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NRCS

Natural  
Resources  
Conservation  
Service

A product of the National  
Cooperative Soil Survey,  
a joint effort of the United  
States Department of  
Agriculture and other  
Federal agencies, State  
agencies including the  
Agricultural Experiment  
Stations, and local  
participants

**Custom Soil Resource  
Report for  
Douglas-Plateau Area,  
Colorado, Parts of Garfield  
and Mesa Counties**

NRCS MAPUNIT DESC

**Harrison Creek Produced Water  
Facility**

**RECEIVED**

MAY 13 2009

**COGCC**



# Preface

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Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://soils.usda.gov/sqi/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<http://offices.sc.egov.usda.gov/locator/app?agency=nracs>) or your NRCS State Soil Scientist ([http://soils.usda.gov/contact/state\\_offices/](http://soils.usda.gov/contact/state_offices/)).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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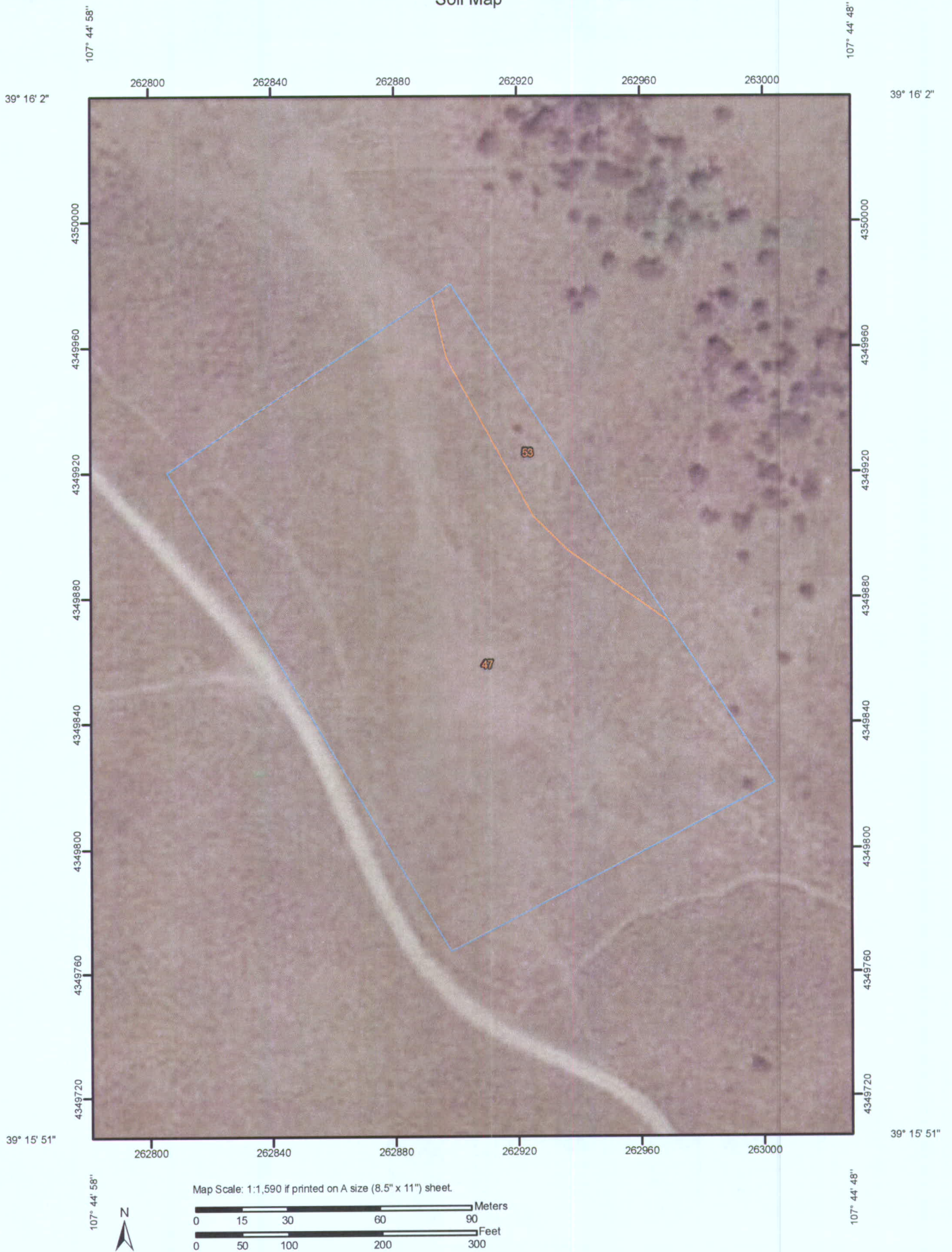


## Soil Map

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The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report  
Soil Map






## Custom Soil Resource Report

### MAP LEGEND



















#### Area of Interest (AOI)


 Area of Interest (AOI)

#### Soils

 Soil Map Units

#### 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

-  Gully
-  Short Steep Slope
-  Other

#### Political Features

 Cities

#### Water Features

-  Oceans
-  Streams and Canals

#### Transportation

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

### MAP INFORMATION

Map Scale: 1:1,590 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
Coordinate System: UTM Zone 13N NAD83

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

Soil Survey Area: Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties  
Survey Area Data: Version 5, Feb 1, 2008

Date(s) aerial images were photographed: 8/29/2005

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

Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties (CO682)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
47	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	4.8	92.1%
53	Pagoda-Hesperus complex, 12 to 40 percent slopes	0.4	7.9%
Totals for Area of Interest		5.2	100.0%

## Map Unit Descriptions

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, 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 and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils 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. Other minor components, however, have properties and behavioral 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



## Custom Soil Resource Report

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*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one 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.

## Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties

### 47—Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes

#### Map Unit Setting

*Elevation:* 6,200 to 8,500 feet  
*Mean annual precipitation:* 18 to 20 inches  
*Mean annual air temperature:* 42 to 44 degrees F  
*Frost-free period:* 85 to 100 days

#### Map Unit Composition

*Hesperus and similar soils:* 35 percent  
*Empedrado, moist, and similar soils:* 30 percent  
*Pagoda and similar soils:* 20 percent

#### Description of Hesperus

##### Setting

*Landform:* Mountainsides  
*Landform position (three-dimensional):* Mountainflank  
*Down-slope shape:* Concave  
*Across-slope shape:* Linear  
*Parent material:* Residuum weathered from sandstone and shale

##### Properties and qualities

*Slope:* 5 to 35 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 (0.20 to 0.60 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water capacity:* Very high (about 21.2 inches)

##### Interpretive groups

*Land capability (nonirrigated):* 6e  
*Ecological site:* Brushy Loam (R048AY238CO)

##### Typical profile

*0 to 7 inches:* Loam  
*7 to 60 inches:* Clay loam, loam

#### Description of Empedrado, Moist

##### Setting

*Landform:* Benches  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Colluvium derived from sandstone and shale and/or residuum weathered from sandstone and shale

##### Properties and qualities

*Slope:* 5 to 35 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained



## Custom Soil Resource Report

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high  
(0.57 to 1.98 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 (0.0 to 2.0 mmhos/cm)

*Available water capacity:* High (about 9.7 inches)

### Interpretive groups

*Land capability (nonirrigated):* 6e

*Ecological site:* Brushy Loam (R048AY238CO)

### Typical profile

*0 to 10 inches:* Loam

*10 to 21 inches:* Clay loam

*21 to 28 inches:* Gravelly sandy clay loam

*28 to 60 inches:* Loam

## Description of Pagoda

### Setting

*Landform:* Benches, mountains

*Landform position (three-dimensional):* Mountainflank

*Down-slope shape:* Linear, concave

*Across-slope shape:* Linear

*Parent material:* Colluvium derived from shale

### Properties and qualities

*Slope:* 5 to 35 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Well drained

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Calcium carbonate, maximum content:* 15 percent

*Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)

*Available water capacity:* Very high (about 18.7 inches)

### Interpretive groups

*Land capability (nonirrigated):* 6e

*Ecological site:* Brushy Loam (R048AY238CO)

### Typical profile

*0 to 6 inches:* Clay loam

*6 to 17 inches:* Clay loam

*17 to 27 inches:* Clay loam, clay

*27 to 60 inches:* Clay loam, clay

### 53—Pagoda-Hesperus complex, 12 to 40 percent slopes

#### Map Unit Setting

*Elevation:* 7,400 to 8,000 feet  
*Mean annual precipitation:* 18 to 22 inches  
*Frost-free period:* 75 to 85 days

#### Map Unit Composition

*Pagoda and similar soils:* 50 percent  
*Hesperus and similar soils:* 20 percent

#### Description of Pagoda

##### Setting

*Landform:* Mudflows  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Parent material:* Alluvium derived from shale and/or colluvium derived from shale

##### Properties and qualities

*Slope:* 12 to 40 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 15 percent  
*Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)  
*Available water capacity:* Very high (about 18.7 inches)

##### Interpretive groups

*Land capability (nonirrigated):* 7e  
*Ecological site:* Brushy Loam (R048AY238CO)

##### Typical profile

*0 to 6 inches:* Clay loam  
*6 to 17 inches:* Clay loam  
*17 to 27 inches:* Clay loam, clay  
*27 to 60 inches:* Clay loam, clay

#### Description of Hesperus

##### Setting

*Landform:* Hills  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Concave



## Custom Soil Resource Report

*Across-slope shape:* Linear

### **Properties and qualities**

*Slope:* 12 to 40 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 (0.20 to 0.60 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water capacity:* Very high (about 21.2 inches)

### **Interpretive groups**

*Land capability (nonirrigated):* 7e

*Ecological site:* Brushy Loam (R048AY238CO)

### **Typical profile**

*0 to 7 inches:* Loam

*7 to 60 inches:* Clay loam, loam

# **Soil Information for All Uses**

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## **Suitabilities and Limitations for Use**

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

## **Building Site Development**

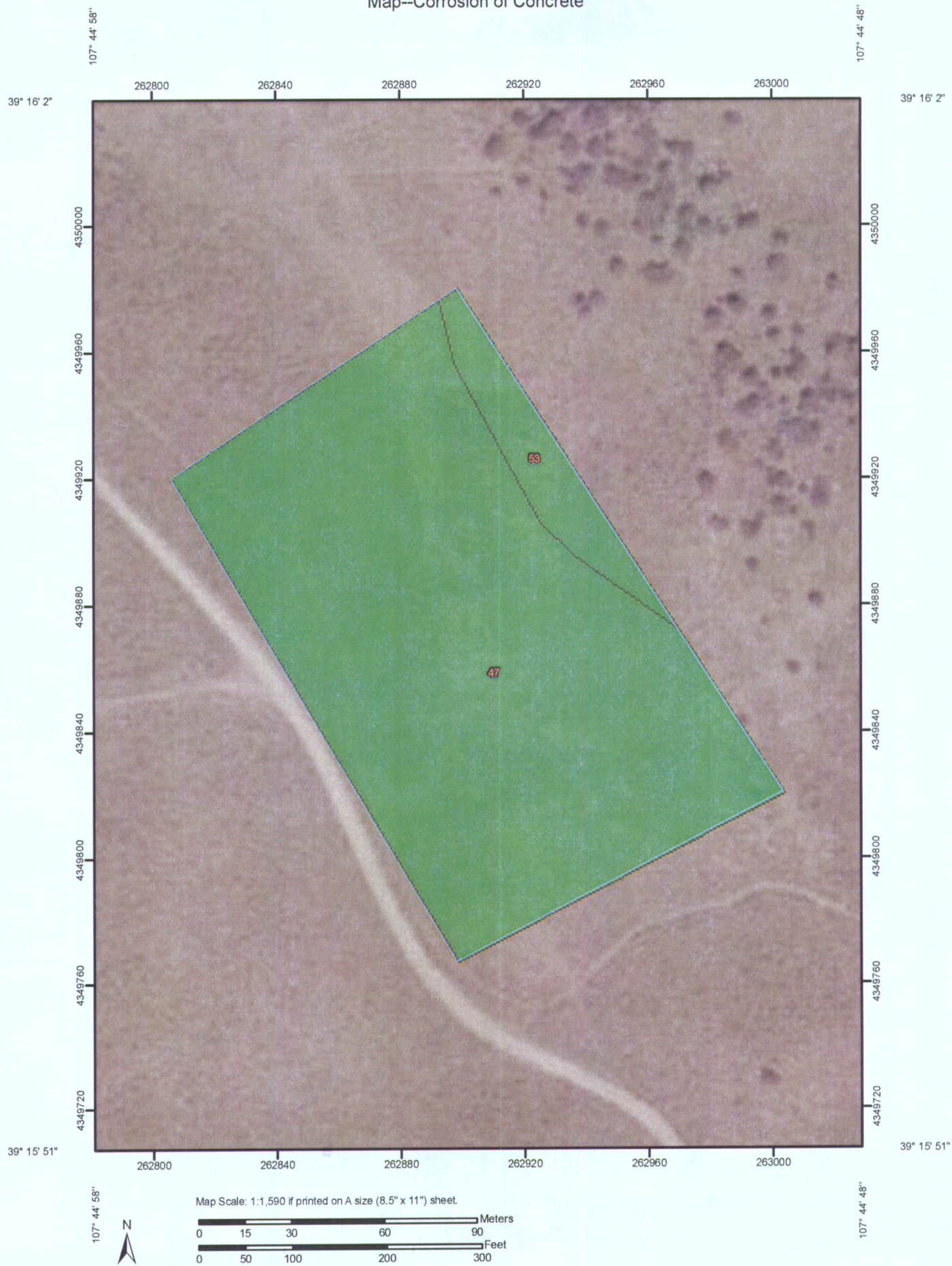
Building site development interpretations are designed to be used as tools for evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its described condition and does not consider present land use. Example interpretations can include corrosion of concrete and steel, shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping.

### **Corrosion of Concrete**

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete. 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 concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Custom Soil Resource Report  
Map--Corrosion of Concrete






## Custom Soil Resource Report

### MAP LEGEND

#### Area of Interest (AOI)

 Area of Interest (AOI)

#### Soils

 Soil Map Units

#### Soil Ratings

 High

 Moderate

 Low

 Not rated or not available

#### Political Features

 Cities

#### Water Features

 Oceans

 Streams and Canals

#### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### MAP INFORMATION

Map Scale: 1:1,590 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
Coordinate System: UTM Zone 13N NAD83

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

Soil Survey Area: Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties  
Survey Area Data: Version 5, Feb 1, 2008

Date(s) aerial images were photographed: 8/29/2005

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.

**Table—Corrosion of Concrete**

Corrosion of Concrete— Summary by Map Unit — Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
47	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	Low	4.8	92.1%
53	Pagoda-Hesperus complex, 12 to 40 percent slopes	Low	0.4	7.9%
<b>Totals for Area of Interest</b>			<b>5.2</b>	<b>100.0%</b>

**Rating Options—Corrosion of Concrete**

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

**Local Roads and Streets**

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

The ratings 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 the specified use. "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 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).

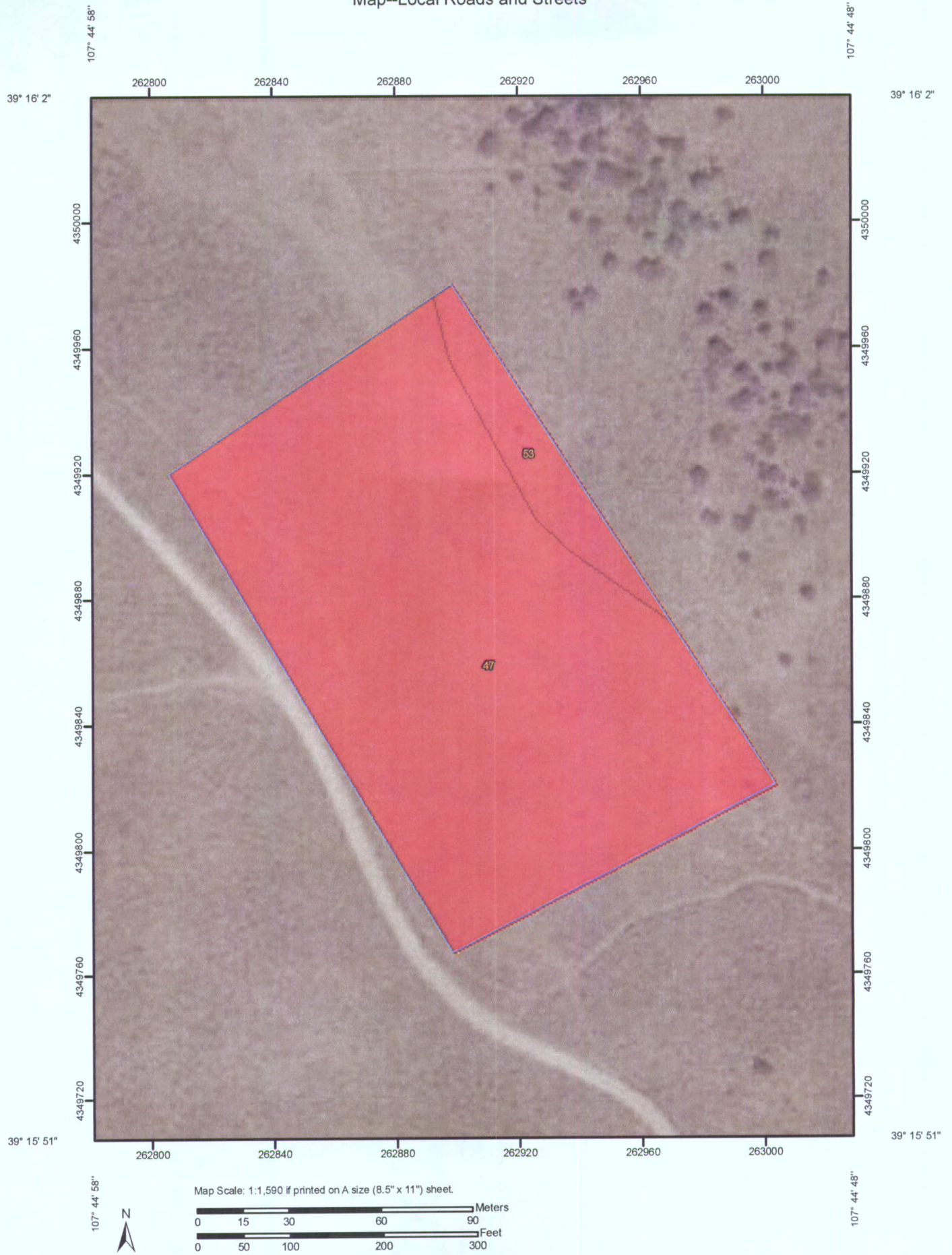
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The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.




Custom Soil Resource Report  
Map--Local Roads and Streets



## Custom Soil Resource Report

### MAP LEGEND

#### Area of Interest (AOI)

 Area of Interest (AOI)

#### Soils

 Soil Map Units

#### Soil Ratings

 Very limited

 Somewhat limited

 Not limited


 Not rated or not available

#### Political Features

 Cities

#### Water Features

 Oceans

 Streams and Canals

#### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### MAP INFORMATION

Map Scale: 1:1,590 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
Coordinate System: UTM Zone 13N NAD83

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

Soil Survey Area: Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties  
Survey Area Data: Version 5, Feb 1, 2008

Date(s) aerial images were photographed: 8/29/2005

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.

## Tables—Local Roads and Streets

Local Roads and Streets— Summary by Map Unit — Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
47	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	Very limited	Hesperus (35%)	Slope (1.00)	4.8	92.1%
				Low strength (1.00)		
				Shrink-swell (0.50)		
				Frost action (0.50)		
			Empedrado, moist (30%)	Slope (1.00)		
				Frost action (0.50)		
			Pagoda (20%)	Slope (1.00)		
				Low strength (1.00)		
				Shrink-swell (0.50)		
53	Pagoda-Hesperus complex, 12 to 40 percent slopes	Very limited	Pagoda (50%)	Slope (1.00)	0.4	7.9%
				Low strength (1.00)		
				Shrink-swell (0.50)		
			Hesperus (20%)	Slope (1.00)		
				Low strength (1.00)		
				Shrink-swell (0.50)		
				Frost action (0.50)		
Totals for Area of Interest					5.2	100.0%

Local Roads and Streets— Summary by Rating Value		
Rating	Acres in AOI	Percent of AOI
Very limited	5.2	100.0%
Totals for Area of Interest	5.2	100.0%

### Rating Options—Local Roads and Streets

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

### Shallow Excavations

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth



## Custom Soil Resource Report

to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

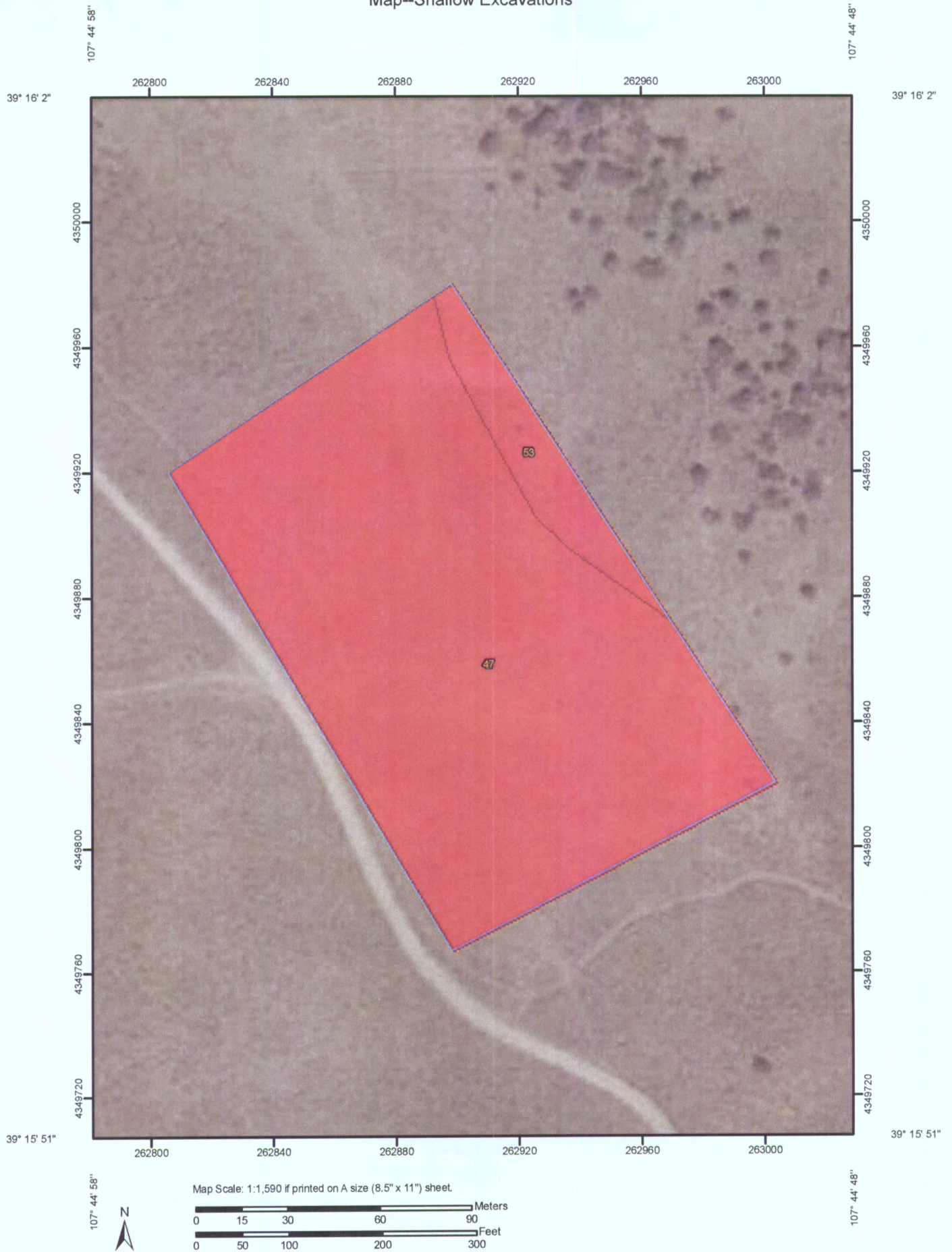
The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance 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 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).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Custom Soil Resource Report  
Map--Shallow Excavations






## Custom Soil Resource Report

### MAP LEGEND

#### Area of Interest (AOI)

 Area of Interest (AOI)

#### Soils

 Soil Map Units

#### Soil Ratings

 Very limited

 Somewhat limited

 Not limited

 Not rated or not available

#### Political Features

 Cities


#### Water Features

 Oceans

 Streams and Canals

#### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### MAP INFORMATION

Map Scale: 1:1,590 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
Coordinate System: UTM Zone 13N NAD83

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

Soil Survey Area: Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties  
Survey Area Data: Version 5, Feb 1, 2008

Date(s) aerial images were photographed: 8/29/2005

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.



## Tables—Shallow Excavations

Shallow Excavations— Summary by Map Unit — Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
47	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	Very limited	Hesperus (35%)	Slope (1.00)	4.8	92.1%
				Cutbanks cave (0.10)		
			Empedrado, moist (30%)	Cutbanks cave (1.00)		
				Slope (1.00)		
			Pagoda (20%)	Slope (1.00)		
				Cutbanks cave (0.10)		
				Too clayey (0.03)		
53	Pagoda-Hesperus complex, 12 to 40 percent slopes	Very limited	Pagoda (50%)	Slope (1.00)	0.4	7.9%
				Cutbanks cave (0.10)		
				Too clayey (0.03)		
			Hesperus (20%)	Slope (1.00)		
				Cutbanks cave (0.10)		
Totals for Area of Interest					5.2	100.0%

Shallow Excavations— Summary by Rating Value		
Rating	Acres in AOI	Percent of AOI
Very limited	5.2	100.0%
Totals for Area of Interest	5.2	100.0%

## Rating Options—Shallow Excavations

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

## Dwellings Without Basements

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.

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

## Custom Soil Resource Report

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 of the soil. 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.

The ratings 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 the specified use. "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.

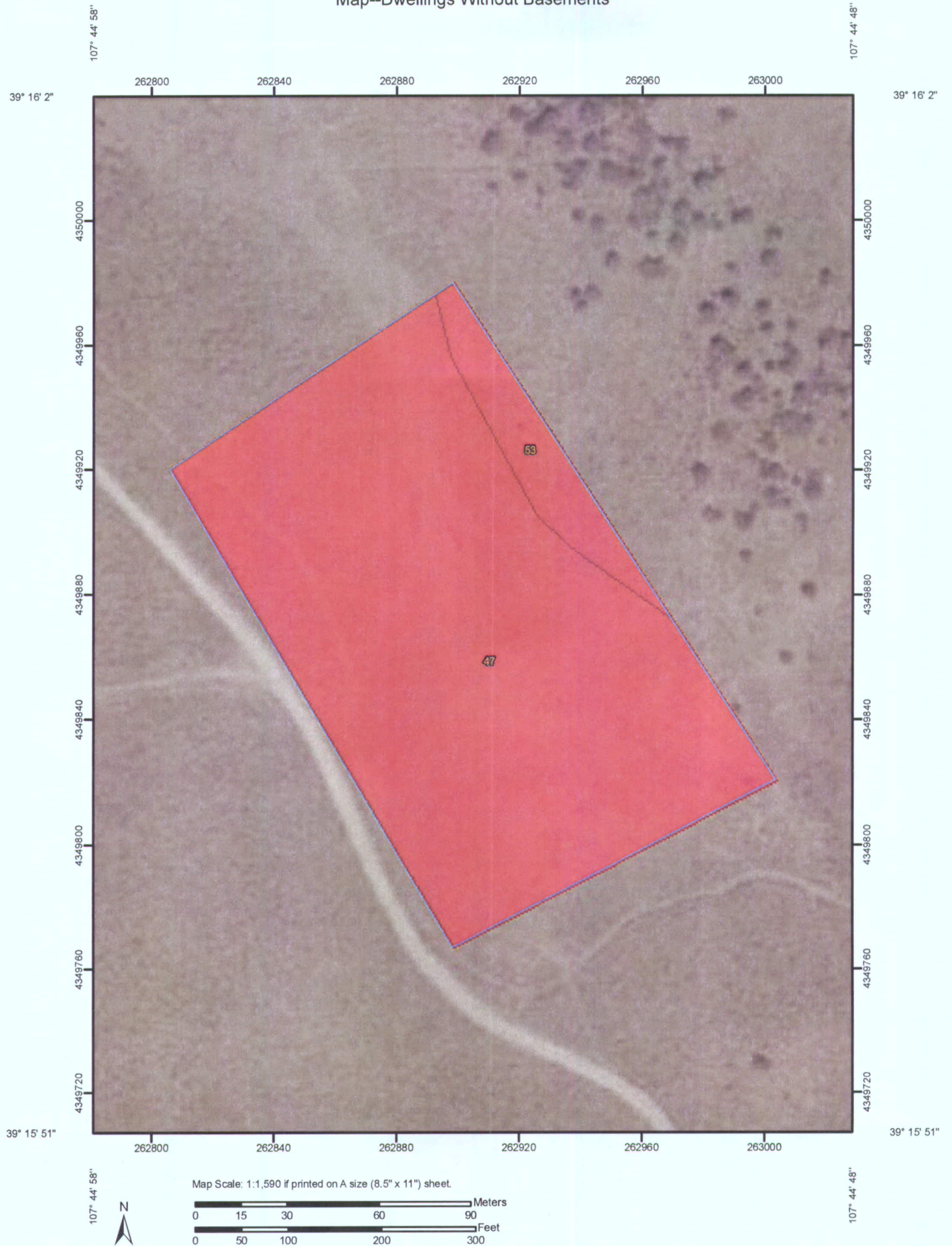
Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not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

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.



Custom Soil Resource Report  
Map--Dwellings Without Basements






## Custom Soil Resource Report

### MAP LEGEND

#### Area of Interest (AOI)

 Area of Interest (AOI)

#### Soils

 Soil Map Units

#### Soil Ratings

 Very limited

 Somewhat limited

 Not limited


 Not rated or not available

#### Political Features

 Cities

#### Water Features

 Oceans

 Streams and Canals

#### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### MAP INFORMATION

Map Scale: 1:1,590 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>

Coordinate System: UTM Zone 13N NAD83

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

Soil Survey Area: Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties

Survey Area Data: Version 5, Feb 1, 2008

Date(s) aerial images were photographed: 8/29/2005

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### Tables—Dwellings Without Basements

Dwellings Without Basements— Summary by Map Unit — Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
47	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	Very limited	Hesperus (35%)	Slope (1.00)	4.8	92.1%
				Shrink-swell (0.50)		
			Empedrado, moist (30%)	Slope (1.00)		
				Pagoda (20%)		
			Shrink-swell (0.50)			
53	Pagoda-Hesperus complex, 12 to 40 percent slopes	Very limited	Pagoda (50%)	Slope (1.00)	0.4	7.9%
				Shrink-swell (0.50)		
			Hesperus (20%)	Slope (1.00)		
				Shrink-swell (0.50)		
				Totals for Area of Interest		

Dwellings Without Basements— Summary by Rating Value		
Rating	Acres in AOI	Percent of AOI
Very limited	5.2	100.0%
<b>Totals for Area of Interest</b>	<b>5.2</b>	<b>100.0%</b>

### Rating Options—Dwellings Without Basements

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

## Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

## Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

## Map Unit Name

A soil map unit is a collection of soil areas or nonsoil areas (miscellaneous areas) delineated in a soil survey. Each map unit is given a name that uniquely identifies the unit in a particular soil survey area.




Custom Soil Resource Report  
Map—Map Unit Name



## Custom Soil Resource Report

### MAP LEGEND




#### Area of Interest (AOI)

 Area of Interest (AOI)

#### Soils

 Soil Map Units

#### Soil Ratings

-  Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes
-  Pagoda-Hesperus complex, 12 to 40 percent slopes
-  Not rated or not available

#### Political Features

 Cities

#### Water Features

 Oceans

 Streams and Canals

#### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### MAP INFORMATION

Map Scale: 1:1,590 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
Coordinate System: UTM Zone 13N NAD83

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Survey Area Data: Version 5, Feb 1, 2008

Date(s) aerial images were photographed: 8/29/2005

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**Table—Map Unit Name**

Map Unit Name— Summary by Map Unit — Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
47	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	4.8	92.1%
53	Pagoda-Hesperus complex, 12 to 40 percent slopes	Pagoda-Hesperus complex, 12 to 40 percent slopes	0.4	7.9%
<b>Totals for Area of Interest</b>			<b>5.2</b>	<b>100.0%</b>

**Rating Options—Map Unit Name**

*Aggregation Method:* No Aggregation Necessary

*Tie-break Rule:* Lower

**Representative Slope**

Slope gradient is the difference in elevation between two points, expressed as a percentage of the distance between those points.

The slope gradient is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.




Custom Soil Resource Report  
Map--Representative Slope



## Custom Soil Resource Report

### MAP LEGEND

#### Area of Interest (AOI)

 Area of Interest (AOI)

#### Soils

 Soil Map Units

#### Soil Ratings

 0 - 5

 5 - 15

 15 - 30

 30 - 45

 45 - 60


 Not rated or not available

#### Political Features

 Cities

#### Water Features

 Oceans

 Streams and Canals

#### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### MAP INFORMATION

Map Scale: 1:1,590 if printed on A size (8.5" × 11") sheet.

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

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Date(s) aerial images were photographed: 8/29/2005

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**Table—Representative Slope**

Representative Slope— Summary by Map Unit — Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties				
Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
47	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	20.0	4.8	92.1%
53	Pagoda-Hesperus complex, 12 to 40 percent slopes	26.0	0.4	7.9%
<b>Totals for Area of Interest</b>			<b>5.2</b>	<b>100.0%</b>

**Rating Options—Representative Slope**

*Units of Measure:* percent

*Aggregation Method:* Dominant Component

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

*Interpret Nulls as Zero:* No

**Unified Soil Classification (Surface)**

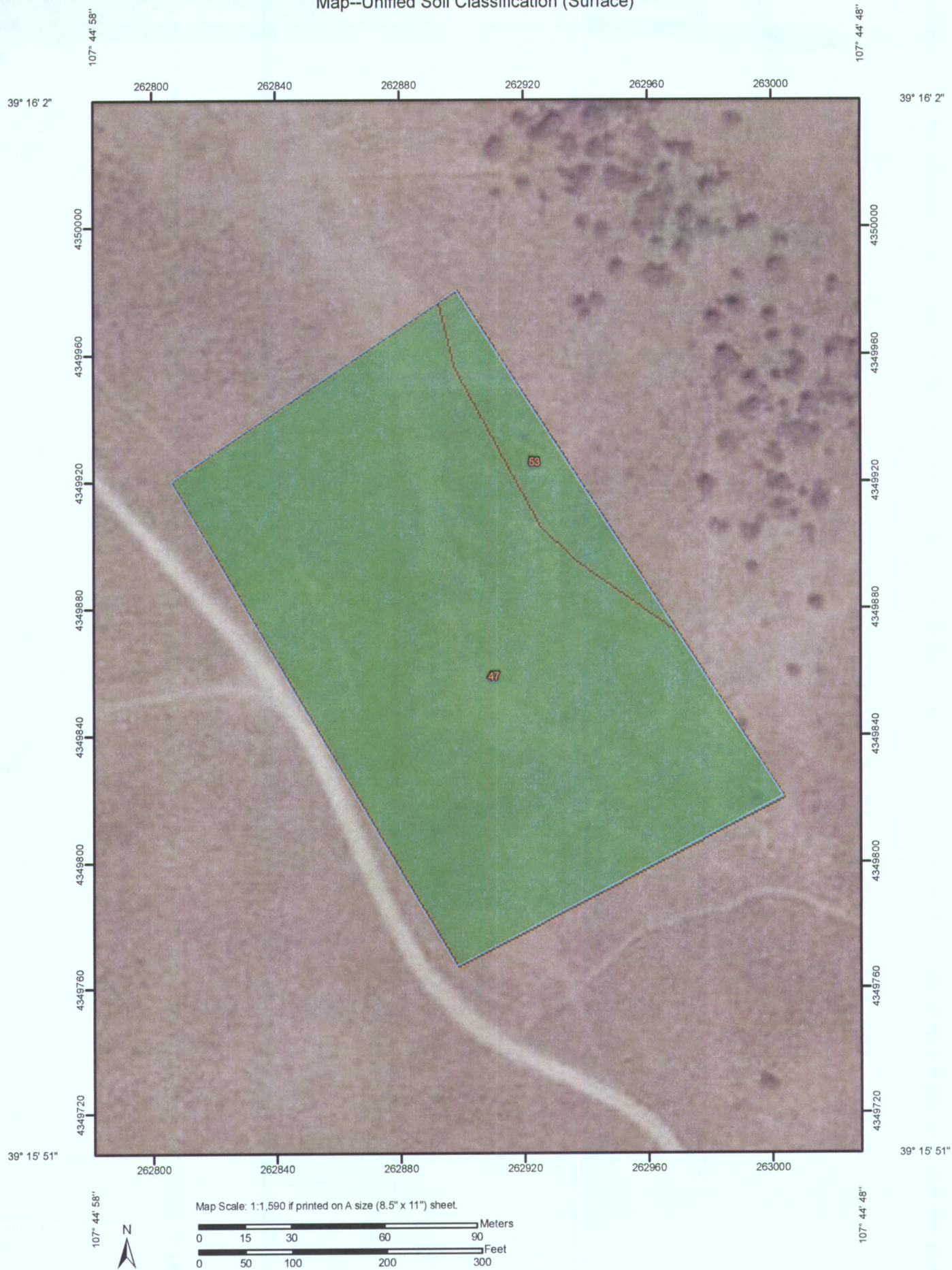
The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.



Custom Soil Resource Report  
Map--Unified Soil Classification (Surface)



# Custom Soil Resource Report

## MAP LEGEND



### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Units

### Soil Ratings

 CH  
 CL  
 CL-A (proposed)  
 CL-K (proposed)  
 CL-ML  
 CL-O (proposed)  
 CL-T (proposed)  
 GC  
 GC-GM  
 GM  
 GP  
 GP-GC  
 GP-GM  
 GW  
 GW-GC  
 GW-GM  
 MH  
 MH-A (proposed)  
 MH-K (proposed)  
 MH-O (proposed)  
 MH-T (proposed)

 ML  
 ML-A (proposed)  
 ML-K (proposed)  
 ML-O (proposed)  
 ML-T (proposed)  
 OH  
 OH-T (proposed)  
 OL  
 PT  
 SC  
 SC-SM  
 SM  
 SP  
 SP-SC  
 SP-SM  
 SW  
 SW-SC  
 SW-SM


 Not rated or not available

### Political Features

 Cities

### Water Features

 Oceans

 Streams and Canals

### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

## MAP INFORMATION

Map Scale: 1:1,590 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
 Coordinate System: UTM Zone 13N NAD83

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

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 Survey Area Data: Version 5, Feb 1, 2008

Date(s) aerial images were photographed: 8/29/2005

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**Table—Unified Soil Classification (Surface)**

Unified Soil Classification (Surface)— Summary by Map Unit — Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
47	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	CL	4.8	92.1%
53	Pagoda-Hesperus complex, 12 to 40 percent slopes	CL	0.4	7.9%
<b>Totals for Area of Interest</b>			<b>5.2</b>	<b>100.0%</b>

**Rating Options—Unified Soil Classification (Surface)**

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Lower

*Layer Options:* Surface Layer

**Water Features**

Water Features include ponding frequency, flooding frequency, and depth to water table.

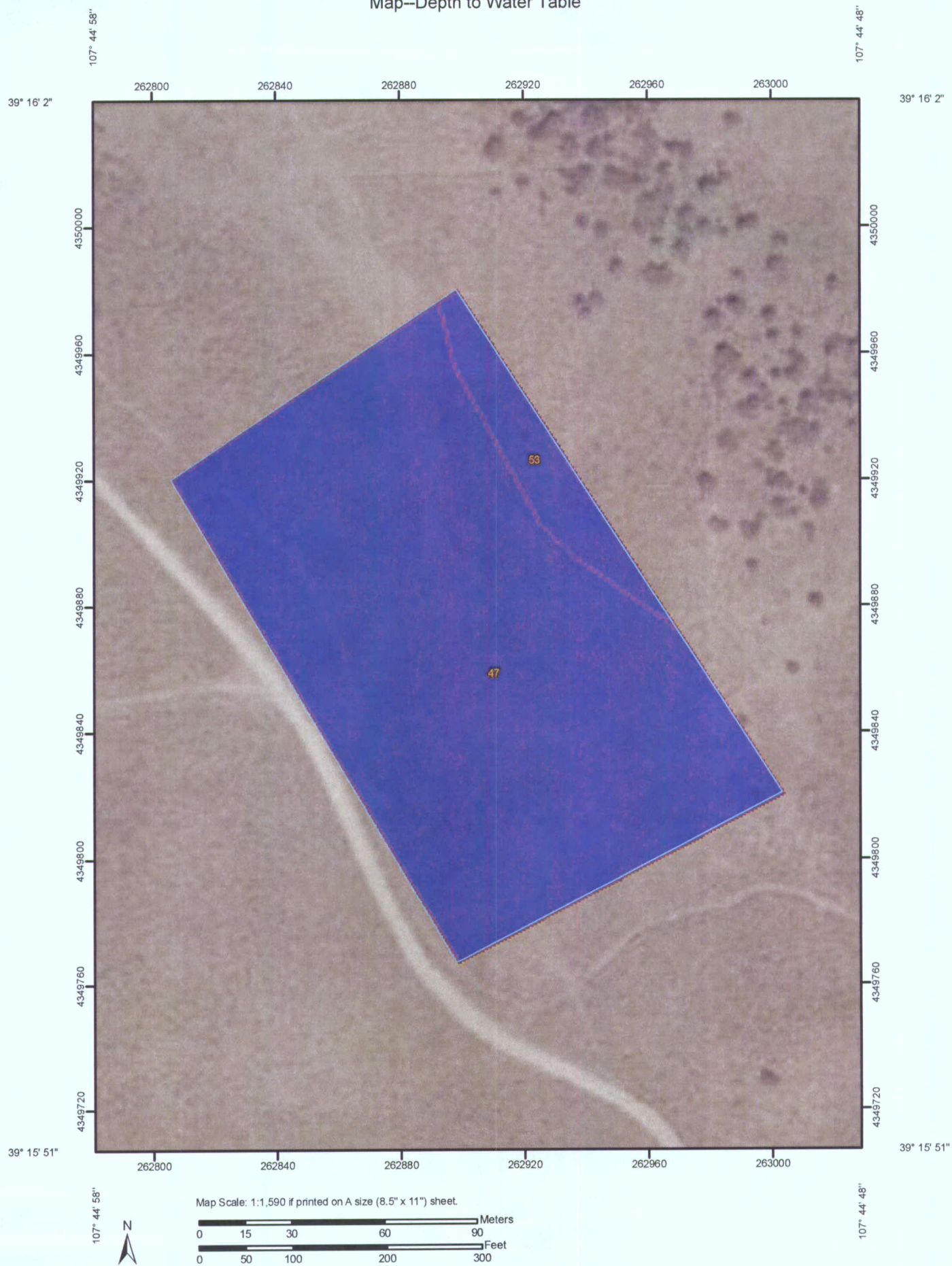
**Depth to Water Table**

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.




Custom Soil Resource Report  
Map-Depth to Water Table



## Custom Soil Resource Report

### MAP LEGEND

#### Area of Interest (AOI)

 Area of Interest (AOI)

#### Soils

 Soil Map Units

#### Soil Ratings

 0 - 25

 25 - 50


 50 - 100

 100 - 150

 150 - 200


 > 200

#### Political Features

 Cities

#### Water Features

 Oceans

 Streams and Canals

#### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### MAP INFORMATION

Map Scale: 1:1,590 if printed on A size (8.5" × 11") sheet.

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

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Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
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Survey Area Data: Version 5, Feb 1, 2008

Date(s) aerial images were photographed: 8/29/2005

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**Table—Depth to Water Table**

Depth to Water Table— Summary by Map Unit — Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties				
Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
47	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	>200	4.8	92.1%
53	Pagoda-Hesperus complex, 12 to 40 percent slopes	>200	0.4	7.9%
<b>Totals for Area of Interest</b>			<b>5.2</b>	<b>100.0%</b>



**Rating Options—Depth to Water Table**

*Units of Measure:* centimeters

*Aggregation Method:* Dominant Component

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Lower

*Interpret Nulls as Zero:* No

*Beginning Month:* January

*Ending Month:* December

## Ecological Site Assessment

Individual soil map unit components can be correlated to a particular ecological site. The Ecological Site Assessment section includes ecological site descriptions, plant growth curves, state and transition models, and selected National Plants database information.

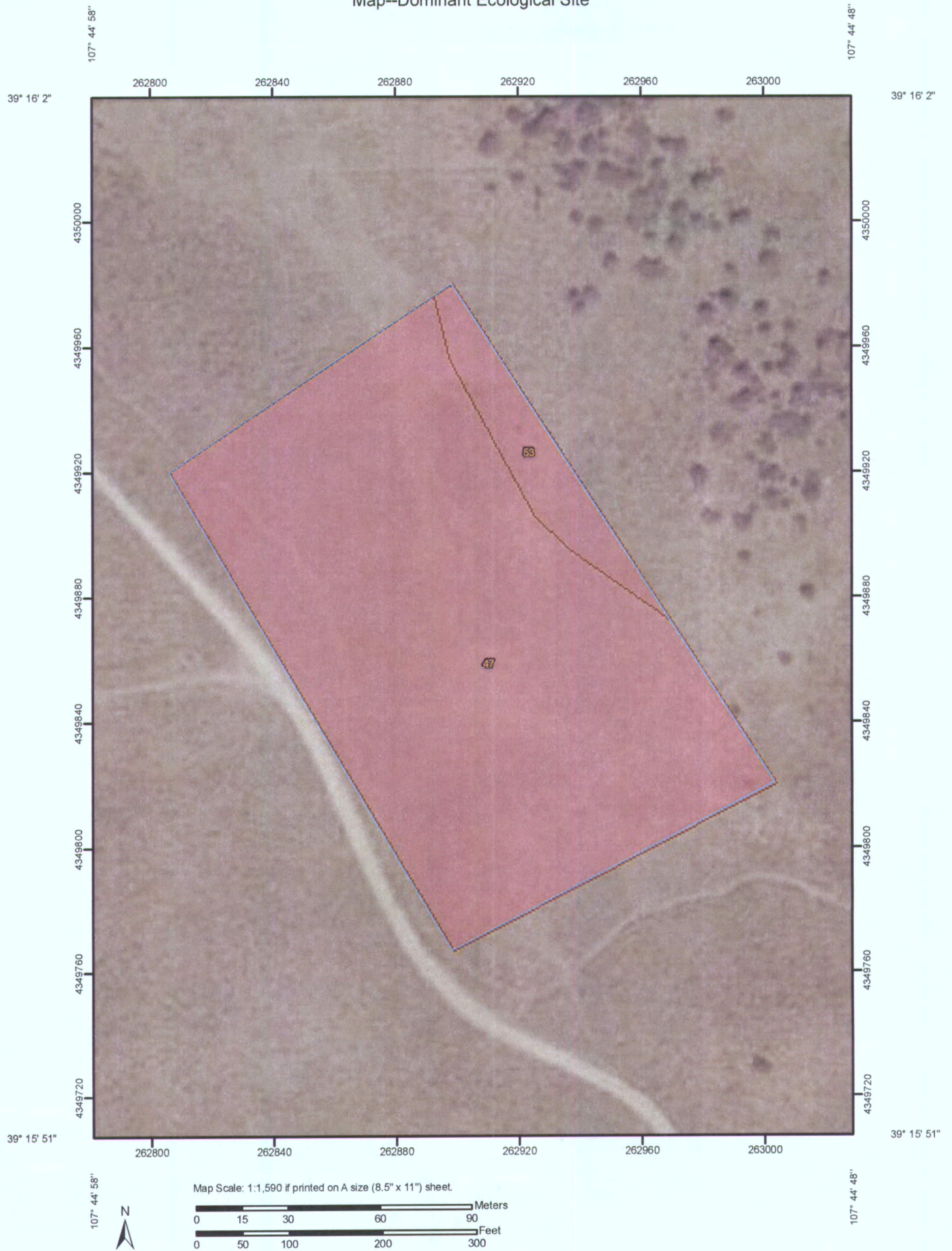
### All Ecological Sites — Rangeland

An "ecological site" is the product of all the environmental factors responsible for its development. It has characteristic soils that have developed over time; a characteristic hydrology, particularly infiltration and runoff, that has developed over time; and a characteristic plant community (kind and amount of vegetation). The vegetation, soils, and hydrology are all interrelated. Each is influenced by the others and influences the development of the others. For example, the hydrology of the site is influenced by development of the soil and plant community. The plant community on an ecological site is typified by an association of species that differs from that of other ecological sites in the kind and/or proportion of species or in total production.

An ecological site name provides a general description of a particular ecological site. For example, "Loamy Upland" is the name of a rangeland ecological site. An "ecological site ID" is the symbol assigned to a particular ecological site.

The map identifies the dominant ecological site for each map unit, aggregated by dominant condition. Other ecological sites may occur within each map unit. Each map unit typically consists of one or more components (soils and/or miscellaneous areas). Each soil component is associated with an ecological site. Miscellaneous areas, such as rock outcrop, sand dunes, and badlands, have little or no soil material and support little or no vegetation and therefore are not linked to an ecological site. The table below the map lists all of the ecological sites for each map unit component in your area of interest.

Custom Soil Resource Report  
Map--Dominant Ecological Site






## Custom Soil Resource Report

### MAP LEGEND

#### Area of Interest (AOI)

 Area of Interest (AOI)

#### Soils


 Soil Map Units

#### Soil Ratings

 R048AY238CO — Brushy Loam


 Not rated or not available

#### Political Features

 Cities

#### Water Features

 Oceans

 Streams and Canals

#### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### MAP INFORMATION

Map Scale: 1:1,590 if printed on A size (8.5" × 11") sheet.

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Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
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**Table—Ecological Sites by Map Unit Component**

Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties				
Map unit symbol	Component name (percent)	Ecological site	Acres in AOI	Percent of AOI
47	Hesperus (35%)	R048AY238CO — Brushy Loam	4.8	92.1%
	Empedrado, moist (30%)	R048AY238CO — Brushy Loam		
	Pagoda (20%)	R048AY238CO — Brushy Loam		
53	Pagoda (50%)	R048AY238CO — Brushy Loam	0.4	7.9%
	Hesperus (20%)	R048AY238CO — Brushy Loam		
<b>Totals for Area of Interest</b>			<b>5.2</b>	<b>100.0%</b>

## Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

## Building Site Development

This folder contains a collection of tabular reports that present soil interpretations related to building site development. The reports (tables) include all selected map units and components for each map unit, limiting features and interpretive ratings. Building site development interpretations are designed to be used as tools for evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its described condition and does not consider present land use. Example interpretations can include corrosion of concrete and steel, shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping.

## 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



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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]

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Dwellings and Small Commercial Buildings— Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties							
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
47—Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes							
Hesperus	35	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Shrink-swell	0.50	Shrink-swell	0.50	Shrink-swell	0.50
Empedrado, moist	30	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
Pagoda	20	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Shrink-swell	0.50	Shrink-swell	0.50	Shrink-swell	0.50
53—Pagoda-Hesperus complex, 12 to 40 percent slopes							
Pagoda	50	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Shrink-swell	0.50	Shrink-swell	0.50	Shrink-swell	0.50
Hesperus	20	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Shrink-swell	0.50	Shrink-swell	0.50	Shrink-swell	0.50

## Roads and Streets, Shallow Excavations, and Lawns and Landscaping

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 local roads and streets, shallow excavations, and lawns and landscaping.

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



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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).

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

*Lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established and maintained. Irrigation is not considered in the ratings. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer.

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—Roads and Streets, Shallow Excavations, and Lawns and Landscaping**

[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



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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]

Roads and Streets, Shallow Excavations, and Lawns and Landscaping– Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties							
Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
47—Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes							
Hesperus	35	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Low strength	1.00	Cutbanks cave	0.10		
		Shrink-swell	0.50				
		Frost action	0.50				
Empedrado, moist	30	Very limited		Very limited		Very limited	
		Slope	1.00	Cutbanks cave	1.00	Slope	1.00
		Frost action	0.50	Slope	1.00		
Pagoda	20	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Low strength	1.00	Cutbanks cave	0.10		
		Shrink-swell	0.50	Too clayey	0.03		
53—Pagoda-Hesperus complex, 12 to 40 percent slopes							
Pagoda	50	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Low strength	1.00	Cutbanks cave	0.10		
		Shrink-swell	0.50	Too clayey	0.03		
Hesperus	20	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Low strength	1.00	Cutbanks cave	0.10		
		Shrink-swell	0.50				
		Frost action	0.50				

## Land Classifications

This folder contains a collection of tabular reports that present a variety of soil groupings. The reports (tables) include all selected map units and components for each map unit. Land classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly

influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

## Prime and other Important Farmlands

This table lists the map units in the survey area that are considered important farmlands. Important farmlands consist of prime farmland, unique farmland, and farmland of statewide or local importance. This list does not constitute a recommendation for a particular land use.

In an effort to identify the extent and location of important farmlands, the Natural Resources Conservation Service, in cooperation with other interested Federal, State, and local government organizations, has inventoried land that can be used for the production of the Nation's food supply.

*Prime farmland* is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forestland, or other land, but it is not urban or built-up land or water areas. The soil quality, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. The water supply is dependable and of adequate quality. Prime farmland is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. Slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

For some of the soils identified in the table as prime farmland, measures that overcome a hazard or limitation, such as flooding, wetness, and droughtiness, are needed. Onsite evaluation is needed to determine whether or not the hazard or limitation has been overcome by corrective measures.

A recent trend in land use in some areas has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

*Unique farmland* is land other than prime farmland that is used for the production of specific high-value food and fiber crops, such as citrus, tree nuts, olives, cranberries, and other fruits and vegetables. It has the special combination of soil quality, growing season, moisture supply, temperature, humidity, air drainage, elevation, and aspect needed for the soil to economically produce sustainable high yields of these crops when properly managed. The water supply is dependable and of adequate quality. Nearness to markets is an additional consideration. Unique farmland is not based on



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national criteria. It commonly is in areas where there is a special microclimate, such as the wine country in California.

In some areas, land that does not meet the criteria for prime or unique farmland is considered to be *farmland of statewide importance* for the production of food, feed, fiber, forage, and oilseed crops. The criteria for defining and delineating farmland of statewide importance are determined by the appropriate State agencies. Generally, this land includes areas of soils that nearly meet the requirements for prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some areas may produce as high a yield as prime farmland if conditions are favorable. Farmland of statewide importance may include tracts of land that have been designated for agriculture by State law.

In some areas that are not identified as having national or statewide importance, land is considered to be *farmland of local importance* for the production of food, feed, fiber, forage, and oilseed crops. This farmland is identified by the appropriate local agencies. Farmland of local importance may include tracts of land that have been designated for agriculture by local ordinance.

### Report—Prime and other Important Farmlands

Prime and other Important Farmlands— Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties		
Map Symbol	Map Unit Name	Farmland Classification
47	Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes	Not prime farmland
53	Pagoda-Hesperus complex, 12 to 40 percent slopes	Not prime farmland

## Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

## Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

*Depth* to the upper and lower boundaries of each layer is indicated.

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."



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*Classification* of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

*Rock fragments* larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

*Liquid limit and plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

### References:

- American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.
- American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

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Engineering Properties— Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties												
Map unit symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	<i>In</i>				<i>Pct</i>	<i>Pct</i>					<i>Pct</i>	
47—Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes												
Hesperus	0-7	Loam	CL, CL-ML	A-4	0	0	100	100	85-95	60-75	25-30	5-10
	7-60	Clay loam, loam	CL	A-6	0	0	90-100	85-100	75-100	60-80	30-40	10-20
Empedrado, moist	0-10	Loam	CL, CL-ML	A-4	0	0	95-100	90-100	80-95	55-75	25-30	5-10
	10-21	Clay loam	CL	A-6	0	0	95-100	90-100	80-95	70-80	30-35	10-15
	21-28	Gravelly sandy clay loam	GC, GC-GM, SC, SC-SM	A-2, A-4, A-1	0	0	60-80	55-75	45-70	20-40	25-30	5-10
	28-60	Loam	CL-ML, CL	A-4	0	0	95-100	90-100	85-95	60-75	25-30	5-10
Pagoda	0-6	Clay loam	CL	A-6	0	0	100	100	95-100	70-80	30-35	10-15
	6-17	Clay loam	CL	A-6	0	0	100	100	95-100	70-80	30-35	10-15
	17-27	Clay loam, clay	CL	A-6, A-7	0	0	100	100	95-100	70-95	35-50	15-25
	27-60	Clay loam, clay	CL	A-6, A-7	0	0	95-100	90-100	85-100	65-95	30-50	10-25



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Engineering Properties— Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties												
Map unit symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	<i>In</i>				<i>Pct</i>	<i>Pct</i>					<i>Pct</i>	
53—Pagoda-Hesperus complex, 12 to 40 percent slopes												
Pagoda	0-6	Clay loam	CL	A-6	0	0	100	100	95-100	70-80	30-35	10-15
	6-17	Clay loam	CL	A-6	0	0	100	100	95-100	70-80	30-35	10-15
	17-27	Clay loam, clay	CL	A-7, A-6	0	0	100	100	95-100	70-95	35-50	15-25
	27-60	Clay loam, clay	CL	A-6, A-7	0	0	95-100	90-100	85-100	65-95	30-50	10-25
Hesperus	0-7	Loam	CL-ML, CL	A-4	0	0	100	100	85-95	60-75	25-30	5-10
	7-60	Clay loam, loam	CL	A-6	0	0	90-100	85-100	75-100	60-80	30-40	10-20



## Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Depth* to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

*Sand* as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

*Silt* as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

*Clay* as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (*K<sub>sat</sub>*), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

*Moist bulk density* is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Saturated hydraulic conductivity (*K<sub>sat</sub>*)* refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (*K<sub>sat</sub>*) is considered in the design of soil drainage systems and septic tank absorption fields.

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*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Linear extensibility* refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

*Erosion factors* are shown in the table as the K factor ( $K_w$  and  $K_f$ ) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and  $K_{sat}$ . Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor  $K_w$*  indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

*Erosion factor  $K_f$*  indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

*Wind erodibility index* is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion.



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There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

### Reference:

United States Department of Agriculture, Natural Resources Conservation Service.  
National soil survey handbook, title 430-VI. (<http://soils.usda.gov>)



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Physical Soil Properties— Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
47—Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes														
Hesperus	0-7	—	—	10-20	1.25-1.40	4.23-42.34	0.14-0.17	0.0-2.9	2.0-5.0	.20	.20	5	5	56
	7-60	—	—	20-35	1.25-1.40	1.41-4.23	0.17-0.20	3.0-5.9	1.0-2.0	.20	.20			
Empedrado, moist	0-10	—	—	18-27	1.25-1.40	4.23-14.11	0.16-0.18	0.0-2.9	2.0-4.0	.24	.24	5	6	48
	10-21	—	—	27-35	1.25-1.40	4.00-14.00	0.17-0.21	3.0-5.9	0.5-1.0	.24	.24			
	21-28	—	—	20-30	1.25-1.40	4.00-14.00	0.10-0.13	0.0-2.9	0.5-1.0	.10	.20			
	28-60	—	—	18-27	1.25-1.40	4.23-14.11	0.14-0.18	0.0-2.9	0.0-0.5	.43	.43			
Pagoda	0-6	—	—	27-35	1.25-1.40	1.41-4.23	0.17-0.21	3.0-5.9	2.0-3.0	.20	.20	5	6	48
	6-17	—	—	27-35	1.25-1.40	1.41-4.23	0.17-0.21	3.0-5.9	1.0-3.0	.20	.20			
	17-27	—	—	35-50	1.15-1.40	0.42-1.41	0.14-0.21	6.0-8.9	0.5-1.0	.32	.20			
	27-60	—	—	30-50	1.15-1.40	0.42-4.23	0.14-0.21	3.0-5.9	0.0-0.5	.20	.20			
53—Pagoda-Hesperus complex, 12 to 40 percent slopes														
Pagoda	0-6	—	—	27-35	1.25-1.40	1.41-4.23	0.17-0.21	3.0-5.9	2.0-3.0	.20	.20	5	6	48
	6-17	—	—	27-35	1.25-1.40	1.41-4.23	0.17-0.21	3.0-5.9	1.0-3.0	.20	.20			
	17-27	—	—	35-50	1.15-1.40	0.42-1.41	0.14-0.21	6.0-8.9	0.5-1.0	.32	.20			
	27-60	—	—	30-50	1.15-1.40	0.42-4.23	0.14-0.21	3.0-5.9	0.0-0.5	.20	.20			
Hesperus	0-7	—	—	10-20	1.25-1.40	4.23-42.34	0.14-0.17	0.0-2.9	2.0-5.0	.20	.20	5	5	56
	7-60	—	—	20-35	1.25-1.40	1.41-4.23	0.17-0.20	3.0-5.9	1.0-2.0	.20	.20			

## Soil Qualities and Features

This folder contains tabular reports that present various soil qualities and features. The reports (tables) include all selected map units and components for each map unit. Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

### 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



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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.



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Soil Features— Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties									
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
		<i>In</i>	<i>In</i>		<i>In</i>	<i>In</i>			
47—Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes									
Hesperus		—	—		0	—	Moderate	Moderate	Low
Empedrado, moist		—	—		0	—	Moderate	High	Low
Pagoda		—	—		0	—	Low	Moderate	Low
53—Pagoda-Hesperus complex, 12 to 40 percent slopes									
Pagoda		—	—		0	—	Low	Moderate	Low
Hesperus		—	—		0	—	Moderate	Moderate	Low

## Water Features

This folder contains tabular reports that present soil hydrology information. The reports (tables) include all selected map units and components for each map unit. Water Features include ponding frequency, flooding frequency, and depth to water table.

## Water Features

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

*Hydrologic soil groups* are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

*Surface runoff* refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

The *months* in the table indicate the portion of the year in which a water table, ponding, and/or flooding is most likely to be a concern.

*Water table* refers to a saturated zone in the soil. The water features table indicates, by month, depth to the top (*upper limit*) and base (*lower limit*) of the saturated zone in most years. Estimates of the upper and lower limits are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely



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grayish colors or mottles (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

*Ponding* is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. The table indicates *surface water depth* and the *duration* and *frequency* of ponding. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, rare, occasional, and frequent. *None* means that ponding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of ponding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of ponding is more than 50 percent in any year).

*Flooding* is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

*Duration* and *frequency* are estimated. Duration is expressed as *extremely brief* if 0.1 hour to 4 hours, *very brief* if 4 hours to 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. *None* means that flooding is not probable; *very rare* that it is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year); *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); *frequent* that it is likely to occur often under normal weather conditions (the chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year); and *very frequent* that it is likely to occur very often under normal weather conditions (the chance of flooding is more than 50 percent in all months of any year).

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.



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Water Features— Douglas-Plateau Area, Colorado, Parts of Garfield and Mesa Counties										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
47—Hesperus-Empedrado, moist-Pagoda complex 5 to 35 percent slopes										
Hesperus	B	Very high	Jan-Dec	—	—	—	—	None	—	—
Empedrado, moist	B	High	Jan-Dec	—	—	—	—	None	—	—
Pagoda	C	Very high	Jan-Dec	—	—	—	—	None	—	—
53—Pagoda-Hesperus complex, 12 to 40 percent slopes										
Pagoda	C	Very high	Jan-Dec	—	—	—	—	None	—	—
Hesperus	B	Very high	Jan-Dec	—	—	—	—	None	—	—

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