weathered										
			SS 3	42	10-11-13-20 (24)				46	25	21	
15.0		Bottom of hole at 15.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-5

CLIENT Austin Civil Group
PROJECT NAME Hillside Drive
PROJECT NUMBER 00302-0050
PROJECT LOCATION Delta, CO
DATE STARTED 11/14/19 **COMPLETED** 11/14/19
GROUND ELEVATION **HOLE SIZE** 4-inches
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Track Rig
AT TIME OF DRILLING dry
LOGGED BY CM **CHECKED BY** MAB
AT END OF DRILLING dry
NOTES
AFTER DRILLING ---

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		ASPHALT										
		Granular Base Course										
		Sandy GRAVEL and COBBLES (gw), tan, moist, dense										
2.5			SS 1	56	10-13-17 (30)							
5.0												
		*** Auger Refusal										
		Bottom of hole at 7.0 feet.										

APPENDIX C
Laboratory Testing Results

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

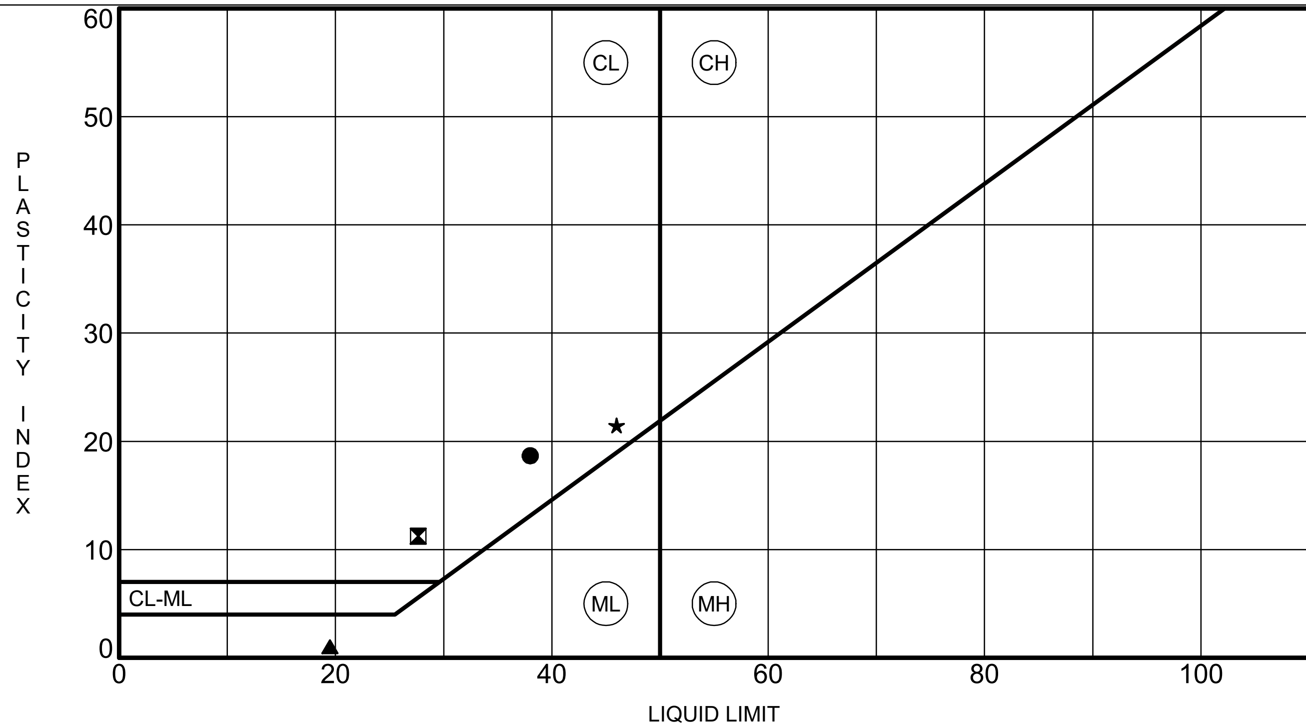
ATTERBERG LIMITS' RESULTS

CLIENT Austin Civil Group

PROJECT NAME Hillside Drive

PROJECT NUMBER 00302-0050

PROJECT LOCATION Delta, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	**B-1, SS1**	**11/2019**	**38**	**19**	**19**	**67**	**SANDY LEAN CLAY(CL)**
⊠	**B-1, SS2**	**11/2019**	**28**	**16**	**12**	**74**	**LEAN CLAY with SAND(CL)**
▲	**B-2, SS3**	**11/2019**	**19**	**18**	**1**	**20**	**SILTY GRAVEL with SAND(GM)**
★	**B-4, SS3**	**11/2019**	**46**	**25**	**21**		

APPENDIX D
ESAL Calculations

Huddleston-Berry
Engineering & Testing, LLC

ESAL CALCULATIONS

Project No.: 00302-0050
Project Name: Hillside Drive
Client Name: City of Delta
Completed By: MAB
Date: 1/18/2023
Current Year: 2023

GIVEN INFORMATION:

Source: KLJ

Year: 2022 **ADT:** 3500
Year: **ADT:**

ASSUMPTIONS:

Growth Rate (%): 2.2
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: 3577

ADT at End of Design Life
ADT: 5528

ADT at Midpoint of Design Life
ADT: 4552.5

Breakdown of Vehicles Multiplied by Equivalency Factors for Flexible Pavements

Automobiles: 13
Single Unit: 48
Combination: 90

Breakdown of Vehicles Multiplied by Equivalency Factors for Rigid Pavement

Automobiles: 13
Single Unit: 55
Combination: 139

Flexible Pavement ESAL's

ESAL's: 661380

Rigid Pavement ESAL's

ESAL's: 906660