Soils Technical Report

Fidelity Exploration and Development
Dry Creek Plan of Development
November, 2004

Contents

Soil Survey of the Big Horn Area Montana……...……1
Formation and Classification of the Soil……...……1
Climate……...……4
Geology……..6
Component Legend…….……10
Mapunit Descriptions…….……..12
Prime and Important Farmland……....23
Chemical Properties of the Soils……..……24
Physical Properties of the Soils……....26
Rutting Hazard……....30
Definitions……...…….33
Official Series Descriptions…….....36

Prepared by:
Bureau of Land Management
Miles City Field Office
Miles City, Montana

Soil Survey of Big Horn Country Area, Montana

Major field work for this soil survey was completed in the period 1962-70. Series names and descriptions were approved in 1970. Data in the soil survey refers to conditions in the area in 1971. This survey was made cooperatively by the Soil Conservation Service, (now Natural Resources Conservation Service), the Bureau of Indian Affairs, Missouri River Basin Investigations Project; and the Montana Agricultural Experiment Station.

Data used in this report uses National Soil Information System (NASIS) data combined with Soil Survey Geographic (SSURGO) data: The SSURGO data are the geographic component (GIS layer) for each soil survey unit. The NASIS data are Microsoft Access database files containing the attribute data related to the GIS polygon layer for each soil survey unit. The repository for this information is the Soil Data Mart at: http://soildatamart.nrcs.usda.gov/. The National NRCS NASIS home page is at: http://nasis.nrcs.usda.gov/.

Formation and Classification of the Soils

Formation of the Soils

Soil is developed by the action of soil-forming processes on material deposited or accumulated by geologic forces. The characteristics of a soil at any given point depends on the physical and mineralogical composition of the parent material; past and present climate under which the soil material has existed since initial development; the plant and animal life on and in the soil; topographic relief; and the length of time the forces of soil development have acted on the soil material.

All five of these factors are important in the genesis of each soil. Some have had more influence than other on a given soil. In this area, climate and parent material have had the greatest influence on soil forming processes and present characteristics and are expanded upon within this document.

Climate

Climate, an active force in the formation of soils, is determined mainly by temperature and precipitation. Erosion and alternate freezing and thawing break down rock into material from which soils form. Water and wind are active agents in transporting and separating weathered material. The weathered material is further broken down by chemical reactions such as solution and hydration. Precipitation and temperature affect the kind and amount of native vegetation that grows on the soil. Vegetation decays to produce organic matter that subsequently becomes part of the soil. Soils with cool temperatures and higher precipitation generally have a dark-colored surface layer. Soils with warm temperatures and lower precipitation generally have a light-colored surface layer. In this area, precipitation is 10 to 16 inches per year, and mean annual temperature is 40 to 46 degrees F.

Living Organisms

Living organisms are active in the formation of soils. Organic matter is the main source of the dark color of the surface layer of soils. Fungi and algae are among the earliest inhabitants of the rock material that contribute to the decomposition of rock. As the rock decomposes, grasses, shrubs, and trees are able to grow and support animal life.

The kinds and amounts of plants and animals present largely determine the kinds and amount of organic matter added to the soil, and the manner in which this matter is incorporated into the mineral part of the soil. Roots, rodents, and insects penetrate the soil and influence its structure. Leaves, roots, and whole plants

remain in the surface layer where they are changed to humus by micro-organisms, chemicals in the soil, and insects.

The native vegetation in this area consists of short and mid grasses, forbs, shrubs, and trees. Trees are commonly juniper with minor amounts of ponderosa pine. Big Sagebrush is the most common shrub and western wheatgrass, green needlegrass, bluebunch wheatgrass, and little bluestem are the dominate grass species.

Common rodents effecting soil characteristics are gophers, prairie dogs, badgers, rabbits, and field mice. Many of the pebbles and cobbles on the surface were brought up by burrowing rodents.

Topography

Topography is determined by the uplift of mountain masses and the resistance of geologic formations to erosion by water and wind. In the uplands of this area, runoff water has eroded deep valleys into the bedrock. The rugged relief contrasts sharply with the smooth, low relief of the terraces and flood plains of the river valleys.

On the uplands the number, distinctness, and thickness of the soil horizons decreases as slope increases. Steep soils on which runoff is rapid have many characteristics similar to those of soils that formed in arid climates. Nearly level to moderately sloping soils that receive runoff water from soils above have many characteristics of soils that formed in a more humid climate. Erosion on steeper slopes removes surface material and limits soil development.

Parent material

Many of the soils in this area formed in place over semiconsolidated sedimentary beds or shale. Some soils formed in alluvium and colluvium and were deposited in valleys and on bordering uplands. Soils take on the textural characteristics of the material they formed in. Some soils in the area have salt and sodium derived from the parent material. The salts and sodium make these soils saline, alkaline, or saline-alkaline, and limit the kind and amount of plants that can grow on them. The density of the parent rock and its mineral composition can limit the rate of weathering and the depth of soils.

Time

The changes that take place in a soil over time are called soil genesis. These changes give the soil distinct horizons. The kinds and arrangement of these horizons are called soil morphology and can be described in terms of color, texture, structure, consistence, thickness, and permeability.

Soils can be classified according to their approximate age, from young to mature. The age or maturity of a soil is generally indicated by the thickness and distinctness of the subsurface horizons, the content of the organic matter and clay, the depth to which soluble material is leached, and the form and distribution of calcium carbonate and gypsum.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (Soil Survey Staff, 1998). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil forming processes and the degree of soil formation. Each order is identified by a word ending in sol. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (Aqu, meaning water, plus ent, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Fluvaquents (fluv, meaning flood plain, plus aquent, the suborder of the Entisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group but do not indicate transitions to any other known kind of soil. The adjective Typic identifies the subgroup that typifies the great group. An example is Typic Fluvaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties the characteristics considered are particle-size class, mineral content, temperature regime, thickness of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, calcareous, frigid Typic Fluvaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series. An example is the Deephole series which is a fine-loamy, mixed, calcareous, frigid Typic Fluvaquent.

Classification of soils effected by this project are found in the Official Soils Description starting on page 36 of this document.

References cited

Soil Survey Staff, 1998, Keys to Soil Taxonomy, United States Department of Agriculture, Natural Resources Conservation Service.

Climate

The climate of the area is characterized by cold dry winters, cool moist springs, hot moderately dry summers and cool dry falls. The area has a modified continental climate and is subject to air masses from several sources. During winter the coldest weather comes from a few Artic air invasions, often supplanted in a few days later by warmer air from the Pacific – sometimes borne on Chinook winds. Spring and early summer are the wettest parts of the year. The heaviest rain is during storms from the Gulf of Mexico, mostly in May and June. Midsummer afternoon thunder storms occur about 25 to 35 days a year, often accompanied by hail and gusty winds. The tables below give temperature and precipitation recorded at nearby stations: Birney, Decker, and Kirby. Data is from the Western Regional Climate Center: http://www.wrcc.dri.edu/climsum.html.

BIRNEY, MONTANA (240819)

Period of Record: 11/13/1954 to 2/ 7/2001

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	33.1	40.4	49.7	61.5	71.6	80.8	89.5	88.5	76.6	64.1	45.0	36.0	61.4
Average Min. Temperature (F)	4.9	11.6	20.5	30.1	40.0	48.8	53.3	51.0	40.7	30.3	18.0	8.6	29.8
Average Total Precipitation (in.)	0.51	0.38	0.65	1.41	2.11	2.64	1.26	0.95	1.07	1.00	0.70	0.50	13.16
Average Total Snow Fall (in.)	6.9	5.4	3.3	3.2	0.2	0.0	0.0	0.0	0.3	0.6	3.6	6.5	30.0
Average Snow Depth (in.)	4	3	1	0	0	0	0	0	0	0	1	2	1

Percent of possible observations for period of record.
Max. Temp.: 95.5% Min. Temp.: 95.7% Precipitation: 95.4% Snowfall: 88.1% Snow Depth: 81.9%

DECKER 1 E, MONTANA (242266)

Period of Record: 4/ 1/1950 to 12/31/2003

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)					Insuff	icient	Data						
Average Min. Temperature (F)					Insuff	icient	Data						
Average Total Precipitation (in.)	0.48	0.34	0.63	1.32	1.92	2.21	1.12	0.88	1.07	0.85	0.61	0.50	11.92
Average Total Snow Fall (in.)	4.1	2.9	3.2	0.9	0.0	0.0	0.0	0.0	0.6	0.4	2.4	4.3	19.0
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 0.5% Min. Temp.: 0.5% Precipitation: 84.9% Snowfall: 68.8% Snow Depth: 44%

KIRBY 1 S, MONTANA (244701)

Period of Record: 11/7/1959 to 7/31/1975

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	33.3	39.4	45.3	56.1	66.6	76.5	86.9	86.5	72.7	62.3	46.6	37.0	59.1
Average Min. Temperature (F)	5.3	11.6	16.8	26.9	35.6	43.3	47.2	45.2	36.2	27.8	18.1	8.9	26.9
Average Total Precipitation (in.)	1.46	1.08	1.20	2.23	2.50	2.94	1.03	1.65	1.77	1.40	0.88	1.11	19.24
Average Total Snow Fall (in.)	17.6	16.6	11.3	9.9	0.7	0.1	0.0	0.0	1.6	1.5	6.6	14.6	80.6
Average Snow Depth (in.)	6	5	2	0	0	0	0	0	0	0	1	3	1

Percent of possible observations for period of record.
Max. Temp.: 99.3% Min. Temp.: 98.8% Precipitation: 99.4% Snowfall: 94.2% Snow Depth: 97.5%

Geology

The area lies within the Unglaciated Missouri Plateau section of the Northern Great Plains Province. The region is underlain by sedimentary rocks, predominantly sandstone, siltstone, and shale.

The terrain of the area is characterized by wide valleys and undulating to steep dissected uplands. Outcrops of sandstone or clinker form ridges and buttes. These topographical forms are local expressions of the hardness of strata and their differential resistance to erosion.

The Tongue River is the major river in the project area. Generally the river is bordered by wide alluvial terraces separated by low bedrock bluffs that are gently sloping to steep and several hundred feet higher than the terraces.

Upland surfaces show that a long period of down cutting has taken place to successionally lower the stream base level. Evidence of this erosion cycle are plateau like upland surfaces and river gravel found capping some upland areas. The terraces near the river are early Pleistocene in age, formed during the glacial epoch. The valley bottoms formed during and after the retreat of glacial ice from northern Montana. At the present time, streams are in a cycle of down cutting.

Bare steep slopes of rugged badlands occur in isolated areas in the region. The badlands are most often formed in the soft erosive shale of the Lebo Member of the Fort Union Formation.

Structure

The area lies within the northern portion of the Powder River Basin. The Powder River Basin is a broad gentle syncline which extends from southeastern Montana to southeastern Wyoming. The northern part of the basin ends at a structure known as the Miles City Arch, which trends east-west south of Miles City. Strata dips from one to three degrees in the area though local displacement has resulted in dips up to 45 degrees. Faults are somewhat common in this area and are of relatively minor displacement, often covered by sediment and are not easily identifiable.

Geologic History

Permanent withdrawal of seas from the area began after the deposition of sediments forming the Pierre Shale. Broad regional uplift in central Montana is believed to have been the cause of the final withdrawal of the sea (Cobban, 1952). This final withdrawal of the Late Cretaceous sea is represented by the fine to medium grained sandstone deposits of the Fox Hills Sandstone. Vast amounts of erosional debris from the uplift were subsequently deposited in the region.

Compressional faulting, folding and uplift during the Laramide Orogeny of Late Cretaceous and Early Tertiary produced the structures of this region, although these were later accentuated and other structures were superposed upon them. The mountain ranges produced by the Laramide Orogeny did not project in the manner they do today, but were eroded about as rapidly as they were uplifted. By the end of the Eocene, erosion of the mountains and filling of adjacent basins had resulted in a fairly level topography. Regional altitudes remained low; floors of basins stood no more than 1,000 feet above sea level, and the intervening mountains projected only a thousand feet higher. The climate was moist and semitropical; no mountain barriers to the west blocked moisture bearing winds from the Pacific Ocean (King, 1977).

Fort Union sediments were being deposited during the Paleocene as the Big Horn Mountains and Black Hills began to rise with the Laramide orogeny, and large volumes of sediment was transported into the swampy flood plain environment of the newly formed Powder River Basin. Outcrops of the Tullock and Lebo Members exhibit varied strata in the northeast part of the basin, indicative of lacustrine deposition. Deposition was irregular and in none of the area was deposition continuous. The intervals of nondeposition allowed limited erosion of sediments and is inferred from the abrupt truncation of cross bedding and channel

depressions filled with sandstone that cut across coal and shale beds. The upper Paleocene is represented by the Tongue River Member of the Fort Union Formation. This unit is alternating sandstone, siltstone, carbonaceous shale, coal, and clinker. Continental conditions prevailed with abundant accumulations of organic material in swamps, from which coal was later formed. Deposition was partly cyclic in nature and generally represented a period of alternating fluvial and lacustrine conditions (Balster, 1971).

During the early Eocene, strata in the basin and surrounding areas was strongly folded and faulted (Glaze and Keller, 1965), forming most of the present day structural features of southeastern Montana. The environment of deposition at this time was similar to that of the underlying Tongue River Member, with sediments that later formed shale, sandstone, and coal of the Wasatch Formation being deposited in an environment of fresh water lakes, stream channels, and swamps. During late Eocene time, uplift was renewed in the Black Hills (Robinson et al, 1964) and the basin tilted westward, creating an asymmetrical structure with the deepest part on the west side adjacent to the Big Horn Mountains.

Following the Black Hills uplift, erosion created a mature landscape of reduced relief over much of the area. During Oligocene and Miocene time, the area was buried by tuffaceous debris from increased volcanic activity to the west (Glaze and Keller, 1965). Erosional debris from the Rocky Mountains also formed extensive deposits across the eastern Montana plains. Only the highest mountain ranges were left unburied. These deposits are present today only as isolated remnants of the original broad sheets of sediment.

Near the end of Pliocene time, regional uplift occurred, with many of the structures in the area, such as the Miles City Arch, becoming more prominent. This uplift caused streams to be rejuvenated, uncovering buried mountains and re-excavating basins. Erosion continued until Pleistocene time and produced much of the present landscape (Glaze and Keller, 1965).

The transition to a more arid climate in late Tertiary resulted in part from a world wide change toward cooler, more arid conditions, which proceeded the Pleistocene ice ages. In part it was the result of the higher mountains to the west, which produced a rain shadow over the plains country. By Pliocene time the climate of the Great Plains was apparently as arid as that of the present (King, 1977).

Dramatic fluctuations in climate during the Pleistocene initiated a series of glacial periods which extensively modified Montana's landscape and surficial geology. Continental ice sheets smoothed the northern plains with glacial scouring and deposition of till and outwash. Ice sheets blocked north flowing rivers and streams, resulting in glacial lakes and forcing drainages to flow to the east. During the Pleistocene, deposition of continental debris was restricted to sites associated with glaciation, eolian features in areas of low relief, alluvial deposits along streams, and lacustrine sediments in low lying areas. Erosion has removed most of the Pleistocene deposits from the area. More recent deposition has been alluvial deposition on flood plains, some eolian deposits, and limited amounts of lacustrine sediments.

Bedrock Geology

Bedrock exposed in the area is of sedimentary origin and ranges in age from Tertiary to Recent. The area is predominately covered by the Fort Union Formation and its members. Near the state line, the Wasatch Formation caps much of the uplands. Western volcanism during this time contributed large volumes of ash that was incorporated into the formations as they were deposited. Surficial deposits of terrace gravel and alluvium deposits ranging in age from Oligocene to Holocene form a thin mantle over the eroded bedrock along streams.

The Fort Union Formation of the early Tertiary Period, Paleocene Epoch contains variable floodplain sediments deposited in an area of low relief with an abundance of ponds and swamps. Sandy beds are river channel deposits and finer textured beds are floodplain and levee deposits with coal forming in swampy areas. This formation is more than 2,000 feet thick and is divided into three members, a basal member

known as the Tullock, followed by the Lebo, and an upper member called the Tongue River. The Tullock and Tongue River Members are very similar in composition except that the Tongue River contains thicker, greater number, and more persistent coal seams and clinker beds. The Lebo Member is an easily distinguished dark gray shale in contrast to the yellowish colors of the other two members, and is finer textured, commonly forming a badland topography. Resistance of the sandstones is related to cementing agents. Dark yellowish brown weathering brown calcareous sandstones are more resistant ridge formers than noncalcareous light gray sandstones. The Fort Union Formation covers much of the adjacent region except for near the state line.

The Tullock Member consists of interbedded fine grained light yellow sandstone and siltstone, medium gray to light gray sandy or silty shale, and thin but persistent coal beds which grade upward to gray carbonaceous shale. Some more resistant sandstones form low ledges and much of the sandstone and shale is calcareous.

The Lebo Member consists of predominantly dark gray alkaline shale with thin interbeds of thin, fine grained sandstone or sandy shale lenses. The most distinguishing characteristics of the Lebo are its dark color, barren surface, and ferriginous concretions. Its color and the predominance of clay distinguish the Lebo from the prevailing yellow and red sandy Tongue River Member that overlies it. The bottom of the Lebo is a distinctive marker bed known as the Big Dirty which contains coal in mineable thickness and quality. In addition to this seam, thin layers of non commercial coal are associated with carbonaceous shale in other sections of the Lebo Member. Siderite and calcareous concretions are common and weather to small reddish brown fragments covering outcrop slopes. Lebo outcrops are usually treeless and support sparse vegetation.

The Tongue River Member is the thickest of the Fort Union members and consists of soft interbedded light yellow to light gray fine to medium grained, thick bedded to massive locally crossbedded lenticular sandstones, and siltstone. It commonly contains light buff to light gray shale, siltstone, and shale, and brown to black carbonaceous shale, coal seams and clinker beds. Most sandstones are soft and weakly cemented by calcium carbonate, some sandstones are more resistant, capping buttes and ridges in dissected areas. Shallow coal seams have been extensively burned in the Tongue River Member, baking the overlying sediments into reddish clinker. Because of the resistance of clinker to erosion, these areas show more relief and tend to develop rugged topography. Most sandstone grades into siltstones and shale within short distances, though some persist laterally. Gypsum crystals and powdery sulfur are found along bedding plains in some carbonaceous shale.

The Wasatch Formation of the early Tertiary Period, Eocene Epoch is the youngest bedrock formation in the area. It consists of yellowish gray to light gray siltstone and medium to coarse grained, massive, or cross bedded sandstone interbedded with medium gray shale, brown carbonaceous shale, coal and associated clinker. The formation typically weathers light gray to tan.

Quaternary Alluvium can be found along valley of the Tongue River as well as its tributaries. Most of the alluvium consists of clay, silt, sand, and local lenses of gravel. Gravel consists of clinker fragments on many smaller streams. The composition is dependent on the type of bedrock from which the alluvium developed. Where the Lebo Member is exposed, the alluvium is predominantly silty with a small amount of sand and no gravel. Where streams cross the Tongue River Member and Wasatch Formation, alluvium is sandy and contains more gravel.

Bibliography

Alden, W. C., 1932, Physiography and glacial geology of eastern Montana and adjacent areas. U.S. Geol. Survey Prof. Paper 174, p 1-131

Balster, C. A. 1971, Catalog of stratigraphic names for Montana. Mont. Bur. Mines Geol. Spec. Pub. 54 488p.

Brown, R. W., 1952, Tertiary strata in eastern Montana and western North and South Dakota. Billings Geol. Soc. Guidebook, 3rd Ann. Field Conf. p 89-92

Cobban, W. A., 1952, Cretaceous rocks on the north flank of the Black Hills Uplift. Billings Geol. Soc. Guidebook, 3rd Ann. Field Conf. p 86-88

Collier, A. J., W. T. Thom Jr., 1918, The Flaxville Gravel and its relation to other Terrace Gravels of the Northern Great Plains. U.S. Geol. Survey Prof. Paper 108-9. p 179-184.

Colton, R. B., R. W. Lemke, and R.M. Indrall, 1961, Glacial Map of Montana East of the Rocky Mountains. U.S. Geol. Survey, Misc. Geo. Invest., Map I-327

Curry, W. H., 1971, Laramide structural history of the Powder River Basin, Wyoming. Wyo. Geol. Assoc. Guidebook, 23rd Ann. Field Conf. p 46-60

Glaze, R. E., and E. R. Keller, 1965 co-chm., Geologic history of the Powder River Basin: Am. Assoc. Petroleum Geologists Bull., v. 49, No. 11, p 1893-1907

Howard, A. D., 1960, Cenozoic history of northeast Montana and northwest North Dakota with emphasis on the Pleistocene. U.S. Geol. Survey Prof. Paper 326 p 1-103

King, P. B., 1977, The Evolution of North America, Princeton University Press, Princeton, New Jersey.

Lewis, B. D. and R. S. Roberts, 1977, Geology and water yielding characteristics of rocks of the northern Powder River Basin, southeastern Montana. U.S. Geol. Survey Open File Rpt. 77-75 p 22

Miller, M. R., 1969, Water Resources of Eastern Montana. Montana Geological Survey Guidebook, 1969, The Economic Geology of Eastern Montana and Adjacent Areas.

Montagne, J. M. 1972, Quaternary system, Wisconsin glaciation In W. M. Mallory, et al. eds. Geologic Atlas of the Rocky Mountain Region. Rocky Mountain Assoc. of Geologists. Hersfield Press, Denver, p 257

Robinson, C. S., W. J. Mapel, and M. H. Bergendahl, 1964, Stratigraphy and structure of the northern and western flanks of the Blackhills uplift, Wyoming, Montana and South Dakota. U.S. Geol. Survey Prof. Paper 404 p 1-108

Weissenborn, A. E. et al., 1963, Mineral and Water Resources of Montana, Mont. Bur. Mines Geol., Special Publication 28.

Component Legend
Fidelity Dry Creek Plan of Development

Big Horn County Area, Montana

NASIS Distribution Generation Date: 8/14/2003

Map Unit Symbol and Map Unit Name	% Composition	Component	Component Kind	Slope Low	Slope RV	Slope High
Ayd: ARVADA SILTY CLAY LOAM	90	ARVADA	Series	0	2	4
Hnf: HYDRO SILTY CLAY LOAM, 2 TO 4 PERCENT SLOPES	90	HYDRO	Series	2	3	4
Lr: LOHMILLER SILTY CLAY LOAM, 4 TO 8 PERCENT SLOPES	85	LOHMILLER	Series	4	6	8
LV: LOHMILLER-MIDWAY SILTY CLAY LOAMS, UNDULATING	75	LOHMILLER	Series	4	7	10
	20	MIDWAY	Series	10	13	15
MVe: MIDWAY-THEDALUND COMPLEX, ROLLING	55	MIDWAY	Series	8	12	15
	30	THEDALUND	Series	8	12	15
MVf: MIDWAY-THEDALUND COMPLEX, HILLY	60	MIDWAY	Series	8	22	35
	25	THEDALUND	Series	8	22	35
THg: THEDALUND-ROCK OUTCROP COMPLEX, HILLY	55	THEDALUND	Series	15	25	35
	20	MIDWAY	Series	15	25	35
	15	ROCK OUTCROP	Miscellaneous area	---	---	---
THn: THEDALUND-WIBAUX STONY LOAMS, HILLY	45	THEDALUND	Series	15	30	45
	30	WIBAUX	Series	15	30	45
	15	ROCK OUTCROP	Miscellaneous area	---	---	---
To: THURLOW-MIDWAY SILTY CLAY LOAMS	50	THURLOW	Series	4	10	15
	40	MIDWAY	Series	12	14	15
TS: TRAVESSILLA-THEDALUND LOAMS, ROLLING	40	THEDALUND	Series	8	12	15
	40	TRAVESSILLA	Series	2	6	10
	15	ROCK OUTCROP	Miscellaneous area	---	---	---

Map Unit Symbol and Map Unit Name	% Comp-	Component	Component Kind	Slope Low	RV	High
Wr: WIBAUX-SPEARMAN COMPLEX, ROLLING	55	WIBAUX	Series	8	12	15
	40	SPEARMAN	Series	8	12	15

Mapunit Descriptions
Fidelity Dry Creek Plan of Development
Big Horn County Area, Montana

NASIS Distribution Generation Date: 8/14/2003

Note: data applies to the entire extent of the mapunit within the survey area. Mapunit and soil properties for a specific parcel of land may vary somewhat and should be determined by on-site investigation.

Ayd - ARVADA SILTY CLAY LOAM

Mean annual precipitation: 12 to 14 inches
Mean annual temperature:
Frost-free period: 110 to 125 days

ARVADA and similar soils

Extent: about 90 percent of the unit
Landform(s):
Slope gradient: 0 to 4 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 6
Wind erodibility index (WEI): 48
Land capability class, non-irrigated: 6s
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: low

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
H1 -- 0 to 3 in		moderately slow	0.4 to 0.6 in	6.6 to 7.8	.43	.43
H2 -- 3 to 13 in		very slow	1.0 to 1.3 in	7.4 to 9.0	.37	
H3 -- 13 to 60 in		very slow	3.7 to 4.7 in	7.9 to 9.0	.43	

Minor Components

Hnf - HYDRO SILTY CLAY LOAM, 2 TO 4 PERCENT SLOPES

Mean annual precipitation: 13 to 15 inches
Mean annual temperature: 45 to 48 degrees F
Frost-free period: 110 to 125 days

HYDRO and similar soils

Extent: about 90 percent of the unit
Landform(s):
Slope gradient: 2 to 4 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 7
Wind erodibility index (WEI): 38
Land capability class, non-irrigated: 3s
Drainage class: well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: low

Representative soil profile:

		Texture	Permeability	Available Water Capacity	pH	Kw	Kf
H1	0 to 7 in		moderately slow	1.0 to 1.3 in	6.1 to 7.3	.32	.32
H2	7 to 21 in		slow	1.5 to 1.8 in	7.4 to 8.4	.37	
H3	21 to 39 in		slow	1.8 to 2.2 in	7.9 to 9.0	.37	
H4	39 to 65 in		moderate	2.6 to 3.1 in	7.9 to 9.0	.43	

Minor Components

Lr - LOHMILLER SILTY CLAY LOAM, 4 TO 8 PERCENT SLOPES

Mean annual precipitation: 12 to 14 inches
Mean annual temperature: 39 to 45 degrees F
Frost-free period: 110 to 125 days

LOHMILLER and similar soils

Extent: about 85 percent of the unit
Landform(s):
Slope gradient: 4 to 8 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 4L
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 4e
Drainage class: well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: low

Representative soil profile:

		Texture	Permeability	Available Water Capacity	pH	Kw	Kf
H1 --	0 to 6 in		moderately slow	0.9 to 1.2 in	6.6 to 8.4	.37	.37
H2 --	6 to 12 in		slow	0.8 to 1.1 in	7.4 to 8.4	.37	
H3 --	12 to 60 in		slow	6.7 to 8.6 in	7.9 to 8.4	.37	

Minor Components

LV - LOHMILLER-MIDWAY SILTY CLAY LOAMS, UNDULATING

Mean annual precipitation: 10 to 14 inches
Mean annual temperature: 39 to 45 degrees F
Frost-free period: 100 to 125 days

LOHMILLER and similar soils

Extent: about 75 percent of the unit
Landform(s):
Slope gradient: 4 to 10 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 4L
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 4e
Drainage class: well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: low

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
H1 -- 0 to 6 in		moderately slow	0.9 to 1.2 in	6.6 to 8.4	.37	.37
H2 -- 6 to 12 in		slow	0.8 to 1.1 in	7.4 to 8.4	.37	
H3 -- 12 to 60 in		slow	6.7 to 8.6 in	7.9 to 8.4	.37	

MIDWAY and similar soils

Extent: about 20 percent of the unit
Landform(s):
Slope gradient: 10 to 15 percent
Parent material:
Restrictive feature(s): bedrock (paralithic) at 10 to 20 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 4
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 6e
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: low

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
H1 -- 0 to 2 in		moderately slow	0.3 to 0.4 in	6.6 to 7.8	.37	.37
H2 -- 2 to 11 in		slow	1.4 to 1.6 in	7.4 to 8.4	.32	
H3 -- 11 to 60 in		impermeable				

Minor Components

MVe - MIDWAY-THEDALUND COMPLEX, ROLLING

Mean annual precipitation: 10 to 14 inches
Mean annual temperature:
Frost-free period: 100 to 125 days

MIDWAY and similar soils

Extent: about 55 percent of the unit
Landform(s):
Slope gradient: 8 to 15 percent
Parent material:
Restrictive feature(s): bedrock (paralithic) at 10 to 20 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 4
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 6e
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: low

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
H1 -- 0 to 2 in		moderately slow	0.3 to 0.4 in	6.6 to 7.8	.37	.37
H2 -- 2 to 11 in		slow	1.4 to 1.6 in	7.4 to 8.4	.32	
H3 -- 11 to 60 in		impermeable				

THEDALUND and similar soils

Extent: about 30 percent of the unit
Landform(s):
Slope gradient: 8 to 15 percent
Parent material:
Restrictive feature(s): bedrock (paralithic) at 20 to 40 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 6
Wind erodibility index (WEI): 48
Land capability class, non-irrigated: 4e
Drainage class: well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: moderate

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
H1 -- 0 to 2 in		moderate	0.3 to 0.4 in	6.6 to 8.4	.37	.37
H2 -- 2 to 14 in		moderate	1.7 to 2.2 in	6.6 to 8.4	.37	
H3 -- 14 to 28 in		moderate	1.9 to 2.5 in	7.9 to 8.4	.37	
H4 -- 28 to 60 in		impermeable				

Minor Components

MVf - MIDWAY-THEDALUND COMPLEX, HILLY

Mean annual precipitation: 10 to 14 inches
Mean annual temperature:
Frost-free period: 100 to 125 days

MIDWAY and similar soils

Extent: about 60 percent of the unit
Landform(s):
Slope gradient: 8 to 35 percent
Parent material:
Restrictive feature(s): bedrock (paralithic) at 10 to 20 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 4
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 7e
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: low

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
H1 -- 0 to 2 in		moderately slow	0.3 to 0.4 in	6.6 to 7.8	.37	.37
H2 -- 2 to 11 in		slow	1.4 to 1.6 in	7.4 to 8.4	.32	
H3 -- 11 to 60 in		impermeable				

THEDALUND and similar soils

Extent: about 25 percent of the unit
Landform(s):
Slope gradient: 8 to 35 percent
Parent material:
Restrictive feature(s): bedrock (paralithic) at 20 to 40 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 6
Wind erodibility index (WEI): 48
Land capability class, non-irrigated: 6e
Drainage class: well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: moderate

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
H1 -- 0 to 2 in		moderate	0.3 to 0.4 in	6.6 to 8.4	.37	.37
H2 -- 2 to 14 in		moderate	1.7 to 2.2 in	6.6 to 8.4	.37	
H3 -- 14 to 28 in		moderate	1.9 to 2.5 in	7.9 to 8.4	.37	
H4 -- 28 to 60 in		impermeable				

Minor Components

THg - THEDALUND-ROCK OUTCROP COMPLEX, HILLY

Mean annual precipitation: 10 to 14 inches
Mean annual temperature: 39 to 45 degrees F
Frost-free period: 100 to 125 days

THEDALUND and similar soils

Extent: about 55 percent of the unit
Landform(s):
Slope gradient: 15 to 35 percent
Parent material:
Restrictive feature(s): bedrock (paralithic) at 20 to 40 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 6
Wind erodibility index (WEI): 48
Land capability class, non-irrigated: 6e
Drainage class: well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: moderate

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
H1 -- 0 to 2 in		moderate	0.3 to 0.4 in	6.6 to 8.4	.37	.37
H2 -- 2 to 14 in		moderate	1.7 to 2.2 in	6.6 to 8.4	.37	
H3 -- 14 to 28 in		moderate	1.9 to 2.5 in	7.9 to 8.4	.37	
H4 -- 28 to 60 in		impermeable				

MIDWAY and similar soils

Extent: about 20 percent of the unit
Landform(s):
Slope gradient: 15 to 35 percent
Parent material:
Restrictive feature(s): bedrock (paralithic) at 10 to 20 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 4
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 7e
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: low

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
H1 -- 0 to 2 in		moderately slow	0.3 to 0.4 in	6.6 to 7.8	.43	.43
H2 -- 2 to 11 in		slow	1.4 to 1.6 in	7.4 to 8.4	.32	
H3 -- 11 to 60 in		impermeable				

ROCK OUTCROP

Extent: about 15 percent of the unit
Landform(s):
Slope gradient:
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil: no
Hydrologic group:
Potential frost action:

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Minor Components

THn - THEDALUND-WIBAUX STONY LOAMS, HILLY

Mean annual precipitation: 12 to 14 inches
Mean annual temperature: 39 to 45 degrees F
Frost-free period: 110 to 125 days

THEDALUND and similar soils

Extent: about 45 percent of the unit
Landform(s):
Slope gradient: 15 to 45 percent
Parent material:
Restrictive feature(s): bedrock (paralithic) at 20 to 40 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 6
Wind erodibility index (WEI): 48
Land capability class, non-irrigated: 6e
Drainage class: well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: moderate

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
H1 -- 0 to 2 in		moderate	0.2 to 0.3 in	7.4 to 7.8	.24	.37
H2 -- 2 to 14 in		moderate	2.1 to 2.3 in	7.4 to 7.8	.37	
H3 -- 14 to 28 in		moderate	2.3 to 2.6 in	7.4 to 8.4	.37	
H4 -- 28 to 60 in		impermeable				

WIBAUX and similar soils

Extent: about 30 percent of the unit
Landform(s):
Slope gradient: 15 to 45 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 7e
Drainage class: well drained
Hydric soil: no
Hydrologic group: A
Potential frost action: low

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
H1 -- 0 to 4 in		moderately rapid	0.4 to 0.5 in	7.4 to 8.4	.20	.37
H2 -- 4 to 12 in		rapid	0.3 to 0.5 in	7.9 to 8.4	.05	
H3 -- 12 to 60 in		very rapid	0.0 to 0.5 in	7.9 to 8.4	.02	

ROCK OUTCROP

Extent: about 15 percent of the unit
Landform(s):
Slope gradient:
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil: no
Hydrologic group:
Potential frost action:

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Minor Components

To - THURLOW-MIDWAY SILTY CLAY LOAMS

Mean annual precipitation: 10 to 14 inches
Mean annual temperature: 45 to 48 degrees F
Frost-free period: 100 to 125 days

THURLOW and similar soils

Extent: about 50 percent of the unit
Landform(s):
Slope gradient: 4 to 15 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 7
Wind erodibility index (WEI): 38
Land capability class, non-irrigated: 4e
Drainage class: well drained
Hydric soil: no
Hydrologic group: B
Potential frost action: low

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
H1 -- 0 to 2 in		moderately slow	0.4 to 0.4 in	6.6 to 7.3	.32	.32
H2 -- 2 to 13 in		moderately slow	1.5 to 1.8 in	6.6 to 8.4	.32	
H3 -- 13 to 61 in		moderately slow	6.7 to 7.7 in	7.4 to 8.4	.32	

MIDWAY and similar soils

Extent: about 40 percent of the unit
Landform(s):
Slope gradient: 12 to 15 percent
Parent material:
Restrictive feature(s): bedrock (paralithic) at 10 to 20 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 4
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 6e
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: low

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
H1 -- 0 to 2 in		moderately slow	0.3 to 0.4 in	6.6 to 7.8	.43	.43
H2 -- 2 to 11 in		slow	1.4 to 1.6 in	7.4 to 8.4	.32	
H3 -- 11 to 60 in		impermeable				

Minor Components

TS - TRAVESSILLA-THEDALUND LOAMS, ROLLING

Mean annual precipitation: 12 to 14 inches
Mean annual temperature: 39 to 45 degrees F
Frost-free period: 110 to 125 days

TRAVESSILLA and similar soils

Extent: about 40 percent of the unit
Landform(s):
Slope gradient: 2 to 10 percent
Parent material:
Restrictive feature(s): bedrock (lithic) at 10 to 20 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 1
Wind erodibility group (WEG): 4L
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 6e
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: moderate

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
H1 -- 0 to 4 in		moderate	0.6 to 0.8 in	6.6 to 8.4	.37	.37
H2 -- 4 to 14 in		moderate	1.4 to 1.8 in	6.6 to 8.4	.37	
H3 -- 14 to 28 in		moderate	1.9 to 2.5 in	7.9 to 8.4	.37	
H4 -- 28 to 60 in		impermeable				

ROCK OUTCROP

Extent: about 15 percent of the unit
Landform(s):
Slope gradient:
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil: no
Hydrologic group:
Potential frost action:

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Minor Components

Wr - WIBAUX-SPEARMAN COMPLEX, ROLLING

Mean annual precipitation: 10 to 14 inches
Mean annual temperature: 39 to 48 degrees F
Frost-free period: 100 to 125 days

WIBAUX and similar soils

Extent: about 55 percent of the unit
Landform(s):
Slope gradient: 8 to 15 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 6
Wind erodibility index (WEI): 48
Land capability class, non-irrigated: 7s
Drainage class: excessively drained
Hydric soil: no
Hydrologic group: A
Potential frost action: low

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
H1 -- 0 to 5 in		moderately rapid	0.6 to 0.7 in	7.4 to 8.4	.17	.37
H2 -- 5 to 10 in		rapid	0.2 to 0.3 in	7.9 to 8.4	.05	
H3 -- 10 to 60 in		rapid	0.0 to 0.5 in	7.9 to 8.4	.02	

SPEARMAN and similar soils

Extent: about 40 percent of the unit
Landform(s):
Slope gradient: 8 to 15 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 6
Wind erodibility index (WEI): 48
Land capability class, non-irrigated: 4e
Drainage class: well drained
Hydric soil: no
Hydrologic group: B
Potential frost action: moderate

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
H1 -- 0 to 4 in		moderate	0.7 to 0.8 in	6.6 to 7.3	.32	.32
H2 -- 4 to 15 in		moderate	1.8 to 2.0 in	6.6 to 7.3	.32	
H3 -- 15 to 23 in		moderate	1.1 to 1.3 in	7.4 to 8.4	.24	
H4 -- 23 to 60 in		very rapid	0.0 to 0.4 in	7.4 to 8.4	.02	

Minor Components

Prime and Important Farmland
Fidelity Dry Creek Plan of Development

Big Horn County Area, Montana

Only the soils considered prime or important farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime or important farmland only under certain conditions, the conditions are specified in parenthesis after the soil name.

Map Symbol	Soil Name
Lr	Lohmiller silty clay loam, 4 to 8 percent slopes (Farmland of statewide importance)

Chemical Properties of the Soils
Fidelity Dry Creek Plan of Development

Big Horn County Area, Montana

NRCS Distribution Generation Date: 8/14/2003

Absence of an entry indicates that data were not estimated.

Map Symbol and Soil Name	Depth	Cation Exchange Capacity	Effective Cation Exchange Capacity	Soil Reaction	Calcium Carbonate	Gypsum	Salinity	Sodium Adsorption Ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
Ayd:								
ARVADA	0-3	15-20	---	6.6 - 7.8	---	---	0.0-2.0	---
	3-13	25-35	---	7.4 - 9.0	---	---	1.0-8.0	10-20
	13-60	20-25	---	7.9 - 9.0	5-15	---	8.0-16.0	13-30
Hnf:								
HYDRO	0-7	15-20	---	6.1 - 7.3	---	---	0.0	---
	7-21	20-30	---	7.4 - 8.4	---	---	4.0-8.0	5-13
	21-39	15-20	---	7.9 - 9.0	5-15	---	4.0-16.0	13-30
	39-65	10-15	---	7.9 - 9.0	5-15	---	4.0-16.0	13-30
Lr:								
LOHMILLER	0-6	25-30	---	6.6 - 8.4	0-5	---	0.0-2.0	0-4
	6-12	20-25	---	7.4 - 8.4	5-10	---	0.0-2.0	4-10
	12-60	20-25	---	7.9 - 8.4	5-15	---	0.0-3.0	4-10
LV:								
LOHMILLER	0-6	25-30	---	6.6 - 8.4	0-5	---	0.0-2.0	1-4
	6-12	20-25	---	7.4 - 8.4	5-10	---	0.0-2.0	5-10
	12-60	20-25	---	7.9 - 8.4	5-15	---	0.0-3.0	5-10
MIDWAY	0-2	20-25	---	6.6 - 7.8	---	---	0.0	---
	2-11	20-25	---	7.4 - 8.4	5-10	---	0.0	---
	11-60	---	---	---	---	---	---	---
MVe:								
MIDWAY	0-2	20-25	---	6.6 - 7.8	---	---	0.0	---
	2-11	20-25	---	7.4 - 8.4	5-10	---	0.0	---
	11-60	---	---	---	---	---	---	---
THEDALUND	0-2	15-20	---	6.6 - 8.4	---	---	0.0-2.0	---
	2-14	15-20	---	6.6 - 8.4	5-10	---	0.0-2.0	---
	14-28	10-15	---	7.9 - 8.4	5-15	---	0.0-2.0	---
	28-60	---	---	---	---	---	---	---
MVf:								
MIDWAY	0-2	20-25	---	6.6 - 7.8	---	---	0.0	---
	2-11	20-25	---	7.4 - 8.4	5-10	---	0.0	---
	11-60	---	---	---	---	---	---	---
THEDALUND	0-2	15-20	---	6.6 - 8.4	---	---	0.0-2.0	---
	2-14	15-20	---	6.6 - 8.4	5-10	---	0.0-2.0	---
	14-28	10-15	---	7.9 - 8.4	5-15	---	0.0-2.0	---
	28-60	---	---	---	---	---	---	---

Chemical Properties of the Soils - Continued

Map Symbol and Soil Name	Depth	Cation Exchange Capacity	Effective Cation Exchange Capacity	Soil Reaction	Calcium Carbonate	Gypsum	Salinity	Sodium Adsorption Ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
THg:								
THEDALUND	0-2	15-20	---	6.6 - 8.4	---	---	0.0-2.0	---
	2-14	15-20	---	6.6 - 8.4	5-10	---	0.0-2.0	---
	14-28	10-15	---	7.9 - 8.4	5-15	---	0.0-2.0	---
	28-60	---	---	---	---	---	---	---
MIDWAY	0-2	20-25	---	6.6 - 7.8	---	---	0.0	---
	2-11	20-25	---	7.4 - 8.4	5-10	---	0.0	---
	11-60	---	---	---	---	---	---	---
ROCK OUTCROP	---	---	---	---	---	---	---	---
THn:								
THEDALUND	0-2	15-20	---	7.4 - 7.8	---	---	0.0-2.0	---
	2-14	10-15	---	7.4 - 7.8	1-10	---	0.0-2.0	---
	14-28	5.0-10	---	7.4 - 8.4	5-15	---	0.0-2.0	---
	28-60	---	---	---	---	---	---	---
WIBAUX	0-4	10-15	---	7.4 - 8.4	---	---	0.0-2.0	---
	4-12	5.0-10	---	7.9 - 8.4	5-15	---	0.0-2.0	---
	12-60	0.0-1.0	---	7.9 - 8.4	---	---	0.0-2.0	---
ROCK OUTCROP	---	---	---	---	---	---	---	---
To:								
THURLOW	0-2	20-25	---	6.6 - 7.3	---	---	0.0	---
	2-13	25-30	---	6.6 - 8.4	---	---	0.0-2.0	---
	13-61	20-25	---	7.4 - 8.4	5-15	---	0.0-2.0	---
MIDWAY	0-2	20-25	---	6.6 - 7.8	---	---	0.0	---
	2-11	20-25	---	7.4 - 8.4	5-10	---	0.0	---
	11-60	---	---	---	---	---	---	---
TS:								
THEDALUND	0-4	15-20	---	6.6 - 8.4	---	---	0.0-2.0	---
	4-14	15-20	---	6.6 - 8.4	5-10	---	0.0-2.0	---
	14-28	10-15	---	7.9 - 8.4	5-15	---	0.0-2.0	---
	28-60	---	---	---	---	---	---	---
TRAVESSILLA	0-2	10-15	---	6.6 - 8.4	---	---	0.0	---
	2-13	5.0-10	---	7.4 - 9.0	5-10	---	0.0-2.0	---
	13-18	5.0-10	---	7.4 - 9.0	5-10	---	0.0-2.0	---
	18-60	---	---	---	---	---	---	---
ROCK OUTCROP	---	---	---	---	---	---	---	---

Chemical Properties of the Soils - Continued

Map Symbol and Soil Name	Depth	Cation Exchange Capacity	Effective Cation Exchange Capacity	Soil Reaction	Calcium Carbonate	Gypsum	Salinity	Sodium Adsorption Ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
Wr:								
WIBAUX	0-5	10-15	---	7.4 - 8.4	1-5	---	0.0-2.0	0
	5-10	5.0-10	---	7.9 - 8.4	5-15	---	0.0-2.0	0
	10-60	0.0	---	7.9 - 8.4	1-5	---	0.0-2.0	0
SPEARMAN	0-4	15-20	---	6.6 - 7.3	---	---	0.0	---
	4-15	15-25	---	6.6 - 7.3	5-10	---	0.0	---
	15-23	10-15	---	7.4 - 8.4	---	---	0.0-2.0	---
	23-60	0.0-1.0	---	7.4 - 8.4	---	---	0.0-2.0	---

Physical Properties of the Soils
Fidelity Dry Creek Plan of Development

Big Horn County Area, Montana

NASIS Distribution Generation Date: 8/14/2003

Entries under "Erosion Factors--T" apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of an entry indicates that data were not estimated.

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensibility	Organic Matter	Erosion Factors Kw	Erosion Factors Kf	Erosion Factors T	Wind Erodibility Group	Wind Erodibility Index
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct	Kw	Kf	T		
Ayd:														
ARVADA	0-3	---	---	15-27	1.20-1.40	0.2-0.6	0.14-0.18	0.0-2.9	1.0-3.0	.43	.43	2	6	48
	3-13	---	---	35-55	1.30-1.55	0.001-0.06	0.10-0.13	6.0-8.9	0.5-1.0	.37	---			
	13-60	---	---	30-50	1.30-1.55	0.001-0.06	0.08-0.10	6.0-8.9	0.0-0.5	.43	---			
Hnf:														
HYDRO	0-7	---	---	28-35	1.25-1.45	0.2-0.6	0.14-0.18	3.0-5.9	1.0-2.0	.32	.32	5	7	38
	7-21	---	---	35-55	1.30-1.50	0.06-0.2	0.11-0.13	6.0-8.9	0.5-1.0	.37	---			
	21-39	---	---	35-45	1.30-1.55	0.06-0.2	0.10-0.12	6.0-8.9	0.0-0.5	.37	---			
	39-65	---	---	15-27	1.25-1.50	0.6-2	0.10-0.12	0.0-2.9	0.0-0.5	.43	---			
Lr:														
LOHMILLER	0-6	---	---	27-40	1.20-1.40	0.2-0.6	0.16-0.20	3.0-5.9	1.0-2.0	.37	.37	5	4L	86
	6-12	---	---	35-45	1.30-1.50	0.06-0.2	0.14-0.18	6.0-8.9	0.5-1.0	.37	---			
	12-60	---	---	35-45	1.30-1.55	0.06-0.2	0.14-0.18	6.0-8.9	0.5-1.0	.37	---			
LV:														
LOHMILLER	0-6	---	---	27-40	1.20-1.40	0.2-0.6	0.16-0.20	3.0-5.9	1.0-2.0	.37	.37	5	4L	86
	6-12	---	---	35-45	1.30-1.50	0.06-0.2	0.14-0.18	6.0-8.9	0.5-1.0	.37	---			
	12-60	---	---	35-45	1.30-1.55	0.06-0.2	0.14-0.18	6.0-8.9	0.5-1.0	.37	---			
MIDWAY	0-2	---	---	27-40	1.10-1.30	0.2-0.6	0.17-0.20	3.0-5.9	0.5-1.0	.37	.37	2	4	86
	2-11	---	---	35-50	1.20-1.40	0.06-0.2	0.15-0.18	6.0-8.9	0.0-0.5	.32	---			
	11-60	---	---	---	---	---	---	---	---	---	---			
MVe:														
MIDWAY	0-2	---	---	27-40	1.10-1.30	0.2-0.6	0.17-0.20	3.0-5.9	0.5-1.0	.37	.37	2	4	86
	2-11	---	---	35-50	1.20-1.40	0.06-0.2	0.15-0.18	6.0-8.9	0.0-0.5	.32	---			
	11-60	---	---	---	---	---	---	---	---	---	---			

Physical Properties of the Soils - Continued

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors Kw	Erosion Factors Kf	Erosion Factors T	Wind Erodi-bility Group	Wind Erodi-bility Index
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
MVe:														
THEDALUND	0-2	---	---	20-27	1.15-1.35	0.6-2	0.16-0.20	0.0-2.9	1.0-3.0	.37	.37	3	6	48
	2-14	---	---	18-35	1.30-1.50	0.6-2	0.14-0.18	0.0-2.9	0.5-1.0	.37	---			
	14-28	---	---	18-35	1.30-1.55	0.6-2	0.14-0.18	3.0-5.9	0.0-0.5	.37	---			
	28-60	---	---	---	---	---	---	---	---	---	---			
MVf:														
MIDWAY	0-2	---	---	27-40	1.10-1.30	0.2-0.6	0.17-0.20	3.0-5.9	0.5-1.0	.37	.37	2	4	86
	2-11	---	---	35-50	1.20-1.40	0.06-0.2	0.15-0.18	6.0-8.9	0.0-0.5	.32	---			
	11-60	---	---	---	---	---	---	---	---	---	---			
THEDALUND	0-2	---	---	20-27	1.15-1.35	0.6-2	0.16-0.20	0.0-2.9	1.0-3.0	.37	.37	3	6	48
	2-14	---	---	18-35	1.30-1.50	0.6-2	0.14-0.18	0.0-2.9	0.5-1.0	.37	---			
	14-28	---	---	18-35	1.30-1.55	0.6-2	0.14-0.18	3.0-5.9	0.0-0.5	.37	---			
	28-60	---	---	---	---	---	---	---	---	---	---			
THg:														
THEDALUND	0-2	---	---	20-27	1.15-1.35	0.6-2	0.16-0.20	0.0-2.9	1.0-3.0	.37	.37	3	6	48
	2-14	---	---	18-35	1.30-1.50	0.6-2	0.14-0.18	0.0-2.9	0.5-1.0	.37	---			
	14-28	---	---	18-35	1.30-1.55	0.6-2	0.14-0.18	3.0-5.9	0.0-0.5	.37	---			
	28-60	---	---	---	---	---	---	---	---	---	---			
MIDWAY	0-2	---	---	27-40	1.10-1.30	0.2-0.6	0.17-0.20	3.0-5.9	0.5-1.0	.43	.43	2	4	86
	2-11	---	---	35-50	1.20-1.40	0.06-0.2	0.15-0.18	6.0-8.9	0.0-0.5	.32	---			
	11-60	---	---	---	---	---	---	---	---	---	---			
ROCK OUTCROP	---	---	---	---	---	---	---	---	---	---	---	---	---	---
THn:														
THEDALUND	0-2	---	---	18-27	1.15-1.35	0.6-2	0.12-0.14	3.0-5.9	1.0-3.0	.24	.37	3	6	48
	2-14	---	---	18-27	1.25-1.45	0.6-2	0.17-0.19	3.0-5.9	0.5-1.0	.37	---			
	14-28	---	---	18-27	1.30-1.50	0.6-2	0.17-0.19	3.0-5.9	0.0-0.5	.37	---			
	28-60	---	---	---	---	---	---	---	---	---	---			

Physical Properties of the Soils - Continued

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensibility	Organic Matter	Erosion Factors Kw	Erosion Factors Kf	Erosion Factors T	Wind Erodibility Group	Wind Erodibility Index
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
THn:														
WIBAUX	0-4	---	---	10-22	1.20-1.40	2-6	0.09-0.13	0.0-2.9	1.0-2.0	.20	.37	2	5	56
	4-12	---	---	10-22	1.25-1.45	6-20	0.04-0.06	0.0-2.9	0.5-1.0	.05	---			
	12-60	---	---	0-1	1.50-1.70	20	0.00-0.01	0.0-2.9	0.0-0.5	.02	---			
ROCK OUTCROP	---	---	---	---	---	---	---	---	---	---	---	---	---	---
To:														
THURLOW	0-2	---	---	27-35	1.15-1.35	0.2-0.6	0.18-0.20	3.0-5.9	3.0-5.0	.32	.32	5	7	38
	2-13	---	---	35-45	1.25-1.45	0.2-0.6	0.14-0.16	3.0-5.9	1.0-2.0	.32	---			
	13-61	---	---	27-35	1.30-1.50	0.2-0.6	0.14-0.16	3.0-5.9	0.5-1.0	.32	---			
MIDWAY	0-2	---	---	27-40	1.10-1.30	0.2-0.6	0.17-0.20	3.0-5.9	0.5-1.0	.43	.43	2	4	86
	2-11	---	---	35-50	1.20-1.40	0.06-0.2	0.15-0.18	6.0-8.9	0.0-0.5	.32	---			
	11-60	---	---	---	---	---	---	---	---	---	---			
TS:														
THEDALUND	0-4	---	---	20-27	1.15-1.35	0.6-2	0.16-0.20	0.0-2.9	1.0-3.0	.37	.37	3	6	48
	4-14	---	---	18-35	1.30-1.50	0.6-2	0.14-0.18	0.0-2.9	0.5-1.0	.37	---			
	14-28	---	---	18-35	1.30-1.55	0.6-2	0.14-0.18	3.0-5.9	0.0-0.5	.37	---			
	28-60	---	---	---	---	---	---	---	---	---	---			
TRAVESSILLA	0-2	---	---	10-27	1.15-1.35	0.6-2	0.17-0.21	0.0-2.9	0.5-2.0	.37	.37	1	4L	86
	2-13	---	---	5-18	1.35-1.55	2-6	0.12-0.15	0.0-2.9	0.5-1.0	.20	---			
	13-18	---	---	5-18	1.40-1.60	2-6	0.10-0.12	0.0-2.9	0.0-0.5	.10	---			
	18-60	---	---	---	---	---	---	---	---	---	---			
ROCK OUTCROP	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Physical Properties of the Soils - Continued

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors Kw	Erosion Factors Kf	Erosion Factors T	Wind Erodi-bility Group	Wind Erodi-bility Index
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct	Kw	Kf	T		
Wr:														
WIBAUX	0-5	---	---	10-22	1.30-1.50	2-6	0.11-0.14	0.0-2.9	1.0-2.0	.17	.37	2	6	48
	5-10	---	---	8-22	1.45-1.65	6-20	0.05-0.06	0.0-2.9	0.5-1.0	.05	---			
	10-60	---	---	0-1	1.60-1.80	6-20	0.00-0.01	0.0-2.9	0.0-0.5	.02	---			
SPEARMAN	0-4	---	---	20-27	1.10-1.30	0.6-2	0.18-0.20	0.0-2.9	3.0-5.0	.32	.32	3	6	48
	4-15	---	---	25-35	1.25-1.45	0.6-2	0.16-0.18	3.0-5.9	1.0-3.0	.32	---			
	15-23	---	---	20-27	1.30-1.50	0.6-2	0.14-0.16	0.0-2.9	0.5-1.0	.24	---			
	23-60	---	---	0	1.50-1.70	20	0.00-0.01	0.0-2.9	0.0-0.5	.02	--			

Rutting Hazard
Fidelity Dry Creek Plan of Development

Big Horn County Area, Montana

NASIS Distribution Generation Date: 8/14/2003

The information in this table indicates the dominant soil condition, but does not eliminate the need for onsite investigation. The numbers in the value column range from 0.01 to 1.00. The larger the value, the greater the potential limitation. Limiting features in this report are limited to the top 5 limitations. Additional limitations may exist.

Map Symbol and Soil Name	Pct of Map Unit	Soil Rutting Hazard Rating Class and Limiting Features	Value
Ayd:			
Arvada	90	Severe Strength	1.00
Hnf:			
Hydro	90	Severe Strength	1.00
Lr:			
Lohmiller	85	Severe Strength	1.00
LV:			
Lohmiller	75	Severe Strength	1.00
Midway	20	Severe Strength	1.00
MVe:			
Midway	55	Severe Strength	1.00
Thedalund	30	Severe Strength	1.00
MVf:			
Midway	60	Severe Strength	1.00
Thedalund	25	Severe Strength	1.00
THg:			
Thedalund	55	Severe Strength	1.00

Rutting Hazard - Continued

Map Symbol and Soil Name	Pct of Map Unit	Soil Rutting Hazard Rating Class and Limiting Features	Value
THg:			
Midway	20	Severe Strength	1.00
Rock Outcrop	15	Not Rated	
THn:			
Thedalund	45	Severe Strength S	1.00
Wibaux	30	Severe Strength	1.00
Rock Outcrop	15	Not Rated	
To:			
Thurlow	50	Severe Strength	1.00
Midway	40	Severe Strength	1.00
TS:			
Thedalund	40	Severe Strength	1.00
Travessilla	40	Severe Strength	1.00
Rock Outcrop	15	Not Rated	
Wr:			
Wibaux	55	Severe Strength	1.00
Spearman	40	Severe Strength	1.00

Definitions

Drainage class:
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."

Hydric soil:
A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Hydric soils along with hydrophytic vegetation and wetland hydrology are used to define wetlands.

The current criteria for generating a list of hydric soils in the Federal Register, February 24, 1995, volume 60, number 37, page 10349. The reference for field identification of hydric soils is Field Indicators of Hydric Soils of the United States, Fall 1996.

Hydrologic group:
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 soils in the United States are placed into four groups A, B, C, and D, and three dual classes, A/D, B/D, and C/D. Definitions of the classes are as follows:

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.

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.

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.

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.

Dual hydrologic groups, A/D, B/D, and C/D, are given for certain wet soils that can be adequately drained. The first letter applies to the drained condition, the second to the undrained. Only soils that are rated D in their natural condition are assigned to dual classes.

Land capability class, non-irrigated:
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 that show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels -- capability class, subclass, and unit. Only class and subclass are included in this dataset.

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

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

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

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

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 that show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels -- capability class, subclass, and unit. Only class and subclass are included in this dataset.

Capability subclasses are soil groups within one capability class. Adding a small letter, e, w, s, or c, to the class numeral, for example, IIe, designates them. 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 I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s, or c because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Prime and important farmland

Farmland Classification identifies soils as prime farmland, farmland of statewide importance, or farmland of local importance. Farmland classification identifies the location and extent of the most suitable land for

producing food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the Federal Register, Vol. 43, No. 21, January 31, 1978.

Permeability

Soil permeability is the quality of the soil that enables water or air to move through it. Historically soil survey has used permeability as term for saturated hydraulic conductivity (Ksat). Saturated hydraulic conductivity is measured as the amount of water that would move vertically through a unit area of saturated soil in unit time under hydraulic gradient. Ksat is expressed as micrometers per second.

Permeability classes for Ksat values are: very rapid 141 - 705, rapid 42 - 141, moderately rapid 14 - 42, moderate 4 - 14, moderately slow 1.4 - 4, slow 0.42 - 1.4, very slow 0.01 - 0.42, impermeable 0.00 - 0.01.

K factor

Soil erodibility factors K factor - whole (Kw) and K factor - rock free (Kf) are erodibility factors which quantify the susceptibility of soil detachment by water. These erodibility factors predict the long-term average soil loss, which results from sheet and rill erosion under various alternative combinations of crop systems and conservation techniques. K factor - whole considers the whole soil, and K factor - rock free considers only the fine-earth fraction, which is the material < 2.0 mm in diameter.

Prime or important farmland

Farmland Classification identifies map units as prime farmland, farmland of statewide importance, or farmland of local importance. Farmland classification identifies the location and extent of the most suitable land for producing food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the Federal Register, Vol. 43, No. 21, January 31, 1978.

T factor (Soil loss tolerance):

The T factor is the soil loss tolerance. It is defined as the maximum amount of erosion in tons per acre per year at which the quality of a soil as a medium for plant growth can be maintained. This quality of the soil to be maintained is threefold in focus. It includes maintaining (1) the surface soil as a seedbed for plants, (2) the atmosphere-soil interface to allow the entry of air and water into the soil and still protect the underlying soil from wind and water erosion, and (3) the total soil volume as a reservoir for water and plant nutrients, which is preserved by minimizing soil loss.

Soil loss tolerance “T” is assigned according to properties of root limiting subsurface soil layers. The designation of a limiting layer implies that the material above the layer has more favorable plant growth properties. As limiting or less favorable soil layers become closer to the surface, the relative ability of a soil to maintain its productivity through natural and managed processes decreases.

WEG (Wind erodibility group) and WEI (Wind erodibility index):

Wind Erodibility Group (WEG) is a grouping of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to blowing. The Wind Erodibility Index (WEI), used in the wind erosion equation, is assigned using the wind erodibility groups.

Official Soils Descriptions

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture.
Official Soil Series Descriptions
Available URL:"http://soils.usda.gov/soils/technical/classification/osd/index.html"

LOCATION ARVADA WY+CO KS MT NE SD
Established Series
MCS/JWW/CJH
12/2003

ARVADA SERIES

The Arvada series consists of very deep, well drained soils formed in alluvium and colluvium derived from sodic shale. Arvada soils are on alluvial fans, fan remnants, fan terraces and hillslopes. Slopes are 0 to 25 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

TAXONOMIC CLASS: Fine, smectitic, mesic Ustertic Natrargids

TYPICAL PEDON: Arvada fine sandy loam-rangeland. (Colors are for dry soil unless otherwise stated)

E--0 to 4 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; moderate very thin platy structure parting to moderate very fine granular; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary. (0 to 8 inches thick)

Btn--4 to 14 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium columnar structure parting to moderate medium angular blocky; extremely hard, firm, sticky and very plastic; common medium roots; many prominent clay films on faces of peds and in root channels; very strongly alkaline (pH 9.2); ESP is 20 percent; clear smooth boundary. (3 to 14 inches thick)

Btkn--14 to 20 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; extremely hard, firm, sticky and very plastic; few faint clay films on faces of peds and in root channels; strongly effervescent, few fine segregations of calcium carbonate in thin seams and streaks; strongly alkaline (pH 9.0); 20 percent exchangeable sodium; gradual smooth boundary. (0 to 17 inches thick)

Bkny--20 to 60 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; massive; hard, friable, sticky and plastic; violently effervescent, common medium soft masses of calcium carbonate and gypsum as crystals in thin seams and as filaments or threads; strongly alkaline (pH 8.8); 20 percent exchangeable sodium.

TYPE LOCATION: Sheridan County, Wyoming; 650 feet south and 200 feet west of the northeast corner of sec. 29, T. 55 N., R. 78 W. 44 degrees 43 minutes 7 seconds north latitude and 106 degrees 15 minutes 54 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to effervescent material ranges from 0 to 19 inches. Depth to layers with greater than 15 percent exchangeable sodium is 4 to 10 inches. The depth to the base of the Bt horizon is 15 inches or more. A thin A horizon occurs in some pedons. A light colored platy E horizon is generally present but is absent in some pedons. Gravel is typically less than 5 percent but ranges from 0 to 15 percent. The moisture control section is usually dry for 60 consecutive days during the 90 day period following the summer solstice. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 195 days. The soil has an aridic moisture regime that borders on ustic.

The E and A horizons have hue of 10YR, 2.5Y or 5Y, value of 4 to 7, 4 or 5 moist, and chroma of 2 to 4. Texture is fine sandy loam, loam, silt loam, clay loam or very fine sandy loam. Reaction ranges from neutral through strongly alkaline. EC ranges from 0 to 4 mmhos/cm.

The Btn horizon has hue of 7.5YR, 10YR, 2.5Y or 5Y, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 to 4. Texture is clay, clay loam, silty clay or silty clay loam and has 35 to 60 percent clay, 10 to 50 percent silt, and 5 to 45 percent sand. This horizon is strongly alkaline or very strongly alkaline (pH 8.8 to 10.0), has 15 to 34 percent exchangeable sodium, and an EC of 4 to 16 mmhos/cm. Some pedons when buffered by gypsum are moderately alkaline. The Btkn horizon, when present, has a calcium carbonate equivalent of 3 to 12 percent and an exchangeable sodium percent of 10 to 30. A thin Bt horizon is present above the Btn in some pedons. Some pedons have a Btkny horizon.

The Bkny horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 or 6 dry, 4 or 5 moist. Textures are clay, clay loam, silty clay or silty clay loam. Reaction ranges from strongly alkaline or very strongly alkaline (pH 8.6 to 10.0). This horizon contains 4 to 15 percent calcium carbonate equivalent. Some pedons when buffered by gypsum are moderately alkaline. Exchangeable sodium typically ranges from 10 to 30 percent but decreases with increasing depth. Electrical conductivity is 4 to 16 mmhos/cm. Some pedons have a C horizon.

Some pedons have a C horizon below 40 inches. It has properties similar to those of the Bkny horizon.

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING: The Arvada soils are on alluvial fans, fan remnants, terraces and hillslopes. The soils formed in moderately fine textured alluvium and colluvium derived from sedimentary rocks. Slopes range from 0 to 25 percent. Elevations range from 2,600 to 6,000 feet. The average annual precipitation is about 12 inches but ranges from 9 to 14 inches with about half the precipitation occurring during April, May, and early June. The mean annual air temperature is about 43 to 53 degrees F., and the mean summer temperature is 63 degrees F. The frost-free season is estimated to range from 100 to 160 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Absted, Bidman, Parmleed, Renohill and Ulm soils. Absted soils have less than 15 percent sodium in the upper part of the argillic horizon. Bidman, Parmleed, Renohill and Ulm soils lack natric horizons.

DRAINAGE AND PERMEABILITY: Well drained; high or very high runoff; very slow permeability.

USE AND VEGETATION: Rangeland and wildlife habitat. Native vegetation is alkali sacaton, Gardner saltbush, western wheatgrass, and scattered greasewood.

DISTRIBUTION AND EXTENT: Eastern Wyoming, eastern Colorado and parts of adjacent states. The series is extensive.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Sheridan County, Wyoming; 1932.

REMARKS: Diagnostic horizons and features recognized in this pedon are: Albic horizon - 0 to 4 inches (E)

Natric horizon - 4 to 20 inches (Btn, Btkn)

SIR- WY1130

LRR- G

National Cooperative Soil Survey
U.S.A.

LOCATION HYDRO MT
Established Series
CJH-JHS
12/2003

HYDRO SERIES

The Hydro series consists of very deep, well drained soils on terraces and footslopes. Slopes are 0 to 15 percent. Mean annual precipitation is about 13 inches and mean annual air temperature is about 48 F.

TAXONOMIC CLASS: Fine, smectitic, frigid Aridic Glossic Natrustalfs

TYPICAL PEDON: Hydro loam - grassland. (Colors are for dry soil unless otherwise noted)

A--0 to 1 inches; dark grayish brown (2.5Y 4/2) loam, very dark grayish brown (2.5Y 3/2) moist; moderate thin platy structure that separates to moderate very fine granules; slightly hard, very friable, slightly sticky, slightly plastic; many very fine roots and tubular pores; slightly acid (pH 6.2); clear boundary. (1 to 3 inches thick)

E--1 to 4 inches; light gray (2.5Y 7/2) on top of plates and light brownish gray (2.5Y 6/2) on bottom of plates, loam, grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) crushing to dark grayish brown (2.5Y 4/2) moist; very thin platy structure; slightly hard, very friable, slightly sticky, slightly plastic; many very fine roots and tubular pores; surfaces of plates have a continuous coating of uncoated mineral grains on top and undersides; slightly acid (pH 6.2); clear boundary. (2 to 4 inches thick)

EB--4 to 11 inches; light gray (2.5Y 7/2) on top of plates and light brownish gray (2.5Y 6/2) on underside of plates, light clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure that separates to strong very thin plates in upper part and strong very fine blocks in lower part; slightly hard, very friable, slightly sticky, slightly plastic; many very fine roots and tubular pores; plates have continuous thick frosting of uncoated mineral grains on top and undersurfaces, blocks have thin coating of uncoated silt grains; slightly acid (pH 6.3); clear boundary. (4 to 8 inches thick)

Btn--11 to 21 inches; pale brown (10YR 6/3) light clay, light olive brown (2.5Y 5/3) moist; brown (10YR 4/3) coating on peds; moderate medium prismatic structure that separates to strong fine and very fine blocks; extremely hard, firm, sticky, plastic; common very fine roots, mainly between prisms; faint continuous clay films; few stained sand grains; moderately alkaline (pH 8.0); clear boundary. (6 to 10 inches thick)

Btkn--21 to 31 inches; light olive brown (2.5Y 5/3) heavy clay loam, olive brown (2.5Y 4/3) moist; weak medium and coarse prismatic structure that separates to moderate medium blocks; very hard, friable, sticky, plastic; few roots; faint patchy clay films; moderate effervescence with common lime nodules; moderately alkaline (pH 8.4); clear boundary. (5 to 15 inches thick)

Bk--31 to 36 inches; light olive brown (2.5Y 5/3) heavy clay loam, olive brown (2.5Y 4/3) moist; weak coarse blocky structure; very hard, friable, sticky, plastic; few roots; moderate effervescence with common soft lime nodules and few nests and seams of gypsum in lower part; moderately alkaline (pH 8.4).

Bky--36 to 51 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; weak coarse blocky structure; hard, friable, sticky, plastic; very few roots; moderate effervescence with few soft lime

segregations and with common segregations of gypsum in seams and nests of crystals; moderately alkaline (pH 8.2); gradual boundary. (0 to 20 inches thick)

BC--51 to 60 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; weak coarse blocky structure; hard, friable, sticky, plastic; moderate effervescence; moderately alkaline (pH 8.2).

TYPE LOCATION: Powder River County, Montana; 200 feet east and 1,200 feet north of S1/4 corner of section 11; T9S, R53E.

RANGE IN CHARACTERISTICS:

Soil Temperature: 48 to 50 degrees F.
Depth to Bk horizon: 12 to 18 inches
Depth to gypsum or other visible salts: more than 30 inches
Combined thickness of A, E and EB horizons: 5 to 10 inches
Notes: Some pedons have a C Horizon.

A horizon:
Hue: 2.5Y, 10YR or 7.5YR
Value: 4 or 5 and 3 or 4 moist (Ap horizons have values of more than 5 dry and 4 or more moist)
Chroma: 2
Texture: loam or silt loam
Clay Content: 18 to 27 percent
Rock Fragments: 0
Reaction: 6.1 to 6.5

E horizon:
Hue: 2.5Y, 10YR or 7.5YR
Value: 6 or 7 and 4 or 5 moist
Chroma: 2
Texture: loam or silt loam
Clay Content: 18 to 27 percent
Rock Fragments: 0
Reaction: 6.1 to 6.5

EB horizon:
Hue: 2.5Y, 10YR or 7.5YR
Value: 6 or 7 and 4 or 5 moist
Chroma: 2
Texture: loam or clay loam
Clay Content: 20 to 35 percent
Rock Fragments: 0
Reaction: 6.1 to 6.5
EC: 4 to 8 mmhos/cm
SAR: 0 to 5
Notes: The coating on the plates and prisms shows many clear uncoated grains with chroma of 1 or 2 and value of 5 or greater. The broken and crushed surfaces have one unit stronger chroma.

Btn horizon:
Hue: 2.5Y, 10YR or 7.5YR

Value: 5 or 6 and 4 or 5 moist
Chroma: 3
Texture: clay loam or clay
Clay Content: 38 to 45 percent
Rock Fragments: 0
Reaction: 7.4 to 8.4
EC: 4 to 8 mmhos/cm
SAR: 5 to 15 (where the SAR is less than 13.5, the Na plus Mg is more than the Ca plus H.

Btkn horizon:
Hue: 2.5Y, 10YR or 7.5YR
Value: 5 or 6 and 4 or 5 moist
Chroma: 2 or 3
Texture: clay loam or clay
Clay Content: 35 to 45 percent
Rock Fragments: 0
Reaction: 7.9 to 8.4
EC: 4 to 16 mmhos/cm
SAR: 15 to 25

Bk horizon:
Hue: 2.5Y, 10YR or 7.5YR
Value: 5 or 6 and 4 or 5 moist
Chroma: 2 or 3
Texture: clay loam
Clay Content: 27 to 35 percent
Rock Fragments: 0
Reaction: 7.9 to 8.4
EC: 4 to 16 mmhos/cm
SAR: 15 to 30

Bky and BC horizons:
Hue: 2.5Y, 10YR or 7.5YR
Value: 5 or 6 and 4 or 5 moist
Chroma: 2 or 3
Texture: loam or clay loam
Clay Content: 18 to 35 percent
Rock Fragments: 0
Reaction: 7.9 to 8.4
EC: 4 to 16 mmhos/cm
SAR: 15 to 30

COMPETING SERIES: These are the Talag series. Talag soils have more than 45 percent clay in the Btn horizons.

GEOGRAPHIC SETTING: The Hydro soils are on nearly level to sloping terraces and footslopes. They formed in very deep transported calcareous loam or clay loam materials of mixed rock origin. The climate is cool semiarid with mean annual air temperature ranging from 45 to 48 degrees F., mean summer air temperature of 65 to 70 degrees F., a frost-free period of 95 to 150 days, and a mean annual precipitation of 10 to 15 inches with 8 to 10 inches of warm season rainfall. Frost-free period is 100 to 150 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These were the Arvada, Fort Collins, Thurlow and Cushman soils (when previously classified as mesic). Arvada soils do not have EB horizons and have an ESP of more than 15 in the Bt horizon. The Fort Collins, Thurlow and Cushman soils do not have E horizons, have prismatic or blocky structured Bt horizons with neutral or moderately alkaline reaction, and have an ESP of less than 7 in any part of the Bt horizon.

DRAINAGE AND PERMEABILITY: Well-drained; slow permeability.

USE AND VEGETATION: Used for irrigated and nonirrigated cropland and for rangeland. Large areas still have western wheatgrass, prairie junegrass, blue grama, and silver sagebrush.

DISTRIBUTION AND EXTENT: An extensive soil occurring in small areas widely distributed throughout the eastern and northern plains of Montana.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Big Horn County (Big Horn Area), Montana, 1970.

REMARKS: Diagnostic horizons and features recognized in this pedon: ochric epipedon - the zone from the surface of the soil to a depth of 4 inches (A and E horizons); glossic horizon - the zone from 4 to 11 inches (EB horizon); natric horizon - the zone from 11 to 31 inches (Btn and Btkn horizons).

National Cooperative Soil Survey
U.S.A.

LOCATION MIDWAY CO+KS MT SD ND WY
Established Series
CJH
04/2004

MIDWAY SERIES

The Midway series consists of shallow, well drained soils that formed in residuum and slope alluvium from calcareous platy, clayey shale. Midway soils are on ridge crests, mesas, plains, and hills in shale bedrock uplands. Slopes range from 0 to 40 percent. Mean annual precipitation is about 13 inches and mean annual air temperature is about 50 degrees F.

TAXONOMIC CLASS: Clayey, smectitic, calcareous, mesic, shallow Ustic Torriorthents

TYPICAL PEDON: Midway clay - grassland. (Colors are for dry soil unless otherwise noted)

A--0 to 3 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate very fine granular structure; hard, friable, strongly effervescent; slightly alkaline; clear smooth boundary. (3 to 8 inches thick)

C--3 to 12 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; weak fine subangular blocky structure; hard, firm; strongly effervescent; few, fine, and medium clusters of gypsum; moderately alkaline; clear smooth boundary. (7 to 12 inches thick)

Cr--12 to 24 inches; light yellowish brown (2.5Y 6/4) partially weathered, platy, clay shale, light olive brown (2.5Y 5/4) moist; massive; hard, very firm; strongly effervescent; few fine nests of gypsum; strongly alkaline.

TYPE LOCATION: Boulder County, Colorado; about 2 miles northwest of Niwot, Colorado; 1,220 feet south and 400 feet east of center of Sec. 14, T. 2 N., R. 70 W.

RANGE IN CHARACTERISTICS:
Midway soils are usually dry unless irrigated.
Mean annual soil temperature ranges from 47 to 52 degrees F.
Depth to paralithic contact: 10 to 20 inches, but is as shallow as 6 inches in some pedons.
Gravel and channery size shale parafragments above the Cr horizon range from 0 to 80 percent.

A horizon:
Hue: 5Y to 10YR
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 2 to 4
Texture: clay or clay loam
Reaction: neutral to moderately alkaline

C horizon: (AC is present in some pedons)
Hue: 5Y to 10YR
Value: 5 or 6 dry,
Chroma: 2 to 4
Texture: silty clay loam, silty clay, clay loam or clay

Clay content: 35 to 45 percent
Silt content: 20 to 50 percent silt
Sand content: less than 10 percent sand coarser than very fine sand
Reaction: slightly alkaline to strongly alkaline

COMPETING SERIES: These are the Cannonville, Danko, Orella, Samday and Zyme series.
Cannonville and Zyme soils: have moisture control sections that are dry for 15 consecutive days from May 15 to July 15 when the soil temperature at 20 inches is greater than 41 degrees F.
Danko soils: have hue of 7.5YR or redder.
Orella soils have 38 to 65 percent clay in the particle-size control section.
Samday soils are dry for 90 cumulative days or 60 consecutive days from July 15 to October 25.

GEOGRAPHIC SETTING:
Landform: crests of ridges, mesas, plains and hills in shale bedrock uplands.
Slopes: 0 to 40 percent
Parent material: slope alluvium and residuum from calcareous platy shale high in smectitic type clay
Mean annual precipitation: 10 to 16 inches, about 13 inches at the type location.
Mean annual air temperature is 45 to 53 degrees F.
Frost free period: 100 to 160 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Gaynor, Shingle and Renohill soils.
Gaynor soils have a paralithic contact above 40 inches.
Shingle soils have less clay in their particle-size control section.
Renohill soils have an argillic horizon, and a paralithic contact at depths of 20 to 40 inches.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is low to very high depending on slope. Permeability is very slow or slow.

USE AND VEGETATION: Principally native range with associations of short grasses or forbs, prairie junegrass, silver sage, threadleaf sage, western wheatgrass and rabbitbrush.

DISTRIBUTION AND EXTENT: Colorado, Wyoming, Montana, South Dakota, North Dakota, Kansas. LRR E, G, and H; MLRA 49, 67, 69, 72. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: Central Montana Reconnaissance, Montana, 1943.

REMARKS: Diagnostic horizons and features recognized in this pedon include:
Ochric epipedon: the zone from 0 to 3 inches. (A horizon)
Paralithic contact - at 12 inches (top of the Cr horizon).

Differentia with the Orella series needs to be better defined.

Series updated from 7/87 to 2/94 for use on the Kit Carson County, Colorado, final correlation. CJH
Geographic Setting: Revised MAP to 13 inches at the type location and ranged the MAP from 8 to 14 inches. CJH
Added, "Diagnostic features include a paralithic contact at 12 inches. Last updated by the state 2/94. CJH

11/21/96 CJH
1. Allowed clay texture in range of A horizon.

2. Range dry value in C horizon to 5 or 6 and chroma to 3 or 4.
3. Add descriptive material to Cr horizon.
4. Change mineralogy to smectitic

7/9/97 CJH
1. Range precipitation from 10 to 16 inches.

12/24/2002 CJH
1. Allow chroma of 2 in C horizon.
2. Allow slightly alkaline reaction in C horizon.
3. Allow very slowly permeable.
4. Update competing series section.

3/22/04 CJH Transfer responsibility to Kansas MO.

4/2004 WAW Change to semi-tabular format, update distribution and extent.

National Cooperative Soil Survey
U.S.A.

LOCATION SPEARMAN MT+WY
Established Series
Rev. JCM/CAM
11/98

SPEARMAN SERIES

Typically, Spearman soils have reddish brown loam A1 horizons, reddish brown light clay loam B horizons, and light reddish brown channery loam C horizons resting on platy hard shale fragments at about 23 inches.

TAXONOMIC CLASS: Fine-loamy over fragmental, mixed, superactive, mesic Aridic Haplustolls

TYPICAL PEDON: Spearman loam - native. (Colors are for dry soil unless otherwise noted.)

A11--0 to 2 inches; reddish brown (5YR 5/3) heavy loam, dark reddish brown (5YR 3/3) moist; moderate thin platy structure; slightly hard, very friable, slightly sticky, slightly plastic; many very fine roots and interstitial pores; neutral; clear smooth boundary.

A12--2 to 4 inches; reddish brown (5YR 5/3) light clay loam, dark reddish brown (5YR 3/3) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; many very fine and fine tubular pores; neutral; clear wavy boundary. (Al horizon 4 to 7 inches thick)

B2--4 to 15 inches; reddish brown (5YR 5/4) light clay loam, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure that separates to moderate medium blocks; hard, friable, slightly sticky, slightly plastic; many very fine roots; many very fine and few fine tubular pores; few red burned shale fragments; neutral; gradual wavy boundary. (8 to 16 inches thick)

C1--15 to 19 inches; light reddish brown (5YR 6/4) channery loam, yellowish red (5YR 4/6) moist; weak fine blocky structure; hard, friable, slightly sticky, slightly plastic; many very fine roots, common very fine and few fine tubular pores; 15 percent flat burned shale fragments; mildly alkaline; clear wavy boundary. (3 to 10 inches thick)

C2--19 to 23 inches; light reddish brown (5YR 6/5) loam, yellowish red (5YR 4/5) moist, massive; hard, friable, slightly sticky, slightly plastic; many very fine roots; common very fine and few fine tubular pores; 30 percent flat burned shale fragments; moderately calcareous with lime crust on underside of shale fragments; moderately alkaline; abrupt wavy boundary.

C3--23 to 60 inches; fragmented hard red burned shale with roots matted between shale layers in upper 2 inches.

TYPE LOCATION: Big Horn County, Montana; 550 feet east and 600 feet north of S1/4 corner section 1, T.1S., R.37E.

RANGE IN CHARACTERISTICS: Spearman soils are usually dry, but their upper horizons are occasionally moistened by summer rains of one or more inches intensity. Mean annual soil temperature is 48 to 50 degrees F. The hue is 7.5YR through 10R. The mollic epipedon is 7 to 15 inches thick. Depth to hard platy shale is 20 to 40 inches. Shale fragments throughout the A and B horizons range from 2 to 10 percent and throughout the C horizons overlying bedded shale range from 10 to 50 percent, but the average volume of coarse fragments from 10 inches to the hard platy shale is less than 35 percent. The A1 horizon

has value of 2 or 3 moist and chroma of 2 through 4, with chroma of 4 occurring below 4 inches. The B horizon has value of 5 or 6, 3 or 4 moist and chroma of 4 through 6. It is heavy loam or light clay loam with estimated 2 to 5 percent more clay than in the A1 or Ap horizons.

COMPETING SERIES: These are the tentative Capps, Deacon, Fishers and Shirk series and the established Nucla, Ortiz and Searing series. Capps, Deacon and Fishers soils lack paralithic contacts at depths of 40 inches or less. Also, Fishers soils are noncalcareous throughout. Nucla and Shirk soils have hue of 10YR or 2.5Y and the Nucla soils are very deep. Ortiz soils are calcareous throughout the solum and have a Cca horizon. Searing soils have dry value of 4 in the Al horizon, are usually moist and have mean annual soil temperature of 39 to 47 degrees F.

GEOGRAPHIC SETTING: Spearman soils are on nearly level to rolling uplands. The soils farmed in loamy materials weathered from underlying hard red burned shales. The climate is cool, moist semiarid with mean annual temperature of 45 to 50 degrees F., and mean annual precipitation of 12 to 16 inches, 70 percent of which falls during April through September.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Chugter and Wibaux soils. Chugter soils are deep over platy hard shale beds and Wibaux soils are shallow over platy hard shale beds and they have ochric epipedons.

DRAINAGE AND PERMEABILITY: Well-drained; slow or medium runoff; moderate or moderately rapid permeability.

USE AND VEGETATION: Use is mainly for range. Grasses are needle-and-thread grass, green needle grass, western wheat grass and Japanese brome grass.

DISTRIBUTION AND EXTENT: Widely distributed in southeastern Montana and northeastern Wyoming. The series is moderately extensive.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Big Horn County (Big Horn Area), Montana, 1970.

REMARKS: Spearman soils were formerly classified as Brown soils.

OSED scanned by SSQA. Last revised by state on 5/71.

National Cooperative Soil Survey
U.S.A.

LOCATION THEDALUND CO+MT UT WY
Established Series
GB
11/98

THEDALUND SERIES

The Thedalund series consists of moderately deep, well drained, moderately permeable soils formed in thick calcareous alluvial materials derived from sedimentary rock. Thedalund soils are on hills and ridges and have slopes of 0 to 30 percent. The mean annual precipitation is about 15 inches and mean annual temperature is about 49 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

TYPICAL PEDON: Thedalund clay loam - grassland. (Colors are for dry soil unless otherwise noted.)

A--0 to 2 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate very fine granular structure; soft, friable; strongly effervescent; moderately alkaline; gradual wavy boundary. (3 to 6 inches thick)

AC--4 to 8 inches; light yellowish brown (2.5Y 6/3) light clay loam, olive brown (2.5Y 4/3) moist; weak medium and fine subangular blocky structure parting to moderate fine granular; strongly effervescent; moderately alkaline; gradual wavy boundary. (3 to 6 inches thick)

C--8 to 30 inches; pale yellow (2.5Y 7/3) light clay loam, light yellowish brown (2.5Y 6/3) moist; massive; hard, very friable; few small concretions of secondary calcium carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary. (12 to 28 inches thick)

Cr--30 inches; soft shale and interbedded soft sandstone and siltstone.

TYPE LOCATION: Arapahoe County, Colorado; 1,400 feet north and 200 feet east of the SW corner of Sec. 7, T. 4 S., R. 57 W.

RANGE IN CHARACTERISTICS: Mean annual soil temperature ranges from 47 to 58 degrees F. and mean summer soil temperature ranges from 59 to 79 degrees F. Normally, these soils are calcareous throughout but they are leached for a few inches in some pedons. Some visible secondary calcium carbonate occurs inconsistently and at variable depths. The particle size control section is generally loam or light clay loam, but clay ranges from 18 to 35 percent, silt from 20 to 55 percent and sand from 15 to 50 percent with more than 15 percent but less than 35 percent fine or coarser sand. Rock fragments range from 0 to 15 percent by volume. Depth to bedrock ranges from 20 to 40 inches.
The A horizon has hue of 5Y through 7.5YR, value of 5 through 7, 3 through 5 moist, and chroma of 2 through 4. The horizon is usually granular but has subangular blocky structure in some pedons. It is soft or slightly hard. It is mildly alkaline or strongly alkaline (pH 7.8 to 8.5).

The C horizon has hue of 5Y through 7.5YR. It is loam or clay loam with more than 18 percent clay. It is moderately alkaline or strongly alkaline (pH 8.0 to 8.6) and contains 1 to 5 percent calcium carbonate equivalent.

COMPETING SERIES: These are the El Rancho, Kim, Kishona, Neville, Pojoaque, Shavano, and Sixmile series. El Rancho, Kim, Kishona, Neville, and Pojoaque soils lack a paralithic contact at a depth of less than 40 inches. Also El Rancho, Neville and Pojoaque soils have hue of 5YR or redder. Shavano soils have a lithic contact between a depth of 20 and 40 inches, Sixmile soils have hue of 5YR or redder.

GEOGRAPHIC SETTING: Thedalund soils are on hills and ridges. Slopes range from 0 to 30 percent. The soils formed in thick calcareous alluvial fan materials derived from sedimentary rock. At the type location the average annual precipitation is 15 inches with peak periods of precipitation in the spring and early summer months. Mean annual temperature is 49 degrees F., mean summer temperature is 69 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Kim soils and the Shingle soils. Shingle soils have bedrock at a depth of 20 inches or less.

DRAINAGE AND PERMEABILITY: Well drained; medium runoff; moderate permeability.

USE AND VEGETATION: They are used as native pastureland or as irrigated or dry cropland. Native vegetation is blue grama, sage, and cactus.

DISTRIBUTION AND EXTENT: Eastern Colorado, Wyoming and Montana. The series is of large extent.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Arapahoe County, Colorado, 1965.

National Cooperative Soil Survey
U.S.A.

LOCATION THURLOW MT
Established Series
CAM/MML/CJH
04/2002

THURLOW SERIES

The Thurlow series consists of very deep, well drained soils that formed in calcareous clay loam unconsolidated materials. These soils are in valleys on river and stream terraces. Slopes are 0 to 15 percent. Mean annual precipitation is about 11 inches, and mean annual air temperature is about 46 degrees F.

TAXONOMIC CLASS: Fine, smectitic, mesic Torrertic Haplustalfs

TYPICAL PEDON: Thurlow clay loam - native grass cover. (Colors are for dry soil unless otherwise noted)

A--0 to 4 inches; grayish brown (10YR 5/2) heavy loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure in the upper part and moderate thin structure in the lower part; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; many clear unstained sand grains on tops of plates; clear smooth boundary. (2 to 6 inches thick)

Bt--4 to 16 inches; brown (10YR 5/3) heavy clay loam, brown (10YR 4/3) moist; dark grayish brown (10YR 4/2) coating on peds, dark brown (10YR 3/3) moist; moderate medium prismatic structure that separates to strong medium blocks; very hard, firm, sticky, plastic; common very fine roots; many very fine and common fine tubular pores; varnish-like coating on peds and on walls of pores and root channels, with some pores having rounded edges; maximum clay content is in the upper part of the horizon; clear boundary. (6 to 16 inches thick)

Bk--16 to 28 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; prisms coated slightly darker in the upper part; moderate medium prismatic grading to weak coarse prismatic structure that separates to weak coarse blocks; hard, friable, sticky, plastic; common very fine roots; common very fine and fine tubular pores; calcareous with common films of segregated lime; gradual boundary. (8 to 20 inches thick)

C--28 to 60 inches; light yellowish brown (2.5Y 6/3) stratified clay loam and clay, light olive brown (2.5Y 5/3) moist; massive; hard, friable, sticky plastic; few very fine roots; common very fine tubular pores; calcareous.

TYPE LOCATION: Yellowstone County, Montana; 1,200 feet north of SE corner section 19, T.2N., R.28E.

RANGE IN CHARACTERISTICS: Thurlow soils are usually dry when not frozen unless irrigated and they have mean annual soil temperature of 47 to 5O degrees F. The nonclacareous part of the solum is 10 to 20 inches thick.

The A horizon has hue lOYR or 2.5Y, value of 5 or 5.5 dry and 3.5 or 4 moist, and chroma of 2 or 3. In its upper part coated colors are one unit of value less than when crushed and less than that of the A horizon. It is silt loam, silty clay loam or clay loam.

The Bt horizon has hue of 10YR or 2.5Y, dry value of 4 or 5 coated and 5 or 6 crushed, moist value of 4 or 5 crushed, and chroma of 2 to 4. It contains 35 to 45 percent clay and has 6 to 10 percent more clay than the A horizon and is highest in clay in the upper part.

COMPETING SERIES: These are the Demar, Horselake, Moorhead and Teeque series. Demar soils are more acid and have a Bz horizon. Horselake soils are moderately deep. Moorhead soils have a Btk horizon and are warmer. Teeque soils are dry during the period of April through June.

Baca, Bew, Fort Collins, Hesper and Renohill series. Baca and Hesper soils have less than 18 percent fine and coarser sand in their pedons. Bew soils have 50 to 60 percent clay in their Bt horizons. Fort Collins soils have less than 35 percent clay in the Bt horizon. Renohill soils have shale bedrock at depths of about 30 inches.

GEOGRAPHIC SETTING: The Thurlow soils are in valleys on river and stream terraces. The soil formed in calcareous, clay loam, unconsolidated materials. Slopes are 0 to 15 percent. Climate is cool semiarid with mean annual air temperature of 45 to 48F., mean summer temperature of more than 62F., and winter temperature 20 to 28F. Mean annual precipitation is l0 to 13 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Arvada, Bew, Fort Collins and Hydro soils. Arvada and Hydro soils have natric horizons. Bew soils have 50 to 60 percent clay in their Bt horizons. Fort Collins soils have less than 35 percent clay in the Bt horizon.

DRAINAGE AND PERMEABILITY: Well-drained; moderately permeable.

USE AND VEGETATION: Used mainly for irrigated production of diversified crops, nonirrigated production of small grains and native range of mid and short grasses. Potential native vegetation is mainly blue grama and western wheatgrass.

DISTRIBUTION AND EXTENT: Thurlow series is moderately extensive in southeastern Montana.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota.

SERIES ESTABLISHED: Big Horn County (Big Horn Area), Montana, 1970.

REMARKS: 4/2002 revisions largely to correct errors in OSED scan by NSSQA and update the "Competing Series" section.

An analysis of the series in 1999 indicated the series may be frigid. It also indicated the series could possibly be included with the Pinehill series.

SIR- MT0492

National Cooperative Soil Survey
U.S.A.
LOCATION TRAVESSILLA NM+AZ CO KS MT OK SD UT WY
Established Series
Rev. VGL-AJC-RJA-ACT
05/2002

TRAVESSILLA SERIES

The Travessilla series consists of very shallow and shallow, well drained soils that formed in calcareous eolian sediments and material weathered from sandstone. These soils are on hills, cuestas, scarps, and mesas with slopes ranging from 0 to 75 percent. Mean annual precipitation is about 11 inches. The mean annual temperature is above 53 degrees F.

TAXONOMIC CLASS: Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents

TYPICAL PEDON: Travessilla stony sandy loam - rangeland. (Colors are for dry soil unless otherwise noted.)

A--0 to 4 inches; light brownish gray (10YR 6/2) stony sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; common fine pores; 15 percent stones; slightly effervescent; slightly alkaline; clear smooth boundary. (2 to 6 inches thick)

C--4 to 8 inches; pale brown (10YR 6/3) channery loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; common fine pores; 20 percent channers; slightly effervescent; moderately alkaline; abrupt smooth boundary. (2 to 14 inches thick)

R--8 inches; hard sandstone with some fractures.

TYPE LOCATION: Union County, New Mexico; approximately 1,560 feet north and 4,200 feet west of the southeast corner, sec. 24, T. 31 N., R. 36 E.

RANGE IN CHARACTERISTICS:

Soil Moisture - Typically, moist intermittently from April 30 through October in some part of the soil moisture control section and dry in all parts periodically from November 1 to April 30.

Soil Temperature - 50 to 58 degrees F.
Depth to lithic contact: typically 4 to 10 inches but ranges to 20 inches.

Particle-size Control Section:
Clay Content: 5 to 18 percent.
Silt Content: 5 to 50 percent.
Sand Content: 40 to 90 percent with more than 25 percent fine sand or coarser.
Rock fragment content: 0 to 10 percent stones, 0 to 10 percent cobbles and 0 to 25 percent pebbles but weighted average is less than 35 percent.

A and C horizons - (an AC horizon is present in some pedons)
Hue: 7.5YR to 2.5Y
Value: 5 to 7 dry, 3 to 5 moist
Chroma: 2 to 4
Texture of the Fine Earth Fraction: sandy loam, fine sandy loam, loam or very fine sandy loam.
Rock fragment content: 0 to 35 percent
Reaction: slightly alkaline or moderately alkaline.

COMPETING SERIES: These are the Hideout (UT), Kenzo (T UT), Lazear (CO), Redspear (WY), Rizno (UT), Rizozo (NM), Simel (UT), Skyvillage (NM), Tesihim (AZ), Travson (WY), and Zukan (UT) series.
Hideout soils: have a mean annual temperature of 47 to 50 degrees F.
Kenzo soils: have hue of 7.5YR or redder.
Lazear soils: have more than 18 percent clay.
Redspear, Rizno and Rizozo soils: have hue of 5YR or redder.
Simel soils: average 27 to 35 percent clay.
Skyvillage soils: are dry in all parts of the soil moisture control section periodically from May 1 to June 30.
Tesihim soils: are derived from soft volcanic tuff.
Travson soils: are dry in the soil moisture control section July through September.
Zuchan soils: have accumulated carbonates in the form of a Bk horizon.

GEOGRAPHIC SETTING:
Parent material: calcareous eolian sediments and residuum weathered from sandstone and shale.
Outcrops of sandstone with a minor amount of shale are common on steep slopes.
Landform: hills, cuestas, scarps, and mesas
Slopes: 0 to 75 percent.
Elevation: 4,700 to 8,000 feet.
Mean annual precipitation: 10 to 16 inches, but has ranged higher.
Mean annual temperature: 50 to 57 degrees F.
Frost-free period is typically 115 to 170 days. Utah has a frost-free period as low as 70 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Bernal, Carnero, Hagerman, Quay and Pajarito soils.
Bernal and Hagerman soils: have an argillic horizon.
Carnero soils: have bedrock at depths of 20 to 40 inches.
Quay and Pajarito soils: do not have bedrock within a depth of 40 inches.
Quay soils have more than 18 percent clay in the particle size control section and have a prominent zone of lime accumulation

DRAINAGE AND PERMEABILITY: Well drained; runoff is high on slopes less than 1 percent and very high on slopes greater than 1 percent; moderate or moderately rapid permeability.

USE AND VEGETATION: Rangeland. Juniper, pinyon, squawbush, oakbrush, blue grama, sideoats grama and snakeweed are the principal plants.

DISTRIBUTION AND EXTENT: Northern New Mexico, Arizona, Colorado, Montana, western Oklahoma, Utah and Wyoming. LRR E, G; MLRA'S 49, 67, 69, 70, 77. The series is extensive.

MLRA OFFICE RESPONSIBLE: Temple, Texas

SERIES ESTABLISHED: Eastern New Mexico Reconnaissance, Harding County, New Mexico, 1937.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric Epipedon - 0 to 4 inches. (A horizon).
Lithic Contact - 8 inches. (R horizon).
Particle-size Control Section - The zone from the surface of the soil to about 8 inches: (A, C horizons).

Additional data: None

Taxonomic Version: Second Edition, 1999

National Cooperative Soil Survey
U.S.A.
LOCATION WIBAUX WY+MT
Established Series
CAP
02/2000

WIBAUX SERIES

The Wibaux series consists of very deep, well drained soils formed in colluvium and alluvium derived from porcelanite. Wibaux soils are on hillslopes, knolls and ridges. Slopes range from 0 to 75 percent. The mean annual precipitation is about 15 inches, and the mean annual temperature is about 46 degrees F.

TAXONOMIC CLASS: Loamy-skeletal over fragmental, mixed, superactive, nonacid, mesic Ustic Torriorthents

TYPICAL PEDON: Wibaux channery fine sandy loam, on a 4 percent north facing slope - utilized as range land. (Colors are for dry soils unless otherwise stated)

A--0 to 3 inches; reddish brown (5YR 5/4) channery fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; noneffervescent; 25 percent angular scoria channers; slightly alkaline; clear wavy boundary. (3 to 6 inches thick)

C--3 to 16 inches; reddish brown (5YR 5/4) very channery loam, reddish brown (5YR 4/4) moist; massive; soft, friable, slightly sticky and slightly plastic; noneffervescent; 55 percent angular scoria channers; slightly alkaline; clear wavy boundary. (4 to 17 inches thick)

2C--16 to 60 inches; fractured porcelanite.

TYPE LOCATION: Campbell County, Wyoming; about 1600 feet west and 150 feet south of the northeast corner of Sec. 14, T 41 N, R 70 W.; USGS Piney Canyon SW, WY topographic quadrangle; lat. 43 degrees 32 minutes 3 seconds N. and long. 105 degrees 12 minutes 42 seconds W.

RANGE IN CHARACTERISTICS: Depth to the fragmental substrata ranges from 7 to 20 inches. These soils typically are noncalcareous throughout the loamy-skeletal part of the control section but some pedons have carbonates within 6 inches. The fragmental materials in some pedons are inconsistently calcareous. The weighted average organic carbon content of the surface 15 inches or that portion of the solum above the fragmental beds ranges from approximately 0.4 to 1.0 percent. Conductivity is typically less than 2 mmhos/cm and exchangeable sodium percentage is normally less than 3 percent. The mean annual soil temperature ranges from 47 to 53 degrees F. The soil temperature at 20 inches is 41 degrees F. or higher for 175 to 210 days. The fragmental material contains interstices ranging from 2 mm to over 2 cm in diameter. These are devoid of any fine earth material.

The A horizon has hue of 5YR, 7.5YR or 10YR, value of 5 to 7 and 3 to 6 moist, and chroma of 2 to 6. When the value of the A horizon is as dark as 5 and 3 moist, the horizon is too thin or contains too little organic matter to be a mollic epipedon. Texture is loam or fine sandy loam, or channery or very channery

analogues of these textures. Rock fragments range from 5 to 40 percent, with 0 to 5 percent flagstone. Reaction is neutral or slightly alkaline. Some pedons have an AC horizon.

The C horizon has hue of 2.5YR, 5YR, 7.5YR or 10YR, value of 4 to 7 and 3 to 6 moist, and chroma of 2 to 8. Texture is very channery or extremely channery loam or fine sandy loam. Rock fragments range from 35 to 90 percent, with 0 to 15 percent flagstones and 0 to 5 percent stones. Reaction is neutral to slightly alkaline. Moderately alkaline reactions may occur where baked shale is sodic.

The 2C horizon consists of fractured and/or folded porcelanite beds. A soil matrix is uncommon but when present is less than 5 percent. Colors of the rock are quite variable but commonly have 10R or 2.5YR hue. Hues of 5Y have been recorded in some areas.

COMPETING SERIES: There are no competing soils.

GEOGRAPHIC SETTING: The Wibaux series occurs on hillslopes, knolls and the crests and shoulders of ridges. Slopes range from 0 to 75 percent. The soil is developing in thin mantels of medium to moderately fine textured, noncalcareous, channery materials weathered principally from porcelanite beds. The average annual precipitation ranges from 10 to 14 inches with peak periods of precipitation occurring in April, May and June. The mean annual temperature is 46 degrees F., and the mean summer temperature is 65 degrees F. Elevation is 3,500 to 5,800 feet. The frost-free season is 105 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Lawver, Shingle, Taluce, Teckla, Theedle and Turnercrest soils. Lawver and Teckla soils occur on uplands and footslopes. They have argillic horizons. Shingle, Taluce, Theedle and Turnercrest occur on similar landscape positions as Wibaux soils lack fragmental discontinuities. Redhills soils are moderately deep to fractured porcelanite.

DRAINAGE AND PERMEABILITY: Well to somewhat excessively drained; runoff is medium; permeability is moderate over very rapid.

USE AND VEGETATION: They are used as native rangeland. Native vegetation includes sage, prairie junegrass, Sandberg bluegrass and needleandthread. Some areas have ponderosa pine and juniper.

DISTRIBUTION AND EXTENT: Wyoming, Montana and South Dakota. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota.

SERIES ESTABLISHED: Campbell County, Wyoming; 1940.

Ochric epipedon - 3 inches (A horizon)

Fragmental discontinuity - 16 inches (top of 2C horizon)

Ustic subgroup of the aridic moisture regime.

National Cooperative Soil Survey
U.S.A.