



United States
Department of
Agriculture



Natural
Resources
Conservation
Service



In cooperation with United
States Department of the
Interior, Bureau of Land
Management, and the
Montana Agricultural
Experiment Station

MT627—Soil Survey of Jefferson County Area and Part of Silver Bow County, Montana

Part II

The original maps and tables have been deleted from this online version. Since the soil survey's publication, more data on soil properties may have been collected, new interpretations developed, or existing interpretive criteria modified. Maps and current data tables can be accessed through the Web Soil Survey (<http://websoilsurvey.nrcs.usda.gov/app/>).

How to Use This Soil Survey

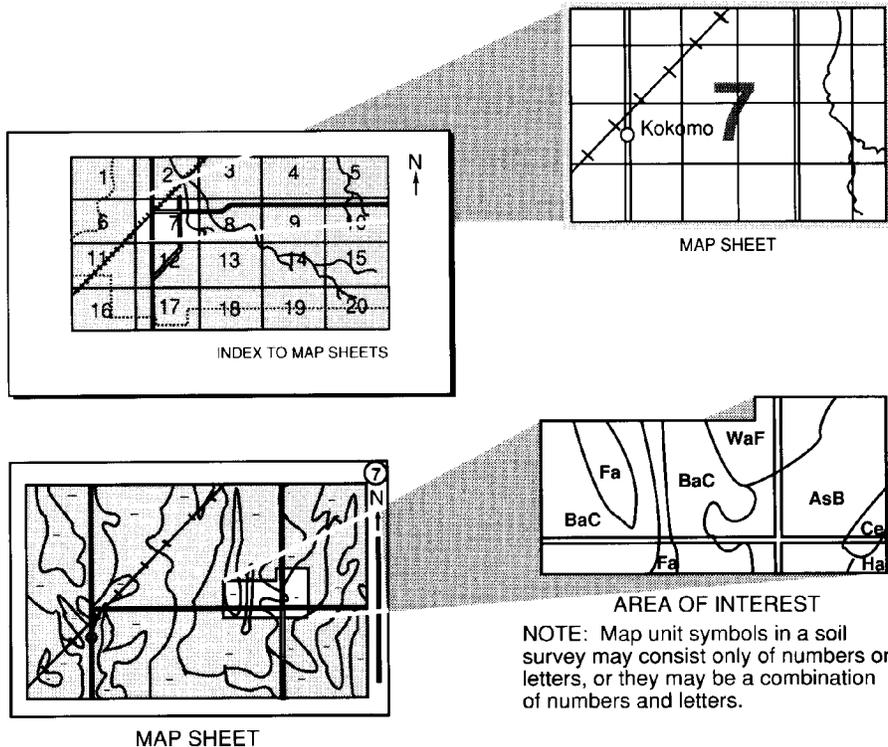
Detailed Soil Maps

The detailed soil maps can be useful in planning the use and management of small areas.

To find information about your area of interest, you can locate the Section, Township, and Range by zooming in on the **Index to Map Sheets**, or you can go to the Web Soil Survey at (<http://websoilsurvey.nrcs.usda.gov/app/>).

Note the map unit symbols that are in that area. The **Contents** lists the map units by symbol and name and shows the page where each map unit is described.

See the Contents for sections of this publication that may address your specific needs.



This soil survey is a publication 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 agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1996. Soil names and descriptions were approved in 1998. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1998. This survey was made cooperatively by the Natural Resources Conservation Service; the United States Department of the Interior, Bureau of Land Management; and the Montana Agricultural Experiment Station. It is part of the technical assistance furnished to the Jefferson Valley Conservation District and the Mile High Conservation District.

The most current official data are available through the NRCS Soil Data Mart website at <http://soildatamart.nrcs.usda.gov>. Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

The United States Department of Agriculture (USDA) prohibits discrimination in all of its programs on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact the USDA's TARGET Center at 202-720-2600 (voice or TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326W, Whitten Building, 14th and Independence Avenue SW, Washington, DC 20250-9410, or call 202-720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.

Cover: A view of the Boulder River valley. Wetsand soils are in the foreground, and Bull Mountain is in the background.

Additional information about the Nation's natural resources is available online from the Natural Resources Conservation Service at <http://www.nrcs.usda.gov>.

Contents

How To Use This Soil Survey	3	General Land Management	629
Detailed Soil Map Unit Legend	6	Engineering	695
Introduction to Part II	23	Building Site Development	695
Agronomy	51	Waste Management	696
Crops and Pasture	51	Construction Materials	696
Cropland Limitations and Hazards	51	Water Management	697
Crop Yield Estimates	53	Soil Properties	1087
Land Capability Classification	53	Engineering Index Properties	1087
Important Farmland	54	Physical Properties	1088
Erosion Factors	55	Chemical Properties	1089
Rangeland	313	Water Features	1090
Forest Land	545	Soil Features	1091
Forest Land Productivity	545	References	2023
Forest Access Roads	545	Glossary	2025

Issued 2003

For tables with the most current data, please visit the
Soil Data Mart at <http://soildatamart.nrcs.usda.gov/>.

Detailed Soil Map Unit Legend

- 1—Riverwash
- 2—Rubble land-Rock outcrop association
- 3—Dumps, mine
- 4—Bronec, Clunton, channeled, and Amesha soils, 0 to 8 percent slopes
- 5—Borrow areas and gravel pits
- 6—Wetsand, Cardwell, and Clunton soils, 0 to 2 percent slopes, channeled
- 9—Bronec, Riverrun, channeled, and Amesha soils, 0 to 8 percent slopes
- 11B—Amesha silt loam, 1 to 4 percent slopes
- 11C—Amesha silt loam, 4 to 8 percent slopes
- 11D—Amesha silt loam, 8 to 15 percent slopes
- 13A—Anamac loam, 0 to 2 percent slopes
- 13C—Anamac loam, 2 to 8 percent slopes
- 18A—Brocko silt loam, 0 to 2 percent slopes
- 18C—Brocko silt loam, 2 to 8 percent slopes
- 18D—Brocko silt loam, 8 to 15 percent slopes
- 18E—Brocko silt loam, 15 to 35 percent slopes
- 20C—Windham gravelly loam, 2 to 8 percent slopes
- 20D—Windham gravelly loam, 8 to 15 percent slopes
- 20E—Windham very gravelly loam, 15 to 35 percent slopes
- 21A—Mckenton silty clay loam, 0 to 2 percent slopes
- 22C—Zatony clay loam, 2 to 8 percent slopes
- 23A—Mckenton silt loam, 0 to 2 percent slopes
- 25C—Cozberg sandy loam, 2 to 8 percent slopes
- 26C—Crago gravelly loam, 2 to 8 percent slopes
- 26D—Crago gravelly loam, 8 to 15 percent slopes
- 26E—Crago gravelly loam, 15 to 25 percent slopes
- 27A—Bronec gravelly loam, 0 to 2 percent slopes
- 27C—Bronec gravelly loam, 2 to 8 percent slopes
- 27D—Bronec gravelly loam, 8 to 15 percent slopes
- 27E—Bronec gravelly loam, 15 to 35 percent slopes
- 30A—Dougcliff mucky peat, 0 to 1 percent slopes
- 32A—Fairway silt loam, 0 to 2 percent slopes
- 33E—Geohrock cobbly clay loam, 15 to 35 percent slopes, stony
- 37A—Pieriver silt loam, 0 to 2 percent slopes
- 38C—Kalsted sandy loam, 2 to 8 percent slopes
- 38D—Kalsted sandy loam, 8 to 15 percent slopes
- 40A—Moltoner loam, 0 to 2 percent slopes
- 41—Bronec, Amesha, and Riverrun, channeled, soils, 0 to 35 percent slopes
- 42D—Perma cobbly loam, 4 to 15 percent slopes, stony
- 42E—Perma cobbly loam, 15 to 25 percent slopes, stony
- 47A—Cardwell silty clay loam, 0 to 2 percent slopes
- 48A—Riverrun sandy loam, 0 to 2 percent slopes
- 52A—Ryell loam, 0 to 2 percent slopes
- 53C—Sappington gravelly clay loam, 2 to 8 percent slopes
- 56A—Trudau loam, 0 to 2 percent slopes
- 56B—Trudau loam, 2 to 8 percent slopes
- 60C—Watne loam, 2 to 8 percent slopes
- 64A—Varney sandy clay loam, 0 to 2 percent slopes
- 64C—Varney sandy clay loam, 2 to 8 percent slopes
- 65C—Judell loam, 2 to 8 percent slopes
- 68D—Bondoe channery loam, 4 to 15 percent slopes
- 69A—Meadowcreek silty clay loam, 0 to 2 percent slopes
- 71C—Raghorn sandy loam, 4 to 8 percent slopes
- 71D—Raghorn sandy loam, 8 to 15 percent slopes
- 72F—Zbart-Rock outcrop association, 25 to 70 percent slopes
- 73C—Martinsdale loam, 2 to 8 percent slopes
- 74D—Shawmut gravelly loam, 4 to 15 percent slopes, bouldery
- 75C—Sixbeacon loam, 2 to 8 percent slopes
- 76A—Absay silty clay loam, 0 to 4 percent slopes
- 77F—Rock outcrop-Pensore, stony-Crago, stony, association, 25 to 60 percent slopes
- 79A—Chinook sandy loam, 0 to 2 percent slopes
- 79C—Chinook sandy loam, 2 to 8 percent slopes
- 79D—Chinook sandy loam, 8 to 15 percent slopes
- 79E—Chinook sandy loam, 15 to 25 percent slopes
- 80A—Floweree silt loam, 0 to 2 percent slopes
- 80C—Floweree silt loam, 2 to 8 percent slopes
- 81A—Ethridge clay loam, 0 to 2 percent slopes
- 81C—Ethridge clay loam, 2 to 8 percent slopes
- 82C—Rothiemay very gravelly loam, 2 to 8 percent slopes
- 83C—Shoddy silty clay loam, 2 to 8 percent slopes
- 83D—Shoddy silty clay loam, 8 to 15 percent slopes
- 84A—Clunton-Faith-Dougcliff complex, 1 to 4 percent slopes
- 85D—Walbert coarse sandy loam, 4 to 15 percent slopes

-
- 87C—Kobarter clay loam, 2 to 8 percent slopes
87D—Kobarter clay loam, 8 to 15 percent slopes
88C—Lahood loam, 2 to 8 percent slopes
88D—Lahood loam, 8 to 15 percent slopes
92D—Clunton, Cometcrik, and Perma, stony, soils, 0 to 15 percent slopes
99D—Libeg gravelly loam, 4 to 15 percent slopes, bouldery
99E—Libeg very gravelly loam, 15 to 35 percent slopes, bouldery
113C—Amesha-Amesha, stony, complex, 2 to 8 percent slopes
113D—Amesha-Amesha, stony, complex, 8 to 15 percent slopes
114D—Amesha-Crago-Shoddy complex, 4 to 15 percent slopes
114E—Amesha-Crago-Shoddy complex, 15 to 45 percent slopes
115A—Amesha gravelly loam, 0 to 2 percent slopes
115C—Amesha gravelly loam, 2 to 8 percent slopes
115D—Amesha gravelly loam, 8 to 15 percent slopes
115E—Amesha gravelly loam, 15 to 35 percent slopes
116A—Amesha loam, 0 to 2 percent slopes
116C—Amesha loam, 2 to 8 percent slopes
116D—Amesha loam, 8 to 15 percent slopes
117E—Amesha-Cabbart-Bronec cobbly loams, 4 to 25 percent slopes
118C—Amesha cobbly loam, 2 to 8 percent slopes
121E—Maiden-Lap-Rock outcrop complex, 15 to 35 percent slopes
121F—Maiden-Lap-Rock outcrop complex, 35 to 60 percent slopes
122D—Maiden-Lap-Windham complex, 4 to 15 percent slopes
122E—Maiden-Lap-Windham complex, 15 to 35 percent slopes
122F—Maiden-Lap-Windham complex, 35 to 60 percent slopes
123E—Maiden, very stony-Rock outcrop-Lap, very stony, complex, 8 to 35 percent slopes
123F—Maiden, very stony-Rock outcrop-Lap, very stony, complex, 35 to 60 percent slopes
125D—Maiden-Lap-Windham complex, 4 to 15 percent slopes, warm
125E—Maiden-Lap-Windham complex, 15 to 35 percent slopes, warm
126F—Maiden, very stony-Rock outcrop-Lap, very stony, complex, 35 to 60 percent slopes, warm
132A—Anamac silt loam, 0 to 2 percent slopes, saline
151D—Delpoint-Abor complex, 4 to 15 percent slopes
171D—Branham-Opitz-Tuggle complex, 2 to 15 percent slopes
171E—Branham-Opitz-Tuggle complex, 15 to 35 percent slopes
172D—Branham-Clugulch-Rock outcrop complex, 2 to 15 percent slopes
172E—Branham-Clugulch-Rock outcrop complex, 15 to 35 percent slopes
173F—Branham, stony-Tuggle, very stony-Rock outcrop complex, 35 to 60 percent slopes
182D—Brocko-Amesha complex, 4 to 15 percent slopes
183E—Brocko-Rock outcrop-Rencot complex, 8 to 35 percent slopes
184E—Brocko-Rock outcrop-Bronec, very stony, complex, 15 to 45 percent slopes
191C—Cabbart-Shoddy-Amesha complex, 2 to 8 percent slopes
191D—Cabbart-Shoddy-Amesha complex, 8 to 15 percent slopes
191E—Cabbart-Shoddy-Amesha complex, 15 to 45 percent slopes
192C—Cabbart clay loam, 2 to 8 percent slopes
193E—Cabbart-Haxby loams, 8 to 45 percent slopes
194E—Cabbart-Bronec, stony-Rencot, very stony, complex, 8 to 25 percent slopes
195E—Cabbart, very stony-Bronec, stony-Rock outcrop complex, 8 to 35 percent slopes
195F—Cabbart, very stony-Rock outcrop-Bronec, very stony, complex, 25 to 60 percent slopes
201E—Windham-Rock outcrop-Lap, very stony, complex, 8 to 35 percent slopes
201F—Windham, very stony-Rock outcrop-Lap, very stony, complex, 35 to 70 percent slopes
202D—Windham-Judell complex, 8 to 15 percent slopes
202E—Windham-Judell complex, 15 to 35 percent slopes

-
- 203D—Windham gravelly loam, 4 to 15 percent slopes, stony
- 203E—Windham gravelly loam, 15 to 35 percent slopes, stony
- 204D—Windham-Maiden-Lap complex, 4 to 15 percent slopes
- 204E—Windham, stony-Maiden, very stony-Lap, very stony, complex, 15 to 35 percent slopes
- 204F—Windham, very stony-Maiden, very stony-Rock outcrop complex, 25 to 60 percent slopes
- 205E—Windham very cobbly loam, 4 to 35 percent slopes, very stony
- 205F—Windham very cobbly loam, 35 to 60 percent slopes, very stony
- 206F—Windham-Windham, stony, complex, 35 to 70 percent slopes
- 207E—Windham, stony-Lap, very stony-Rock outcrop complex, 15 to 35 percent slopes
- 207F—Windham, stony-Lap, very stony-Rock outcrop complex, 35 to 70 percent slopes
- 208D—Windham-Judell gravelly loams, 8 to 25 percent slopes, stony
- 211A—Clunton silty clay loam, 0 to 2 percent slopes
- 221A—Zatony clay loam, 0 to 2 percent slopes, wet
- 231A—Ledger-Moltoner-Mckenton complex, 0 to 2 percent slopes
- 232A—Clunton-Wetsand-Bonebasin complex, 0 to 2 percent slopes
- 233A—Ledger-Wetsand, saline, complex, 0 to 2 percent slopes
- 241E—Whitlash, very stony-Rock outcrop-Perma, stony, complex, 2 to 25 percent slopes
- 241F—Whitlash, very stony-Rock outcrop-Perma, very stony, complex, 25 to 60 percent slopes
- 245E—Tolbert, very stony-Rock outcrop-Absarook, stony, complex, 8 to 35 percent slopes
- 251B—Cozberg sandy loam, 1 to 4 percent slopes, stony
- 251D—Cozberg sandy loam, 4 to 15 percent slopes, stony
- 261D—Crago-Brocko complex, 4 to 15 percent slopes
- 261E—Crago-Brocko complex, 15 to 60 percent slopes
- 263D—Crago-Rock outcrop-Pensore complex, 4 to 25 percent slopes
- 263F—Crago, stony-Rock outcrop-Pensore, stony, complex, 25 to 60 percent slopes
- 264C—Crago-Amesha complex, 2 to 8 percent slopes
- 264D—Crago-Amesha complex, 8 to 15 percent slopes
- 264E—Crago-Amesha complex, 15 to 35 percent slopes
- 264F—Crago-Amesha complex, 35 to 60 percent slopes
- 265B—Crago gravelly loam, 1 to 4 percent slopes, stony
- 265D—Crago gravelly loam, 4 to 15 percent slopes, stony
- 265E—Crago very cobbly loam, 15 to 45 percent slopes, very stony
- 266D—Crago, stony-Crago complex, 4 to 15 percent slopes
- 266E—Crago, stony-Crago complex, 15 to 45 percent slopes
- 267F—Crago, very stony-Pensore, stony-Rock outcrop complex, 25 to 60 percent slopes
- 268C—Crago-Amesha cobbly loams, 2 to 8 percent slopes
- 269D—Crago, very stony, and Crago, rubbly, soils, 2 to 15 percent slopes
- 271C—Bronec-Amesha complex, 2 to 8 percent slopes
- 271D—Bronec-Amesha complex, 8 to 15 percent slopes
- 271E—Bronec-Amesha complex, 15 to 35 percent slopes
- 271F—Bronec-Amesha-Rock outcrop complex, 35 to 60 percent slopes
- 272E—Bronec-Geohrock-Rock outcrop complex, 15 to 45 percent slopes
- 273D—Bronec-Shoddy-Amesha complex, 4 to 15 percent slopes
- 273E—Bronec-Shoddy-Amesha complex, 15 to 35 percent slopes
- 274A—Bronec complex, 0 to 2 percent slopes
- 274C—Bronec complex, 2 to 8 percent slopes
- 274D—Bronec complex, 8 to 15 percent slopes
- 274E—Bronec-Bronec, very stony, complex, 15 to 45 percent slopes

-
- 275A—Bronec gravelly loam, 1 to 4 percent slopes, stony
- 275D—Bronec very gravelly loam, 4 to 15 percent slopes, very stony
- 275E—Bronec very gravelly loam, 15 to 35 percent slopes, very stony
- 276C—Bronec gravelly loam, 2 to 8 percent slopes, saline
- 277C—Bronec-Amesha cobbly loams, 2 to 8 percent slopes
- 278E—Bronec-Rencot-Rock outcrop complex, 15 to 45 percent slopes
- 291C—Sieben complex, 2 to 8 percent slopes
- 292C—Sieben-Varney cobbly loams, 2 to 8 percent slopes
- 293D—Sieben cobbly loam, 4 to 15 percent slopes, stony
- 294C—Sieben, stony-Sieberell, very stony, complex, 2 to 15 percent slopes
- 295D—Sieben cobbly loam, 4 to 15 percent slopes, bouldery
- 296D—Sieberell-Sieben-Beaverell complex, 4 to 15 percent slopes, stony
- 297D—Sieben, very stony-Sieben, rubbly, complex, 2 to 25 percent slopes
- 297F—Sieben, rubbly-Sieben, very stony, complex, 15 to 60 percent slopes
- 311D—Beenom, stony-Wimper-Whitlash, very stony, complex, 4 to 15 percent slopes
- 311F—Beenom, stony-Wimper-Whitlash, very stony, complex, 15 to 45 percent slopes
- 321A—Fairway-Meadowcreek complex, 0 to 2 percent slopes
- 322A—Fairway loam, 0 to 2 percent slopes
- 323A—Fairway-Mckenton silt loams, 0 to 2 percent slopes
- 324A—Fairway clay loam, 0 to 2 percent slopes
- 325A—Fairway-Nestley clay loams, 0 to 2 percent slopes
- 326A—Fairway-Moltoner complex, 0 to 2 percent slopes
- 327A—Faith loam, 0 to 2 percent slopes
- 328A—Faith loam, 0 to 2 percent slopes, cool
- 329C—Faith-Slickens complex, 0 to 8 percent slopes, impacted
- 331C—Geohrock-Bronec gravelly loams, 2 to 8 percent slopes
- 331D—Geohrock-Bronec gravelly loams, 8 to 15 percent slopes
- 332D—Geohrock-Sappington complex, 4 to 15 percent slopes, stony
- 334D—Geohrock, stony-Bronec, very stony, complex, 4 to 15 percent slopes
- 341A—Pieriver-Cardwell-Riverrun loams, 0 to 2 percent slopes
- 342A—Handke fine sandy loam, 0 to 2 percent slopes
- 361D—Udecide-Varney-Walbert complex, 4 to 25 percent slopes
- 362C—Udecide-Varney sandy clay loams, 2 to 8 percent slopes
- 371A—Havre-Ryell-Handke complex, 0 to 2 percent slopes
- 372A—Havre loam, 0 to 2 percent slopes
- 381C—Kalsted gravelly sandy loam, 2 to 8 percent slopes
- 382D—Kalsted gravelly sandy loam, 4 to 15 percent slopes, stony
- 391C—Musselshell-Crago gravelly loams, 2 to 8 percent slopes
- 394B—Musselshell-Crago cobbly loams, 1 to 4 percent slopes
- 401A—Moltoner silty clay loam, 0 to 2 percent slopes
- 411A—Nestley loam, 0 to 2 percent slopes
- 413A—Nestley-Riverrun-Pieriver complex, 0 to 2 percent slopes
- 421E—Perma, stony-Whitlash, very stony, complex, 15 to 35 percent slopes
- 421F—Perma-Whitlash complex, 35 to 60 percent slopes, very stony
- 422F—Perma, very stony-Whitlash, very stony-Rock outcrop complex, 15 to 45 percent slopes, moist
- 423C—Wimper loam, 2 to 8 percent slopes
- 423D—Wimper loam, 8 to 15 percent slopes
- 423E—Wimper loam, 15 to 35 percent slopes
- 424D—Wimper-Wimper, stony, complex, 4 to 15 percent slopes
- 424E—Wimper-Wimper, stony, complex, 15 to 35 percent slopes
- 425E—Wimper gravelly loam, 8 to 35 percent slopes, stony

-
- 426F—Wimper-Whitlash association, 35 to 60 percent slopes
- 427E—Perma-Whitlash complex, 15 to 35 percent slopes, bouldery
- 429E—Perma, very stony-Perma, rubbly-Rock outcrop complex, 8 to 35 percent slopes
- 441F—Warneke-Warneke, very stony-Rock outcrop association, 8 to 60 percent slopes
- 451A—Geohrock cobbly clay loam, 1 to 4 percent slopes, stony
- 461D—Absarook-Beenom complex, 2 to 15 percent slopes
- 471A—Cardwell-Pieriver complex, 0 to 2 percent slopes
- 481A—Riverrun gravelly sandy loam, 0 to 2 percent slopes
- 482A—Riverrun-Cardwell complex, 0 to 2 percent slopes
- 483A—Riverrun, Handke, and Ryell soils, 0 to 2 percent slopes, channeled
- 492D—Roto-Pensore-Crago complex, 4 to 15 percent slopes
- 492E—Roto-Pensore-Crago complex, 15 to 35 percent slopes
- 492F—Roto-Pensore-Crago complex, 35 to 60 percent slopes, stony
- 493D—Pensore-Rock outcrop-Roto complex, 2 to 25 percent slopes
- 511C—Haxby-Amesha-Rencot complex, 4 to 15 percent slopes
- 521A—Cardwell-Riverrun complex, 0 to 2 percent slopes
- 522A—Ryell-Riverrun complex, 0 to 2 percent slopes
- 523A—Cardwell-Riverrun-Pieriver complex, 0 to 2 percent slopes
- 524A—Cardwell loam, 0 to 2 percent slopes
- 525A—Cardwell-Riverrun complex, 0 to 2 percent slopes, saline
- 531C—Sappington very cobbly clay loam, 2 to 8 percent slopes
- 532C—Sappington-Amesha complex, 2 to 8 percent slopes
- 533A—Sappington clay loam, 0 to 2 percent slopes
- 533C—Sappington clay loam, 2 to 8 percent slopes
- 533D—Sappington clay loam, 8 to 15 percent slopes
- 534C—Sappington-Geohrock complex, 2 to 8 percent slopes
- 534D—Sappington-Geohrock complex, 8 to 15 percent slopes
- 536A—Sappington-Amesha complex, 0 to 2 percent slopes
- 537B—Sappington loam, 1 to 4 percent slopes, stony
- 537D—Sappington loam, 4 to 15 percent slopes, stony
- 538C—Sappington gravelly loam, 2 to 8 percent slopes
- 539B—Sappington-Amesha complex, 2 to 8 percent slopes, cobbly
- 539C—Sappington-Amesha complex, 2 to 8 percent slopes, stony
- 541D—Whitlash, very stony-Brickner, stony-Rock outcrop complex, 4 to 25 percent slopes
- 541E—Whitlash, very stony-Brickner, stony-Rock outcrop complex, 25 to 60 percent slopes
- 551E—Brickner, stony-Whitlash, very stony-Rock outcrop complex, 35 to 60 percent slopes
- 552F—Brickner, very bouldery-Rock outcrop-Tolbert, very bouldery, association, 25 to 60 percent slopes
- 553F—Brickner, very stony-Wickes, very bouldery-Rock outcrop complex, 15 to 60 percent slopes
- 554F—Brickner, very stony-Rock outcrop-Mocmont, stony, complex, 25 to 60 percent slopes
- 562C—Trudau-Bronec, saline, complex, 2 to 8 percent slopes
- 564C—Trudau-Benz clay loams, 2 to 8 percent slopes
- 581E—Whitecow, stony-Warneke, very stony-Rock outcrop complex, 8 to 35 percent slopes
- 581F—Whitecow, very stony-Warneke, very stony-Rock outcrop complex, 35 to 70 percent slopes
- 582E—Whitecow, bouldery-Shawmut, very bouldery-Rock outcrop complex, 15 to 45 percent slopes, warm
- 583E—Whitecow-Warneke complex, 8 to 35 percent slopes
- 584F—Whitecow-Whitecow, stony-Warneke complex, 25 to 60 percent slopes
- 585E—Whitecow, bouldery-Shawmut, very bouldery-Rock outcrop complex, 15 to 45 percent slopes

-
- 591F—Windham-Rock outcrop-Warneke complex, 35 to 60 percent slopes
- 631D—Rencot-Rock outcrop-Rencot, stony, complex, 8 to 25 percent slopes
- 631E—Rencot-Rencot, very stony-Rock outcrop complex, 25 to 60 percent slopes
- 631F—Rencot-Bronec-Rock outcrop complex, 35 to 70 percent slopes
- 632C—Rencot-Lahood-Rock outcrop complex, 2 to 8 percent slopes
- 632D—Rencot-Lahood-Rock outcrop complex, 8 to 25 percent slopes
- 632E—Rencot, very stony-Lahood, stony-Rock outcrop complex, 25 to 45 percent slopes
- 633D—Rencot, very stony-Bronec, very stony-Rock outcrop complex, 4 to 25 percent slopes
- 634E—Rencot, very stony-Rock outcrop-Bronec, very stony, complex, 25 to 45 percent slopes
- 641C—Varney gravelly loam, 2 to 8 percent slopes
- 642C—Varney clay loam, 2 to 8 percent slopes
- 642D—Varney clay loam, 8 to 15 percent slopes
- 643A—Varney cobbly loam, 0 to 2 percent slopes
- 643C—Varney cobbly loam, 2 to 8 percent slopes
- 644C—Varney complex, 2 to 15 percent slopes, gullied
- 645B—Varney-Sieben complex, 1 to 4 percent slopes, stony
- 645D—Varney, stony-Sieben, very stony, complex, 4 to 15 percent slopes
- 645E—Varney, stony-Sieben, very stony, complex, 15 to 35 percent slopes
- 646C—Varney loam, 2 to 8 percent slopes, stony
- 651C—Judell gravelly loam, 2 to 8 percent slopes
- 652C—Judell cobbly loam, 2 to 8 percent slopes
- 655C—Judell gravelly loam, 2 to 8 percent slopes, warm
- 662B—Judell gravelly loam, 1 to 4 percent slopes, very stony
- 691A—Meadowcreek, Clunton, and Cardwell soils, 0 to 2 percent slopes, channeled
- 692A—Meadowcreek-Nestley-Riverrun complex, 0 to 2 percent slopes
- 713E—Raghorn-Ethridge-Kalsted complex, 15 to 35 percent slopes
- 713F—Raghorn-Ethridge-Kalsted complex, 35 to 70 percent slopes
- 721E—Zbart-Bondoe-Brocko complex, 4 to 25 percent slopes
- 731C—Martinsdale, stony-Martinsdale-Hilger complex, 2 to 8 percent slopes
- 732D—Martinsdale-Shawmut, stony-Martinsdale, bouldery, complex, 4 to 25 percent slopes
- 734D—Martinsdale loam, 4 to 15 percent slopes, very stony
- 735C—Martinsdale-Absarook-Whitlash complex, 2 to 8 percent slopes, stony
- 736C—Martinsdale-Work complex, 2 to 8 percent slopes
- 742E—Shawmut, stony-Martinsdale, very stony, complex, 4 to 25 percent slopes
- 744E—Shawmut, bouldery-Shawmut, stony-Tolbert, bouldery, complex, 15 to 35 percent slopes
- 745D—Shawmut-Wickes-Gnojek complex, 2 to 15 percent slopes, bouldery
- 745E—Shawmut, bouldery-Shawmut, very bouldery-Tolbert, bouldery, complex, 15 to 45 percent slopes, dry
- 746E—Shawmut-Tolbert complex, 8 to 35 percent slopes
- 747E—Shawmut, stony-Tolbert, very stony, complex, 15 to 35 percent slopes
- 748E—Shawmut, stony-Wickes, very stony, complex, 15 to 45 percent slopes
- 751C—Sixbeacon gravelly sandy loam, 2 to 8 percent slopes
- 752B—Sixbeacon-Vendome complex, 1 to 4 percent slopes
- 753C—Sixbeacon-Cozberg complex, 2 to 8 percent slopes
- 754D—Sixbeacon-Cozberg, stony, complex, 4 to 15 percent slopes
- 755A—Vendome very cobbly loam, 0 to 4 percent slopes, very stony
- 773F—Rock outcrop-Pensore association, 15 to 60 percent slopes
- 774F—Rock outcrop-Whitlash, bouldery, association, 35 to 70 percent slopes

-
- 775F—Rock outcrop-Lap-Lap, very stony, association, 15 to 70 percent slopes
- 776D—Rock outcrop-Devilfence association, 2 to 25 percent slopes
- 777E—Rock outcrop-Clugulch-Bobowic complex, 15 to 35 percent slopes
- 777F—Rock outcrop-Clugulch-Bobowic complex, 35 to 70 percent slopes
- 778E—Rock outcrop-Kounter, very bouldery-Jeffcity, bouldery, complex, 15 to 45 percent slopes
- 781A—Vendome sandy loam, 0 to 8 percent slopes
- 782A—Vendome sandy loam, 0 to 8 percent slopes, stony
- 791C—Chinook sandy clay loam, 2 to 8 percent slopes, saline
- 811C—Ethridge, saline-Zatony clay loams, 2 to 8 percent slopes
- 821C—Rothiemay loam, 2 to 8 percent slopes
- 831E—Shoddy-Cabbart-Kobarter complex, 4 to 25 percent slopes
- 832E—Shoddy-Rock outcrop-Delpoint complex, 2 to 25 percent slopes
- 841A—Clunton loam, 0 to 2 percent slopes
- 851D—Walbert-Shoddy-Cabbart complex, 2 to 15 percent slopes
- 851F—Walbert-Shoddy-Cabbart complex, 15 to 35 percent slopes
- 852C—Walbert sandy clay loam, 4 to 15 percent slopes
- 858E—Yetull-Yetull, stony, complex, 8 to 35 percent slopes
- 859C—Yetull loamy fine sand, 2 to 8 percent slopes
- 872E—Kobarter-Abor, stony, complex, 15 to 35 percent slopes
- 911C—Absarook-Martinsdale, stony, complex, 2 to 8 percent slopes
- 915C—Quincreek channery loam, 2 to 8 percent slopes
- 941E—Tigeron, bouldery-Tigeron, very bouldery, complex, 15 to 45 percent slopes
- 942E—Tigeron extremely gravelly loam, 15 to 35 percent slopes, bouldery
- 943F—Tigeron, stony-Tigeron, very stony, complex, 25 to 60 percent slopes
- 944E—Tigeron, very bouldery-Redfern, bouldery-Rock outcrop complex, 15 to 45 percent slopes, warm
- 945E—Tigeron, very bouldery-Redfern, bouldery-Rock outcrop complex, 15 to 45 percent slopes, dry
- 946F—Tigeron, very stony-Redfern, rubbly-Rock outcrop complex, 25 to 60 percent slopes
- 947F—Tigeron, very stony-Redfern, rubbly-Rock outcrop complex, 25 to 60 percent slopes, dry
- 952F—Redfern, bouldery-Rock outcrop-Tigeron, very bouldery, complex, 25 to 60 percent slopes
- 953F—Redfern, rubbly-Rock outcrop-Rubble land association, 25 to 60 percent slopes
- 954F—Redfern, rubbly-Rock outcrop-Tigeron, very bouldery, complex, 35 to 70 percent slopes
- 963E—Elve-Warwood complex, 15 to 45 percent slopes, stony
- 964E—Elve, very stony-Elve, rubbly-Cowood, rubbly, complex, 15 to 35 percent slopes
- 964F—Elve, very stony-Cowood, rubbly-Rock outcrop complex, 35 to 60 percent slopes, cool
- 965E—Elve, very stony-Cowood, rubbly, complex, 15 to 35 percent slopes
- 965F—Elve, very stony-Cowood, rubbly-Rock outcrop complex, 35 to 60 percent slopes, dry
- 966E—Elve, very stony-Rock outcrop-Rubble land complex, 8 to 35 percent slopes
- 967F—Elve, very stony-Cowood, rubbly-Rock outcrop complex, 35 to 60 percent slopes
- 968E—Elve, stony-Worock complex, 15 to 35 percent slopes
- 968F—Elve, stony-Worock complex, 35 to 60 percent slopes
- 969F—Elve, bouldery-Worock-Rock outcrop complex, 35 to 60 percent slopes
- 971F—Cowood, rubbly-Rock outcrop association, 25 to 60 percent slopes
- 972F—Cowood, very bouldery-Kimpton, very bouldery-Rock outcrop complex, 15 to 45 percent slopes
- 973D—Cowood, very stony-Elve, very stony-Rock outcrop complex, 4 to 25 percent slopes
- 982F—Kimpton, very bouldery-Rock outcrop-Tiban, very bouldery, complex, 25 to 50 percent slopes

-
- 991E—Libeg loam, 15 to 35 percent slopes, bouldery
 992E—Libeg, very bouldery-Libeg, bouldery-Nieman, bouldery, complex, 15 to 45 percent slopes
 993D—Ratiopeak-Tiban gravelly loams, 4 to 15 percent slopes, bouldery
 994E—Libeg, stony-Nieman, bouldery, complex, 15 to 45 percent slopes
 996D—Libeg-Monaberg gravelly loams, 2 to 15 percent slopes, bouldery
 997E—Libeg, stony-Monaberg-Adel complex, 15 to 35 percent slopes
 998E—Libeg-Nieman, stony, complex, 8 to 25 percent slopes
 999E—Libeg, very stony-Libeg, very bouldery, complex, 4 to 25 percent slopes
 999F—Libeg, very stony-Libeg, rubbly, association, 25 to 60 percent slopes
 1003E—Tiban, bouldery-Cheadle, very bouldery, complex, 15 to 35 percent slopes
 1004E—Tiban, rubbly-Tiban, very bouldery-Rock outcrop complex, 15 to 45 percent slopes
 1101E—Monaberg, stony-Libeg, bouldery, complex, 15 to 35 percent slopes
 1102B—Adel-Libeg, stony, complex, 1 to 4 percent slopes
 1103D—Adel-Libeg complex, 4 to 15 percent slopes, stony
 1104C—Adel loam, 2 to 8 percent slopes
 1120E—Quaint channery loam, 8 to 35 percent slopes, very stony
 1121E—Quaint-Rock outcrop-Redfist complex, 4 to 25 percent slopes
 1121F—Quaint-Rock outcrop complex, 15 to 45 percent slopes
 1122D—Quaint-Redfist channery loams, 4 to 15 percent slopes
 1131C—Redfist-Quaint channery loams, 2 to 8 percent slopes
 1131D—Redfist-Quaint channery loams, 8 to 15 percent slopes
 1132D—Redfist, bouldery-Perma, bouldery-Rock outcrop complex, 2 to 35 percent slopes
 1141D—Devilfence very channery loam, 4 to 15 percent slopes
 1142E—Devilfence-Rock outcrop-Wilpring complex, 8 to 35 percent slopes
 1142F—Devilfence-Rock outcrop complex, 35 to 60 percent slopes
 1143F—Deville-Wilde-Rock outcrop complex, 25 to 60 percent slopes
 1146E—Deville-Rock outcrop-Wilde complex, 8 to 35 percent slopes
 1152D—Wilpring-Devilfence complex, 4 to 15 percent slopes
 1152E—Wilpring-Devilfence-Rock outcrop complex, 15 to 35 percent slopes
 1153C—Wilpring-Quincreek-Devilfence complex, 2 to 8 percent slopes
 1154E—Wilde-Deville-Vigilante complex, 8 to 35 percent slopes
 1154F—Wilde, stony-Vigilante-Deville, very stony, complex, 35 to 70 percent slopes
 1161E—Yreka, bouldery-Hoyt, bouldery-Shaboom, very bouldery, complex, 15 to 45 percent slopes
 1162E—Yreka very cobbly loam, 15 to 35 percent slopes, bouldery
 1163F—Ymark, very bouldery-Elmark, very bouldery-Rock outcrop complex, 25 to 60 percent slopes
 1164F—Yreka-Brickner, stony, complex, 35 to 70 percent slopes
 1170E—Whitlash-Whitlash, stony-Rock outcrop complex, 15 to 35 percent slopes
 1171F—Castner, bouldery-Rock outcrop complex, 25 to 50 percent slopes
 1172F—Castner, very bouldery-Rock outcrop complex, 35 to 60 percent slopes
 1180E—Farnuf loam, 15 to 35 percent slopes, stony
 1182C—Breeton gravelly loam, 2 to 8 percent slopes
 1191E—Silverchief very cobbly clay loam, 8 to 35 percent slopes, bouldery
 1210C—Ferball clay loam, 2 to 8 percent slopes
 1222C—Martinsdale-Martinsdale, stony-Shawmut complex, 2 to 8 percent slopes
 1222E—Martinsdale-Martinsdale, stony-Shawmut complex, 15 to 35 percent slopes
 1223D—Martinsdale-Shawmut complex, 2 to 15 percent slopes, bouldery

-
- 1242D—Baxton-Connieo, very bouldery-Rock outcrop complex, 4 to 15 percent slopes, moist
- 1242E—Baxton-Connieo, very bouldery-Rock outcrop complex, 15 to 35 percent slopes, moist
- 1243D—Baxton-Connieo coarse sandy loams, 4 to 15 percent slopes, bouldery
- 1244D—Baxton-Connieo, very bouldery-Rock outcrop complex, 4 to 15 percent slopes
- 1244E—Baxton-Connieo-Rock outcrop complex, 15 to 35 percent slopes
- 1245E—Baxton-Breeton-Connieo complex, 15 to 35 percent slopes
- 1246E—Baxton, stony-Breeton, bouldery-Catgulch, very stony, complex, 15 to 35 percent slopes
- 1247E—Baxton-Kellygulch-Connieo complex, 15 to 45 percent slopes
- 1250C—Work cobbly clay loam, 2 to 8 percent slopes, stony
- 1250E—Work very cobbly clay loam, 8 to 25 percent slopes
- 1271D—Placerton-Farnuf-Connieo complex, 8 to 15 percent slopes
- 1272D—Placerton-Connieo-Jeffcity complex, 4 to 15 percent slopes
- 1273E—Placerton-Farnuf-Breeton complex, 15 to 35 percent slopes
- 1275D—Placerton-Farnuf-Connieo gravelly sandy clay loams, 8 to 15 percent slopes
- 1275E—Placerton-Farnuf-Connieo complex, 15 to 35 percent slopes
- 1276D—Placerton-Connieo-Jeffcity complex, 4 to 15 percent slopes, warm
- 1277C—Placerton-Jeffcity complex, 2 to 8 percent slopes
- 1280D—Crackerville-Catgulch complex, 2 to 15 percent slopes, bouldery
- 1281D—Crackerville-Catgulch, bouldery-Rock outcrop complex, 8 to 25 percent slopes
- 1282D—Crackerville-Bielenberg-Catgulch, bouldery, complex, 8 to 20 percent slopes
- 1283E—Crackerville-Bielenberg-Catgulch, bouldery, complex, 20 to 35 percent slopes
- 1286E—Crackerville-Bielenberg-Catgulch, bouldery, complex, 15 to 35 percent slopes, warm
- 1287E—Clancy, very stony-Crampton, bouldery-Bielenberg, very stony, complex, 15 to 45 percent slopes
- 1321B—Beaverell, very stony-Beaverell-Sieberell, stony, complex, 1 to 4 percent slopes
- 1321D—Beaverell, very stony-Sieberell, stony, complex, 4 to 15 percent slopes
- 1322D—Beaverell, stony-Beaverell, rubbly-Sieberell, stony, complex, 2 to 15 percent slopes
- 1331A—Bonebasin-Wetsand complex, 0 to 2 percent slopes
- 1341D—Windham very gravelly loam, 2 to 15 percent slopes, very stony
- 1342E—Windham-Lap very cobbly loams, 15 to 45 percent slopes, bouldery
- 1343D—Windham-Judell very cobbly loams, 4 to 15 percent slopes, bouldery
- 1351D—Perma stony loam, 2 to 15 percent slopes, very bouldery
- 1352E—Perma-Whitlash complex, 15 to 35 percent slopes, bouldery, warm
- 1353F—Perma, very stony-Whitlash, very stony-Rock outcrop complex, 15 to 45 percent slopes
- 1355D—Wimper-Wimper, stony, complex, 4 to 15 percent slopes, warm
- 1355E—Wimper-Wimper, stony, complex, 15 to 35 percent slopes, warm
- 1356E—Wimper gravelly loam, 8 to 35 percent slopes, stony, moist
- 1357F—Perma, very bouldery-Shaboom, extremely bouldery-Rock outcrop complex, 35 to 60 percent slopes
- 1361E—Lumpgulch, bouldery-Rock outcrop-Elmark, bouldery, complex, 8 to 35 percent slopes
- 1362F—Lumpgulch, bouldery-Rock outcrop complex, 25 to 60 percent slopes
- 1372D—Burtone-Connieo, bouldery-Rock outcrop complex, 4 to 15 percent slopes
- 1373E—Burtone-Elmark-Connieo complex, 8 to 25 percent slopes, very bouldery
- 1374D—Burtone-Clancy-Connieo complex, 4 to 15 percent slopes
- 1375D—Burtone-Connieo, bouldery-Rock outcrop complex, 4 to 15 percent slopes, warm

-
- 1375E—Burtoner, very stony-Connieo, bouldery-Rock outcrop complex, 15 to 45 percent slopes
- 1376F—Burtoner, very stony-Connieo, very stony-Rock outcrop complex, 35 to 60 percent slopes
- 1377E—Burtoner, very stony-Crampton, bouldery-Catgulch, bouldery, complex, 15 to 45 percent slopes
- 1378E—Burtoner-Elmark-Shaboom, very bouldery, complex, 15 to 45 percent slopes
- 1381D—Jeffcity, stony-Connieo, stony-Rock outcrop complex, 2 to 15 percent slopes
- 1391B—Bronec fine sandy loam, 1 to 4 percent slopes
- 1451F—Blaincreek, very stony-Sawicki, very stony-Tolbert, very bouldery, complex, 35 to 70 percent slopes
- 1460C—Clasoil loam, 2 to 8 percent slopes
- 1461D—Bielenberg-Burtoner, very stony-Catgulch, bouldery, complex, 8 to 25 percent slopes
- 1540F—Shaboom, extremely bouldery-Rock outcrop-Elmark, very bouldery, association, 35 to 60 percent slopes
- 1541E—Shaboom, bouldery-Lumpgulch, very bouldery-Rock outcrop complex, 8 to 35 percent slopes
- 1542E—Shaboom, very bouldery-Rock outcrop-Kellygulch, very bouldery, complex, 8 to 35 percent slopes
- 1543E—Shaboom, very bouldery-Kellygulch, very bouldery-Rock outcrop complex, 15 to 35 percent slopes
- 1543F—Shaboom, extremely bouldery-Kellygulch, extremely bouldery-Rock outcrop complex, 35 to 60 percent slopes
- 1544E—Shaboom, bouldery-Kellygulch, bouldery-Rock outcrop complex, 8 to 45 percent slopes
- 1563D—Hilger, rubbly-Hilger complex, 8 to 25 percent slopes
- 1564E—Hilger, very stony-Hilger, rubbly-Rock outcrop complex, 8 to 35 percent slopes
- 1591E—Catgulch, bouldery-Crackerville-Rock outcrop complex, 15 to 45 percent slopes
- 1595E—Connieo, bouldery-Crackerville-Rock outcrop complex, 15 to 45 percent slopes
- 1596C—Connieo-Rock outcrop-Placerton complex, 2 to 8 percent slopes
- 1602C—Farnuf-Placerton sandy clay loams, 2 to 8 percent slopes
- 1603C—Farnuf sandy loam, 2 to 8 percent slopes
- 1604D—Farnuf-Farnuf, stony-Burtoner complex, 4 to 15 percent slopes
- 1605C—Farnuf-Placerton sandy clay loams, 2 to 8 percent slopes, warm
- 1606D—Farnuf loam, 2 to 15 percent slopes
- 1607D—Farnuf-Placerton-Martinsdale complex, 4 to 15 percent slopes
- 1621D—Connieo, stony-Baxton, stony-Rock outcrop complex, 2 to 15 percent slopes
- 1621E—Connieo, very stony-Baxton, stony-Rock outcrop complex, 15 to 35 percent slopes
- 1622D—Connieo, moist-Rock outcrop complex, 2 to 15 percent slopes
- 1623D—Connieo-Burtoner complex, 2 to 15 percent slopes
- 1623E—Connieo-Baxton-Rock outcrop complex, 15 to 35 percent slopes
- 1624F—Connieo, very stony-Baxton, bouldery-Rock outcrop complex, 35 to 60 percent slopes
- 1625F—Connieo, extremely bouldery-Rock outcrop-Burtoner, extremely stony, complex, 35 to 60 percent slopes
- 1626D—Connieo, bouldery-Burtoner, bouldery-Rock outcrop complex, 4 to 15 percent slopes
- 1627E—Connieo, very bouldery-Burtoner-Rock outcrop complex, 8 to 35 percent slopes, moist
- 1628D—Connieo, bouldery-Ashbray, very bouldery-Rock outcrop complex, 2 to 15 percent slopes
- 1629C—Connieo-Catgulch-Rock outcrop complex, 2 to 8 percent slopes
- 1640D—Nieman, very stony-Rock outcrop-Libeg, stony, complex, 2 to 15 percent slopes
- 1641E—Nieman, very stony-Rock outcrop-Libeg, bouldery, complex, 15 to 45 percent slopes
- 1641F—Nieman, very stony-Rock outcrop-Libeg, very stony, complex, 45 to 70 percent slopes
- 1642F—Nieman, bouldery-Rock outcrop-Libeg, very bouldery, complex, 25 to 60 percent slopes
- 1643E—Nieman, stony-Libeg complex, 15 to 35 percent slopes
- 1643F—Nieman, stony-Libeg-Rock outcrop complex, 35 to 60 percent slopes

-
- 1651C—Sawbuck-Sawbuck, very stony-Clasoil complex, 2 to 8 percent slopes
1652E—Sawicki-Clasoil complex, 8 to 35 percent slopes, bouldery
1654E—Sawicki, stony-Blaincreek-Tolbert, very stony, complex, 15 to 45 percent slopes
1655E—Sawicki-Clasoil complex, 8 to 35 percent slopes, bouldery, warm
1656E—Sawicki-Bielenberg, very stony-Tolbert, very stony, complex, 15 to 45 percent slopes
1657E—Sawicki, very bouldery-Crampton, bouldery-Catgulch, bouldery, complex, 15 to 45 percent slopes
1658D—Sawicki, stony-Blaincreek, very stony, complex, 4 to 15 percent slopes
1658E—Sawicki, very stony-Blaincreek, very stony-Tolbert, bouldery, complex, 15 to 45 percent slopes
1659E—Sawbuck, stony-Sawbuck, bouldery, complex, 15 to 35 percent slopes
1661D—Catgulch-Baxton complex, 2 to 15 percent slopes, stony
1661E—Catgulch-Baxton complex, 15 to 35 percent slopes, stony
1662D—Catgulch, very stony-Rock outcrop-Burtoner complex, 4 to 15 percent slopes
1663D—Catgulch, bouldery-Burtoner, bouldery-Rock outcrop complex, 2 to 15 percent slopes
1664E—Catgulch, bouldery-Rock outcrop-Ashbray, bouldery, complex, 4 to 35 percent slopes
1665F—Catgulch, very bouldery-Rock outcrop-Connio, very stony, complex, 35 to 60 percent slopes
1667E—Catgulch, extremely bouldery-Baxton, extremely bouldery-Burtoner, bouldery, complex, 15 to 35 percent slopes
1671E—Tolbert-Blaincreek complex, 8 to 35 percent slopes, warm
1672E—Tolbert-Blaincreek complex, 8 to 35 percent slopes
1675E—Tolbert, very stony-Blaincreek, stony-Rock outcrop complex, 8 to 35 percent slopes
1675F—Tolbert, very stony-Rock outcrop-Blaincreek, very stony, complex, 35 to 60 percent slopes
1680D—Raynesford silt loam, 4 to 15 percent slopes
1690F—Cheadle, very stony-Rock outcrop-Tiban, bouldery, complex, 15 to 45 percent slopes
1721C—Martinsdale loam, 2 to 8 percent slopes, warm
1722C—Martinsdale-Martinsdale, stony-Shawmut complex, 2 to 8 percent slopes, warm
1722E—Martinsdale-Martinsdale, stony-Shawmut complex, 15 to 35 percent slopes, warm
1723D—Martinsdale-Shawmut complex, 2 to 15 percent slopes, bouldery, warm
1724D—Martinsdale-Shawmut, stony-Martinsdale, bouldery, complex, 4 to 25 percent slopes, warm
1731E—Tepecreek, bouldery-Caseypeak, very bouldery-Rock outcrop complex, 8 to 35 percent slopes
1731F—Tepecreek, very bouldery-Caseypeak, rubbly-Rock outcrop complex, 35 to 60 percent slopes
1732F—Tepecreek, very bouldery-Caseypeak, very bouldery-Rock outcrop complex, 35 to 60 percent slopes
1734F—Hiore, stony-Kurrie, stony-Caseypeak, very stony, complex, 35 to 60 percent slopes
1735E—Tepecreek, stony-Caseypeak, very bouldery-Rock outcrop complex, 15 to 35 percent slopes
1735F—Tepecreek, stony-Caseypeak, very stony-Rock outcrop complex, 35 to 60 percent slopes
1740E—Tropal, bouldery-Hanson, stony-Rock outcrop complex, 8 to 25 percent slopes
1741F—Tropal, bouldery-Rock outcrop-Whitore, bouldery, complex, 15 to 45 percent slopes
1742F—Tropal, very bouldery-Rock outcrop complex, 25 to 60 percent slopes
1750F—Whitore, bouldery-Tropal, very bouldery-Rock outcrop complex, 25 to 45 percent slopes
1751F—Whitore, very stony-Tropal, very bouldery-Rock outcrop complex, 15 to 45 percent slopes
1752E—Whitore, stony-Helmville, bouldery-Firada, very stony, complex, 15 to 45 percent slopes
1753E—Whitore, stony-Tropal, very stony-Firada, very stony, complex, 8 to 35 percent slopes
1760E—Hanson, stony-Whitore, bouldery, complex, 8 to 35 percent slopes
1770E—Helmville, rubbly-Tiban, very bouldery-Rock outcrop complex, 15 to 45 percent slopes

-
- 1781E—Firada, stony-Tropal, very stony-Rock outcrop complex, 4 to 25 percent slopes
- 1790F—Sigbird, very bouldery-Sigbird, stony-Rock outcrop complex, 25 to 70 percent slopes
- 1800D—Breeton coarse sandy loam, 4 to 15 percent slopes
- 1802D—Breeton-Baxton-Connieo complex, 4 to 15 percent slopes
- 1803C—Breeton-Cometcrik complex, 2 to 8 percent slopes
- 1810F—Hoyt, very stony-Ymark, bouldery-Shaboom, very bouldery, complex, 25 to 60 percent slopes
- 1821F—Kellygulch, bouldery-Rock outcrop-Bielenberg complex, 35 to 70 percent slopes
- 1822F—Kellygulch, stony-Shaboom, very bouldery-Rock outcrop association, 45 to 75 percent slopes
- 1823E—Kellygulch, stony-Shaboom, very bouldery-Rock outcrop complex, 15 to 35 percent slopes
- 1823F—Kellygulch, stony-Shaboom, very bouldery-Rock outcrop complex, 35 to 60 percent slopes
- 1830E—Clancy-Bielenberg-Breeton complex, 15 to 35 percent slopes
- 1831D—Clancy-Burtoner, bouldery, complex, 4 to 15 percent slopes
- 1832D—Clancy-Burtoner, bouldery-Rock outcrop complex, 4 to 15 percent slopes
- 1833D—Clancy-Connieo complex, 2 to 15 percent slopes
- 1835D—Clancy-Bielenberg-Connieo complex, 4 to 15 percent slopes
- 1836E—Clancy, bouldery-Bielenberg, stony-Catgulch, bouldery, complex, 15 to 45 percent slopes
- 1837E—Clancy-Bielenberg-Connieo complex, 15 to 35 percent slopes
- 1838D—Clancy-Clancy, very stony-Bielenberg complex, 4 to 15 percent slopes
- 1841D—Tuggle-Branham-Rock outcrop complex, 2 to 15 percent slopes
- 1842D—Caseypeak-Branham-Rock outcrop complex, 2 to 15 percent slopes
- 1842E—Caseypeak-Branham-Rock outcrop complex, 15 to 35 percent slopes
- 1842F—Caseypeak, bouldery-Branham, bouldery-Rock outcrop complex, 35 to 60 percent slopes
- 1851D—Branham-Lowder loams, 0 to 8 percent slopes
- 1851E—Branham-Lowder loams, 8 to 25 percent slopes
- 1853D—Branham-Tuggle complex, 2 to 15 percent slopes
- 1853E—Branham-Tuggle complex, 15 to 35 percent slopes
- 1861F—Clugulch-Bobowic-Rock outcrop complex, 35 to 70 percent slopes
- 1871E—Hiore, stony-Rock outcrop complex, 15 to 35 percent slopes
- 1871F—Hiore, stony-Rock outcrop complex, 35 to 70 percent slopes
- 1872E—Hiore-Clugulch-Rock outcrop complex, 15 to 35 percent slopes
- 1872F—Hiore-Clugulch-Rock outcrop complex, 35 to 70 percent slopes
- 1901F—Warwood-Tigeron, very stony-Cowood, very stony, complex, 25 to 60 percent slopes
- 1902D—Warwood, very bouldery-Warwood, very stony-Tigeron, very bouldery, complex, 2 to 15 percent slopes
- 1910F—Elmark, very bouldery-Rock outcrop-Shaboom, extremely bouldery, complex, 25 to 60 percent slopes
- 1921D—Judell-Lap, very stony, complex, 4 to 15 percent slopes
- 1921E—Judell-Lap, very stony, complex, 15 to 35 percent slopes
- 1930E—Elmark-Kellygulch, very bouldery-Rock outcrop complex, 8 to 35 percent slopes
- 1933E—Elmark, bouldery-Breeton-Shaboom, bouldery, complex, 15 to 45 percent slopes
- 1940E—Elmark, bouldery-Lumpgulch, very bouldery-Rock outcrop complex, 8 to 35 percent slopes
- 1945E—Elmark, bouldery-Lumpgulch, very bouldery-Rock outcrop complex, 8 to 35 percent slopes, dry
- 1946E—Elmark, bouldery-Hoyt-Shaboom, very bouldery, complex, 8 to 35 percent slopes, dry
- 1947E—Elmark, bouldery-Burtoner-Rock outcrop complex, 8 to 45 percent slopes
- 1948E—Elmark, very bouldery-Skyview, very bouldery-Rock outcrop complex, 15 to 45 percent slopes

-
- 1950F—Franconi, very bouldery-Warwood-aseypeak, very bouldery, complex, 25 to 60 percent slopes
- 1960D—Lumpgulch, bouldery-Hoyt-Shaboom, very bouldery, complex, 4 to 15 percent slopes
- 1961E—Lumpgulch, bouldery-Hoyt-Shaboom, very bouldery, complex, 15 to 45 percent slopes
- 1962E—Lumpgulch, bouldery-Yreka, very bouldery-Shaboom, very bouldery, complex, 15 to 35 percent slopes
- 1963F—Lumpgulch, very bouldery-Rock outcrop-Kellygulch, very bouldery, complex, 25 to 60 percent slopes
- 1964E—Lumpgulch, very bouldery-Shaboom, very bouldery-Rock outcrop complex, 8 to 25 percent slopes
- 1965E—Lumpgulch, bouldery-Ymark, very bouldery-Rock outcrop complex, 15 to 45 percent slopes
- 1970E—Bignell, stony-Yreka, very stony, complex, 15 to 35 percent slopes
- 1980F—Stemple cobbly loam, 35 to 60 percent slopes, very stony
- 1990F—Bobowic, very bouldery-Rock outcrop-Tepecreek, very bouldery, complex, 25 to 60 percent slopes
- 1991D—Bobowic-Clugulch, bouldery-Rock outcrop complex, 4 to 25 percent slopes
- 2000E—Skyview, very bouldery-Rock outcrop-Roegulch, very bouldery, complex, 8 to 35 percent slopes
- 2001E—Skyview, very bouldery-Elmark, very bouldery-Rock outcrop complex, 15 to 45 percent slopes
- 2011D—Shawmut gravelly loam, 4 to 15 percent slopes, bouldery, warm
- 2012D—Shawmut, stony-Martinsdale, very stony, complex, 4 to 15 percent slopes, warm
- 2012E—Shawmut, stony-Martinsdale, very stony, complex, 15 to 25 percent slopes, warm
- 2013E—Shawmut, bouldery-Wickes, stony-Tolbert, bouldery, complex, 15 to 35 percent slopes
- 2014E—Shawmut-Tolbert complex, 8 to 35 percent slopes, warm
- 2020D—Shawmut, stony-Shawmut, bouldery, complex, 4 to 15 percent slopes
- 2030E—Kokoruda-Elmark, very bouldery-Rock outcrop complex, 8 to 35 percent slopes
- 2031D—Eagleton, stony-Kokoruda-Cometcrik complex, 2 to 25 percent slopes
- 2040F—Shaboom, extremely bouldery-Rock outcrop-Rubble land association, 35 to 70 percent slopes
- 2041F—Rock outcrop-Catgulch, bouldery, complex, 15 to 70 percent slopes
- 2042F—Rock outcrop-Cheadle, very bouldery-Tiban, very bouldery, complex, 15 to 50 percent slopes
- 2043F—Rencot, very stony-Rencot, bouldery-Rock outcrop association, 15 to 60 percent slopes
- 2045F—Caseypeak, very stony-Rock outcrop-Rubble land association, 15 to 60 percent slopes, dry
- 2046F—Caseypeak, very bouldery-Rock outcrop-Rubble land association, 15 to 60 percent slopes, cool
- 2051E—Opitz, bouldery-Branham, very bouldery-Tuggle, very bouldery, complex, 8 to 35 percent slopes
- 2081F—Windham, very stony-Rock outcrop-Lap, very stony, complex, 35 to 70 percent slopes, warm
- 2082D—Windham-Judell complex, 8 to 15 percent slopes, warm
- 2084E—Windham, stony-Maiden, very stony-Lap, very stony, complex, 15 to 35 percent slopes, warm
- 2086E—Windham-Windham, stony, complex, 15 to 35 percent slopes, warm
- 2088D—Windham-Judell gravelly loams, 8 to 25 percent slopes, stony, warm
- 2090F—Caseypeak, very bouldery-Franconi, very bouldery-Rock outcrop complex, 25 to 60 percent slopes
- 2091E—Caseypeak, bouldery-Franconi, bouldery-Rock outcrop complex, 8 to 35 percent slopes
- 2110D—Sebud very cobbly loam, 4 to 15 percent slopes, very stony
- 2111E—Sebud, very stony-Hapgood complex, 8 to 45 percent slopes
- 2112D—Sebud-Marcel complex, 4 to 25 percent slopes, bouldery
- 2121F—Hapgood-Hanson-Tiban complex, 25 to 60 percent slopes, very stony

-
- 2122F—Hapgood-Tiban complex, 35 to 70 percent slopes, very stony
- 2123F—Hapgood-Sebud-Arrowpeak complex, 35 to 60 percent slopes, very stony
- 2125F—Cowood, rubbly-Elve, very stony-Rock outcrop complex, 25 to 60 percent slopes
- 2151E—Releep, very bouldery-Kurrie, very bouldery-Rock outcrop complex, 15 to 35 percent slopes
- 2161E—Ellena, bouldery-Worock, very bouldery-Rock outcrop complex, 15 to 45 percent slopes
- 2161F—Kurrie, very bouldery-Ellena, very bouldery-Rock outcrop complex, 25 to 60 percent slopes
- 2171F—Hiore-Kurrie, stony, complex, 25 to 60 percent slopes
- 2172F—Rubick, very stony-Rock outcrop complex, 35 to 60 percent slopes
- 2173F—Rubick gravelly sandy loam, 35 to 60 percent slopes, stony
- 2181F—Repkie, very stony-Yreka, stony-Skyview, very bouldery, complex, 25 to 60 percent slopes
- 2211E—Sebud-Arrowpeak, stony, complex, 8 to 45 percent slopes
- 2211F—Sebud, very stony-Arrowpeak, very stony-Rock outcrop complex, 35 to 60 percent slopes
- 2212D—Sebud, very stony-Libeg-Arrowpeak, stony, complex, 4 to 15 percent slopes
- 2212E—Sebud, very stony-Libeg, stony-Arrowpeak, stony, complex, 15 to 35 percent slopes
- 2213E—Sebud, stony-Surdal, stony-Arrowpeak, very stony, complex, 8 to 35 percent slopes
- 2213F—Sebud, stony-Surdal, stony-Arrowpeak, very stony, complex, 35 to 60 percent slopes
- 2214E—Sebud, bouldery-Surdal, very bouldery-Arrowpeak, very bouldery, complex, 15 to 35 percent slopes
- 2215D—Sebud-Tibkey cobbly loams, 2 to 15 percent slopes, bouldery
- 2216D—Sebud-Surdal complex, 4 to 25 percent slopes, stony
- 2221E—Arrowpeak, very stony-Surdal, stony-Rock outcrop complex, 8 to 35 percent slopes
- 2222F—Arrowpeak, very stony-Sebud, stony-Surdal, very stony, complex, 25 to 60 percent slopes
- 2230B—Tineman cobbly loam, 2 to 8 percent slopes, very stony
- 2251F—Nivean, very stony-Rock outcrop-Rubble land complex, 25 to 60 percent slopes
- 2252E—Nivean, very stony-Macabre, stony-Rock outcrop complex, 15 to 35 percent slopes
- 2261D—Lowland loam, 4 to 15 percent slopes, stony
- 2261E—Lowland loam, 15 to 35 percent slopes, stony
- 2261F—Lowland, stony-Rock outcrop-Rubble land complex, 35 to 60 percent slopes
- 2270F—Macabre, very stony-Rock outcrop-Rubble land complex, 35 to 60 percent slopes
- 2271D—Macabre gravelly loam, 8 to 15 percent slopes
- 2281F—Judco, stony-Torpy, stony-Rock outcrop complex, 35 to 60 percent slopes
- 2291F—Mocmont-Kadygulch cobbly loams, 35 to 60 percent slopes, very stony
- 2301F—Mocmont, bouldery-Roegulch, rubbly-Rock outcrop complex, 25 to 60 percent slopes
- 2311F—Worock, stony-Cowood, very stony-Rock outcrop complex, 35 to 60 percent slopes
- 2312F—Worock, stony-Elve, stony-Rock outcrop complex, 35 to 60 percent slopes
- 2321D—Torpy loam, 4 to 15 percent slopes
- 2321E—Torpy gravelly loam, 15 to 35 percent slopes
- 2321F—Torpy gravelly loam, 35 to 60 percent slopes
- 2322E—Lowland-Torpy complex, 15 to 35 percent slopes
- 2322F—Lowland-Torpy complex, 35 to 60 percent slopes
- 2331B—Mooseflat loam, 1 to 4 percent slopes
- 2332B—Mooseflat-Elvick loams, 1 to 4 percent slopes
- 2350D—Clasoil, very stony-Sawicki, bouldery, complex, 4 to 15 percent slopes
- 2360E—Gnojek, stony-Wickes, stony-Shawmut complex, 8 to 35 percent slopes
- 2360F—Gnojek, stony-Wickes, stony-Rock outcrop complex, 35 to 70 percent slopes
- 2361E—Gnojek, stony-Wickes, stony-Rock outcrop complex, 8 to 35 percent slopes
- 2361F—Gnojek, stony-Rock outcrop-Wickes, stony, complex, 25 to 60 percent slopes
- 2391C—Marcel, very bouldery-Tibkey, bouldery, complex, 2 to 8 percent slopes
- 2411E—Ashbray, bouldery-Rock outcrop-Rubble land complex, 8 to 45 percent slopes

-
- 2412F—Ashbray, rubbly-Rock outcrop-Kellygulch, very stony, complex, 35 to 70 percent slopes
- 2421E—Surdal, stony-Arrowpeak, very stony, complex, 4 to 25 percent slopes
- 2431C—Foolhen, stony-Tibkey, bouldery, complex, 0 to 8 percent slopes
- 2441E—Tineman, very stony-Franconi, bouldery-Rock outcrop complex, 4 to 25 percent slopes
- 2450E—Kounter, bouldery-Rock outcrop-Cedric, bouldery, complex, 8 to 35 percent slopes
- 2451D—Kounter, bouldery-Rock outcrop-Cedric, bouldery, complex, 4 to 25 percent slopes, dry
- 2452E—Kounter, very bouldery-Rock outcrop-Jeffcity, bouldery, complex, 15 to 35 percent slopes
- 2460D—Cedric, bouldery-Jeffcity, bouldery-Rock outcrop complex, 2 to 15 percent slopes
- 2461D—Cedric, bouldery-Rock outcrop-Jeffcity, bouldery, complex, 2 to 15 percent slopes
- 2471F—Elve, stony-Worock, stony-Rock outcrop complex, 35 to 60 percent slopes
- 2472E—Elvick-Lowder complex, 8 to 25 percent slopes, very bouldery
- 2473E—Elve-Cowood very cobbly loams, 8 to 35 percent slopes, very stony
- 2481F—Brickner, very bouldery-Rock outcrop-Rubble land complex, 15 to 60 percent slopes
- 2483F—Elve, rubbly-Rock outcrop-Rubble land association, 25 to 60 percent slopes, cool
- 2484F—Rock outcrop-Rubble land-Redfern, rubbly, association, 35 to 70 percent slopes
- 2485F—Redfern, rubbly-Rock outcrop-Tigeron, very bouldery, association, 25 to 70 percent slopes
- 2486F—Elve, rubbly-Rock outcrop-Rubble land complex, 35 to 60 percent slopes
- 2487F—Torpy, rubbly-Rock outcrop-Rubble land complex, 35 to 60 percent slopes
- 2488D—Elve, very stony-Rock outcrop-Rubble land complex, 4 to 35 percent slopes
- 2501D—Lowder-Elvick very cobbly loams, 2 to 15 percent slopes, very bouldery
- 2511C—Monaberg loam, 2 to 8 percent slopes, bouldery
- 2581E—Worock, very bouldery-Elve, very stony, complex, 15 to 35 percent slopes
- 2582D—Worock-Elve very cobbly loams, 2 to 15 percent slopes, very bouldery, cool
- 2582E—Worock, very bouldery-Worock, rubbly, complex, 8 to 35 percent slopes
- 2582F—Worock, rubbly-Rock outcrop-Rubble land complex, 35 to 60 percent slopes
- 2583D—Worock, stony-Worock, very bouldery, complex, 2 to 15 percent slopes
- 2583F—Worock, very bouldery-Worock, rubbly, complex, 35 to 60 percent slopes
- 2584E—Worock, very bouldery-Worock, rubbly, complex, 15 to 45 percent slopes, dry
- 2591F—Kadygulch-Roegulch, stony, complex, 35 to 60 percent slopes
- 2661F—Elve-Cowood complex, 45 to 70 percent slopes
- 2662E—Elve-Cowood complex, 15 to 45 percent slopes
- 2681E—Sawbuck-Catgulch, stony, complex, 8 to 45 percent slopes
- 2682E—Sawbuck, stony-Yreka, stony-Catgulch, very stony, complex, 15 to 45 percent slopes
- 2691F—Connieo, very stony-Crackerville, stony-Rock outcrop complex, 35 to 60 percent slopes
- 2695E—Macabre-Nivean complex, 15 to 35 percent slopes
- 2695F—Macabre-Judco-Rock outcrop complex, 35 to 60 percent slopes
- 2701F—Crampton-Catgulch complex, 35 to 60 percent slopes, very stony
- 2705F—Vitroff-Torpy loams, 35 to 60 percent slopes
- 2711E—Libeg very gravelly loam, 15 to 45 percent slopes
- 2712D—Libeg-Mooseflat loams, 4 to 25 percent slopes
- 3001B—Aridic Ustifluvents, 0 to 4 percent slopes
- 3033B—Sappington-Amesha loams, 1 to 4 percent slopes
- 3033C—Sappington-Amesha loams, 4 to 8 percent slopes
- 3061E—Holter-Castner channery loams, 8 to 45 percent slopes
- 3064D—Windham channery loam, 4 to 15 percent slopes

3137B—Musselshell-Crago complex, 2 to 8 percent slopes
3141E—Crago-Pensore channery loams, 15 to 45 percent slopes
3218A—Meadowcreek-Fairway complex, 0 to 2 percent slopes
3233C—Geohrock-Crago very cobbly loams, 2 to 8 percent slopes
3433E—Crago-Musselshell gravelly loams, 4 to 35 percent slopes
3486F—Peeler-Rock outcrop complex, 15 to 60 percent slopes
3501B—Fluvaquents-Fluvaquentic Haplustolls complex, 0 to 4 percent slopes

3513A—Attewan-Nippt complex, 0 to 2 percent slopes
3532B—Geohrock gravelly loam, 2 to 8 percent slopes
3664E—Windham-Whitecow-Lap channery loams, 15 to 45 percent slopes
3685F—Whitecow channery loam, 25 to 60 percent slopes
3885F—Whitecow-Warneke channery loams, 15 to 45 percent slopes
DAM—Dam
M-W—Miscellaneous water
W—Water

Soil Survey of Jefferson County Area and Part of Silver Bow County, Montana

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

This part of the soil survey includes interpretations for various uses of the soils and data on soil properties. This information can be used to plan the use and management of soils for crops and pasture; as rangeland; as forest land; and as sites for buildings, sanitary facilities, and highways and other transportation systems. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Interpretive ratings help engineers, planners, and others understand how soil properties influence important nonagricultural uses, such as building site development and construction materials. The ratings indicate the most restrictive soil features affecting the suitability of the soils for these uses.

Soils are rated in their natural state. No unusual modification of the soil site or material is made other than that which is considered normal practice for the rated use. Even though soils may have limitations, it is important to remember that engineers and others can modify soil features or can design or adjust the plans for a structure to compensate for most of the limitations. Most of these practices, however, are costly. The final decision in selecting a site for a particular use generally involves weighing the costs of site preparation and maintenance.

The interpretive tables in this survey rate the soils in the survey area for various uses. Many of the tables

identify the limitations that affect specified uses and indicate the severity of those limitations. The ratings in these tables are both verbal and numerical.

Rating classes are expressed in the tables in terms that indicate the extent to which the soils are limited by all of the soil features that affect a specified use or in terms that indicate the suitability of the soils for the use. Thus, the tables may show limitation classes or suitability classes. Terms for the limitation classes are *not limited*, *somewhat limited*, and *very limited*. The suitability ratings are expressed as *well suited*, *moderately suited*, *poorly suited*, and *unsuited* or as *good*, *fair*, and *poor*.

Numerical ratings in the tables indicate the relative severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use and the point at which the soil feature is not a limitation. The limitations appear in order from the most limiting to the least limiting. Thus, if more than one limitation is identified, the most severe limitation is listed first and the least severe one is listed last.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The tables "Classification of the Soils" and "Acreage and Proportionate Extent of the Soils" are at the end of this section.

Agronomy

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The estimated yields of the main crops and pasture plants are listed, the system of land capability classification used by the Natural Resources Conservation Service is explained, and important farmland is described.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units" in Part I of this survey. Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

According to 1989 Montana agricultural statistics, the survey area includes about 77,100 acres of cropland. Of this total, about 15,000 acres is nonirrigated and 62,100 acres is under irrigation. The main crops include wheat, barley, and oats. Alfalfa and other grasses and legumes are used for hay and pasture.

The major areas in which dryland crops are produced are near Three Forks and Milligan Canyon and along the northern boundary of Jefferson County just south of East Helena. Most dryland crops are produced using a crop-fallow rotation. If moisture is available at planting time, fields may be recropped instead of fallowed.

Yields of nonirrigated crops near East Helena are generally higher and more consistent from year to year than in the southeastern part of Jefferson County. Major management concerns affecting dryland farming are the hazard of winter injury, a lack of snow cover, dry soil conditions, soil blowing, and calcareous soils.

Dryland farming yields generally can be maintained or improved by reducing the hazard of erosion, increasing the content of organic matter in the soil, controlling weeds and insects, applying fertilizer, and avoiding excess tillage.

Dryland pastures consist mainly of crested wheatgrass for spring grazing.

The major irrigated areas are along Pipestone and Whitetail Creeks and along the North Boulder and

Jefferson Rivers. The main crops grown under sprinkler and flooding irrigation are legumes, mixed grasses and legumes, and grasses grown for hay and pasture in rotation with small grain crops. Some annual legume specialty crops also are grown.

The main management concerns affecting irrigated cropland are proper management of irrigation water, weed control, and applications of fertilizer. Proper management of irrigation water, which includes timely applications and adequate amounts of water, helps to prevent overirrigation and the loss of nutrients and increases the life of the stands. Proper irrigation also helps to maintain higher production levels.

Pasture and hayland areas could be improved by reestablishing the desired grasses and legumes. Growing small grain crops for several years and then planting and maintaining a permanent cover for a period of 5 to 12 years can improve these areas.

Cropland Limitations and Hazards

The management concerns affecting the use of the detailed soil map units in the survey area for crops are shown in the table "Cropland Limitations and Hazards." The main concerns in managing nonirrigated cropland are conserving moisture, controlling soil blowing and water erosion, and maintaining soil fertility.

Conserving moisture consists primarily of reducing the evaporation and runoff rates and increasing the rate of water infiltration. Applying conservation tillage and conservation cropping systems, farming on the contour, stripcropping, establishing field windbreaks, and leaving crop residue on the surface conserve moisture.

Generally, a combination of several practices is needed to control *soil blowing* and *water erosion*. Conservation tillage, stripcropping, field windbreaks, contour farming, conservation cropping systems, crop residue management, terraces, diversions, and grassed waterways help to prevent excessive soil loss.

Measures that are effective in maintaining *soil fertility* include applying fertilizer, both organic and inorganic, including manure; incorporating crop residue or green manure crops into the soil; and using proper crop rotations. Controlling erosion helps to

prevent the loss of organic matter and plant nutrients and thus helps to maintain productivity, although the level of fertility can be reduced even in areas where erosion is controlled. All soils used for nonirrigated crops respond well to applications of fertilizer.

Some of the considerations shown in the table cannot be easily overcome. These are *channels*, *flooding*, *depth to rock*, *ponding*, *gullies*, and *lack of timely precipitation*. Additional considerations are as follows:

Areas of rock outcrop and areas of rubble land.—Farming around these areas may be feasible. Subsoiling or deep ripping soft sedimentary beds increases the effective rooting depth and the rate of water infiltration.

Excessive permeability.—This limitation causes deep leaching of nutrients and pesticides. The capacity of the soil to retain moisture for plant use is poor.

Lime content, limited available water capacity, poor tilth, and restricted permeability.—These limitations can be minimized by incorporating green manure crops, manure, or crop residue into the soil; applying a system of conservation tillage; and using conservation cropping systems. Also, crops may respond well to additions of phosphate fertilizer to soils that have a high content of lime.

Potential for ground-water contamination.—The proper use of nutrients and pesticides can reduce the risk of ground-water contamination.

Potential for surface-water contamination.—The risk of surface-water contamination can be reduced by the proper use of nutrients and pesticides and by conservation farming practices that reduce the runoff rate.

Rock fragments in the surface layer.—This limitation causes rapid wear of tillage equipment. It cannot be easily overcome.

Root-restrictive layer.—A cemented pan limits root development and may restrict the types of crops that can be grown.

Salt or sodium content.—In areas where this is a limitation, only salt- and sodium-tolerant crops should be grown.

Short frost-free period.—If the growing season is less than 90 days, short-season crops or grasses should be grown.

Slope.—Where the slope is more than 8 percent, water erosion and soil blowing may be accelerated unless conservation farming practices are applied.

Stones or boulders on the surface.—Stones or boulders on or near the surface can hinder normal tillage unless they are removed.

On irrigated soils the main management concerns

are *efficient water use*, *nutrient management*, *control of erosion*, *pest and weed control*, and *timely planting and harvesting* for a successful crop. An irrigation system that provides optimum control and distribution of water at minimum cost is needed. Overirrigation wastes water, leaches plant nutrients, and causes erosion. Also, it can create drainage problems, raise the water table, and increase soil salinity.

Explanation of Criteria

Areas of rock outcrop.—Rock outcrop is a named component of the map unit.

Areas of rubble land.—Rubble land is a named component of the map unit.

Channeled.—The word “channeled” is included in the map unit name.

Dense layer.—The bulk density is 1.80 g/cc or greater within the soil profile.

Depth to rock.—The depth to bedrock is less than 40 inches.

Excessive permeability.—The upper limit of the permeability range is 6 inches per hour or more within the soil profile.

Flooding.—The component of the map unit is occasionally flooded or frequently flooded.

Gullied.—The word “gullied” is included in the map unit name.

Lack of timely precipitation.—The component of the map unit has a Xeric moisture regime. The amount of annual precipitation is no more than 14 inches.

Lime content.—The component is assigned to wind erodibility group 4L or has more than 5 percent lime in the upper 10 inches.

Limited available water capacity.—The available water capacity calculated to a depth of 60 inches or to a root-limiting layer is 5 inches or less.

Ponding.—Ponding duration is assigned to the map unit component. The water table is above the surface.

Poor tilth.—The component of the map unit has more than 35 percent clay in the surface layer.

Potential for ground-water contamination.—The soil has a water table within a depth of 4 feet or hard bedrock within the profile, or permeability is more than 6 inches per hour within the soil.

Restricted permeability.—Permeability is 0.06 inch per hour or less within the soil profile.

Rock fragments in the surface layer.—The terms describing the texture of the surface layer include any rock fragment modifier, except for gravelly or channery, and “stones or boulders on the surface” are not already indicated as a limitation.

Root-restrictive layer.—A cemented pan is within 40 inches of the surface.

Salt content.—The electrical conductivity is 4 or

more in the surface layer or 8 or more within a depth of 30 inches.

Short frost-free period.—The map unit has a growing season of less than 90 frost-free days.

Slope.—The upper slope range of the component of the map unit is more than 8 percent.

Sodium content.—The sodium adsorption ratio of the component of the map unit is more than 13 within a depth of 30 inches.

Soil blowing.—The wind erodibility index multiplied by the selected high C factor for the survey area and then divided by the T factor is more than 8 for the component of the map unit.

Stones or boulders on the surface.—The terms describing the texture of the surface layer include any stony or bouldery modifier, or the soil is a stony or bouldery phase.

Surface crusting.—The sodium adsorption ratio in the surface layer is 5 or more for any texture and 4 or more if the texture is silt, silt loam, loam, or very fine sandy loam.

Water erosion.—The K factor of the surface layer multiplied by the upper slope limit is more than 2.

Water table.—The component of the map unit has a water table within a depth of 60 inches.

Crop Yield Estimates

The average yields per acre that can be expected of the principal crops under a high level of management are shown in the table “Land Capability and Yields per Acre of Crops and Pasture.” In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of map units in the survey area also is shown in the table.

The nonirrigated small grain yields represent a maximum potential estimated using a crop yield model based on Montana Agricultural Experiment Station Special Report 35. Basic assumptions in this model include soil moisture at field capacity to a depth of 40 inches, a 70 percent annual precipitation probability as published by the National Climatic Data Center, fertilization, and full control of pests and weeds. Yields of irrigated small grain crops are not provided in the table. The model has been validated with collected yield data.

Forage crop yields are estimates based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated

yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the forage crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in the table are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Pasture and Hayland Interpretations

Under good management, proper grazing is essential for the production of high-quality forage, stand survival, and erosion control. Proper grazing helps plants to maintain sufficient and generally vigorous top growth during the growing season. Brush control is essential in many areas, and weed control generally is needed. Rotation grazing and renovation also are important management practices.

Yield estimates are often indicated in animal unit months (AUM)—the amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about forage yields other than those shown in the table “Land Capability and Yields per Acre of Crops and Pasture.”

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded.

The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest land, or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have slight limitations that restrict their use.

Class 2 soils have moderate limitations that restrict the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that restrict the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that restrict the choice of plants or that require very careful management, or both.

Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forest land, or wildlife habitat.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forest land, or wildlife habitat.

Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forest land, or wildlife habitat.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, 3e. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used

in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, forest land, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, 2e-4 and 3e-6. These units are not given in all soil surveys.

The capability classification of map units in this survey area is given in the yields table.

Important Farmland

This section provides definitions of prime farmland and other kinds of important farmland. The soils in the survey area that are considered important farmland are listed in the table "Important Farmland" at the end of this section. This list does not constitute a recommendation for a particular land use. On some soils included in the list, 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. The extent of each listed map unit is shown in the table "Acreage and Proportionate Extent of the Soils." The location is shown on the detailed soil maps. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units" in Part I of this survey.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It 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, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, 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. It 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.

A recent trend in land use in some parts of the survey area 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

Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil qualities, location, growing season, and moisture supply needed for the economic production of sustained high yields of a specific high-quality crop when treated and managed by acceptable farming methods. Examples of such crops are citrus, tree nuts, olives, cranberries, and vegetables.

Unique farmland is used for a specific high-value food or fiber crop; has an adequate supply of available moisture for the specific crop because of stored moisture, precipitation, or irrigation; and has a combination of soil qualities, growing season, temperature, humidity, air drainage, elevation, aspect, and other factors, such as nearness to markets, that favors the production of a specific food or fiber crop.

Lists of unique farmland are developed as needed in cooperation with conservation districts and others.

Additional Farmland of Statewide Importance

Some areas other than areas of prime and unique farmland are of statewide importance in the production of food, feed, fiber, forage, and oilseed crops. The criteria used in defining and delineating these areas are determined by the appropriate state agency or

agencies. Generally, additional farmland of statewide importance includes areas that nearly meet the criteria for prime farmland and that economically produce high yields of crops when treated and managed by acceptable farming methods. Some areas can produce as high a yield as areas of prime farmland if conditions are favorable. In some states, additional farmland of statewide importance may include tracts of land that have been designed for agriculture by state law.

Farmland of statewide importance in the survey area is included in the table "Important Farmland." Criteria are provided in the Field Office Technical Guide, which is available in the local office of the Natural Resources Conservation Service.

Additional Farmland of Local Importance

This land consists of areas that are of local importance in the production of food, feed, fiber, forage, and oilseed crops and are not identified as having national or statewide importance. Where appropriate, this land is identified by local agencies. It may include tracts of land that have been designated for agriculture by local ordinance.

Lists of farmland of local importance are developed as needed in cooperation with conservation districts and others.

Erosion Factors

Soil erodibility (K) and soil-loss tolerance (T) factors are used in an equation that predicts the amount of soil lost through water erosion in areas of cropland. The procedure for predicting soil loss is useful in guiding the selection of soil and water conservation practices. The erosion factors for the soils in the survey area are listed in the table "Physical Properties of the Soils" under the heading "Soil Properties."

Soil Erodibility (K) Factor

The soil erodibility (K) factor indicates the susceptibility of a soil to sheet and rill erosion by water. The soil properties that influence erodibility are those that affect the infiltration rate, the movement of water through the soil, and the water storage capacity of the soil and those that allow the soil to resist dispersion, splashing, abrasion, and the transporting forces of rainfall and runoff. The most important soil properties are the content of silt plus very fine sand, the content of sand coarser than very fine sand, the content of organic matter, soil structure, and permeability.

Fragment-Free Soil Erodibility (Kf) Factor

This is one of the factors used in the revised Universal Soil Loss Equation. It shows the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Soil-Loss Tolerance (T) Factor

The soil-loss tolerance (T) factor is an estimate of the maximum annual rate of soil erosion that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons of soil loss per acre per year. Ratings of 1 to 5 are used, depending on soil properties and prior erosion. The criteria used in assigning a T factor to a soil include maintenance of an adequate rooting depth for crop production, potential reduction of crop yields, maintenance of water-control structures affected by sedimentation, prevention of gullyng, and the value of nutrients lost through erosion.

Wind Erodibility Groups

Wind erodibility is directly related to the percentage of dry, nonerodible surface soil aggregates larger than 0.84 millimeter in diameter. From this percentage, the wind erodibility index (I) factor is determined. This factor is an expression of the stability of the soil aggregates, or the extent to which they are broken down by tillage and the abrasion caused by windblown soil particles. Soils are assigned to wind erodibility groups (WEG) having similar percentages of dry soil aggregates larger than 0.84 millimeter. The wind erodibility groups and wind erodibility index numbers are listed in the table "Physical Properties of the Soils."

Additional information about wind erodibility groups and K, Kf, T, and I factors can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service.

Rangeland

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland or forest understory vegetation are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

The table “Rangeland and Grazeable Understory Productivity and Characteristic Plant Communities” shows, for each soil that supports vegetation suitable for grazing, the ecological site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. An explanation of the column headings in the table follows.

An *ecological site* is the product of all the environmental factors responsible for its development. It has characteristic soils that have developed over time throughout the soil development process; a characteristic hydrology, particularly infiltration and runoff, that has developed over time; and a characteristic plant community (kind and amount of vegetation). The hydrology of the site is influenced by development of the soil and plant community. The vegetation, soils, and hydrology are all interrelated. Each is influenced by the others and influences the development of the others. 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. Descriptions of ecological sites are provided in the Field Office Technical Guide, which is available in local offices of the Natural Resources Conservation Service.

Total dry-weight production is the amount of vegetation that can be expected to grow annually in a well managed area that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year’s growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a *favorable* year, the

amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a *normal* year, growing conditions are about average. In an *unfavorable* year, growing conditions are well below average, generally because of low available soil moisture. Yields are adjusted to a common percent of air-dry moisture content.

Characteristic native vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. The expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range similarity index and rangeland trend. Range similarity index is determined by comparing the present plant community with the potential natural plant community on a particular rangeland ecological site. The more closely the existing community resembles the potential community, the higher the range similarity index. Rangeland trend is defined as the direction of change in an existing plant community relative to the potential natural plant community. Further information about the range similarity index and rangeland trend is available in chapter 4 of the “National Range and Pasture Handbook” (<http://www.ftw.nrcs.usda.gov/glti/NRPH.html>).

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, an area with a range similarity index somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Forest Land

Forest Land Productivity

The table "Forest Land Productivity" at the end of this section can help woodland owners or forest managers plan the use of soils for wood crops. Only those soils suitable for wood crops are listed.

In the table, the *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as *volume* numbers. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume of wood fiber* is the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, cubic feet per acre per year, and board feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Suggested trees to plant are those that are suitable for commercial wood production.

Forest Access Roads

The major management concerns affecting the use of the detailed soil map units in the survey area for forest access roads are listed in the table "Limitations and Hazards Affecting Forest Access Roads." The significance of each limitation or hazard and the criteria used to determine the limitation or hazard are described in this section.

Areas of rock outcrop and *depth to bedrock* can increase the cost of road construction and influence route planning. Constructing the roads is difficult because of the need for rock removal and for additional soil material to provide a suitable road surface.

Boulders can increase the cost of road construction and influence route planning. Construction is difficult mainly because of the need for extraction and disposal of the boulders.

Dustiness of the road surface material may cause safety problems and accelerate equipment wear. Dust-abatement measures are needed during dry periods.

The erodibility of the soil material in the roadbed influences the probability of *water erosion* resulting from the channeling of runoff in the roadway. Erosion can result in the sedimentation of streams. It can be controlled by reducing road grades and controlling runoff onto and off of the road surface through the installation of drainage measures.

Flooding in the area where a road is constructed may restrict use, result in damage to the roadway, and result in the sedimentation of waterways. The hazard of flooding can be reduced by installing a drainage system, elevating the roadbed, and using riprap and diversions.

Low soil strength of the soil material used to construct the road surface can result in rutting, in drainage problems, and in poor trafficability during wet periods. The road should be used only during dry periods or when the surface is frozen. Surfacing with material of suitable strength and installing a drainage system can help to overcome this limitation.

Roadbed material that has a high *shrink-swell potential* shrinks and swells markedly during dry and wet periods. Excessive shrinking and swelling can damage the road surface or other features, such as bridge abutments, culverts, and erosion-control structures.

A steep *slope* results in increased construction and maintenance costs and increased sedimentation because of the large cuts necessary to create an adequate roadbed. Seeding the cut slope to suitable vegetation minimizes sedimentation. Large cuts can increase instability of the slope. Where slumping is a hazard, slope failure can become a significant maintenance and environmental problem. Areas where the slope is steep should not be used as sites for roads.

Slumping causes safety problems and increases maintenance costs. Frequent clearing of slumped soil

in the roadbed or rebuilding of the roadway may be needed to keep the road serviceable and drainage systems functioning.

Stones cause problems in maintaining a smooth road surface that has good trafficability. Unless the stones are removed, additions of suitable stone-free material may be needed when the road is surfaced.

Roads built across soils that have a *water table* may require substantial ballast, fabric, internal drainage systems, and other measures that maintain a road surface that has good trafficability. Construction and use of the road only during periods when the water table is not near the surface or when the road is frozen can help to maintain trafficability and reduce the potential for site damage.

Explanation of Criteria

Areas of rock outcrop.—Rock outcrop is a named component of the map unit.

Areas of rubble land.—Rubble land is a named component of the map unit.

Boulders.—The terms describing the texture within a depth of 24 inches include a bouldery modifier, or the soil is a bouldery phase.

Depth to rock.—Hard bedrock is within a depth of 60 inches.

Dustiness.—The surface layer is silt, silt loam, loam, or very fine sandy loam.

Erosion by water.—The K factor of the surface layer multiplied by the upper slope limit is more than 10.

Flooding.—The component of the map unit is occasionally flooded or frequently flooded.

Low soil strength.—The component of the map unit has one of the following Unified classifications within the 60-inch profile: ML, CL, MH, CH, OL, PT, or GC.

Shrink-swell potential.—The component of the map unit has a high shrink-swell potential in a layer that is at least 10 inches thick and is within 40 inches of the surface.

Slope.—The upper slope limit is more than 35 percent.

Slumping.—The component of the map unit meets the requirements for low soil strength and has slopes of more than 35 percent.

Stones.—The terms describing the texture within a depth of 24 inches include a very stony or extremely stony modifier, or the soil is a very stony or extremely stony phase.

Water table.—The component of the map unit has a water table within a depth of 60 inches.

General Land Management

This section provides interpretations applicable across a wide spectrum of land uses. These interpretations reflect the hazard of soil degradation resulting from erosion in areas of exposed soil, the risk of damage during the development of unsurfaced roads, the risk of damage caused by fire, and the hazard of soil rutting when the soil is subject to traffic in moist or wet conditions. The ratings are given in the table “Land Management” at the end of this section.

Ratings in the column *hazard of off-road erosion* are based on slope and on soil erodibility factor K. The soil loss is caused by sheet or rill erosion in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by such disturbances as traffic, logging, grazing, or mining. The hazard is described as slight, moderate, severe, or very severe. A rating of *slight* indicates that erosion is unlikely under ordinary climatic conditions; *moderate* indicates that some erosion is likely and that erosion-control measures may be needed; *severe* indicates that erosion is very likely and that erosion-control measures, including revegetation of bare areas, are advised; and *very severe* indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

Ratings in the column *hazard of erosion on roads* are based on the soil erodibility factor K, slope, and content of rock fragments. The ratings apply to

unsurfaced roads and trails. The hazard is described as slight, moderate, or severe. A rating of *slight* indicates that little or no erosion is likely; *moderate* indicates that some erosion is likely, that the roads or trails may require occasional maintenance, and that simple erosion-control measures are needed; and *severe* indicates that significant erosion is expected, that the roads or trails require frequent maintenance, and that costly erosion-control measures are needed.

Ratings in the column *potential for damage to soil by fire* are based on texture of the surface layer, content of rock fragments and organic matter in the surface layer, thickness of the surface layer, and slope. The soils are described as having a low, moderate, or high potential for this kind of damage. The ratings indicate an evaluation of the potential impact of prescribed fires or wildfires that are intense enough to remove a duff layer and consume organic matter in the surface layer.

Ratings in the column *soil rutting hazard* are based on depth to a water table, rock fragments on or below the surface, the Unified classification, depth to a restrictive layer, and slope. Ruts form as a result of equipment or vehicle operation under moist or wet soil conditions. The hazard is described as slight, moderate, or severe. A rating of *slight* indicates that the soil is subject to little or no rutting, *moderate* indicates that rutting is likely, and *severe* indicates that ruts form readily.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, construction materials, and water management. The ratings are based on observed performance of the soils and on the data in the tables described under the heading "Soil Properties."

Information in this section 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 section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about particle-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 7 feet of the surface, soil wetness, depth to a water table, ponding, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial,

industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for septic tank absorption fields; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

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. The table "Building Site Development" at the end of this section shows the degree and kind of soil limitations that affect septic tank absorption fields and dwellings with and without basements.

The ratings in the tables 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 tables 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).

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. Permeability, depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Stones and boulders, ice, and bedrock or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the distribution lines. In these soils the absorption field may not adequately filter the effluent, particularly when the system is new. As a result, the ground water may become contaminated.

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

a cemented pan, and the amount and size of rock fragments.

Waste Management

Soil properties are important when organic waste is applied as fertilizer and wastewater is applied in irrigated areas. They also are important when the soil is used as a medium for the treatment and disposal of the organic waste and wastewater. Unfavorable soil properties can result in environmental damage.

The use of organic waste and wastewater as production resources results in energy and resource conservation and minimizes the problems associated with waste disposal. If disposal is the goal, applying a maximum amount of the organic waste or the wastewater to a minimal area holds costs to a minimum and environmental damage is the main hazard. If reuse is the goal, a minimum amount should be applied to a maximum area and environmental damage is unlikely.

Interpretations developed for waste management may include ratings for manure- and food-processing waste, municipal sewage sludge, use of wastewater for irrigation, and treatment of wastewater by slow rate, overland flow, and rapid infiltration processes.

Specific information regarding waste management is available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Construction Materials

The table "Construction Material Potential" at the end of this section provides information about the soils as potential sources of gravel, sand, roadfill, and topsoil. Normal compaction, minor processing, and other standard construction practices are assumed.

The numerical ratings in the table are percentages indicating the probability that the soil is a source of the material.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In the table, only the likelihood of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material. The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the

bottom layer of the soil contains sand or gravel, the soil is considered a likely source regardless of thickness. The assumption is that the sand or gravel layer below the depth of observation exceeds the minimum thickness.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area. The ratings are based on the soil properties that affect plant growth; the ease of excavating, loading, and spreading the material; and reclamation of the borrow area. Toxic substances, soil reaction, and the properties that are inferred from soil texture, such as available water capacity and fertility, affect plant growth. The ease of excavating, loading, and spreading is affected by rock fragments, slope, depth to a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, depth to a water table, rock fragments, depth to bedrock or a cemented pan, and toxic material.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the whole soil, from the surface to a depth of about 5 feet. It is assumed that soil layers will be mixed when the soil material is excavated and spread.

The ratings are based on the amount of suitable material and on soil properties that affect the ease of excavation and the performance of the material after it is in place. The thickness of the suitable material is a major consideration. The ease of excavation is affected by large stones, depth to a water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the AASHTO classification of the soil) and linear extensibility (shrink-swell potential).

Water Management

The “Water Management” table at the end of this section provides information on the soil properties and site features that affect water management. Ratings

are given for constructing grassed waterways, vegetating grassed waterways and filter strips, and irrigating using a sprinkler method. 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 these uses. *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. *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. *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 tables 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).

Grassed waterways are natural or constructed channels, generally broad and shallow, that are seeded with erosion-resistant sod-forming grasses. They are used to conduct surface water to outlets at a nonerosive velocity and help to contain and absorb water-borne materials.

Filter strips are strips of permanent vegetation that retard the flow of runoff water. They are established above farm ponds, diversion terraces, and other structures.

The soil properties and qualities that affect the construction and maintenance of grassed waterways are permeability, large stones, slope, depth to the water table, and depth to bedrock or a cemented pan. The soil properties and qualities that affect the growth and maintenance of vegetation after construction are moisture regime, susceptibility to soil blowing or water erosion, available water capacity, rooting depth, salinity, sodicity, and permeability.

Sprinkler irrigation is the controlled application of water to supplement rainfall and support plant growth. The soil properties and qualities important in the design and management of sprinkler irrigation systems include the sodium adsorption ratio, the depth to a seasonal high water table, the available water capacity, permeability, wind erodibility, erosion factor K, slope, and flooding. Soil properties and qualities

that influence the installation of a sprinkler irrigation system include surface rock fragments, surface topography, and slope. Soil properties that affect the

performance of sprinkler irrigation systems include the depth to bedrock or a cemented pan, bulk density, the sodium adsorption ratio, salinity, and soil reaction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey.

Soil properties are ascertained by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine particle-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties are shown in tables. They include engineering index properties, physical and chemical properties, and pertinent soil and water features.

Engineering Index Properties

The table “Engineering Index Properties” at the end of this section gives the engineering classifications and the range of index 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.” Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2001) and the system adopted by the American Association

of State Highway and Transportation Officials (AASHTO, 2000).

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.

The estimates of particle-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is generally omitted in the table.

Physical Properties

The table "Physical Properties of the Soils" at the end of this section 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.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In the 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 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, permeability, 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 $\frac{1}{3}$ - or $\frac{1}{10}$ -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 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.

K_{sat} (permeability) refers to the ability of a soil to transmit water or air. The term "permeability," as used in soil surveys, indicates saturated hydraulic conductivity (K_{sat}). The estimates in the table indicate the rate of water movement, in inches per hour, when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

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.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; *high*, 6 to 9 percent; and *very high*, more than 9 percent.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In the

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 permeability. 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 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 soil blowing in cultivated areas. The soils assigned to group 1 are the most susceptible to soil blowing, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.
- 4L. Calcareous loams, silt loams, clay loams, and silty clay loams.
4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5. Noncalcareous loams and silt loams that are

less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.

8. Soils that are not subject to soil blowing because of rock fragments on the surface or because of surface wetness.

Wind erodibility index is a numerical value indicating the susceptibility of soil to soil blowing, or the tons per acre per year that can be expected to be lost to soil blowing. There is a close correlation between soil blowing 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 soil blowing.

Chemical Properties

The table "Chemical Properties of the Soils" at the end of this section shows estimates of some chemical 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.

Cation-exchange capacity is the total amount of extractable bases that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations reduces the hazard of ground-water pollution.

Soil reaction is a measure of acidity or alkalinity. The pH of each soil horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Calcium carbonate equivalent is the percent of carbonates, by weight, in the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients is influenced by the amount of carbonates in the soil. Incorporating nitrogen fertilizer into calcareous soils helps to prevent nitrite accumulation and ammonium-N volatilization.

Gypsum is expressed as a percent, by weight, of hydrated calcium sulfates in the fraction of the soil less than 20 millimeters in size. Gypsum is partially soluble in water. Soils that have a high content of gypsum may collapse if the gypsum is removed by percolating water.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Sodium adsorption ratio (SAR) is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. Soils that have SAR values of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced permeability and aeration, and a general degradation of soil structure.

Water Features

The table "Water Features" at the end of this section gives estimates of various 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.

The *months* in the table indicate the portion of the year in which the feature is most likely to be a concern.

Water table refers to a saturated zone in the soil. The 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 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.

Soil Features

The table “Soil Features” at the end of this section gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

In the table, *restrictions* refer to a restrictive layer in the soil—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 thickness of the restrictive layer, which significantly affects the ease of excavation. *Depth* 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 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, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

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

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

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

References

Alt and Hyndman. 1991. Roadside geology of Montana.

American Association of State Highway and Transportation Officials (AASHTO). 2000. Standard specifications for transportation materials and methods of sampling and testing. 20th edition, 2 volumes.

American Society for Testing and Materials (ASTM). 2001. Standard classification of soils for engineering purposes. ASTM Standard D 2487-00.

Campbell. 1978. Caves of Montana. Montana Bureau of Mines and Geology, Bulletin 105.

Roby, R.N., and others. 1960. Mines and mineral deposits of Jefferson County, Montana. Montana Bureau of Mines and Geology, Bulletin 16.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. (<http://soils.usda.gov/technical/manual/>)

Soil Survey Staff. 1998. Keys to soil taxonomy. 8th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. (http://soils.usda.gov/technical/classification/tax_keys/)

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436. (<http://soils.usda.gov/technical/classification/taxonomy/>)

Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. See Sodic (alkali) soil.

Alluvial fan. A body of alluvium, with overflow of water and debris flow deposits, whose surface forms a segment of a cone that radiates downslope from the point where the stream emerges from a narrow valley onto a less sloping surface. Source uplands range in relief and area extent from mountains to gullied terrains on hillslopes.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Alpha,alpha-dipyridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Argillite. Weakly metamorphosed mudstone or shale.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the

amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3.75
Low	3.75 to 5.0
Moderate	5.0 to 7.5
High	more than 7.5

Avalanche chute. The track or path formed by an avalanche.

Backslope. The geomorphic component that forms the steepest inclined surface and principal element of many hillslopes. Backslopes in profile are commonly steep and linear and descend to a footslope. In terms of gradational process, backslopes are erosional forms produced mainly by mass wasting and running water.

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Base slope. A geomorphic component of hills consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

Bedding planes. Fine strata, less than 5 millimeters

thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-floored plain. An extensive nearly level to gently rolling or moderately sloping area that is underlain by hard bedrock and has a slope of 0 to 8 percent.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Board foot. A unit of measure of the wood in lumber, logs, or trees. The amount of wood in a board 1 foot wide, 1 foot long, and 1 inch thick before finishing.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Bouldery. Refers to a soil in an area where 0.01 to 0.1 percent of the surface is covered with boulders.

Bouldery soil material. Soil that is 15 to 35 percent, by volume, rock fragments that are dominantly larger than 24 inches (60 centimeters) in diameter.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Breast height. An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Cable yarding. A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees

generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds directly beneath the solum, or it is exposed at the surface by erosion.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channeled. Refers to a drainage area in which natural meandering or repeated branching and convergence of a streambed have created deeply incised cuts, either active or abandoned, in alluvial material.

Channery soil material. Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Cirque. A semicircular, concave, bowl-like area that has steep faces primarily resulting from glacial ice and snow abrasion.

- Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.
- Claypan.** A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.
- Clearcut.** A method of forest harvesting that removes the entire stand of trees in one cutting. Reproduction is achieved artificially or by natural seeding from the adjacent stands.
- Climax plant community.** The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.
- Closed depression.** A low area completely surrounded by higher ground and having no natural outlet.
- Coarse textured soil.** Sand or loamy sand.
- Cobble (or cobblestone).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.
- Cobbly soil material.** Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.
- Codominant trees.** Trees whose crowns form the general level of the forest canopy and that receive full light from above but comparatively little from the sides.
- COLE (coefficient of linear extensibility).** See Linear extensibility.
- Colluvium.** Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.
- Commercial forest.** Forestland capable of producing 20 cubic feet or more per acre per year at the culmination of the mean annual increment.
- Complex, soil.** A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.
- Complex slope.** Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.
- Concretions.** Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.
- Conglomerate.** A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.
- Conservation cropping system.** Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.
- Conservation tillage.** A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.
- Consistence, soil.** Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."
- Consolidated sandstone.** Sandstone that disperses within a few hours when fragments are placed in water. The fragments are extremely hard or very hard when dry, are not easily crushed, and cannot be textured by the usual field method.
- Consolidated shale.** Shale that disperses within a few hours when fragments are placed in water. The fragments are extremely hard or very hard when dry and are not easily crushed.
- Contour stripcropping.** Growing crops in strips that

follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace). A ridge of earth,

generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Dominant trees. Trees whose crowns form the general level of the forest canopy and that receive full light from above and from the sides.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained*, *somewhat excessively drained*, *well drained*, *moderately well drained*, *somewhat poorly drained*, *poorly drained*, and *very poorly drained*. These classes are defined in the "Soil Survey Manual."

Drainageway. An area of ground at a lower elevation than the surrounding ground and in which water collects and is drained to a closed depression or lake or to a drainageway at a lower elevation. A drainageway may or may not have distinctly incised channels at its upper reaches or throughout its course.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Dune. A mound, ridge, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation.

Ecological site. An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the

product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Esker. A long, narrow, sinuous, steep-sided ridge composed of irregularly stratified sand and gravel that were deposited by a subsurface stream flowing between ice walls or through ice tunnels of a retreating glacier and that were left behind when the ice melted. Eskers range from less than a mile to more than 100 miles in length and from 10 to 100 feet in height.

Even aged. Refers to a stand of trees in which only small differences in age occur between individual trees. A range of 20 years is allowed.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flaggy soil material. Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as

much as 1,000 feet (300 meters) and fringes a mountain range or high-plateau escarpment.

Footslope. The geomorphic component that forms the inner, gently inclined surface at the base of a hillslope. In profile, footslopes are commonly concave. In terms of gradational processes, a footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Giant ripple mark. The undulating surface sculpture produced in noncoherent granular materials by currents of water and by the agitation of water in wave action during the drainage of large glacial lakes, such as Glacial Lake Missoula.

Glacial drift. Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash. Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciated uplands. Land areas that were previously covered by continental or alpine glaciers and that are at a higher elevation than the flood plain.

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited

in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter. Very gravelly soil is 35 to 60 percent gravel, and extremely gravelly soil is more than 60 percent gravel.

Grazeable forestland. Land capable of sustaining livestock grazing by producing forage of sufficient quantity during one or more stages of secondary forest succession.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water. Water filling all the unblocked pores of the material below the water table.

Grus. The fragmental products of in-situ granular disintegration of granite and granitic rocks.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Gypsum. A mineral consisting of hydrous calcium sulfate.

Habitat type. An aggregation of all land areas capable of producing similar climax plant communities.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head out. To form a flower head.

Head slope. A geomorphic component of hills

consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Heavy metal. Inorganic substances that are solid at ordinary temperatures and are not soluble in water. They form oxides and hydroxides that are basic. Examples are copper, iron, cadmium, zinc, manganese, lead, and arsenic.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasesers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasesers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be

limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Interfluve. An elevated area between two drainageways that sheds water to those drainageways.

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made

by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Kame terrace. A terracelike ridge consisting of stratified sand and gravel that were deposited by a meltwater stream flowing between a melting glacier and a higher valley wall or lateral moraine and that remained after the disappearance of the ice. It is commonly pitted with kettles and has an irregular ice-contact slope.

K_{sat} . Saturated hydraulic conductivity. (See Permeability.)

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain. A surface marking the floor of an extinct lake, filled in by well sorted, stratified sediments.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Lateral moraine. A ridgelike moraine carried on and deposited at the side margin of a valley glacier. It is composed chiefly of rock fragments derived from the valley walls by glacial abrasion and plucking or by mass wasting.

Leaching. The removal of soluble material from soil or other material by percolating water.

Linear extensibility. Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. 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. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

- Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.
- Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.
- Loamy soil.** Coarse sandy loam, sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam, silt, clay loam, sandy clay loam, or silty clay loam.
- Loess.** Fine grained material, dominantly of silt-sized particles, deposited by wind.
- Low-residue crops.** Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.
- Low strength.** The soil is not strong enough to support loads.
- Marl.** An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.
- Masses.** Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.
- Mean annual increment (MAI).** The average annual increase in volume of a tree during its entire life.
- Mechanical treatment.** Use of mechanical equipment for seeding, brush management, and other management practices.
- Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.
- Merchantable trees.** Trees that are of sufficient size to be economically processed into wood products.
- Metamorphic rock.** Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.
- Microhigh.** An area that is 2 to 12 inches higher than the adjacent microlow.
- Microlow.** An area that is 2 to 12 inches lower than the adjacent microhigh.
- Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.
- Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.
- Miscellaneous area.** An area that has little or no natural soil and supports little or no vegetation.
- Moderately coarse textured soil.** Coarse sandy loam, sandy loam, or fine sandy loam.
- Moderately fine textured soil.** Clay loam, sandy clay loam, or silty clay loam.
- Mollic epipedon.** A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.
- Moraine.** An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.
- Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.
- Mountain.** A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range.
- Muck.** Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)
- Mudstone.** Sedimentary rock formed by induration of silt and clay in approximately equal amounts.
- Munsell notation.** A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.
- Natric horizon.** A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.
- Naturalized pasture.** Forestland that is used primarily for the production of forage for grazing by livestock rather than for wood products. Overstory trees are removed or managed in a way that promotes the native and introduced understory vegetation on the site. This vegetation is managed for its forage value through the application of grazing management principles.
- Neutral soil.** A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)
- Nose slope.** A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent.
- Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium,

magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Overstory. The trees in a forest that form the upper crown cover.

Oxbow. The horseshoe-shaped channel of a former meander, remaining after the stream formed a cutoff across a narrow meander neck.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan*, *fragipan*, *claypan*, *plowpan*, and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms

describing permeability, measured in inches per hour, are as follows:

Impermeable	less than 0.0015 inch
Very slow	0.0015 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Playa. The generally dry and nearly level lake plain that occupies the lowest parts of closed depressional areas, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential natural community (PNC). The biotic community that would become established on an ecological site if all successional sequences were completed without interference by human activities under the present environmental conditions. Natural disturbances are inherent in its development. The PNC may include acclimatized or naturalized nonnative species.

Potential rooting depth (effective rooting depth).

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Quartzite, metamorphic. Rock consisting mainly of quartz that formed through recrystallization of quartz-rich sandstone or chert.

Quartzite, sedimentary. Very hard but unmetamorphosed sandstone consisting chiefly of quartz grains.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. (See Similarity index.)

Range site. See Ecological site.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Recessional moraine. A moraine formed during a

temporary but significant halt in the retreat of a glacier.

Red beds. Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redox concentrations. See Redoximorphic concentrations.

Redox depletions. See Redoximorphic depletions.

Redox features. See Redoximorphic features.

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regeneration. The new growth of a natural plant community, developing from seed.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relict stream terrace. One of a series of platforms in or adjacent to a stream valley that formed prior to the current stream system.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Riser. The relatively short, steeply sloping area below a terrace tread that grades to a lower terrace tread or base level.

Road cut. A sloping surface produced by mechanical

means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salinity. The electrical conductivity of a saline soil. It is expressed, in millimhos per centimeter, as follows:

Nonsaline	0 to 4
Slightly saline	4 to 8
Moderately saline	8 to 16
Strongly saline	more than 16

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sandy soil. Sand or loamy sand.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Sawlogs. Logs of suitable size and quality for the production of lumber.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Scribner's log rule. A method of estimating the number of board feet that can be cut from a log of a given diameter and length.

Sedimentary plain. An extensive nearly level to gently rolling or moderately sloping area that is underlain by sedimentary bedrock and that has a slope of 0 to 8 percent.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Sedimentary uplands. Land areas of bedrock formed from water- or wind-deposited sediments. They are higher on the landscape than the flood plain.

Semiconsolidated sedimentary beds. Soft geologic sediments that disperse when fragments are placed in water. The fragments are hard or very hard when dry. Determining the texture by the usual field method is difficult.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder. The position that forms the uppermost inclined surface near the top of a hillslope. It is a transition from backslope to summit. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Side slope. A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner,

and have similar conservation needs or management requirements for the major land uses in the survey area.

Similarity index. The percentage of a specific vegetation-state plant community that is presently on the site.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Skid trails. Pathways along which logs are dragged to a common site for loading onto a logging truck.

Slash. The branches, bark, treetops, reject logs, and broken or uprooted trees left on the ground after logging.

Slickens. Accumulations of fine textured material, such as that separated in placer-mine and ore-mill operations. Slickens from ore mills consist largely of freshly ground rock that commonly has undergone chemical treatment during the milling process. Slickens are commonly confined in a specially constructed basin.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

Nearly level	0 to 2 percent
Gently sloping	2 to 4 percent
Moderately sloping	4 to 8 percent
Strongly sloping	8 to 15 percent
Moderately steep	15 to 25 percent
Steep	25 to 45 percent
Very steep	more than 45 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specified use.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent

or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Sodium adsorption ratio (SAR). A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage. In an area of stony soil, stones cover 0.01 to 0.1 percent of the surface. Very stony means that stones cover 0.1 to

3.0 percent of the surface, and extremely stony means that stones cover 3 to 15 percent of the surface.

Strath terrace. A type of stream terrace, formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

Stream channel. The hollow bed where a natural stream of surface water flows or may flow; the deepest or central part of the bed, formed by the main current and covered more or less continuously by water.

Strippcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Summit. The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Tailwater. The water directly downstream from a structure.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Terracette. A small, irregular, steplike form on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may or may not be induced by trampling of livestock.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Till plain. An extensive nearly level to gently rolling or moderately sloping area that is underlain by or consists of till and that has a slope of 0 to 8 percent.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope. The position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a

hillslope continuum that grades to valley or closed-depression floors.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Trafficability. The degree to which a soil is capable of supporting vehicular traffic across a wide range in soil moisture conditions.

Tread. The relatively flat terrace surface that was cut or built by stream or wave action.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Understory. Any plants in a forest community that grow to a height of less than 5 feet.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley. An elongated depressional area primarily developed by stream action.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

NRCS Accessibility Statement

The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at <http://offices.sc.egov.usda.gov/locator/app>.