

APPENDIX B

SOUTH DAKOTA MAJOR LAND RESOURCE AREA REPORT

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Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin

MLRA Explorer Custom Report

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F - Northern Great Plains Spring Wheat Region

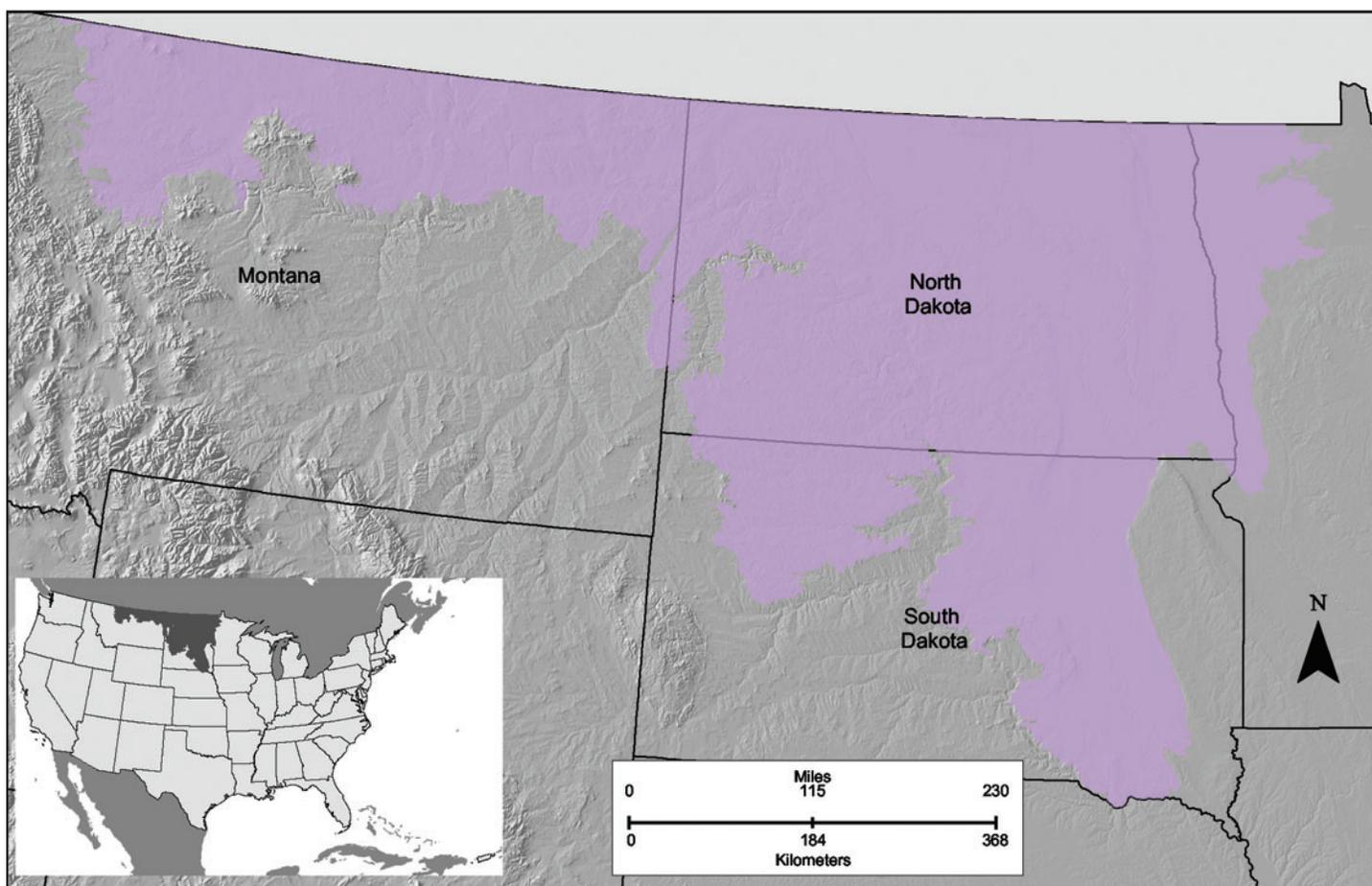


Figure F-1: Location of Land Resource Region F

LRR Overview

This region (shown in fig. F-1) is in North Dakota (48 percent), Montana (23 percent), South Dakota (23 percent), and Minnesota (6 percent). It makes up 142,225 square miles (368,535 square kilometers).

Much of this region has been topographically smoothed by continental glaciation and is blanketed by undulating till and level to gently rolling lacustrine deposits. The Red River Valley, in the eastern part of the region, is dominated by lacustrine deposits, as are other areas where ancient glacial lakes occurred. The surficial geology in the southwestern part of the region consists mainly of residual sediments weathered from sedimentary rocks. Alluvial deposits are along drainageways.

Fertile soils and dominantly smooth topography in this region favor agricultural uses (fig. F-2), but relatively low precipitation and a short growing season severely limit the choice of crops that can be grown. The climate is dry and continental, characterized by short, hot summers and long, cold winters. High winds are an important climatic factor. The region also is subject to periodic intense droughts. The mean annual precipitation in most of the region is 14 to 21 inches (355 to 535 millimeters). About 30 percent of the annual precipitation occurs as snow during the winter, and the rest occurs during the growing season. In most of the region, the mean annual air

temperature is 39 to 45 degrees F (4 to 7 degrees C) and the freeze-free period ranges from 130 to 170 days. The mean annual air temperature and length of the freeze-free period increase from north to south.

The total withdrawals of freshwater in this region average 3,005 million gallons per day (11,375 million liters per day). About 92 percent is from surface water sources, and 8 percent is from ground water sources. About 80 percent of the water is used for cooling thermoelectric power plants.

The soils in this region are dominantly Mollisols. Ustolls and Aquolls are the dominant suborders. Ustolls are on uplands, and Aquolls are in low wet areas and along streams. Aquolls are extensive in the Red River Valley. Some of the Ustolls have a high content of sodium, and some of the Aquolls have a high content of sodium and lime. Other important soils are Orthents on the steeper slopes. The soils in the region dominantly have a frigid soil temperature regime, an ustic or aquic soil moisture regime, and mixed or smectitic mineralogy.

About 96 percent of the land in this region is privately owned. The native vegetation consists mainly of mixed and tall prairie grasses. The main crop is spring wheat, which is grown by dryfarming methods. Other spring-planted grains, flax, and hay also are grown. Potatoes, sugar beets, soybeans, and corn are important crops in the Red River Valley. The main management concerns in areas of cropland are a reduced nutrient content, increasing salinity, and susceptibility to water erosion and wind erosion.



F-2: Cropland, pasture, and rangeland in an area of Land Resource Region F

MLRA 53C - Southern Dark Brown Glaciated Plains

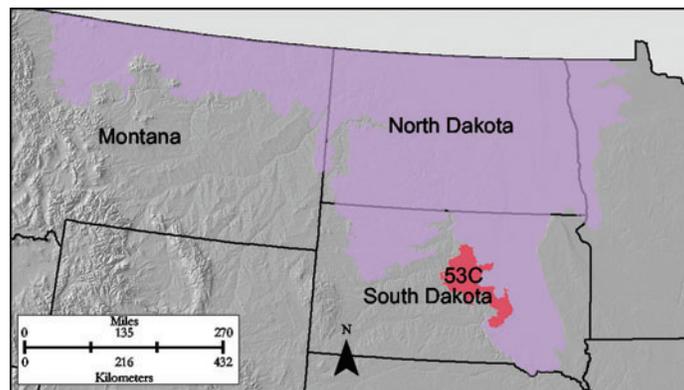


Figure 53C-1: Location of MLRA 53C in Land Resource Region F

Introduction

This area is entirely in South Dakota (fig. 53C-1). It makes up about 3,990 square miles (10,340 square kilometers). It has no major population centers. U.S. Highways 14, 83, and 212 cross the area, and a portion of the Crow Creek Indian Reservation is in the area. The area is generally bounded by the Missouri Breaks to the west and the James Valley Lowlands to the east and south.

Physiography

The entire MLRA is in the Missouri Plateau, Glaciated, Section of the Great Plains Province of the Interior Plains. Elevation ranges from 1,300 to 2,300 feet (395 to 700 meters). The nearly level to gently rolling till plains include many areas of potholes. A terminal moraine occurs in the southern end of the MLRA, north and west of Wessington Springs. Local relief is about 390 feet (120 meters) from the top of the moraine to the outwash and till plain to the east. Moderately steep and steep slopes are adjacent to the major valleys.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-White (1014), 55 percent; Missouri-Oahe (1013), 35 percent; and James (1016), 10 percent. The headwaters of many creeks in central South Dakota occur in this high-lying MLRA.

Geology

This area is covered by glacial till plains broken by numerous potholes. A terminal moraine occurs in the southern end of the area. Cretaceous Pierre Shale lies beneath the glacial deposits in the MLRA.

Climate

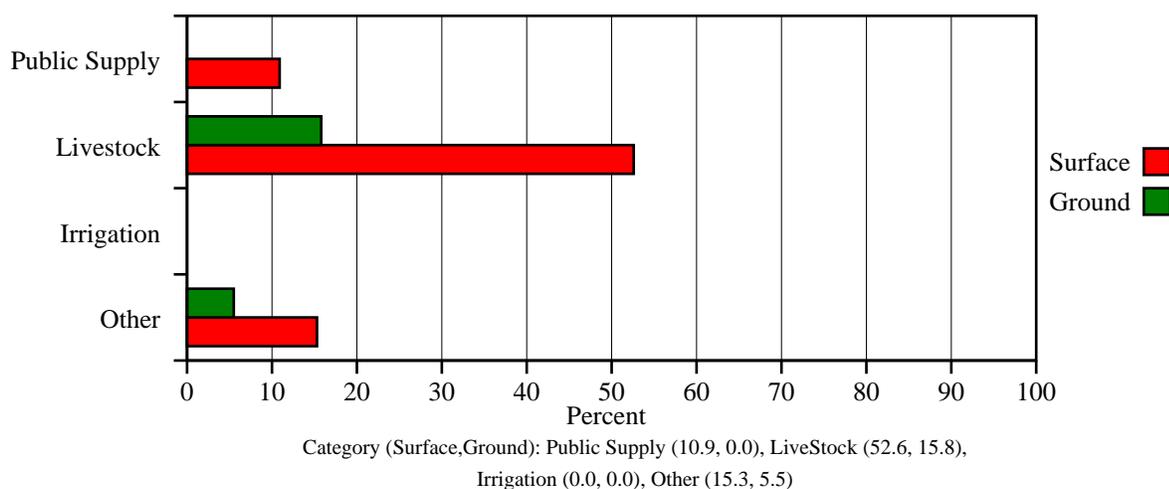
The average annual precipitation is 15 to 25 inches (380 to 635 millimeters). About 70 percent of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The annual snowfall is typically 25 to 45 inches (635 to 1,145 millimeters). The average annual temperature is 43 to 49 degrees F (6 to 9 degrees C). The freeze-free period averages 150 days and ranges from 140 to 160 days.

Water

The total withdrawals average 9 million gallons per day (34 million liters per day). About 21 percent is from ground water sources, and 79 percent is from surface water sources. In most years moisture is inadequate for maximum crop production. Most of the water for livestock comes from dug ponds. Rural water systems in the area supply domestic water to an increasing number of farms and communities. Water for these systems comes from the Missouri River, which has water of very good quality.

There is a limited supply of ground water in the glacial drift and alluvial aquifers that occur near the ground surface. These aquifers consist of unconsolidated sand and gravel. The fresh to saline water is hard and is a calcium, bicarbonate, and sulfate type. The aquifers provide water primarily for domestic use and livestock. The level of total dissolved solids typically exceeds the recommended levels for drinking water. Many private wells have high levels of nitrate plus nitrite. Most of this contamination occurs where the wells are located downslope from septic tank absorption fields, feedlots, barnyards, and fertilizer storage areas.

MLRA 53C Water Use by Category

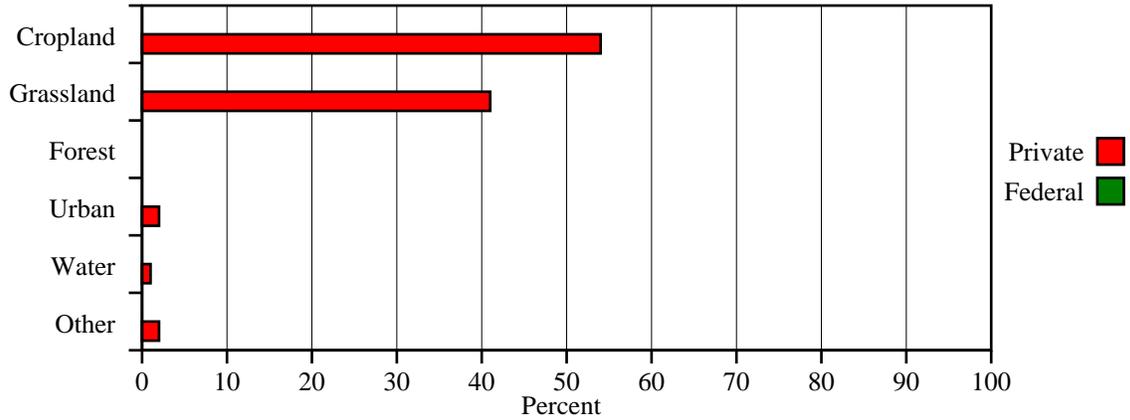


Land Use

Most of this area is in farms and ranches. Slightly more than one-half of the area is dry-farmed cropland. Winter wheat is the chief cash crop. Corn, sunflowers, grain sorghum, oats, and alfalfa are grown on many farms. The more sloping soils are used as rangeland.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture. Conservation practices on cropland generally include systems of crop residue management and no-till systems that conserve moisture and improve soil quality. Other practices include windbreaks, vegetative wind barriers, wind strip cropping, and nutrient management.

MLRA 53C Land Use by Category



Category (Private,Federal): Cropland (54.0, 0.0), Grassland (41.0, 0.0), Forest (0.0, 0.0),
Urban (2.0, 0.0), Water (1.0, 0.0), Other (2.0, 0.0)

MLRA 54 - Rolling Soft Shale Plain

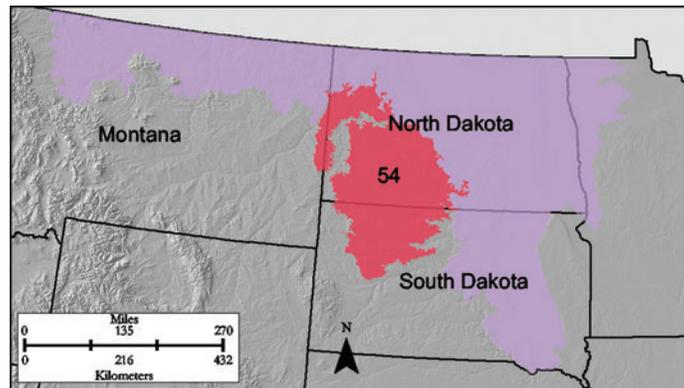


Figure 54-1: Location of MLRA 54 in Land Resource Region F

Introduction

This area (shown in fig. 54-1) is in North Dakota (64 percent), South Dakota (33 percent), and Montana (3 percent). It makes up about 29,280 square miles (75,870 square kilometers). The cities of Dickinson and Mandan, North Dakota, and the towns of Lemmon and Faith, South Dakota, are in this MLRA. Interstate 94 crosses the northern half of the area, and U.S. Highways 12, 85, and 212 are in the area. The Missouri River is at the eastern edge of the area, and Lake Sakakawea, formed by the Garrison Dam, is the northeastern boundary of the area. Grand River National Grasslands, most of the Standing Rock Indian Reservation, and the northwest third of the Cheyenne River Indian Reservation are in the southern part of the area.

Physiography

This area is in the Missouri Plateau, Unglaciaded, and Missouri Plateau, Glaciaded, Sections of the Great Plains Province of the Interior Plains. It is dominantly unglaciaded, but the eastern and northern edges have been glaciaded. The area is on an old, moderately dissected, rolling plain with some local badlands, buttes, and isolated hills. Terraces are adjacent to broad flood plains along most of the major drainages. Elevation is 1,650 feet (505 meters) in the east with a gradual slope to about 3,600 feet (1,100 meters) in the west. Maximum local relief is about 330 feet (100 meters), but relief is considerably lower in most of the area.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-Oahe (1013), 73 percent; Missouri-Little Missouri (1011), 17 percent; Cheyenne (1012), 6 percent; and Lower Yellowstone (1010), 4 percent. The Knife, Heart, Cannonball, and Cedar Rivers, which are major tributaries of the Missouri River in North Dakota, drain this area. Also, the Grand and Moreau Rivers in South Dakota drain the southern part of the area.

Geology

This area is underlain by soft, calcareous shales, siltstones, and sandstones of the Tertiary Fort Union Formation and the Fox Hills and Hell Creek units. The principal sources of ground water in the area are in these rocks. Impermeable Cretaceous shale underlies these aquifers. The northern and eastern parts of the area have a glacially modified topography and in places are covered by thin layers of glacial drift.

Climate

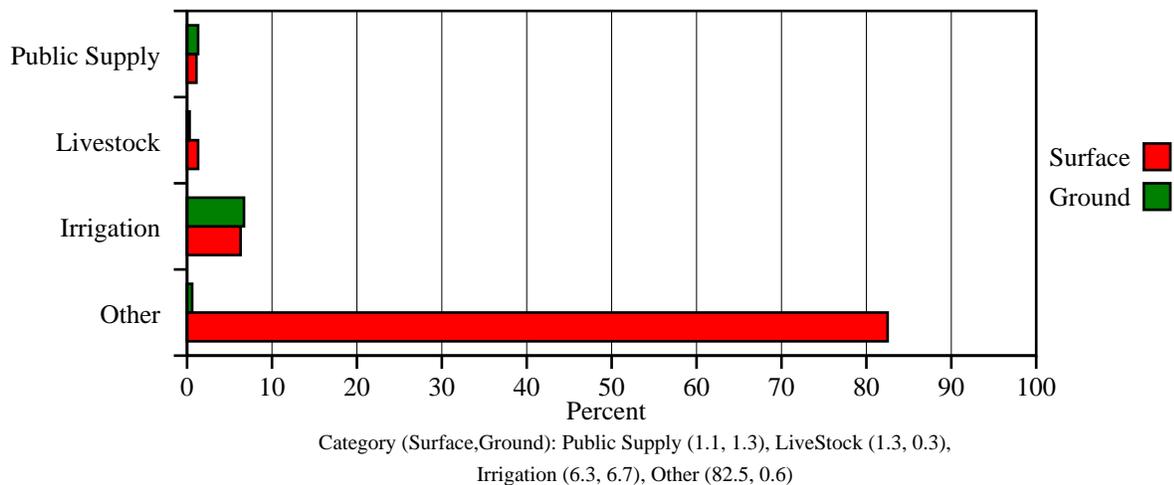
The average annual precipitation is 14 to 18 inches (355 to 455 millimeters). Most of the rainfall occurs as convective thunderstorms during the growing season. About half of the annual precipitation occurs as snow in winter. The average annual temperature is 38 to 46 degrees F (3 to 8 degrees C). The freeze-free period averages 150 days and ranges from 130 to 165 days. It is shortest in the southern part of the area and longest in the northern part.

Water

The total withdrawals average 415 million gallons per day (1,570 million liters per day). About 9 percent is from ground water sources, and 91 percent is from surface water sources. In most years the supply of moisture is inadequate for maximum crop production. Water for irrigation is available in quantity only from the Missouri River and a few of its larger tributaries. The surface water is generally soft and is typically a sodium bicarbonate type. Water for livestock is stored primarily in small reservoirs. The Missouri River water is used dominantly as cooling water for thermoelectric power generation.

Small areas of sand and gravel buried beneath valley floors in this MLRA yield moderate quantities of hard water. Ground water from the Tertiary units is generally hard or very hard. Sodium, sulfate, and bicarbonate are the major ions in the ground water. The Fort Union Formation in North Dakota yields soft water, but the water is high in content of selenium. The content of molybdenum is high in the water in the shallow aquifers in South Dakota. High levels of selenium and molybdenum affect the health of humans and livestock. Ground water is scarce or does not occur in areas underlain by shale. Farms, ranches, and small communities use ground water for most purposes, except for irrigation.

MLRA 54 Water Use by Category



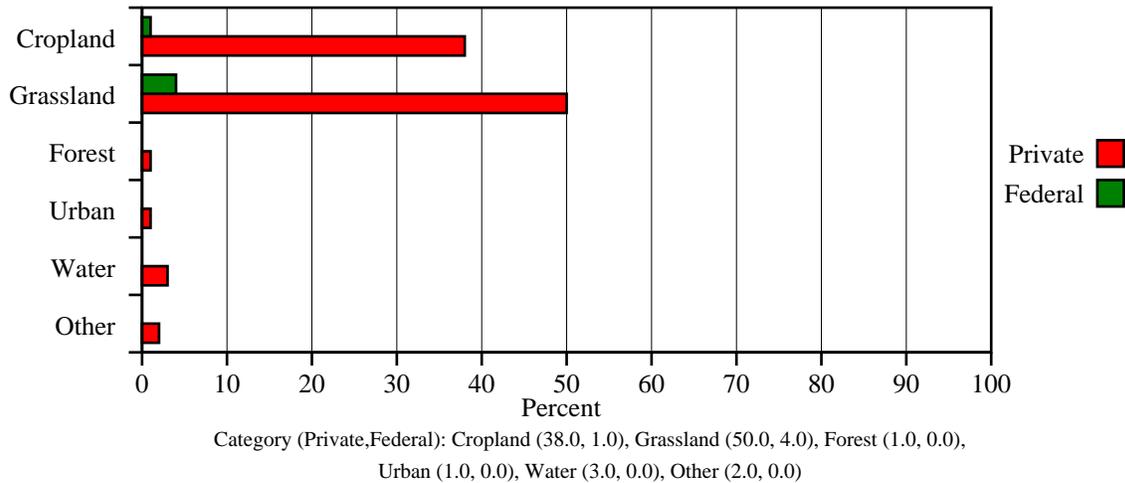
Land Use

Farms and ranches make up nearly all of this area. They produce a combination of cash-grain crops and livestock. More than one-half of the area supports native grasses and shrubs that are grazed. About one-third of the area is used for dry-farmed small grains, such as wheat, barley, oats, rye, and flax. Corn for grain and silage, sunflowers, and alfalfa also are important crops. Some small tracts on the bottom land along the Missouri River are irrigated.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, management of soil moisture, and control of saline

seeps. Conservation practices on cropland generally include systems of crop residue management and minimum-till and no-till systems that reduce the need for summer fallow tillage. Other practices include cover crops, windbreaks, vegetative wind barriers, wind stripcropping, nutrient management, and soil salinity management. Conservation practices on rangeland generally include prescribed grazing, fencing, and water developments.

MLRA 54 Land Use by Category



MLRA 55B - Central Black Glaciated Plains

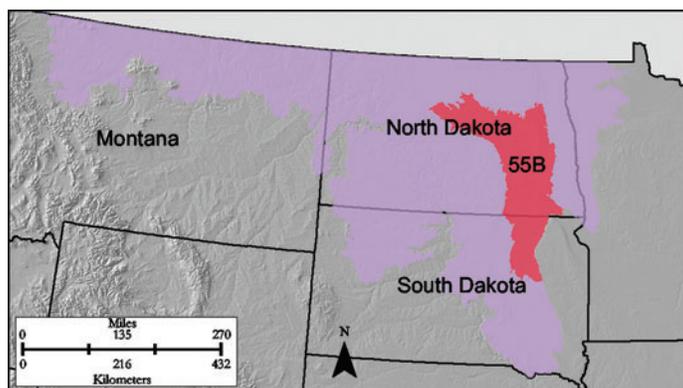


Figure 55B-1: Location of MLRA 55B in Land Resource Region F

Introduction

This area (shown in fig. 55B-1) is in North Dakota (79 percent) and South Dakota (21 percent). It makes up about 17,155 square miles (44,455 square kilometers). The cities of Jamestown, North Dakota, and Aberdeen, South Dakota, are in this MLRA. Interstate 94 passes through Jamestown in the northern half of the area. Numerous national wildlife refuges are in this MLRA, including the Lambs Lake, Johnson Lake, Sibley Lake, Buffalo Lake, Arrowwood, Tewaukon, Chase Lake, and Lake George National Wildlife Refuges in North Dakota and the Sand Lake National Wildlife Refuge in South Dakota.

Physiography

Almost the entire MLRA is in the Western Lake Section of the Central Lowland Province of the Interior Plains. Elevation ranges from 1,000 to 2,050 feet (305 to 625 meters), increasing from east to west. This area is characterized by nearly level to gently rolling till plains and many poorly defined drainage channels. Steep slopes adjacent to the main streams and the glacial lake plains break up the nearly level to gently rolling terrain. The eastern edge of the part of the area in North Dakota and the part of the area in South Dakota are adjacent to glacial Lake Agassiz. A continental drainage divide occurs in the east-central part of the MLRA.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Red (0902), 48 percent; James (1016), 46 percent; and Souris (0901), 6 percent. The James River flows south through all of this area and joins the Missouri River, and the Sheyenne River flows east and north and joins the Red River of the North. The James River is the longest unnavigable river in the United States.

Geology

This MLRA is covered by glacial till plains that include glacial lacustrine deposits. Glacial deposits in kettle holes, kames, and moraines break up the till plain. One of the major river systems in this area is the James River, which was carved by floodwaters draining glacial Lake Dakota. Its valley is filled with glacial outwash and alluvial deposits. A high terrace scarp separates the valley floor from the surrounding land. Alluvial deposits and low terraces occur along the Sheyenne River.

Climate

The average annual precipitation in most of this area is 16 to 21 inches (405 to 535 millimeters). Almost 75 percent of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. Winter precipitation is typically snow. The annual snowfall is 25 to 50 inches (635 to 1,270 millimeters). The average annual temperature is 37 to 44 degrees F (3 to 7 degrees C). The freeze-free period averages 150 days and ranges from 135 to 165 days.

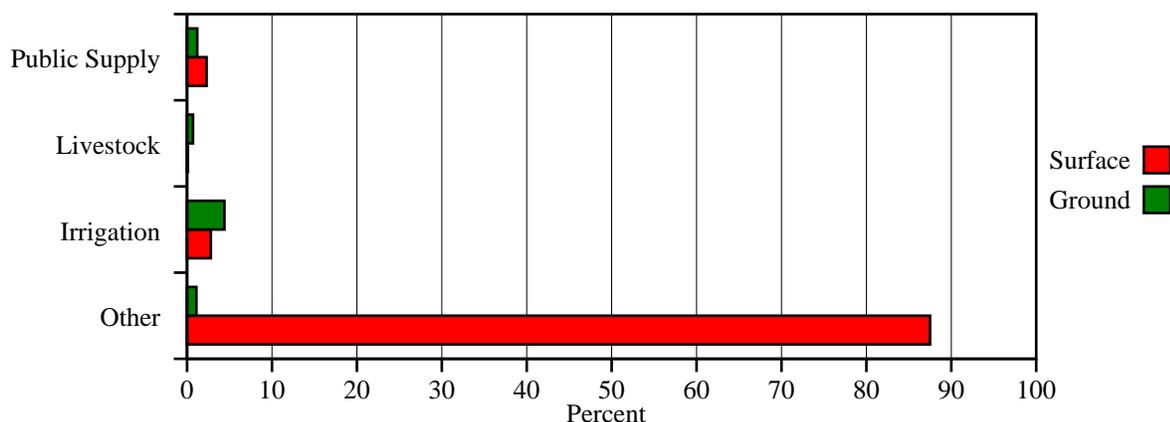
Water

The total withdrawals average 685 million gallons per day (2,590 million liters per day). About 7 percent is from ground water sources, and 93 percent is from surface water sources. In some years precipitation is inadequate for maximum crop production. Perennial streams are few and widely spaced and are little used for irrigation. Water for livestock is stored in ponds and small reservoirs on individual farms and ranches. The surface water is of fair or good quality but at times is limited in quantity. Most of the surface water in this MLRA is used as cooling water in the generation of electricity from burning fossil fuels.

Ground water occurs in consolidated rocks and glacial drift in this area. The water from the glacial drift is typically fresh or saline and hard or very hard. The freshwater is high in calcium, bicarbonate, and sulfate. The saline water is high in sodium and sulfate. Shallow ground water is used as drinking water in some rural areas. The high salinity in some aquifers limits the use of the water for irrigation, but the aquifers provide water for livestock. One sedimentary bedrock aquifer is Dakota Sandstone in North Dakota. It is about 1,000 feet (305 meters) beneath the land surface.

Two additional sedimentary bedrock aquifers, the Niobrara-Codell and Dakota-Newcastle, occur at a depth of about 1,100 feet (335 meters) in South Dakota. Hell Creek-Fox Hills sedimentary bedrock is under the glacial deposits in the northwest corner of the MLRA. This aquifer system contains soft water with high levels of sodium and dissolved solids. High salinity limits the use of the water for irrigation. The sedimentary bedrock aquifers yield large quantities of slightly saline or moderately saline artesian water. Water from the Niobrara-Codell aquifer is used for domestic purposes and for livestock, but the level of total dissolved solids is too high for the water to be used for irrigation. Water from the Dakota-Newcastle aquifer is used only for livestock.

MLRA 55B Water Use by Category



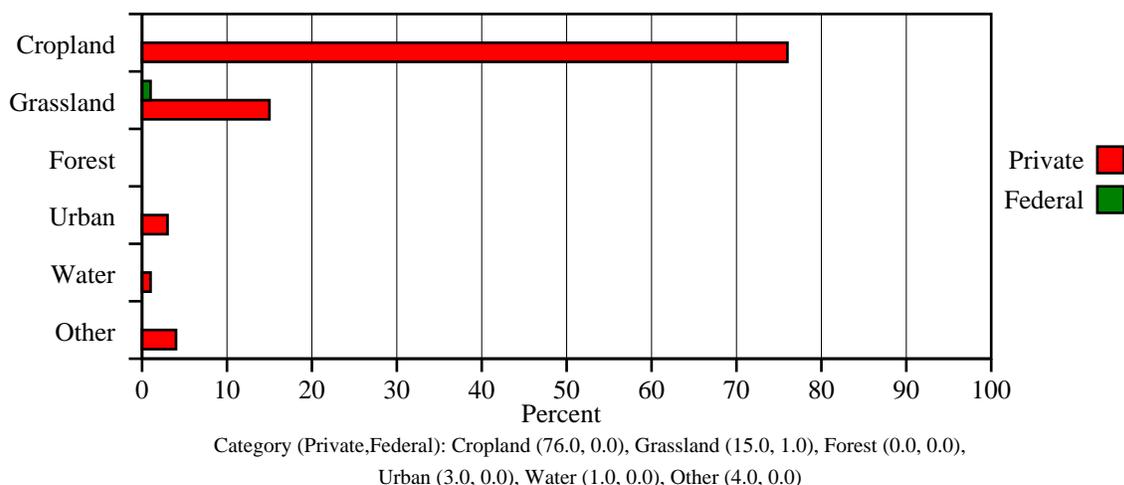
Category (Surface,Ground): Public Supply (2.3, 1.2), LiveStock (0.1, 0.7), Irrigation (2.8, 4.4), Other (87.5, 1.1)

Land Use

About three-fourths of this area is dry-farmed cropland. Cash-grain production is the principal enterprise on many farms. Less than one-fifth of the area, consisting of the more sloping and shallower soils, is used for livestock production on native range or woodland. The dry-farmed crops are principally small grains, such as wheat, durum, and barley, corn for grain, and soybeans. Flax, canola, peas, dry edible beans, sunflowers, forage crops, and corn for silage also are grown.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, management of soil moisture, and salinity around wetland borders. Conservation practices on cropland generally include crop residue management, no-till and other conservation tillage systems, conservation cropping systems that eliminate the need for fallowing, cover crops, nutrient management, and pest management.

MLRA 55B Land Use by Category



MLRA 55C - Southern Black Glaciated Plains

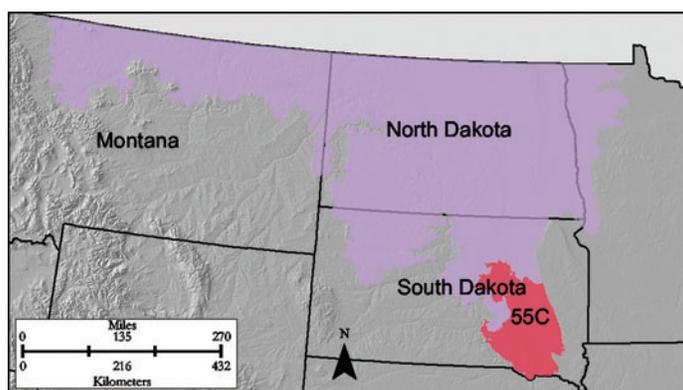


Figure 55C-1: Location of MLRA 55C in Land Resource Region F

Introduction

This area is entirely in South Dakota (fig. 55C-1). It makes up about 10,835 square miles (28,075 square kilometers). The cities of Huron, Mitchell, and Yankton are in this MLRA. Interstate 90 bisects the area. The Lake Andes National Wildlife Refuge and the Yankton Indian Reservation are in this MLRA.

Physiography

Three-fourths of this MLRA is in the Western Lake Section of the Central Lowland Province of the Interior Plains. The southwest quarter is in the Missouri Plateau, Glaciated, Section of the Great Plains Province of the Interior Plains. Elevation ranges from 1,310 to 1,970 feet (400 to 600 meters). Most of the area consists of nearly level to undulating till plains with potholes and moraines. Steep slopes are adjacent to the major streams.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: James (1016), 66 percent; Missouri-Big Sioux (1017), 19 percent; and Missouri-White (1014), 15 percent. The Missouri River runs along the southwest edge of this MLRA, and the James River flows north to south down the center of the MLRA.

Geology

Most of this MLRA is on nearly level to undulating glacial till plains interrupted by steeper slopes adjacent to streams and moraines. Minor moraines are in scattered areas throughout the MLRA, and stagnation moraines are dominant in the southwestern part. Small areas of outwash are adjacent to the minor moraines. The James River is an under-fit stream. Its valley was carved by floodwaters draining glacial Lake Dakota and is filled with glacial outwash and alluvial deposits. The Missouri River flows in a trench cut by glacial meltwater in the adjacent MLRA 63B. A high terrace scarp separates the valley floor along the Missouri and James Rivers from the surrounding land. The transitional area between the uplands and the valley floors of the two rivers is deeply eroded. This area is called the “breaks” along the Missouri River.

Climate

The average annual precipitation is 18 to 25 inches (455 to 635 millimeters). About 70 percent of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. Winter precipitation is typically snow. The annual snowfall is 23 to 46 inches (585 to 1,170 millimeters). The average annual temperature is 43 to 49 degrees F (6 to 10 degrees C). The freeze-free period averages 165 days and ranges from 140 to 190 days.

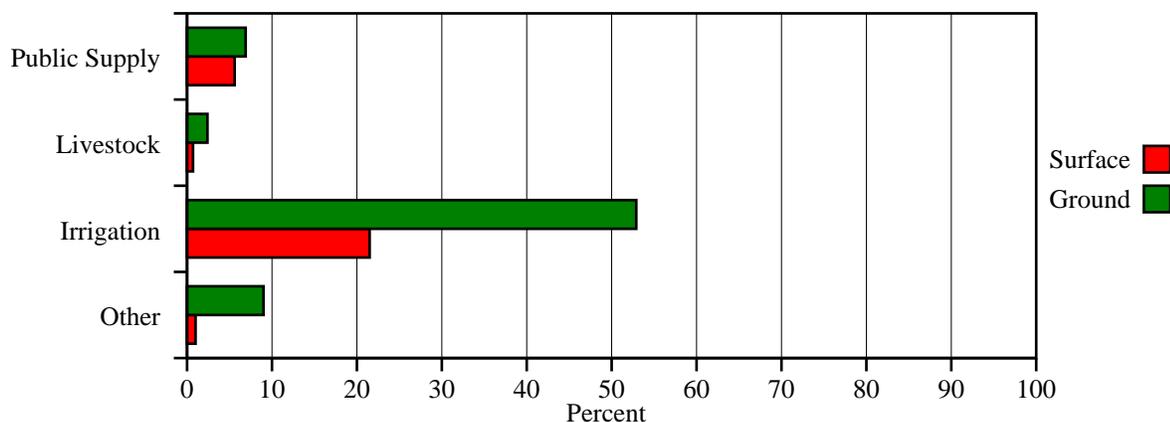
Water

The total withdrawals average 90 million gallons per day (340 million liters per day). About 71 percent is from ground water sources, and 29 percent is from surface water sources. In most years precipitation is inadequate for maximum crop production. Perennial streams are few and widely spaced and are little used for irrigation. Water for livestock is stored in ponds and small reservoirs on individual farms and ranches. The surface water is of fair or poor quality. Limited quantities and high amounts of dissolved solids limit the use of the water. Missouri River water is of good quality. It meets national drinking water standards. Water from reservoirs on the Missouri River is used for irrigation on the adjacent upland soils.

There is a limited supply of ground water in the shallow, unconsolidated sand and gravel deposits that make up the glacial drift and alluvial aquifers. A significant glacial outwash deposit is beneath the flood plain along the lower reaches of the James River in the southern part of the MLRA. A significant acreage is irrigated by this local aquifer. The fresh or saline water is hard and is a calcium, bicarbonate, and sulfate type. The ground water is used primarily for domestic supply, livestock, and irrigation. The level of total dissolved solids typically exceeds the recommended levels for drinking water. Many private wells have high levels of nitrate plus nitrite. Most of this contamination occurs in areas where the wells are located downslope from septic tank absorption fields, feedlots, barnyards, and fertilizer storage areas.

A confining layer of shale beneath the glacial deposits overlies two sedimentary bedrock aquifers in this MLRA, the Niobrara-Codell and Dakota-Newcastle. These aquifers are at a depth of about 1,100 feet (335 meters). The shale lying directly beneath the glacial deposits is not an aquifer. The sedimentary bedrock aquifers yield large quantities of slightly saline or moderately saline artesian water. The water is very hard and is typically a sodium sulfate type. The Niobrara-Codell aquifer provides water for domestic uses and livestock, but the level of total dissolved solids is too high for the water to be used for irrigation. Water from the Dakota-Newcastle aquifer is used only for livestock.

MLRA 55C Water Use by Category



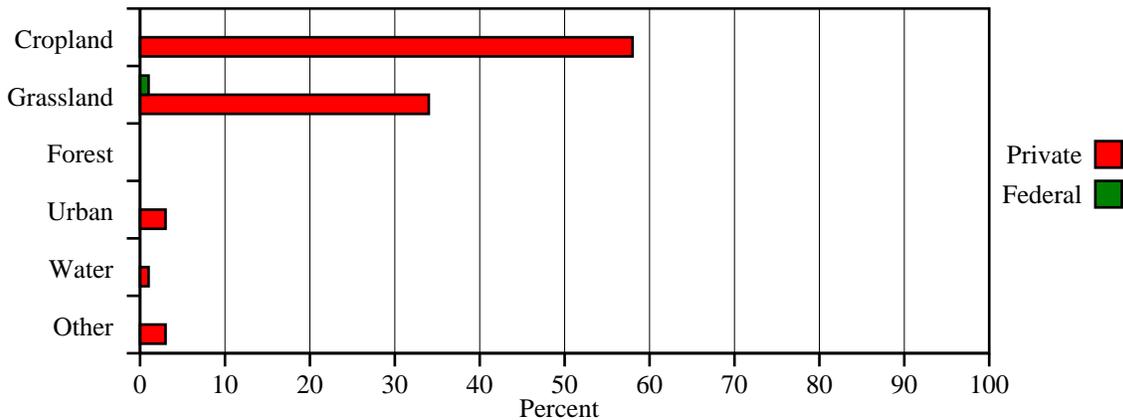
Category (Surface,Ground): Public Supply (5.6, 6.9), LiveStock (0.7, 2.4),

Land Use

Nearly all this area is in farms and ranches. Slightly more than one-half of the area is dry-farmed cropland. Corn, soybeans, small grains, and alfalfa are the principal crops. Grain sorghum also is grown. About one-third of the area is used as native range or tame pasture.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture. Conservation practices on cropland generally include systems of crop residue management and no-till systems that conserve moisture and improve soil quality. Other practices include vegetative wind barriers, wind stripcropping, grassed waterways, and nutrient management.

MLRA 55C Land Use by Category



Category (Private,Federal): Cropland (58.0, 0.0), Grassland (34.0, 1.0), Forest (0.0, 0.0), Urban (3.0, 0.0), Water (1.0, 0.0), Other (3.0, 0.0)

MLRA 56 - Red River Valley of the North



Figure 56-1: Location of MLRA 56 in Land Resource Region F

Introduction

This area (shown in fig. 56-1) is primarily in Minnesota (57 percent) and North Dakota (43 percent), but a small portion (61 square miles, or 158 square kilometers) is in South Dakota. The area makes up about 16,300 square miles (42,235 square kilometers). The cities of Grand Forks and Fargo, North Dakota, and the towns of Thief River Falls, Crookston, and Moorhead, Minnesota, are in this MLRA. Interstate 29 parallels the west bank of the Red River of the North along the length of this area. This MLRA has numerous State parks, the Ardoch and Kellys Slough National Wildlife Refuges, and the Sheyenne National Grasslands.

Physiography

This area is in the Western Lake Section of the Central Lowland Province of the Interior Plains. It is on a nearly level glacial lake plain bordered on the east by outwash plains, gravelly beaches, and dunes. Elevation is generally 1,000 feet (305 meters), but it gradually decreases to 650 feet (200 meters) to the north.

The only Hydrologic Unit Area (identified by a four-digit number) that makes up this MLRA is Red (0902). The Red River bisects this MLRA. It is formed where the Otter Tail and Bois de Sioux Rivers meet at Wahpeton, North Dakota. The Sheyenne River is the largest tributary to the Red River in the part of the area in North Dakota, and the Red Lake River is the largest tributary in the part in Minnesota.

Geology

This area is the bed of glacial Lake Agassiz. It is a glacial lake plain with remnants of gravelly beaches marking its eastern border. The erosion resistance of the gravel causes the beaches to appear as ridges in an otherwise flat landscape. Some dunes have formed in areas near the beaches where sand has been deposited.

Climate

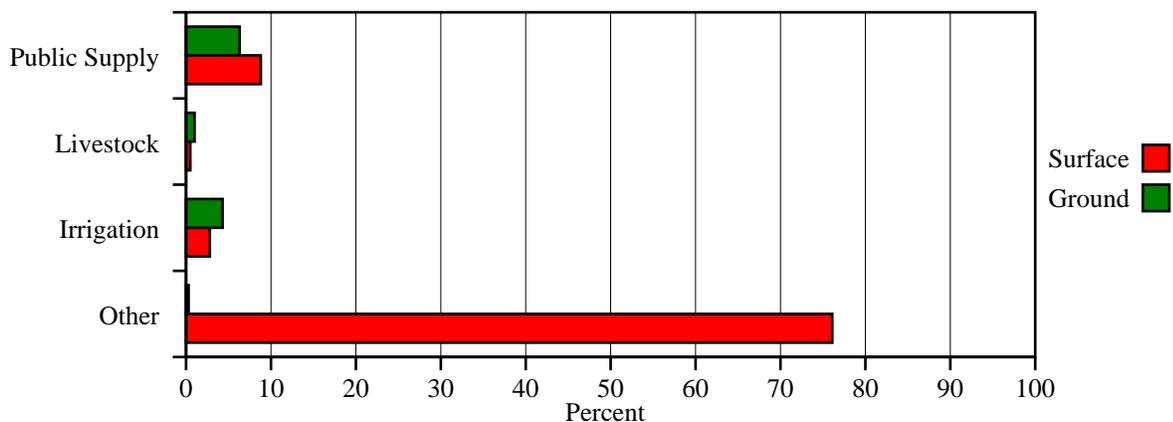
The average annual precipitation in this area is 18 to 23 inches (455 to 585 millimeters). About 70 percent of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. Winter precipitation typically occurs as 25 to 50 inches (630 to 1,270 millimeters) of snow, which accounts for about 15 percent of the annual precipitation. The average annual temperature is 36 to 44 degrees F (2 to 7 degrees C), decreasing from south to north. The freeze-free period averages 145 days and ranges from 125 to 170 days. It is shortest in the northern part of the area and longest in the southern part.

Water

The total withdrawals average 330 million gallons per day (1,250 million liters per day). About 12 percent is from ground water sources, and 88 percent is from surface water sources. In years of normal precipitation, moisture is sufficient for the crops commonly grown in the area, but some areas are irrigated. Surface water is more abundant in Minnesota than in North Dakota. The surface water is used primarily for municipal, commercial, and industrial supplies, but some is used for irrigation. Water from the Red River and its tributaries in North Dakota is generally suitable for drinking. Most of the tributaries on the Minnesota side of the Red River are saline. The water in the Wild Rice and Goose Rivers, for example, exceeds the drinking water standard for sulfate. Late winter and early spring flooding along the Red River is a constant threat. In the southern part of the area, thaws occur earlier in spring, while the river's outlet in Canada is still frozen. The flat slope of the Red River exacerbates the flooding problems. In most areas drainage systems are needed so that farming operations can be started when the temperature is favorable.

Ground water is not used to a great extent in this MLRA because of the relative abundance of better quality surface water. Almost all of the rural domestic water used in the MLRA, however, is ground water. The city of Fargo pumps public water from a buried glacial deposit of sand and gravel. The surficial and buried glacial outwash deposits are the primary aquifers in this area. Ground water from these aquifers is hard or very hard, and much of the ground water in the area exceeds the secondary national drinking water standard of 500 parts per million (milligrams per liter) total dissolved solids. The water in the Cretaceous sedimentary bedrock aquifers that lie beneath the glacial deposits and the Precambrian crystalline igneous and metamorphic rocks that lie beneath the sedimentary rocks is unsuitable for most uses, except for livestock watering. The latter aquifer has low-yield wells.

MLRA 56 Water Use by Category



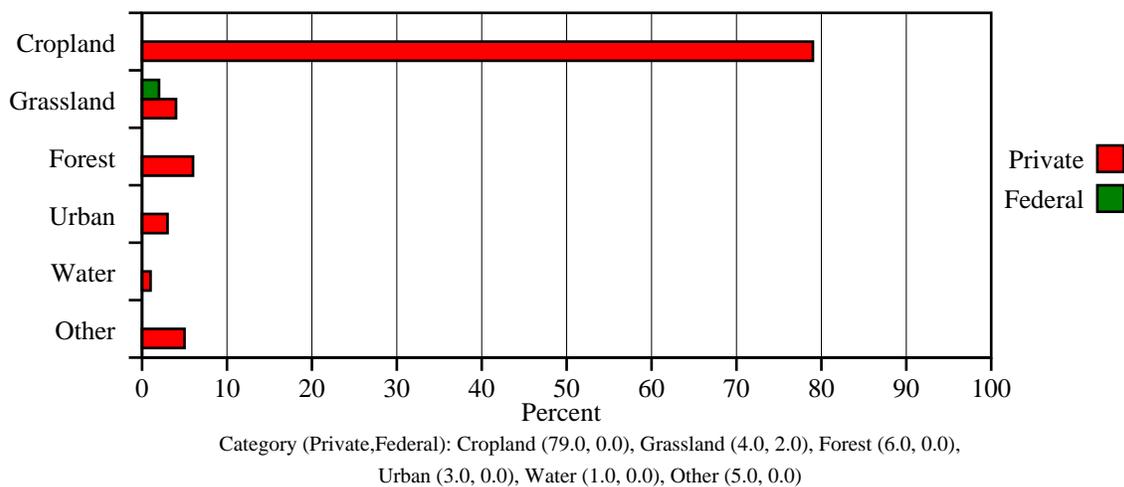
Category (Surface,Ground): Public Supply (8.8, 6.3), LiveStock (0.5, 1.0),
Irrigation (2.8, 4.3), Other (76.1, 0.3)

Land Use

Nearly all of this area is in farms and ranches. More than three-fourths of the area is dry-farmed cropland. Important cash crops are spring wheat, soybeans, potatoes, sugar beets, corn, oil-producing crops, and edible beans. Less than one-tenth of the area is forested. The forestland is in the northeastern part of the area.

The major soil resource concerns in this area are wind erosion, deposition of sediment by floodwater, maintenance of the content of organic matter and productivity of the soils, management of soil moisture, salinity in selected areas, surface compaction, and aggregate stability. The efficient use of water is a major concern on irrigated land. Conservation practices on cropland generally include crop residue management, conservation tillage systems, conservation cropping systems, field windbreaks, herbaceous wind barriers, filter strips, cover crops, nutrient management, and pest management.

MLRA 56 Land Use by Category



MLRA 53B - Central Dark Brown Glaciated Plains

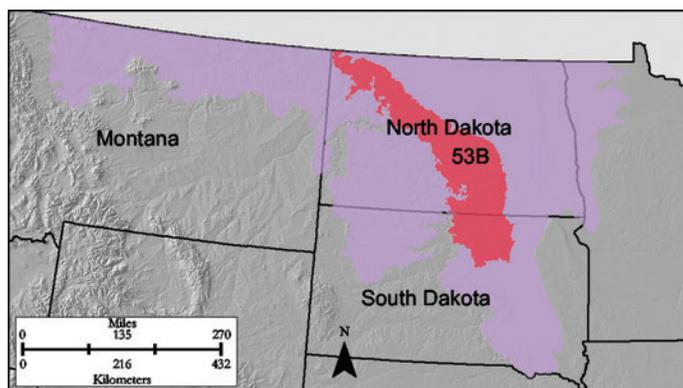


Figure 53B-1: Location of MLRA 53B in Land Resource Region F

Introduction

This area (shown in fig. 53B-1) is in North Dakota (77 percent) and South Dakota (23 percent). It makes up about 19,640 square miles (50,900 square kilometers). The city of Bismarck, North Dakota, is in this MLRA, and Interstate 94 crosses the area, passing through Bismarck. Part of the Fort Berthold Indian Reservation is in this MLRA. The Lostwood, Long Lake, Des Lacs, Upper Souris, Lost Lake, Audubon, Canfield Lake, and Pocasse National Wildlife Refuges are in this area. Garrison Dam, on the Missouri River north of Bismarck, formed Lake Sakakawea on the western border of the MLRA.

Physiography

Almost the entire MLRA is in the Missouri Plateau, Glaciated, Section of the Great Plains Province of the Interior Plains. Small portions of the northeast and southeast corners of the area are in the Western Lake Section of the Central Lowland Province of the Interior Plains. Elevation ranges from 1,640 to 1,970 feet (500 to 600 meters), increasing gradually from southeast to northwest. The nearly level to rolling till plains in this MLRA include kettle holes, kames, moraines, and small glacial lakes. Moderately steep and steep slopes are adjacent to the major stream valleys. The southeast corner of the MLRA consists of nearly level terrain on the west edge of a glacial lake plain.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-Oahe (1013), 47 percent; James (1016), 24 percent; Missouri-Little Missouri (1011), 23 percent; Souris (0901), 4 percent; Red (0902), 1 percent; and Missouri-Poplar (1006), 1 percent. The Missouri River runs parallel with the western boundary along most of this MLRA. The Des Lacs and Upper Souris Rivers just touch the northeast corner of the MLRA.

Geology

Almost all of this MLRA is covered by glacial till plains. Some glaciolacustrine deposits also occur. Kettle holes, kames, moraines, and small glacial lakes break up the nearly level terrain. Alluvial deposits are extensive along the Missouri, Des Lacs, and Souris Rivers but occur in narrow and discontinuous strips along other streams and rivers. Low terraces occur along the major rivers.

Climate

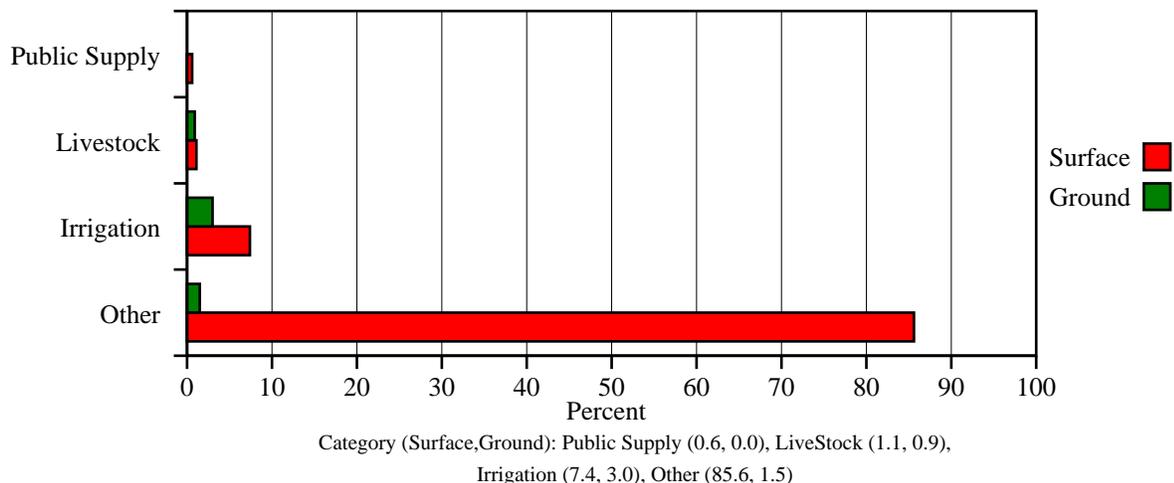
The average annual precipitation is 14 to 20 inches (355 to 510 millimeters). About 75 percent of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. Winter precipitation is typically snow. The annual snowfall is 25 to 50 inches (635 to 1,270 millimeters). The average annual temperature is 38 to 45 degrees F (3 to 7 degrees C). The freeze-free period averages 145 days and ranges from 130 to 165 days.

Water

The total withdrawals average 545 million gallons per day (2,060 million liters per day). About 5 percent of the water is from ground water sources, and 95 percent is from surface water sources. In most years moisture is inadequate for maximum crop production. The Missouri River is the only dependable source of water for irrigation. Thus, only small areas close to the river and to Lake Sakakawea are irrigated. Missouri River water is of good quality. The city of Bismarck obtains its drinking water from the river. In areas away from the Missouri River, ponds are a source of water for livestock. Surface water quality outside of the Missouri River is fair or poor. Limited quantities and high amounts of dissolved solids limit the use of this water. Rural water systems are improving the quality of water available for domestic use. These systems typically obtain their water from the Missouri River and its reservoirs.

There is a limited supply of ground water in surficial, unconsolidated aquifers and in the Cenozoic sedimentary bedrock aquifers beneath the till plains. The unconsolidated aquifers consist of alluvial deposits in stream valleys and glacial drift and outwash deposits. Water in the unconsolidated aquifers is generally very hard and high in sodium and sulfate. It is used as drinking water in some rural areas. The high salinity limits its use for irrigation. The sedimentary bedrock aquifers are the Fort Union aquifer system in the northern two-thirds of the MLRA and the Hell Creek-Fox Hills aquifer system in the southern third. Both of these bedrock aquifer systems contain soft water with high levels of sodium and dissolved solids. High salinity limits the use of the water for irrigation. Naturally occurring selenium levels in the Fort Union aquifer system are much greater than the recommended levels for drinking water.

MLRA 53B Water Use by Category



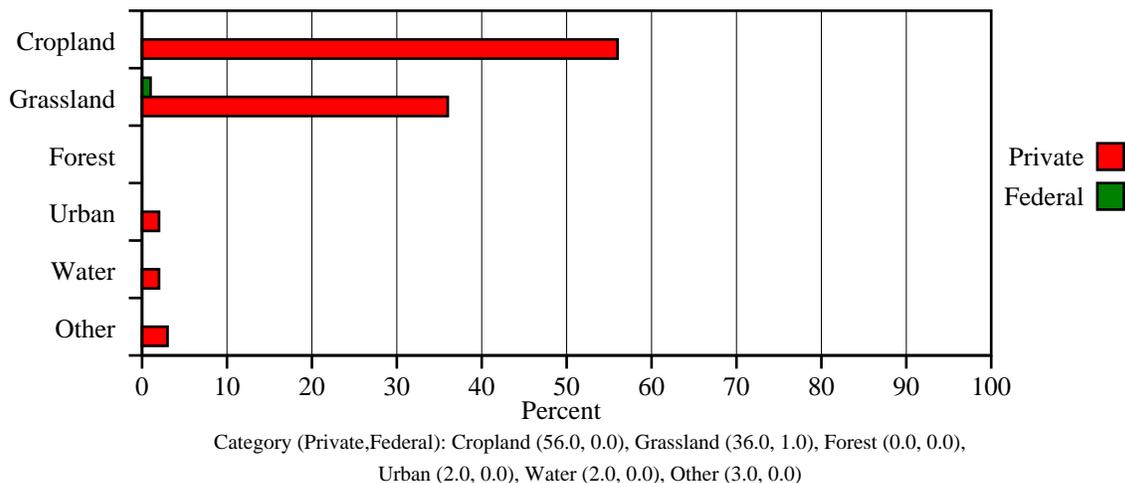
Land Use

Most of this area is in farms and ranches. Slightly more than one-half of the area is dry-farmed cropland. Spring wheat is the chief crop, but flax, oats, barley, and alfalfa are grown on many

farms. The more sloping soils support native grasses and are used as rangeland.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture. Conservation practices on cropland generally include systems of crop residue management and no-till systems that conserve moisture and improve soil quality. Other practices include vegetative wind barriers, wind stripcropping, grassed waterways, and nutrient management.

MLRA 53B Land Use by Category



G - Western Great Plains Range and Irrigated Region

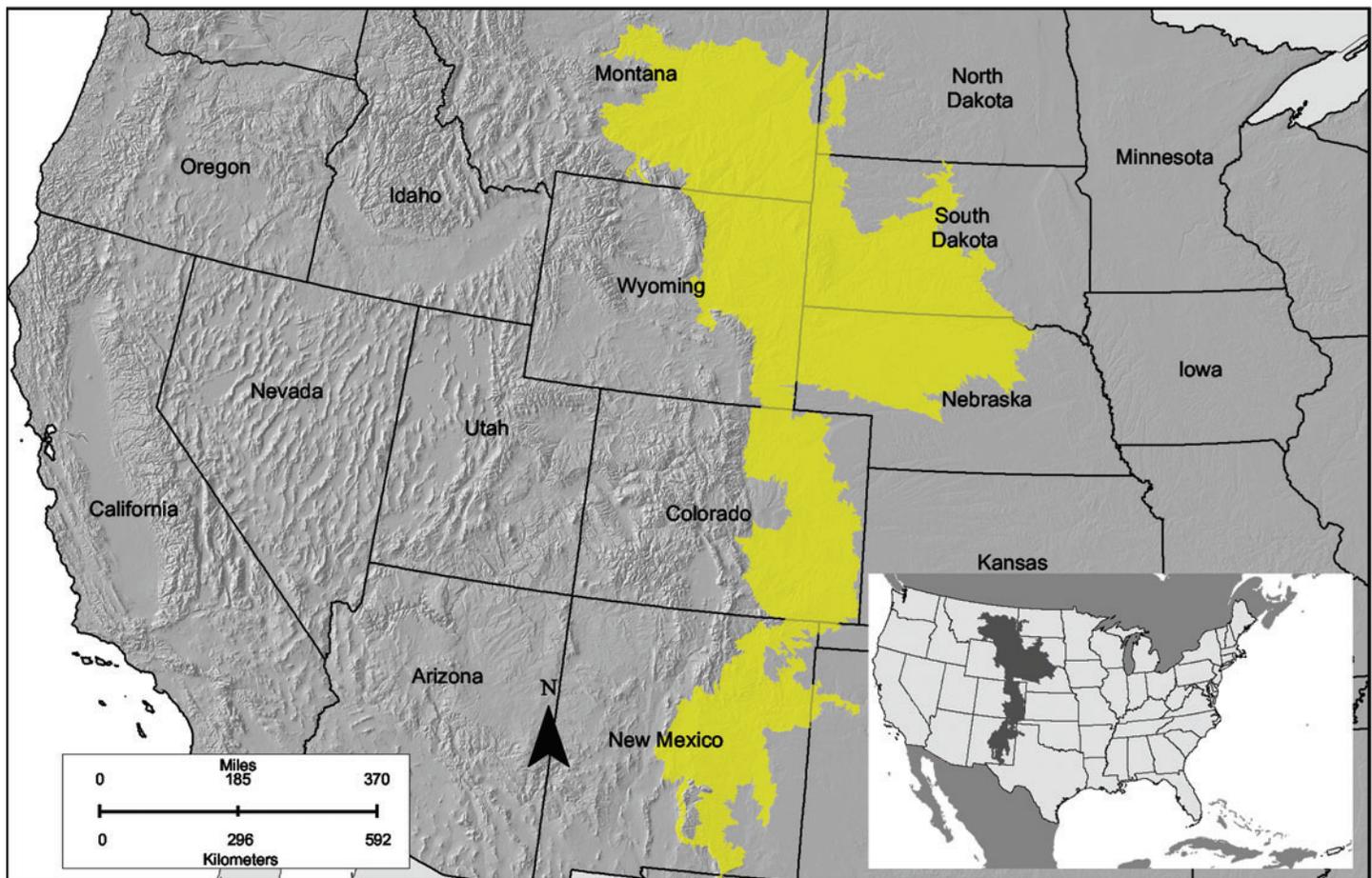


Figure G-1: Location of Land Resource Region G

LRR Overview

This region (shown in fig. G-1) is in Montana (22 percent), New Mexico (16 percent), South Dakota (16 percent), Colorado (15 percent), Nebraska (15 percent), Wyoming (14 percent), North Dakota (1 percent), and Texas (1 percent). Very small portions of Oklahoma and Kansas also are in this region. The region makes up 213,945 square miles (554,395 square kilometers).

This region forms the western edge of the Great Plains (fig. G-2). It butts up against the foothills of the Rocky Mountains. It is an elevated piedmont plain dissected by numerous rivers flowing to the east. Slopes generally are gently rolling or rolling. Flat-topped, steep-sided buttes commonly rise above the general level of the plain. Badlands occur in some areas.

The amount of precipitation in this region typically is low because much of the region is on the leeward side of mountains. The average annual precipitation is 13 to 22 inches (330 to 560 millimeters) in most of the region. Most of the precipitation falls during spring thunderstorms and winter snowfalls. The average annual temperature ranges from 44 to 51 degrees F (7 to 11 degrees C) in most of the region. The freeze-free period ranges from 135 to 185 days, increasing in length from north to south.

The total withdrawals of freshwater in this region average about 13,830 million gallons per day (52,345 million liters per day). About 77 percent is from surface water sources, and 23 percent is

from ground water sources. About 84 percent of the water is used for irrigation.

The soils in this region are dominantly Entisols and Mollisols. Other notable orders are Alfisols, Aridisols, Inceptisols, and some Vertisols. The dominant suborders are Ustorthents, Torriorthents, Haplustolls, and Argiustolls. Other notable suborders are Haplargids, Haplustalfs, and Haplustepts. Most of the soils in the region have a mesic or frigid soil temperature regime and an ustic or aridic soil moisture regime. Most have mixed or smectitic mineralogy, but some have carbonatic mineralogy.

About 88 percent of the land in this region is privately owned. The native vegetation consists mainly of short prairie grasses, but some large areas support mid and tall prairie grasses. Ponderosa pine and pinyon-juniper forests occur at the higher elevations. The dominant land use is grazing by cattle and by some sheep. Dry-farmed winter wheat and other small grains are grown either for cash or for feed. Irrigated crops are grown along many of the major streams. These crops primarily include corn, alfalfa, forage crops, and sugar beets.

The major soil resource concerns in this region are overgrazing and the wind erosion and water erosion that occur where the ground cover has deteriorated. The invasion of undesirable plant species is a concern on rangeland. Wind erosion, water erosion, maintenance of the content of organic matter in the soils, and soil moisture management are major resource concerns on cropland. The quality of surface water also is a concern. Sediment, nutrients, pesticides, and organic material are the major nonpoint sources of surface- and ground-water pollution. Control of saline seeps on rangeland and salt management on irrigated land are needed in some areas.



G-2: An area of Land Resource Region G

MLRA 63A - Northern Rolling Pierre Shale Plains

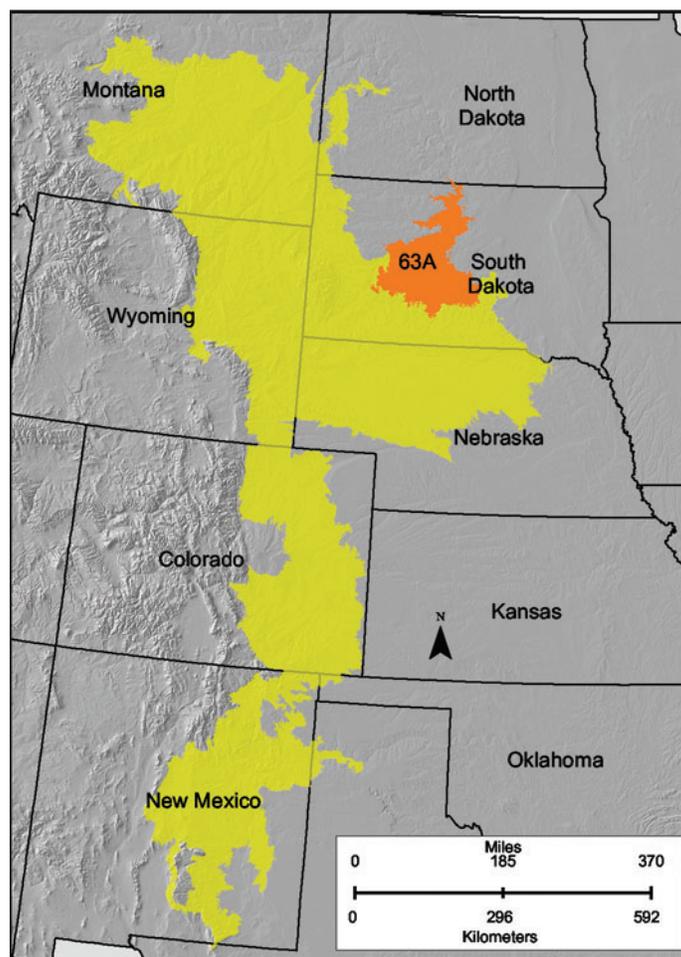


Figure 63A-1: Location of MLRA 63A in Land Resource Region G

Introduction

This area is primarily in South Dakota, but a very small part is in North Dakota (fig. 63A-1). The area makes up about 10,160 square miles (26,330 square kilometers). The towns of Murdo, Philip, Fort Pierre, and Pierre, the capital of South Dakota, are in this MLRA. Interstate 90 crosses the southernmost part of this area. The Fort Pierre and Buffalo Gap National Grasslands are in this MLRA. Several Indian reservations, including the Cheyenne River, Lower Brule, and Standing Rock Indian Reservations, are in this area.

Physiography

This area is primarily in the Missouri Plateau, Unglaciaded, Section of the Great Plains Province of the Interior Plains. This is an area of old plateaus and terraces that have been deeply eroded. Parts of the eastern edge of this area are in the Missouri Plateau, Glaciaded, Section of the Great Plains Province of the Interior Plains. Isolated remnants of glacial till are in the glaciaded section. Glacial erratics have been found as far west as the center of this area. Elevation ranges from 1,300 to 1,640 feet (395 to 500 meters) on the bottom land along the Missouri River to 1,640 to 2,950 feet (500 to 900 meters) on the shale plain uplands. The areas that are cropped are mainly at

elevations of about 1,640 to 2,620 feet (500 to 800 meters). These areas are nearly level to rolling and have long, smooth slopes and a well defined dendritic drainage system. River and creek valleys have smooth floors and steep walls.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-White (1014), 50 percent; Missouri-Oahe (1013), 34 percent; and Cheyenne (1012), 16 percent. The Missouri River is mostly inside this area along its east edge. All five of the major rivers draining western South Dakota cross this area. From north to south, these are the Grand, Moreau, Cheyenne, Bad, and White Rivers. With the exception of the White River, the confluence of all these rivers with the Missouri River occurs in this area. Three of the four lakes created by main-stem dams on the Missouri River are in this area—Lake Oahe, Lake Sharpe, and Lake Francis Case.

Geology

Cretaceous Pierre Shale underlies almost all of this area. This is a marine sediment having layers of volcanic ash that has been altered to smectitic clays. These clays shrink as they dry and swell as they get wet, causing significant problems for road and structural foundations. Fox Hills Sandstone occurs at the higher elevations in the northern and western parts of the area. Tertiary and Quaternary river deposits, remnants of erosion from the Black Hills following their uplift, cap isolated highs in this area. Deposits of alluvial sand and gravel occur on the valley floors adjacent to the major streams in the area.

Climate

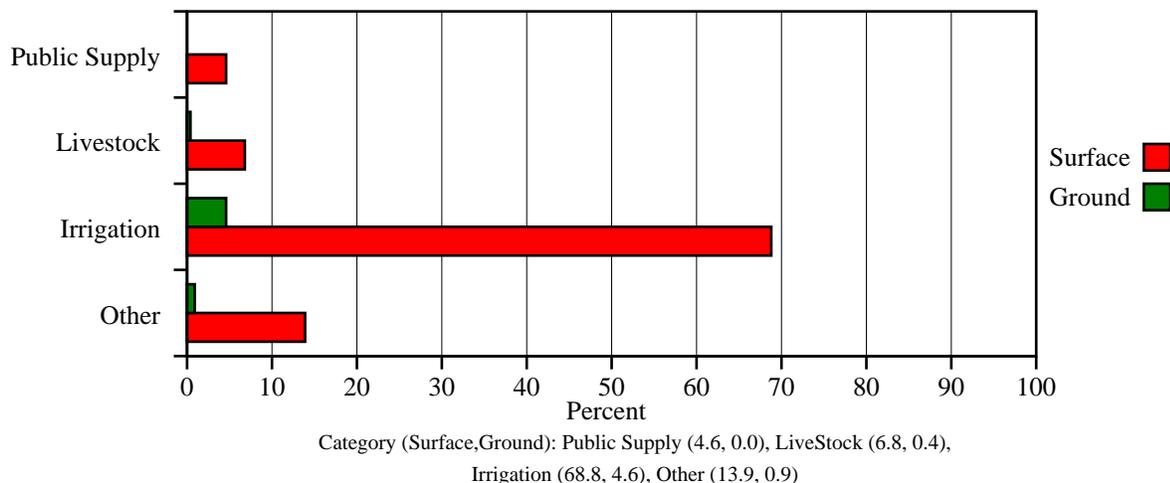
The average annual precipitation in this area is 14 to 19 inches (355 to 485 millimeters). Most of the precipitation falls during the growing season as frontal storms in spring and as high-intensity, convective thunderstorms in summer. Precipitation in winter occurs mostly as snow. The annual snowfall is typically 20 to 48 inches (50 to 120 centimeters). The average annual temperature is 43 to 49 degrees F (6 to 10 degrees C). The freeze-free period averages 160 days and ranges from 145 to 180 days.

Water

The total withdrawals average 90 million gallons per day (340 million liters per day). About 6 percent is from ground water sources, and 94 percent is from surface water sources. In most years precipitation is inadequate for maximum plant growth. Some irrigated land is along the Missouri River and on the flood plains along its major tributaries. The surface water is generally of good quality. It is a sodium bicarbonate type and is soft.

This area has few shallow water developments. Most of the water for livestock comes from surface runoff that flows into dams or from deep artesian flows from wells finished in Dakota Sandstone. Because of high amounts of dissolved solids, mostly sodium, chloride, and sulfate, the well water is slightly saline or moderately saline. It is very hard and is suitable only for watering livestock. High levels of selenium and molybdenum in the runoff from the shale plains may cause some health problems for livestock. Rural water systems are improving the quality of the water available for domestic use. The Missouri River is the source of water for these systems.

MLRA 63A Water Use by Category



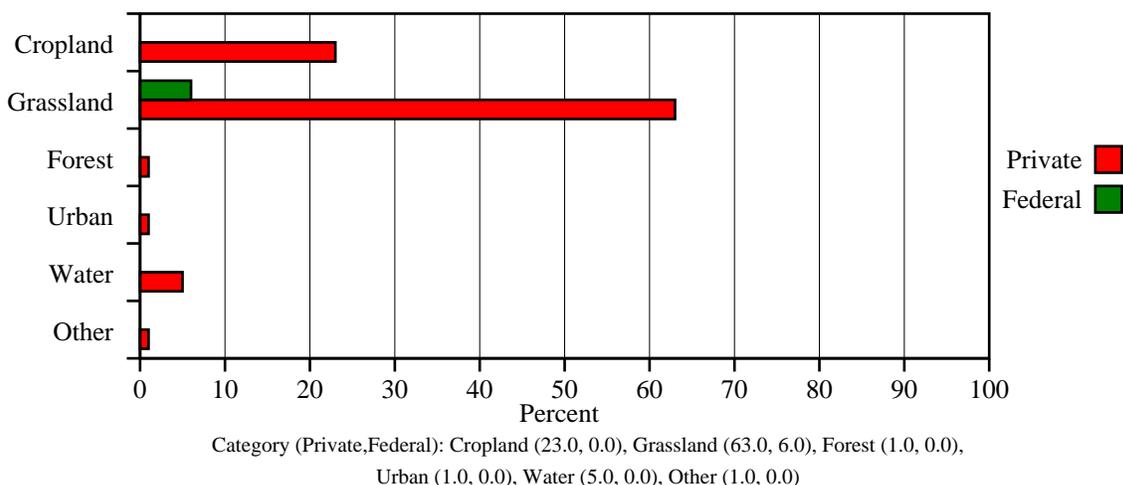
Land Use

Most of this area is in farms or ranches. Urban expansion is limited. The area is used mainly for livestock production and cash-grain farming. Alfalfa, sorghum, and hay are the principal crops grown for livestock feed. Winter wheat is the main cash crop; spring wheat and sunflowers are grown to a lesser extent. Dryfarming soils that are not suited to cultivation is destroying the native grassland.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture. Conservation practices on cropland generally include systems of crop residue management (especially no-till systems that reduce the need for summer fallow tillage), cover crops, windbreaks, vegetative wind barriers, wind stripcropping, and nutrient management.

The most important conservation practice on rangeland is prescribed grazing. Generally, cultural treatments are not used to increase forage production on the rangeland in this area. Cool-season tame pastures are established to supplement forage production. Haying commonly provides feed during the winter.

MLRA 63A Land Use by Category



MLRA 58D - Northern Rolling High Plains, Eastern Part

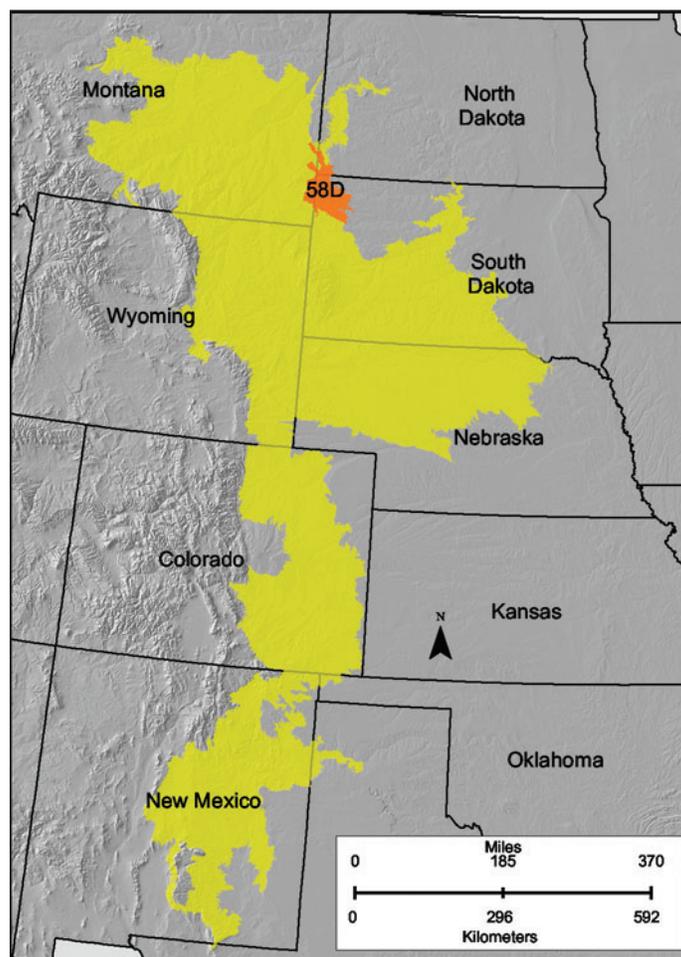


Figure 58D-1: Location of MLRA 58D in Land Resource Region G

Introduction

This area (shown in fig. 58D-1) is in South Dakota (65 percent), Montana (21 percent), and North Dakota (14 percent). It makes up about 2,755 square miles (7,145 square kilometers). It has no major cities. U.S. Highway 85 traverses this area from north to south. The Little Missouri National Grasslands and Custer National Forest occur in this area.

Physiography

This area is in the Missouri Plateau, Unglaciated, Section of the Great Plains Province of the Interior Plains. Elevation ranges from 2,300 to 4,000 feet (700 to 1,220 meters), increasing gradually from east to west. Harding Peak, the highest point in the MLRA, reaches an elevation of 4,019 feet (1,225 meters). Slopes generally are gently rolling to steep. Local relief is mainly 80 to 330 feet (25 to 100 meters). In places flat-topped, steep-sided buttes rise sharply above the general level of the plains.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-Little Missouri (1011), 52 percent; Missouri-Oahe (1013), 46

percent; and Lower Yellowstone (1010), 2 percent. The Little Missouri River and the headwaters of the major tributaries that eventually form the Grand and Moreau Rivers in South Dakota are in this area.

Geology

Cretaceous marine and continental sediments of shale, siltstone, and sandstone occur in the majority of this MLRA. The continental and marine Hell Creek Formation occurs in approximately 85 percent of the MLRA, and the Fox Hills Sandstone forms the southern boundary of the MLRA. Tertiary deposits also occur in scattered areas throughout the MLRA. These deposits are made up of the Paleocene Ludlow and Tongue River Formations, the Oligocene White River Group, and the Miocene Arikaree Group. These resistant Paleocene, Oligocene, and Miocene beds stand above the Cretaceous beds. Ponderosa pine growing on these Tertiary beds further distinguishes them from the other formations in the MLRA. Quaternary river sand and gravel deposits occur on the valley floors and on the terraces along the larger rivers in the area. A large Quaternary eolian deposit occurs directly south of the town of Buffalo.

Climate

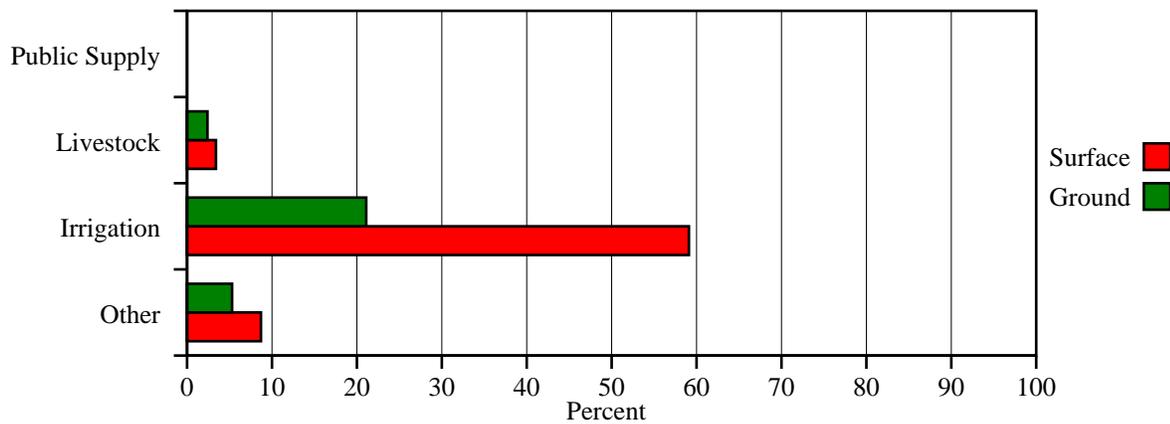
The average annual precipitation is 14 to 17 inches (355 to 430 millimeters) in most of this area. It fluctuates widely from year to year. Most of the rainfall occurs as frontal storms early in the growing season, in May and June. Some high-intensity, convective thunderstorms occur in July and August. Precipitation in winter occurs as snow. The average annual temperature is 42 to 45 degrees F (6 to 7 degrees C). The freeze-free period averages 140 days and ranges from 130 to 150 days.

Water

The total withdrawals average 2.5 million gallons per day (9.5 million liters per day). About 29 percent is from ground water sources, and 71 percent is from surface water sources. The low and erratic precipitation is the principal source of water for agriculture. Most of the surface water in this MLRA is of good quality and is used for limited irrigation on the flood plains and terraces along the major streams. Water for livestock is stored in small ponds or dugouts.

Some wells in the Fort Union-Fox Hills-Hell Creek aquifer provide water for domestic use and livestock. High levels of total dissolved solids and salinity limit the use of this ground water for irrigation. Naturally high levels of selenium and molybdenum occur in the water from the Fort Union sediments. These elements can cause health problems in livestock.

MLRA 58D Water Use by Category



Category (Surface,Ground): Public Supply (0.0, 0.0), LiveStock (3.4, 2.4),

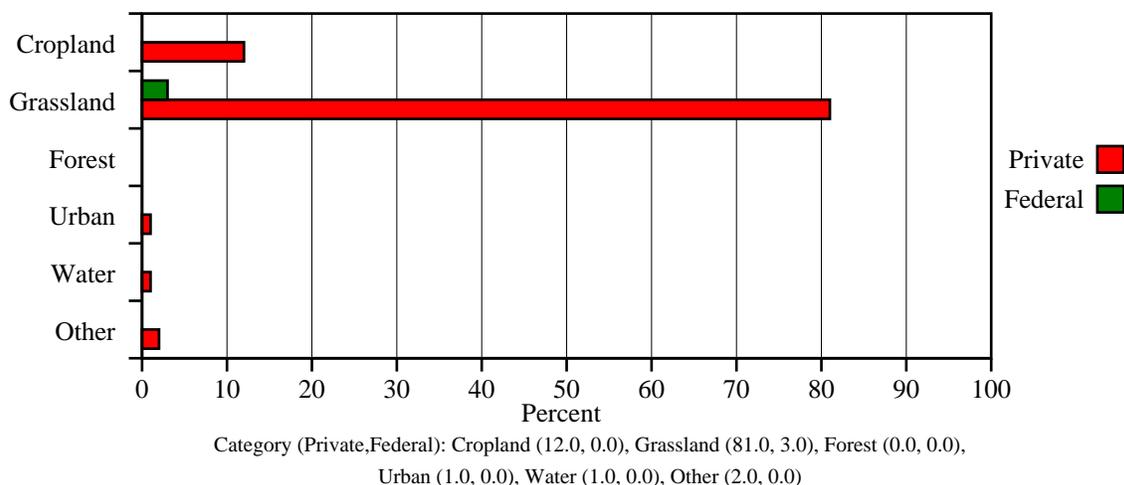
Land Use

More than four-fifths of this area is in private ranches. The dominant land uses are rangeland and hayland. Less than 5 percent of the area is federally owned. Most of the area supports native grasses and shrubs grazed by cattle and sheep. Gently sloping, deep and moderately deep soils, making up 10 to 15 percent of the area, are used for dry-farmed wheat or alfalfa. Some tracts are used as tame pasture. Open woodland is on the upper slopes and the top of some of the higher buttes.

The major soil resource concerns are wind erosion and soil quality on cropland, especially where wheat-fallow is the principal crop rotation. Surface water quality also is a resource concern. Wind erosion and soil quality are resource concerns on continuously overgrazed rangeland.

The most important conservation practices on rangeland are prescribed grazing, fencing, and water developments. The establishment of food plots and range improvement practices benefit wildlife. The establishment of early and late season pastures supplements forage production and keeps livestock off the rangeland during critical growth periods. The conservation practices that are important on cropland are no-till and other conservation tillage systems, contour farming, and crop residue management.

MLRA 58D Land Use by Category



MLRA 60A - Pierre Shale Plains

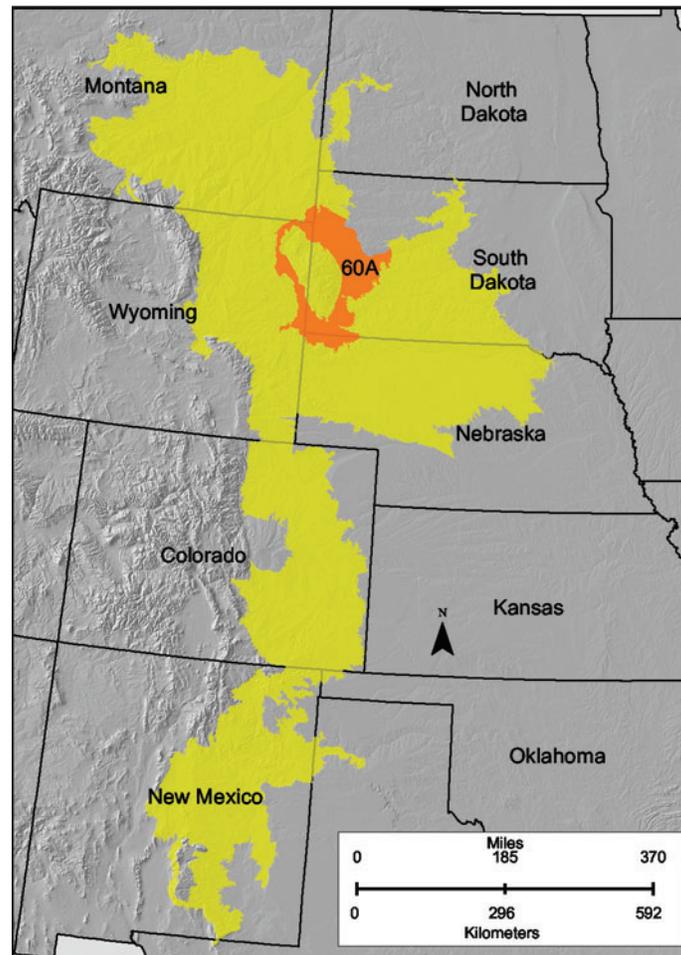


Figure 60A-1: Location of MLRA 60A in Land Resource Region G

Introduction

This area (shown in fig. 60A-1) is in South Dakota (70 percent), Wyoming (20 percent), Nebraska (8 percent), and Montana (2 percent). It makes up about 10,150 square miles (26,295 square kilometers). It encircles the Black Hills and the Dakota Hogback. The eastern half of Rapid City and the town of Belle Fourche, South Dakota, are in this area. Interstate 90 bisects part of the area as it parallels the northern border of the Badlands National Park, near Cactus Flat, and enters Rapid City on the east. It then skirts the Black Hills as it leaves South Dakota and enters Wyoming in the northwest part of the area. This MLRA includes the Oglala National Grasslands and parts of the Thunder Basin and Buffalo Gap National Grasslands. Small parts of the Pine Ridge Indian Reservation, the Badlands National Park, and the Black Hills National Forest occur in this MLRA. Ellsworth Air Force Base is just outside Rapid City.

Physiography

This area is in the Missouri Plateau, Unglaciaded, Section of the Great Plains Province of the Interior Plains. It is an area of old plateaus and terraces that have been deeply eroded. Elevation is generally 2,620 to 3,610 feet (800 to 1,100 meters) on uplands, but it ranges to 4,260 feet (1,300 meters). The shale plains have long, smooth slopes and generally are gently sloping to strongly sloping. Slopes are moderately steep or steep along drainages and streams. Extensive terraces occur along many of the major streams draining the Black Hills.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Cheyenne (1012), 82 percent; Missouri-White (1014), 9 percent; Missouri-Oahe (1013), 5 percent; and Missouri-Little Missouri (1011), 4 percent. The Cheyenne and Belle Fourche Rivers occur in this MLRA.

Geology

Cretaceous Pierre Shale underlies almost all of this area. This is a marine sediment having layers of volcanic ash that has been altered to smectitic clay. This clay shrinks as it dries and swells as it gets wet, causing significant problems for road and structural foundations. Cretaceous shale of the Belle Fourche, Mowry, and Skull Creek Formations is adjacent to the Dakota Hogback. These formations, along with Newcastle Sandstone, make up what is called the Graneros Group. Tertiary river gravel, deposited by streams carrying erosional debris from the Black Hills following their uplift, caps the ridges separating the streams draining the Black Hills.

Climate

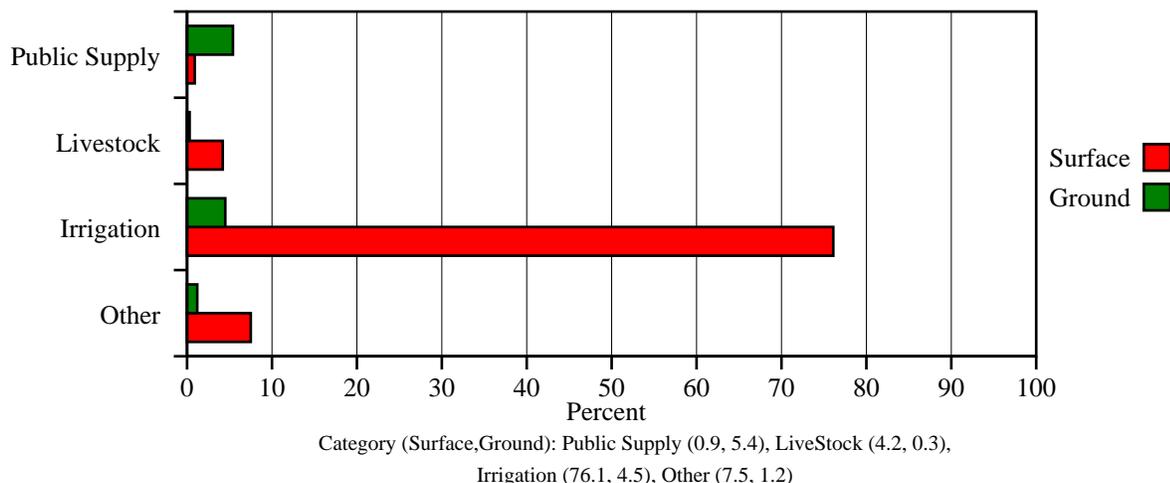
The average annual precipitation in this area is 13 to 22 inches (330 to 560 millimeters). Most of the rainfall occurs as frontal storms early in the growing season, in May and June. Some high-intensity, convective thunderstorms occur in July and August. Precipitation in winter occurs mainly as snow that usually is accompanied by high winds that cause much drifting. The average annual temperature is 43 to 49 degrees F (6 to 9 degrees C). The freeze-free period averages about 150 days and ranges from 130 to 170 days.

Water

The total withdrawals average 110 million gallons per day (415 million liters per day). About 11 percent is from ground water sources, and 89 percent is from surface water sources. Because of the limited amount of precipitation, the production of dry-farmed crops is marginal. Most of the soils are moist or wet early in spring and are deficient in moisture during much of the growing season. In irrigated areas along the Belle Fourche River in the northern part of the area and the Cheyenne River in the southern part, surface water is drawn from the Belle Fourche and Angostura Reservoirs, respectively. Some areas along Rapid Creek are irrigated. Water for livestock comes mainly from runoff that flows into dams. Surface runoff from the forested Black Hills is of good quality. Stream runoff seeps into the cavernous Pahasapa limestone within the Black Hills. Springs occur at the edges of the Black Hills when this water discharges at the surface. This water is of excellent quality and is used for public supply.

Pierre Shale underlies almost all of this area, so ground water is scarce. A few areas have shallow water wells for domestic use, but the water is of marginal quality for drinking. Some shallow wells also draw domestic water from alluvial sand and gravel under the larger stream valleys. This water is of much better quality than the shallow ground water in the Pierre Shale.

MLRA 60A Water Use by Category



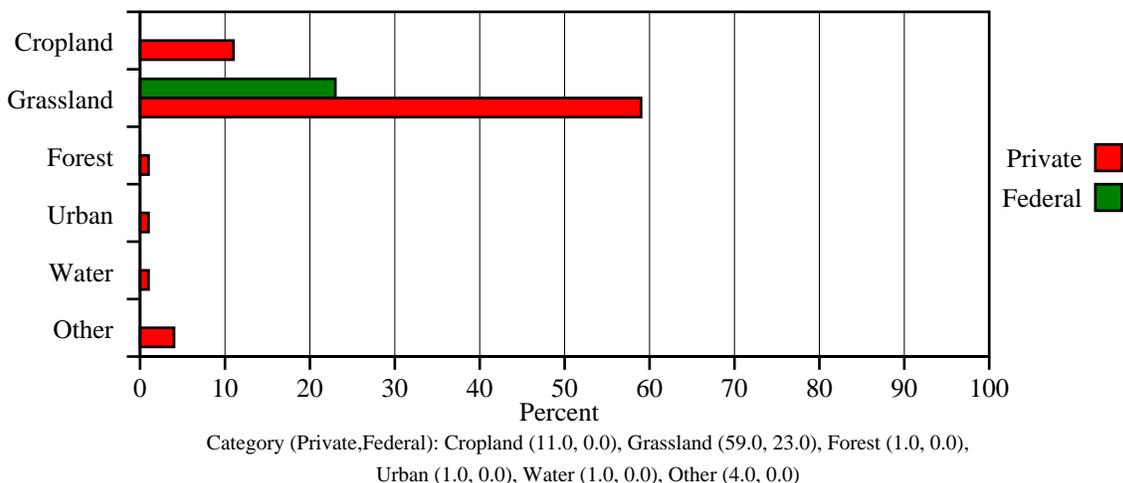
Land Use

The dominant land uses are rangeland and hayland. Practically all of this area is in farms and ranches. Most of it supports native grasses and is grazed by livestock. Approximately 10 percent of the area is used for small grain grown for grain and livestock feed. Some small areas of nearly level to moderately sloping soils are used for winter wheat or feed crops for livestock.

The major resource concerns are wind erosion and surface water quality. The major soil resource concerns are wind erosion and soil quality on cropland, especially where wheat-fallow is the principal crop rotation. Wind erosion and soil quality also are concerns on continuously overgrazed rangeland.

Conservation practices on rangeland generally include prescribed grazing, fencing, and water developments. The establishment of food plots and range improvement practices benefit wildlife. The establishment of early and late season pastures supplements forage production and keeps livestock off the rangeland during critical growth periods. Conservation practices on cropland generally include no-till and other kinds of conservation tillage, contour farming, and crop residue management.

MLRA 60A Land Use by Category



MLRA 62 - Black Hills

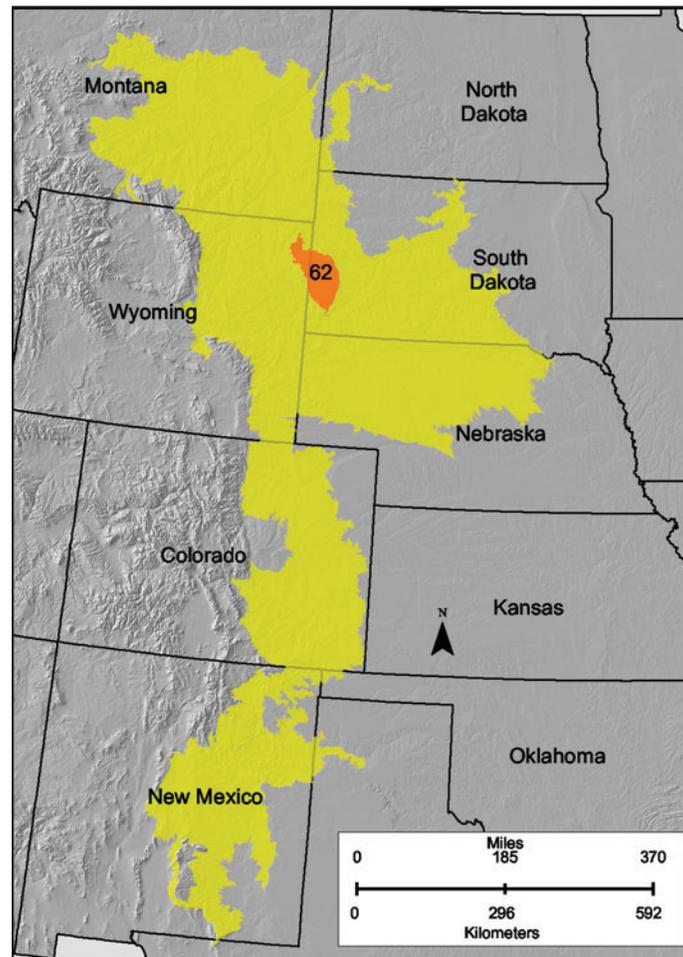


Figure 62-1: Location of MLRA 62 in Land Resource Region G

Introduction

This area (shown in fig. 62-1) is in South Dakota (74 percent) and Wyoming (26 percent). It makes up about 3,040 square miles (7,875 square kilometers). The towns of Lead, Deadwood, Hill City, and Custer, South Dakota, are in this area. U.S. Highways 16 and 385 cross the MLRA. The Black Hills National Forest, Custer State Park, Mt. Rushmore National Monument, Wind Cave National Park, and Jewel Cave National Monument are in this MLRA. A large-scale mountain carving, the privately owned Crazy Horse Monument, also is in this area. The Black Hills is a major tourist destination in the United States.

Physiography

This area forms the core of the Black Hills Section of the Great Plains Province of the Interior Plains. It is an area of maturely dissected domed mountains. Elevation is mainly 3,600 to 6,565 feet (1,100 to 2,000 meters), but it is 7,242 feet (2,208 meters) on Harney Peak, the highest point in the United States east of the Rocky Mountains. Slopes range from moderately sloping on some of the high plateaus to very steep along drainageways and on peaks and ridges. Narrow valleys generally are gently sloping to strongly sloping.

The only Hydrologic Unit Area (identified by a four-digit number) that makes up this MLRA is Cheyenne (1012). Many streams that drain the MLRA, including Box Elder, Castle, French, Rapid, Spearfish, and Spring Creeks, are popular destinations for trout fishermen.

Geology

The core of the Black Hills is a plutonic mass of granite with steeply dipping metamorphic rocks, primarily slate and schist, directly surrounding it. A plateau of Mississippian limestone surrounds the igneous and metamorphic rock core. This Pahasapa (Madison) limestone is broken around the outer edges of the uplifted area. The Permian Minnekahta limestone forms the outermost boundary of the area. Many other tilted sandstone, shale, and limestone units are exposed like a bathtub ring inside the steeply dipping Pahasapa limestone. These older units are also exposed on the valley walls along the major drainages that cut through the rock layers.

There are two unique geologic features in the Black Hills. One is the loss of water in the creeks that flow across the cavernous Pahasapa limestone ringing the Black Hills. This water is discharged to the surface again in major springs that occur at the margins of the Black Hills. The other feature involves a series of Tertiary igneous intrusives, aligned east to west across the northern third of the Black Hills. Gold deposits formed in the country rock adjacent to these igneous rocks. The largest gold mine in North America, the Homestake Gold Mine in Lead, South Dakota, operated for 120 years in this area. The mine closed in 2001. Scientists across the country are working on converting some of the mined levels into underground laboratories for the study of nuclear particles.

Climate

The average annual precipitation in this area is 16 to 37 inches (405 to 940 millimeters), increasing with elevation and decreasing from west to east and north to south. Most of the rainfall occurs as frontal storms early in the growing season, in May and June. Some high-intensity, convective thunderstorms occur in July and August. Precipitation in winter occurs mostly as snow. The annual snowfall ranges from about 60 inches (150 centimeters) at the lower elevations to as much as 140 inches (355 centimeters) at the higher elevations. The average annual temperature is 36 to 48 degrees F (2 to 9 degrees C). The freeze-free period averages 125 days and ranges from 85 to 165 days. It is shortest at the higher elevations and in the northwestern part of the area.

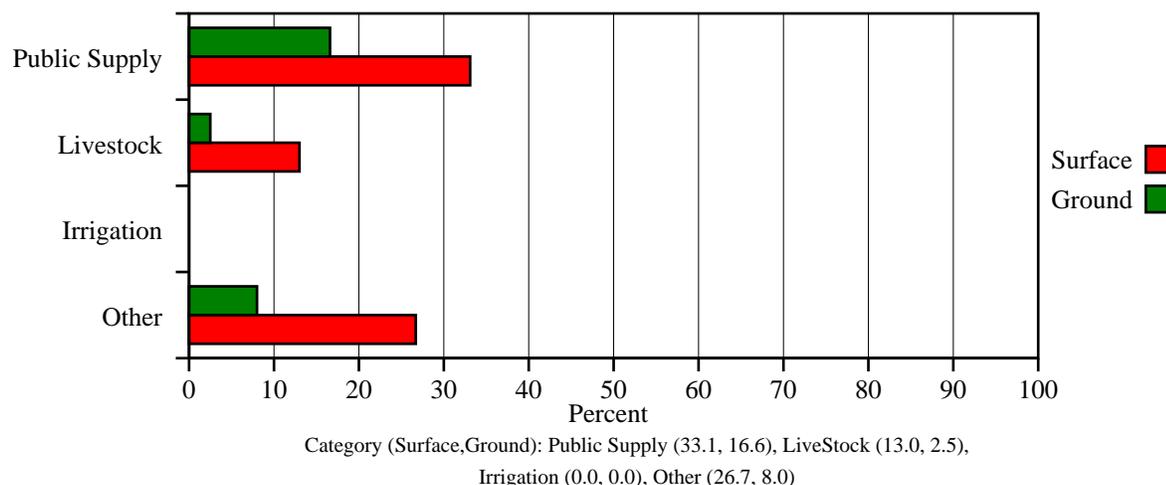
Water

The total withdrawals average 2.4 million gallons per day (9 million liters per day). About 27 percent is from ground water sources, and 73 percent is from surface water sources. In most years soil moisture is adequate for normal plant growth. Precipitation, perennial streams, springs, and shallow wells provide adequate water for domestic use. The surface water is plentiful and of good quality. Most public supply water for towns in the Black Hills comes from streams. Small hydroelectric plants are on Spearfish Creek.

Most of the granitic and metamorphic rocks in this area are not principal aquifers. Some of the purest water in South Dakota, however, comes from springs in the granite rocks around the Mt. Rushmore National Monument. The metamorphic rocks have joints and bedding and cleavage

planes that allow for transmission of water at the lower elevations. These rocks commonly are the source of the domestic supply in the Black Hills. The water from the metamorphic rocks is much more mineralized than the water in the granite. The Pahasapa (Madison) limestone and younger sandstone and limestone sediments are the primary aquifers in this MLRA. The ground water is plentiful and is used primarily for irrigation and livestock. It has high levels of total dissolved solids and is mostly a sodium sulfate type.

MLRA 62 Water Use by Category



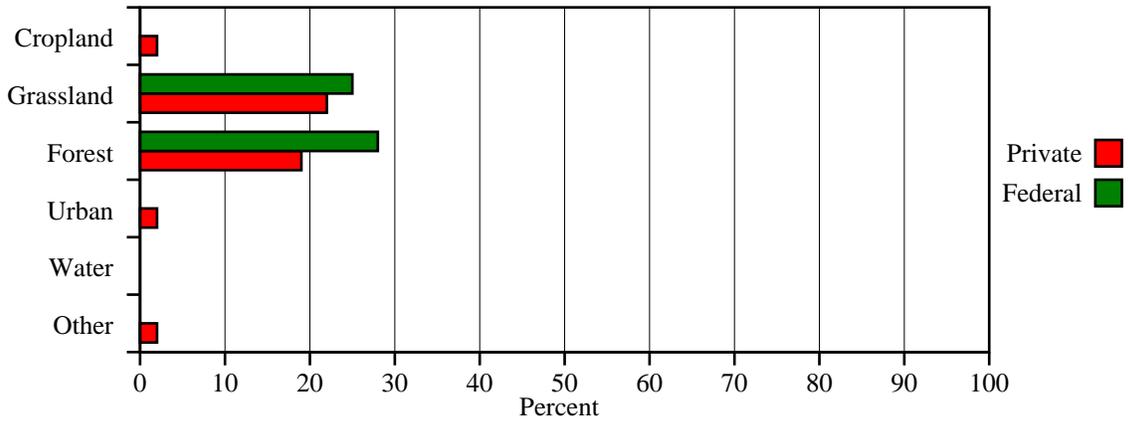
Land Use

The forestland in this area is used mainly for timber production, recreation, and grazing. About half of the area is in the Black Hills National Forest. The Black Hills area, an important tourist attraction, is used for logging, mining, recreation, and hunting. Some areas, especially in the northern part of the Black Hills, are mined for gold and other minerals. Scattered small farms and ranches, rural homes, and summer homes on small acreages are throughout the area. Small ranches and farms depend on the Black Hills National Forest for summer grazing.

The major resource concerns are the erosion and surface compaction caused by logging, mining, wildfires, grazing, and urban expansion. The quality of ground water and surface water is another concern, especially in the northern part of the Black Hills, because of contamination from mine waste and septic systems in areas of rural development and urban expansion.

The major erosion-control practices are critical area planting and proper tree harvesting on disturbed or burned sites and proper grazing management. Conservation practices on rangeland generally include prescribed grazing, fencing, and water developments. Forest stand improvement and firebreaks reduce the hazard of wildfires and improve forest growth, quality, health, and productivity.

MLRA 62 Land Use by Category



Category (Private,Federal): Cropland (2.0, 0.0), Grassland (22.0, 25.0), Forest (19.0, 28.0), Urban (2.0, 0.0), Water (0.0, 0.0), Other (2.0, 0.0)

MLRA 63B - Southern Rolling Pierre Shale Plains

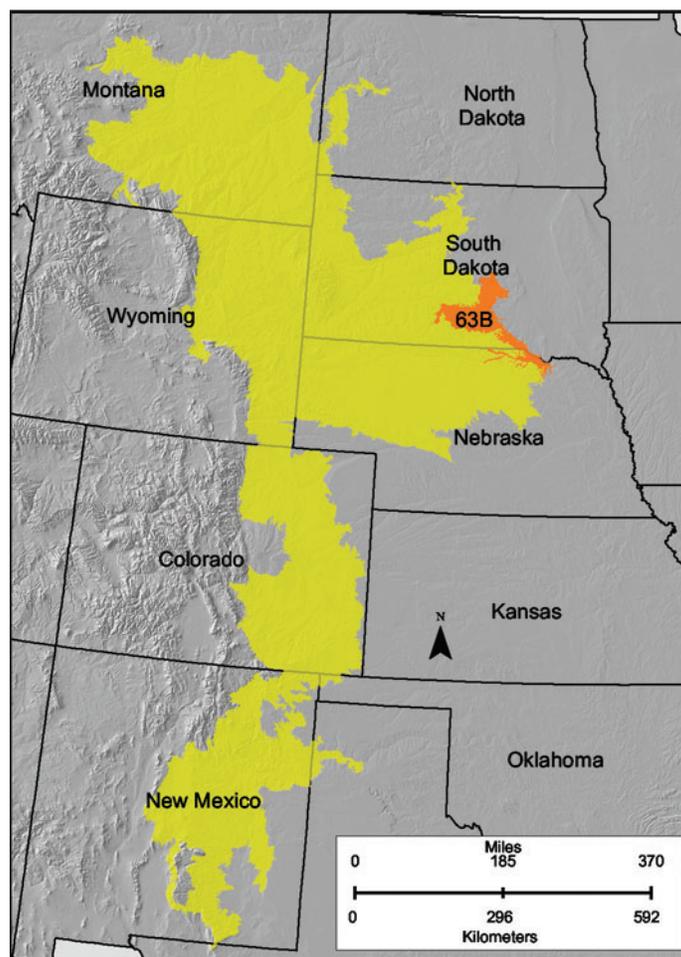


Figure 63B-1: Location of MLRA 63B in Land Resource Region G

Introduction

This area (shown in fig. 63B-1) is in South Dakota (82 percent) and Nebraska (18 percent). It makes up about 4,460 square miles (11,565 square kilometers). The towns of Winner, Kennebec, Chamberlain, and Pickstown, South Dakota, are in this area. Interstate 90 crosses the northernmost part of the area. Several Indian reservations are in this MLRA, including the Lower Brule, Crow Creek, Santee, and Yankton Indian Reservations.

Physiography

Almost all of this area is in three different sections of the Great Plains Province of the Interior Plains. Most of the area is in the Missouri Plateau, Unglaciaded, Section. This part of the MLRA is an area of old plateaus and terraces that have been deeply eroded. It is nearly level to rolling and has long, smooth slopes and a well defined dendritic drainage system. Rivers and creek valleys have smooth floors and steep walls.

The northeast corner of the MLRA, east of the Missouri River, is in the Missouri Plateau, Glaciaded, Section, and the southwest tip is in the High Plains Section. The glaciaded section is

very similar to the unglaciated section. Some of the higher areas have deposits of glacial drift. The topography of the High Plains Section is typified by nearly level and broad intervalley remnants of smooth fluvial plains.

The southeast tip of the MLRA is in the Dissected Till Plains Section of the Central Lowland Province of the Interior Plains. The topography is very similar to that of the Missouri Plateau, Glaciated, Section, but the original surface is a till plain rather than an old plateau.

Elevation ranges from 1,310 to 1,640 feet (400 to 500 meters) on the bottom land along the Missouri River and from 1,310 to 1,970 feet (400 to 600 meters) on the shale plain uplands. The areas that are cropped are mainly at an elevation of about 1,640 feet (500 meters).

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-White (1014), 79 percent; Niobrara (1015), 15 percent; and Missouri-Big Sioux (1017), 6 percent. The Missouri River and the breaks along the river are in this MLRA. The river runs through the north part of the MLRA and then along the east edge. The confluence of the White and Missouri Rivers is in this area. The lower reach of the Niobrara River, in Nebraska, also is in this area. Lake Francis Case, Fort Randall Dam, and Lewis and Clark Lake are in this MLRA. Lewis and Clark Lake formed behind Gavins Point Dam, which is outside this MLRA, in an area near Yankton, South Dakota. Gavins Point Dam is the last and farthest downstream of the five main-stem dams on the Missouri River.

Geology

Cretaceous Pierre Shale underlies most of this area. This is a marine sediment having layers of volcanic ash that have been altered to smectitic clays. These clays shrink as they dry and swell as they become wet, causing significant problems for road and structural foundations. The younger Niobrara Chalk is in the southern part of this area. Some glacial drift remnants are in the northeast corner of the area, east of the Missouri River. Alluvial sand and gravel underlie the valley floors along the major streams.

Climate

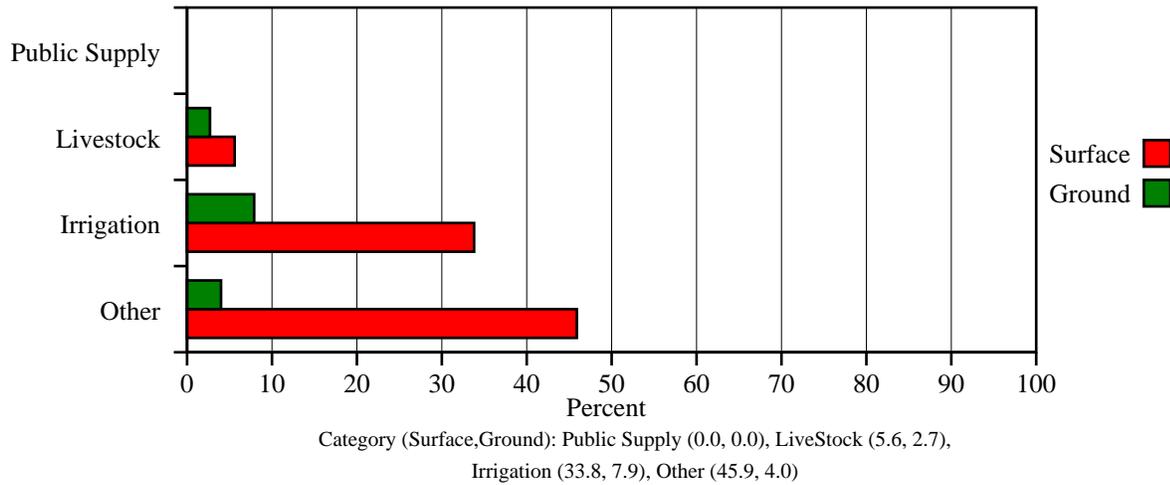
The average annual precipitation in this area is 17 to 25 inches (430 to 635 millimeters). Most of the precipitation falls during the growing season as frontal storms in spring and as high-intensity, convective thunderstorms in summer. Precipitation in winter occurs mostly as snow. The annual snowfall is typically 16 to 46 inches (40 to 115 centimeters). The average annual temperature is 45 to 50 degrees F (7 to 10 degrees C). The freeze-free period averages 165 days and ranges from 145 to 185 days.

Water

The total withdrawals average 57 million gallons per day (215 million liters per day). About 15 percent is from ground water sources, and 85 percent is from surface water sources. In most years precipitation is inadequate for maximum plant growth. Some irrigated land is along the Missouri River and on the flood plain along the White River. The water in the Missouri River generally is of good quality. It is a sodium bicarbonate type and is soft. High loads of suspended sediments cause water-quality problems in the White River and in some of the smaller tributaries to the Missouri River.

There are few shallow water developments in this area, and most of the water for livestock comes from surface runoff that flows into dams or from deep artesian flows from wells finished in Dakota Sandstone. Because of high amounts of dissolved solids, mostly sodium, chloride, and sulfate, the well water is slightly saline or moderately saline. It is very hard and is suitable only for watering livestock. Rural water systems are improving the quality of water available for domestic use. The Missouri River is the source of water for these systems.

MLRA 63B Water Use by Category



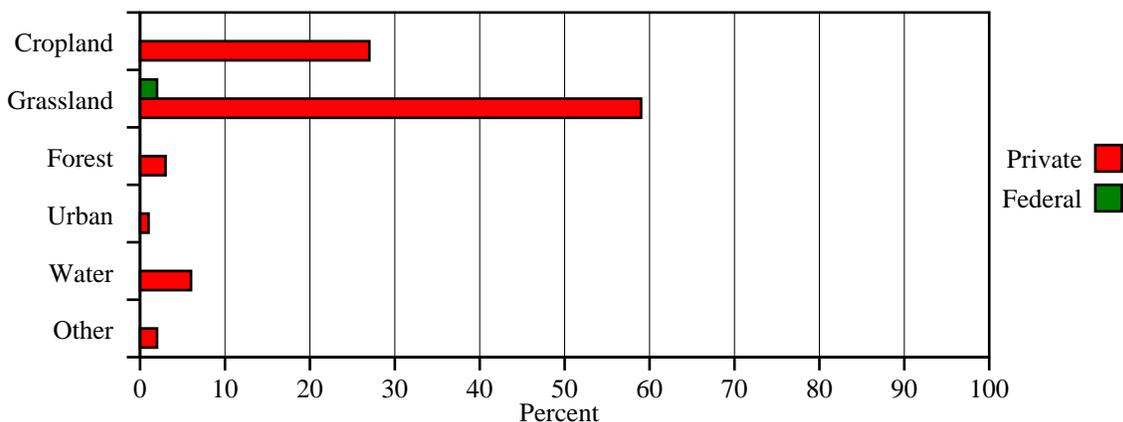
Land Use

Most of this area is in ranches or farms. About three-fifths of the area is rangeland that is grazed primarily by livestock. A little more than one-fourth of the area is cropland. The major enterprise is cash-grain farming. Winter wheat is the main crop, and sunflowers, soybeans, and spring wheat are grown to a lesser extent. In other parts of the area, the crops are grown mainly as feed and forage for livestock. Irrigated corn is grown in areas where the supply of water is adequate and the soils are suitable.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture.

Conservation practices on cropland generally include systems of crop residue management (especially no-till systems that reduce the need for summer fallow tillage), cover crops, windbreaks, vegetative wind barriers, wind stripcropping, and nutrient management. The most important conservation practice on rangeland is prescribed grazing. Generally, cultural treatments are not used to increase forage production on the rangeland in this area. Cool-season, tame pastures are established to supplement forage production. Haying commonly provides supplemental feed during winter. Forest stand improvement and firebreaks reduce the hazard of wildfires on forestland and improve forest growth, quality, health, and productivity.

MLRA 63B Land Use by Category



Category (Private,Federal): Cropland (27.0, 0.0), Grassland (59.0, 2.0), Forest (3.0, 0.0),
Urban (1.0, 0.0), Water (6.0, 0.0), Other (2.0, 0.0)

MLRA 64 - Mixed Sandy and Silty Tableland and Badlands

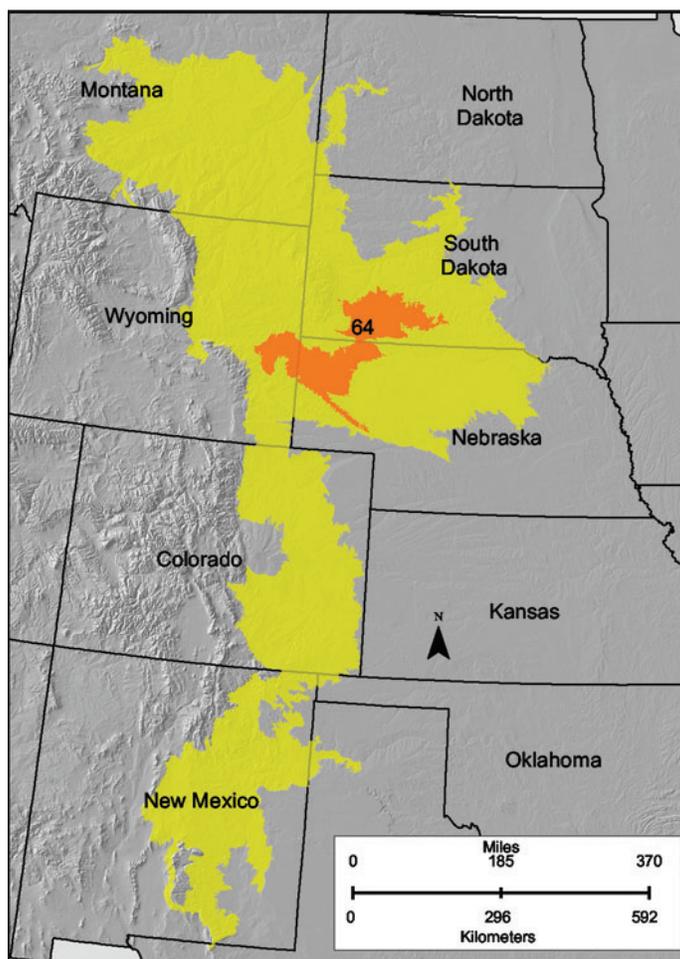


Figure 64-1: Location of MLRA 64 in Land Resource Region G

Introduction

This area (shown in fig. 64-1) is in South Dakota (42 percent), Nebraska (41 percent), and Wyoming (17 percent). It makes up about 11,895 square miles (30,825 square kilometers). The town of Kadoka, South Dakota, is in the northern part of this area. The towns of Pine Ridge, South Dakota, and Chadron, Alliance, and Scottsbluff, Nebraska, are in the southern part of the area. The town of Lusk, Wyoming, is in the southwestern part of the area. Interstate 90 goes through the northernmost part of the area, in South Dakota. The Nebraska National Forest, the Badlands National Park, parts of the Oglala and Buffalo Gap National Grasslands, the Agate Fossil Beds National Monument, Chadron State Park, Fort Robinson State Park, and the Pine Ridge Indian Reservation are in this MLRA. The Badlands are internationally renowned for their Oligocene vertebrate fossils.

Physiography

The northern half of this MLRA is in the Missouri Plateau, Unglaciaded, Section of the Great Plains Province of the Interior Plains. This part of the MLRA is an area of old plateaus and terraces that have been deeply eroded. The southern half of the MLRA is in the High Plains Section of the same province and division. The topography in this part of the MLRA is typified by nearly level and broad intervalley remnants of smooth fluvial plains. The Pine Ridge escarpment separates the two areas. The area north of the escarpment is strongly sloping but becomes less sloping as distance from the escarpment increases. Local relief is generally less than 30 feet (9 meters). In the Pine Ridge and Badlands regions, however, relief is 100 to 300 feet (30 to 90 meters), and the bottom land along the Niobrara River is 100 to 200 feet (30 to 60 meters) below the surrounding hills and escarpments. Elevation ranges from 2,950 to 3,940 feet (900 to 1,200 meters), increasing gradually from east to west. It is highest on a nearly level to gently sloping tableland south of the narrow, steep-walled valleys near Pine Ridge. The Badlands consist of eroded walls and escarpments, small grass-covered tablelands and mesas, and basins in which there are scattered eroded buttes. Slopes range from nearly level to very steep. Many streams and gullies cut the Badlands.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-White (1014), 47 percent; Niobrara (1015), 30 percent; North Platte (1018), 14 percent; and Cheyenne (1012), 9 percent. The headwaters of the White and Niobrara Rivers are in the part of this MLRA in northwestern Nebraska. The White River is the main drainage through the Badlands National Park. Tributaries to the White River carved the badlands in the northwest corner of the MLRA.

Geology

Tertiary continental sediments consisting of sandstone, siltstone, and claystone underlie most of this area. Locally, these units are called the Ogallala Group and the Arikaree Group. Many of the bedrock units in the southern third of the area are covered by loess. Sand, silt, and clay alluvium is under the valley floors of the major drainages. The Pine Ridge escarpment marks the northern extent of the Ogallala aquifer. This is the most extensive and heavily used aquifer on the high plains between the Rocky Mountains and the Mississippi River. The Badlands consist of stream-laid layers of silt, clay, and sand mixed with layers of volcanic ash. They are internationally famous for their Oligocene fossil assemblages and as a tourist destination.

Climate

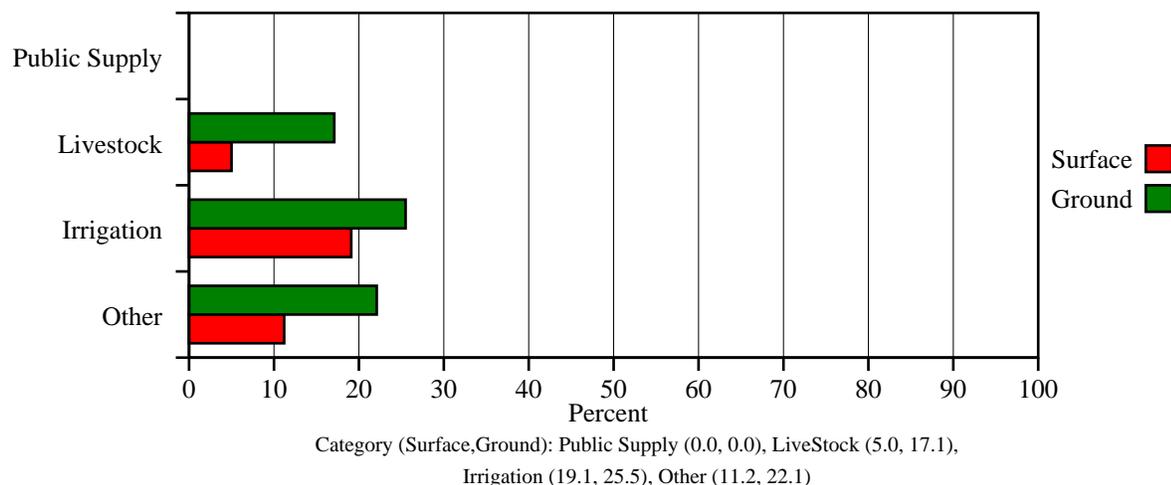
The average annual precipitation in this area is 13 to 19 inches (330 to 485 millimeters). Most of the rainfall occurs as frontal storms in spring and early summer. Some high-intensity, convective thunderstorms occur in late summer. Precipitation in winter occurs as snow. Much of this area receives about 35 inches (90 centimeters) of snow annually, but the snow seldom covers the ground for more than a week at a time. The average annual temperature is 43 to 51 degrees F (6 to 10 degrees C). The freeze-free period averages about 150 days and ranges from 125 to 180 days.

Water

The total withdrawals average 39 million gallons per day (1,985 million liters per day). About 65 percent is from ground water sources, and 35 percent is from surface water sources. Most of the area depends on the rather low and erratic precipitation for water. Some surface water for irrigation is obtained from the Niobrara and White Rivers in Nebraska. This water is of good quality. It contains less total dissolved solids than the local ground water. It is a sodium bicarbonate type and is hard or very hard.

Ground water is scarce and of poor quality in most of the area. Locally, mainly south of Pine Ridge and in Nebraska, underground sand and gravel in the Ogallala and Arikaree Formations yield moderate to large quantities of good-quality water. The level of total dissolved solids is typically less than 400 parts per million (milligrams per liter) in South Dakota, but the sodium levels are high. This water is the least mineralized ground water in South Dakota but is still hard or very hard. Selenium concentrations from the underlying Pierre Shale can exceed the standards for drinking water. Water for all uses is pumped from the Arikaree Formation in Nebraska. This water is less mineralized than that in South Dakota and is not so hard. It is a sodium bicarbonate type and does not contain selenium.

MLRA 64 Water Use by Category



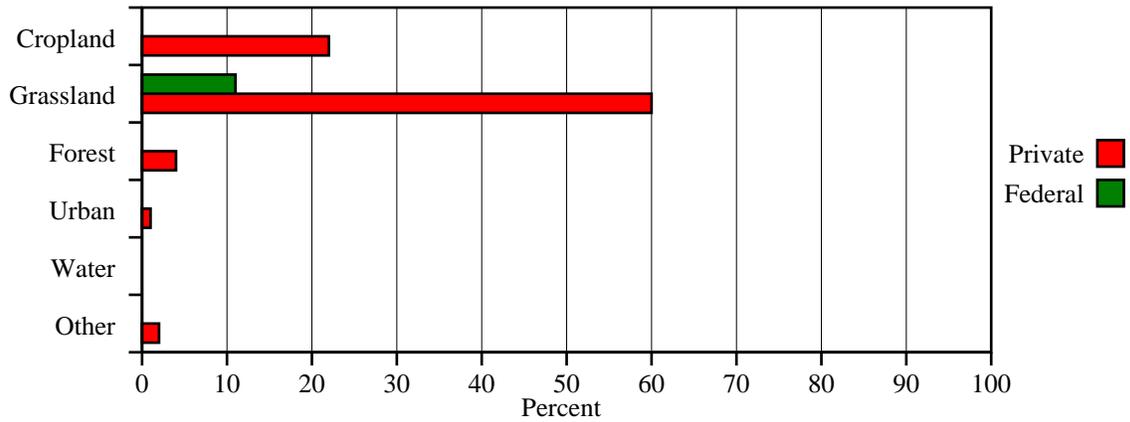
Land Use

Most of this area is in ranches or farms. More than three-fifths of the area is rangeland that is grazed primarily by livestock. Scenic Pine Ridge has grassed areas and pine trees of commercial value. About 20 percent of the area is cropland. South of Pine Ridge, the major enterprise is cash-grain farming and winter wheat is the main crop. In other parts of the area, the crops are grown mainly as feed and forage for livestock. Irrigated corn and sugar beets are grown in areas where the supply of water is adequate and the soils are suitable. The Badlands National Park is a major tourist attraction in the northern part of this MLRA.

The main resource concerns are wind erosion, water erosion, and the quality of surface water. Wind erosion and water erosion are hazards on cropland and hayland and in areas of pasture and rangeland where the plant cover is depleted by overgrazing. Additional soil resource concerns are maintenance of the content of organic matter and tilth of the soils and soil moisture management.

The important conservation practices on cropland are cropping systems that include high-residue crops, systems of crop residue management (such as no-till and mulch-till systems), level terraces, contour farming, contour stripcropping, irrigation water management, and nutrient management. The most important conservation practice on rangeland is prescribed grazing. Generally, cultural treatments are not used to increase forage production on the rangeland in this area. Cool-season, tame pastures are established to supplement forage production. Haying commonly provides supplemental feed during winter. Forest stand improvement and firebreaks reduce the hazard of wildfires on forestland and improve forest growth, quality, health, and productivity.

MLRA 64 Land Use by Category



Category (Private,Federal): Cropland (22.0, 0.0), Grassland (60.0, 11.0), Forest (4.0, 0.0), Urban (1.0, 0.0), Water (0.0, 0.0), Other (2.0, 0.0)

MLRA 65 - Nebraska Sand Hills

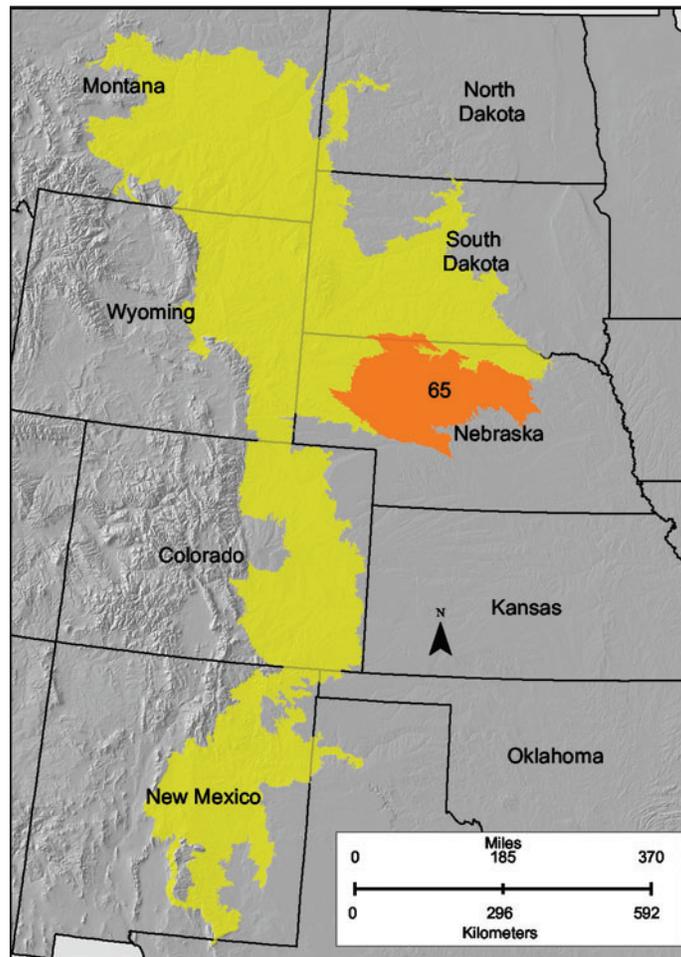


Figure 65-1: Location of MLRA 65 in Land Resource Region G

Introduction

This area (shown in fig. 65-1) is in Nebraska (98 percent) and South Dakota (2 percent). It makes up about 20,545 square miles (53,235 square kilometers). It has no major cities. The towns of Ainsworth, Mullen, and Valentine, Nebraska, are in this area. Several national wildlife refuges occur in this area, including Lacreek, Fort Niobrara, Valentine, and Crescent Lake National Wildlife Refuges. The Samuel R. McKelvie and Nebraska National Forests are in the area. This MLRA is the largest sand-dune area in the Western Hemisphere and is one of the largest grass-stabilized dune regions in the world.

Physiography

This area is in the High Plains Section of the Great Plains Province of the Interior Plains. Elevation ranges from 1,970 to 3,940 feet (600 to 1,200 meters), increasing gradually from east to west. Most of the area occurs as rolling to steep, irregular sand dunes stabilized by grasses and as narrow, elongated, nearly level to gently sloping valleys between the sand dunes. The height of the dunes ranges from 10 to 400 feet (3 to 120 meters). The dunes and narrow valleys commonly extend for several miles in a northwest-southeast direction. Many small depressions are in scattered areas. The area has few streams but has many small permanent and intermittent lakes.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Loup (1021), 45 percent; Niobrara (1015), 24 percent; North Platte (1018), 16 percent; Elkhorn (1022), 9 percent; Platte (1020), 4 percent; and Missouri-White (1014), 2 percent. The Niobrara River is near the northern boundary of the area. It provides opportunities for river rafting. The North Platte River runs along the southwest edge of the MLRA. The North and Middle Loup Rivers and the Calamus, Snake, and Dismal Rivers are in the central and eastern parts of the MLRA.

Geology

This area consists of Quaternary sand dunes. The sands are derived from the underlying Tertiary Ogallala and Arikaree Groups. These units formed when rivers deposited sediments that originated as erosional detritus following the uplift of the Rocky Mountains to the west. The Ogallala aquifer underlies this area. It is the most extensive and heavily used aquifer on the high plains between the Rocky Mountains and the Mississippi River. The major recharge area for this aquifer is the Sand Hills.

Climate

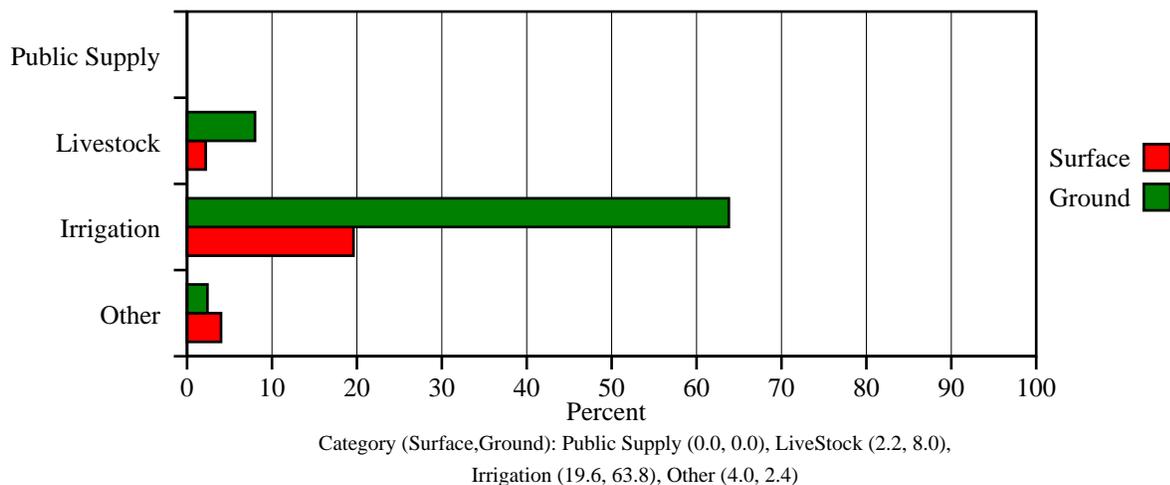
The average annual precipitation in this area is 15 to 26 inches (380 to 660 millimeters). About three-fourths of the precipitation falls from the middle of spring to the middle of autumn. The rainfall occurs as frontal storms in spring and early summer and high-intensity, convective thunderstorms in late summer. Precipitation in winter occurs as snow. The average annual temperature is 46 to 50 degrees F (8 to 10 degrees C). The freeze-free period averages 155 days and ranges from 140 to 175 days.

Water

The total withdrawals average 840 million gallons per day (3,180 million liters per day). About 74 percent is from ground water sources, and 26 percent is from surface water sources. Precipitation is the source of water for range vegetation. The many small lakes and ponds and a few streams provide water for livestock, some irrigation, and domestic use. The surface water is of excellent quality and is suitable for all uses.

The Sand Hills is a primary recharge area for the Ogallala aquifer. Ground water from the Ogallala aquifer is abundant and of good quality. It is a calcium bicarbonate type and is very hard. It is very low in total dissolved solids (less than 200 parts per million or milligrams per liter) in this area. Because of the abundance of surface water for livestock and domestic use, the ground water is used primarily for irrigation in the flatter areas of the MLRA.

MLRA 65 Water Use by Category



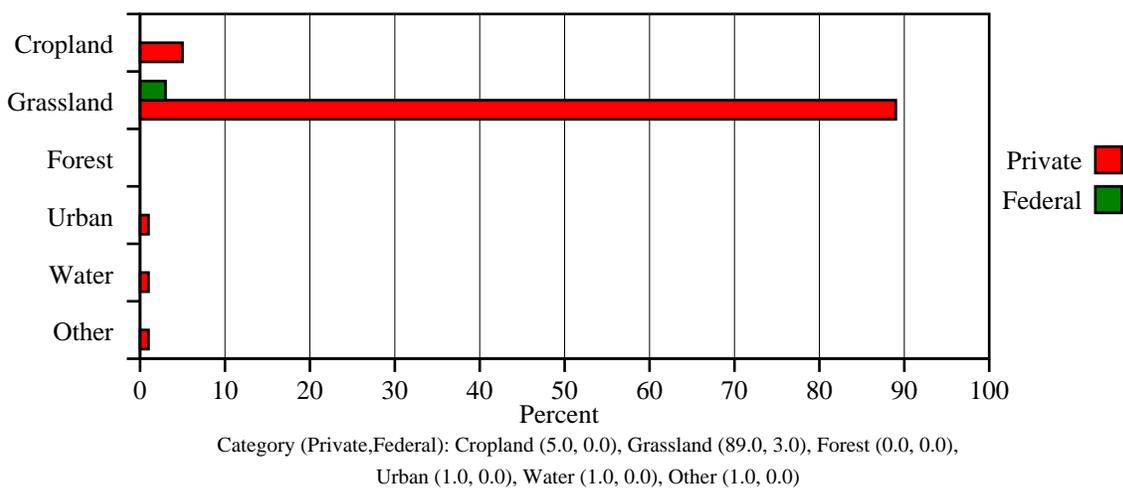
Land Use

More than nine-tenths of this area is in large ranches, most of which support native grasses grazed by livestock. Tracts along streams and in subirrigated valleys are used mainly for hay. The rolling hills and dry valleys are grazed. Use of sprinkler irrigation has increased in recent years. Corn is the principal irrigated crop.

The major soil resource concern on rangeland is wind erosion in areas where the plant cover has been depleted by overgrazing. The major soil resource concerns on cropland are wind erosion, maintenance of the content of organic matter and tith of the soils, and soil moisture management.

Conservation practices on rangeland generally include proper range management and improvement practices, such as proper grazing use, deferment or rest periods, planned grazing systems, range seeding or interseeding, and weed control. The important conservation practices on cropland are cropping systems that include high-residue crops, systems of crop residue management (such as no-till and mulch-till systems), irrigation water management, and nutrient management.

MLRA 65 Land Use by Category



MLRA 66 - Dakota-Nebraska Eroded Tableland

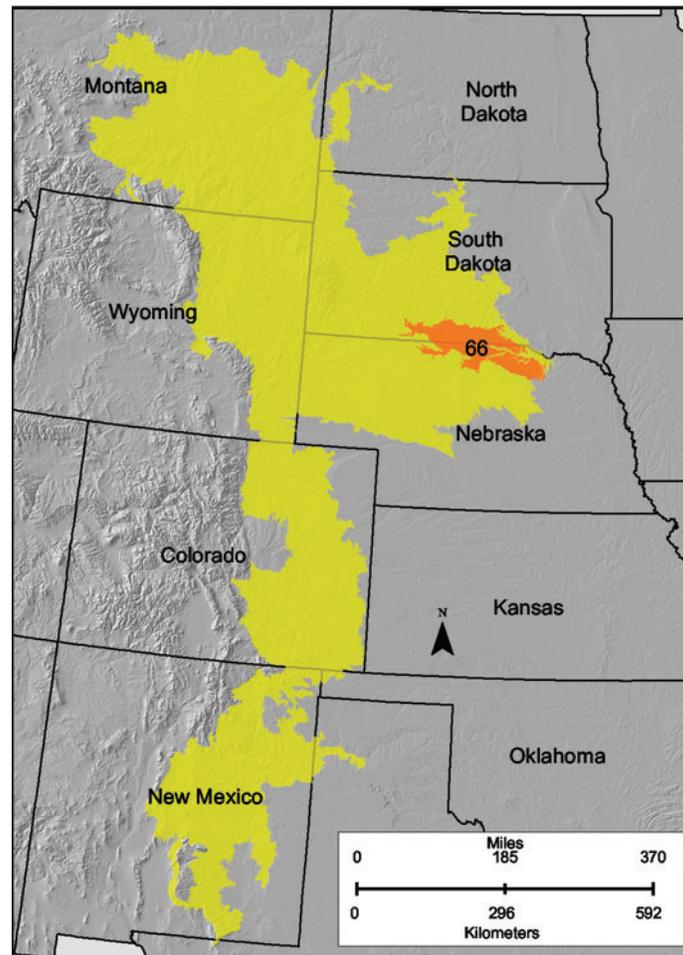


Figure 66-1: Location of MLRA 66 in Land Resource Region G

Introduction

This area (shown in fig. 66-1) is in Nebraska (56 percent) and South Dakota (44 percent). It makes up about 5,660 square miles (14,665 square kilometers). The town of Springview, Nebraska, is in the central part of the area, and O'Neill, Nebraska, is in the southeastern part. The town of Winner, South Dakota, is just north of the MLRA, and the town of Valentine, Nebraska, is just outside the southwest corner. U.S. Highways 18, 20, 83, and 183 cross the area. A portion of the Rosebud Indian Reservation is in the northwestern part of the MLRA.

Physiography

The northern half of this MLRA is in the Missouri Plateau, Unglaciaded, Section of the Great Plains Province of the Interior Plains. The southern half is in the High Plains Section of the same division and province. This MLRA is part of the fluvial plain that built up to the east as the Rocky Mountains eroded. Broad intervalley remnants of that smooth fluvial plain dominate the area. Some terraces and river breaks and local badlands are along the major drainages. Elevation ranges from 1,970 to 2,950 feet (600 to 900 meters). The higher parts of the tableland are nearly level to moderately sloping. Steeper areas are on the sides of ridges and drainages. Stream valleys are well

defined, except in some undulating areas where sandy eolian sandy material mantles the bedrock.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Niobrara (1015), 82 percent; Missouri-White (1014), 16 percent; and Elkhorn (1022), 2 percent. The Keya Paha, Elkhorn, and Niobrara Rivers flow through this area. The Niobrara is a National Scenic River.

Geology

The Cretaceous Niobrara Formation underlies most of this area. It is made up of layers of marine sediments, mostly shaly chalk and limestone. Some eolian deposits are on the surface in the western and southern parts of the area. Alluvial sand and gravel underlie the valley floors along the major streams.

Climate

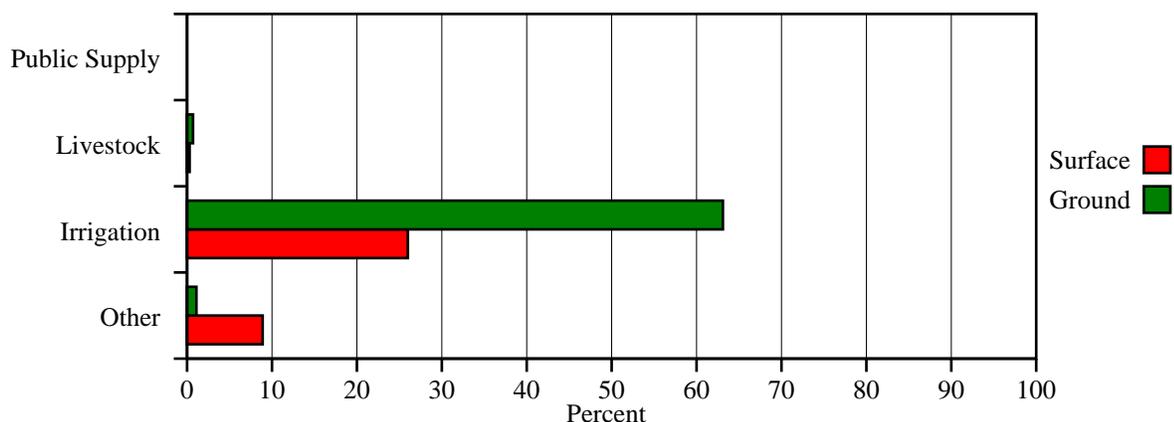
The average annual precipitation in this area is 18 to 25 inches (455 to 635 millimeters). Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. Precipitation in winter occurs mainly as snow. The annual snowfall ranges from about 24 to 40 inches (610 to 1,015 millimeters). Summers are hot, and winters are cold. The average annual temperature is 46 to 49 degrees F (8 to 9 degrees C). The freeze-free period averages 160 days and ranges from 145 to 175 days.

Water

The total withdrawals average 220 million gallons per day (833 million liters per day). About 65 percent is from ground water sources, and 35 percent is from surface water sources. Because of the limited amount of precipitation, farming is risky and maximum crop production is not expected in most years. Most of the soils are deficient in moisture during much of the latter part of the growing season. The surface water is of good quality. It is a calcium, magnesium, and bicarbonate type and is very hard. The level of total dissolved solids averages about 390 parts per million (milligrams per liter). The Niobrara River, the only perennial stream in the area, provides water for irrigation, livestock, domestic uses, and public supply.

Throughout most of the area, shallow water is available in quantities sufficient for livestock and domestic uses. Most of the shallow water is from sand and gravel deposits in drainages. The Niobrara Formation supplies ground water for irrigation, livestock, and domestic uses. This unit typically is considered an aquifer only where solution channels and fractures have opened the rock. The ground water is a calcium bicarbonate type and is very hard. The level of total dissolved solids averages about 490 parts per million (milligrams per liter).

MLRA 66 Water Use by Category



Category (Surface,Ground): Public Supply (0.0, 0.0), LiveStock (0.3, 0.7),
Irrigation (26.0, 63.1), Other (8.9, 1.1)

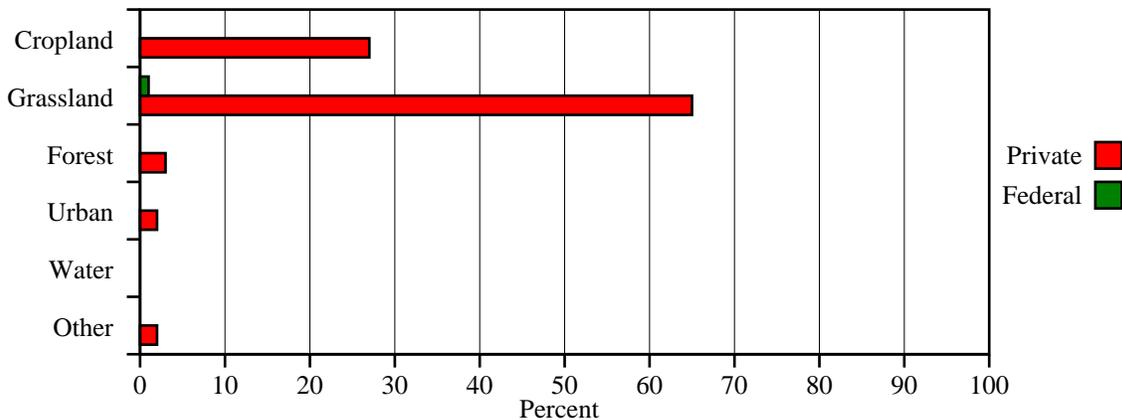
Land Use

Most of this area supports native grasses and is grazed by cattle. Some of the smoother areas are used for crops, mainly corn, forage and grain sorghum, and alfalfa for livestock feed. Winter wheat is grown as a cash crop in a few areas.

The major resource concerns are erosion and the quality of surface water. The major soil resource concerns on cropland and hayland are wind erosion, water erosion, maintenance of the content of organic matter and tilth of the soils, and soil moisture management. The major soil resource concerns on pasture and rangeland are wind erosion and water erosion in areas where the plant cover has been depleted by overgrazing.

The most important conservation practice on rangeland is prescribed grazing. Generally, cultural treatments are not used to increase forage production on the rangeland in this area. Cool-season, tame pastures are established to supplement forage production. The most important conservation practices on cropland are cropping systems that include high-residue crops, systems of crop residue management (such as no-till and mulch-till systems), level terraces, contour farming, contour stripcropping, irrigation water management, and nutrient management.

MLRA 66 Land Use by Category



Category (Private,Federal): Cropland (27.0, 0.0), Grassland (65.0, 1.0), Forest (3.0, 0.0),
Urban (2.0, 0.0), Water (0.0, 0.0), Other (2.0, 0.0)

MLRA 61 - Black Hills Foot Slopes

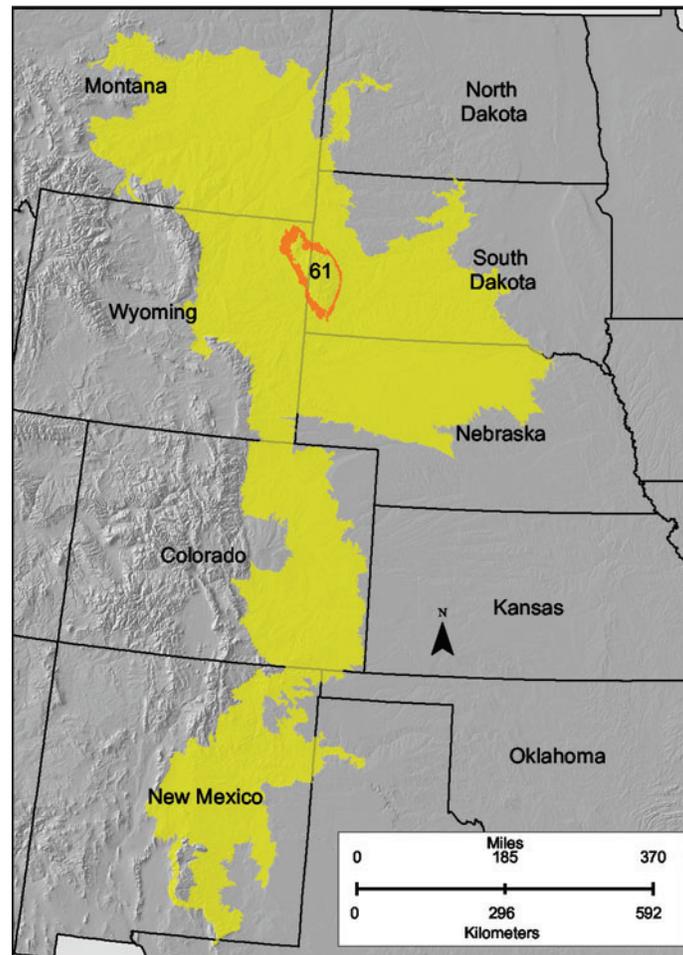


Figure 61-1: Location of MLRA 61 in Land Resource Region G

Introduction

This area (shown in fig. 61-1) is in Wyoming (58 percent) and South Dakota (42 percent). It makes up about 1,865 square miles (4,840 square kilometers). The cities of Spearfish, Sturgis, and Hot Springs, South Dakota, and Sundance and Newcastle, Wyoming, are in this area. Rapid City, South Dakota, is on the eastern edge of the MLRA. Wind Cave National Park, Devil's Tower National Monument, and parts of the Thunder Basin National Grasslands and the Black Hills National Forest occur in this MLRA.

Physiography

This area is in the Black Hills Section of the Great Plains Province of the Interior Plains. It is an area of steeply dipping rocks circling the maturely dissected domed mountains of the Black Hills. As the mountains were uplifted, older sediments were tipped up, so they dip away from the core of the mountains. Elevation is mainly 2,950 to 3,940 feet (900 to 1,200 meters) but ranges to 5,580 feet (1,700 meters). Slopes generally are hilly but are nearly level to moderately sloping where shale red beds occur in the middle of this area. They are steep along both edges of the area where rocks that are more erosion resistant occur. The drainage pattern is well defined.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Cheyenne (1012), 98 percent, and Missouri-Little Missouri (1011), 2 percent. The Belle Fourche River is the only river flowing through this MLRA, but many creeks draining the Black Hills cross the area. The creeks are the headwaters of the Cheyenne River, one of the major rivers in western South Dakota.

Geology

This area consists of marine sediments older than the Cretaceous Pierre Shale on the high plains surrounding this area. The older rocks were brought closer to the surface during the uplift that formed the Black Hills. The Lower Cretaceous Fall River and Lakota (Inyan Kara Group) sandstones occur on the outside boundary of the area and are referred to as the Dakota Hogback. Permian limestone and shale of the Minnekahta limestone form the inside boundary and occur in the mountains of the Black Hills (MLRA 62). The Triassic red beds of the Spearfish shale form a low valley, the “red valley,” surrounding the Black Hills between the two ridges formed by the Inyan Kara and Minnekahta Formations. Native Americans called these red beds the “Great Race Track.” The red beds have gypsum and anhydrous layers. Ground-water seepage can dissolve these layers, creating sinkholes on the surface.

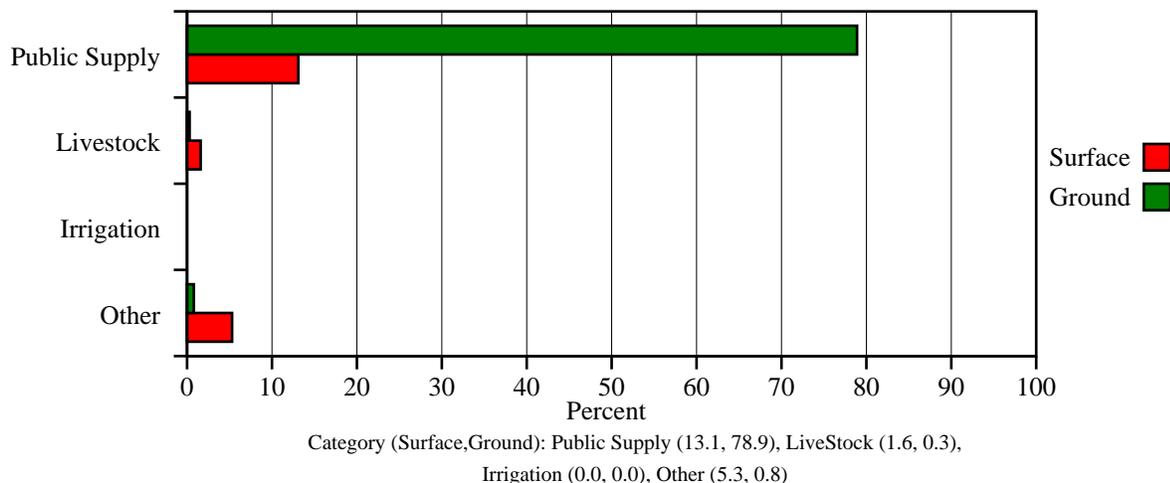
Climate

The average annual precipitation in this area is 14 to 24 inches (355 to 610 millimeters). Most of the rainfall occurs as frontal storms early in the growing season, in May and June. Some high-intensity, convective thunderstorms occur in July and August. The average snowfall in winter is 24 to 39 inches (60 to 100 centimeters), increasing with elevation. The average annual temperature is 40 to 49 degrees F (5 to 9 degrees C). The freeze-free period averages 140 days and ranges from 115 to 165 days.

Water

The total withdrawals average 7.5 million gallons per day (28 million liters per day). About 80 percent is from ground water sources, and 20 percent is from surface water sources. Flowing streams, shallow wells, and springs provide almost all of the domestic and public water. The surface water is of good quality during high runoff periods. At low flows, however, much of the surface water does not meet drinking water standards because of pollution and high levels of total dissolved solids. Much of the water used in this area is for public supply for the numerous cities and towns that were built on the level ground that forms the core of the area. Crop production in the area is marginal because of the limited amount of precipitation. Some limited irrigation occurs along the major streams that headwater in the Black Hills and cross the area. Most of the soils suitable for cultivation are dry during much of the growing season. Ground water is scarce because of the shale under most of the area. Many cities obtain public supply water from large springs in the Pahasapa limestone on the inside edge of this area.

MLRA 61 Water Use by Category



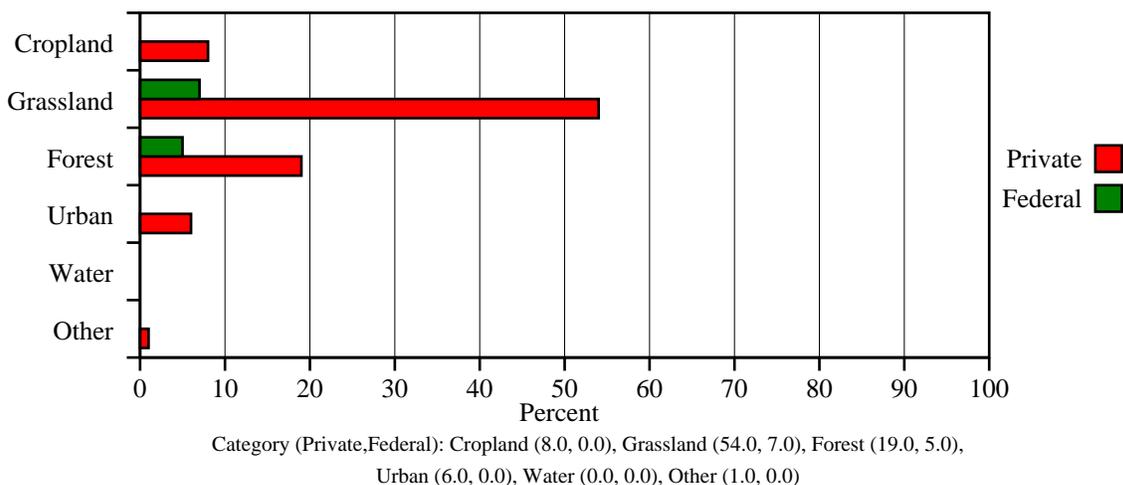
Land Use

Most of this area is privately owned land in farms and ranches. The native grasses are used mainly for grazing by livestock. Some of the less sloping areas are used for alfalfa and small grain for livestock feed. Ponderosa pine grows in some areas adjacent to the Black Hills. Urban expansion is a growing concern.

The major resource concerns in this area are water quality and urban expansion. The major soil resource concerns are wind erosion, water erosion, and urban expansion.

Conservation practices on rangeland generally include prescribed grazing, fencing, and water developments. The establishment of food plots and range improvement practices benefit wildlife. Conservation practices on cropland generally include contour farming, crop rotations that include grasses and legumes, and crop residue management. The Grassland Reserve Program is an increasingly important tool that helps to limit urban expansion. Forest stand improvement and firebreaks reduce the hazard of wildfires and improve forest growth, quality, health, and productivity.

MLRA 61 Land Use by Category



M - Central Feed Grains and Livestock Region

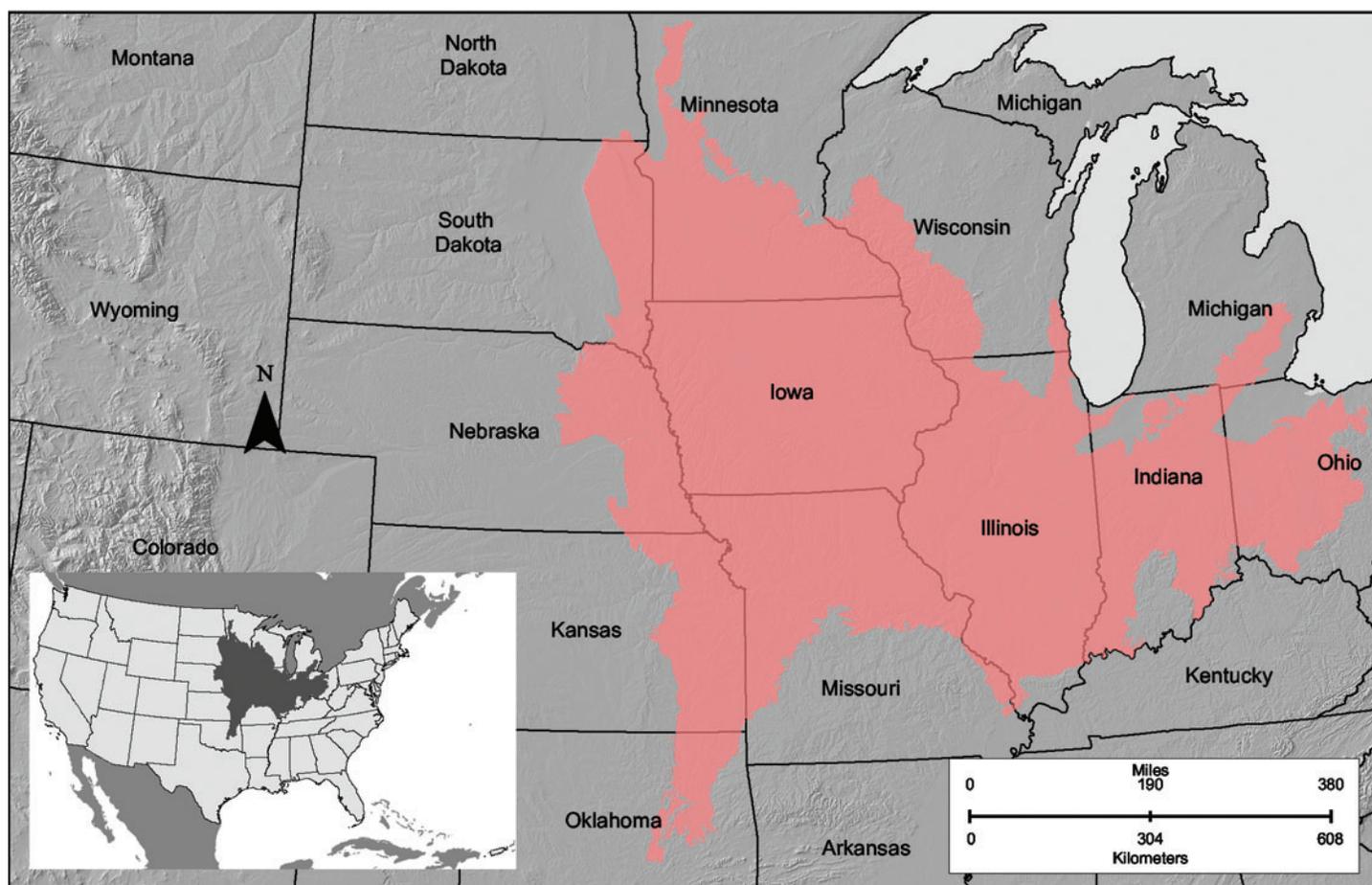


Figure M-1: Location of Land Resource Region M

LRR Overview

This region (shown in fig. M-1) is in Iowa (20 percent), Illinois (18 percent), Missouri (13 percent), Minnesota (11 percent), Indiana (9 percent), Kansas (6 percent), Nebraska (6 percent), Ohio (6 percent), Wisconsin (4 percent), South Dakota (4 percent), Oklahoma (2 percent), and Michigan (1 percent). Also, very small parts are in North Dakota and Kentucky. The region makes up 282,450 square miles (731,905 square kilometers).

Typically, the land surface is a nearly level to gently sloping, dissected glaciated plain (fig. M-2). The average annual precipitation is typically 32 to 39 inches (815 to 990 millimeters), but it ranges from 19 to 48 inches (485 to 1,220 millimeters), increasing from north to south. Most of the precipitation occurs during the growing season. In most of the region, the average annual temperature is 47 to 53 degrees F (8 to 12 degrees C), but it ranges from 38 to 62 degrees F (4 to 17 degrees C), increasing from north to south. The freeze-free period generally is 170 to 210 days. It increases in length from north to south.

The total withdrawals of freshwater in this region average about 35,945 million gallons per day (136,050 million liters per day). This is one of six land resource regions that use more than 30,000 million gallons per day (113,550 million liters per day). This region is second only to the Northwestern Wheat and Range Region (LRR B) in total amount of water used. About 87 percent

is from surface water sources, and 13 percent is from ground water sources. Abundant precipitation and numerous perennial streams provide ample supplies of good-quality surface water for all uses in the region. The lower reaches of the large rivers in the southern part of the region have poor-quality water primarily because of sediment, nutrients, and pesticides from agricultural runoff.

The soils in this region are dominantly Alfisols, Entisols, Inceptisols, or Mollisols. Some Histosols occur on flood plains and in wetlands. The dominant suborders are Udalfs, Aqualfs, and Aquolls. The sandy soils are typically Psamments. The soils in the region dominantly have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed or smectitic mineralogy.

About 99 percent of this region is privately owned. The soils and climate favor agriculture. This region produces most of the corn, soybeans, and feed grains produced in the U.S. The grains and hay grown in the region commonly are fed to beef cattle. Some specialty crops are grown near markets in the metropolitan areas. Much of the cropland near the larger cities is being subdivided and developed for urban uses. Small areas in the parts of this region in southern Indiana and in Illinois are strip-mined for coal.

The major soil resource concerns are water erosion, wetness, and maintenance of the content of organic matter and productivity of the soils. Wind erosion is a hazard in some of the northern parts of the region where the lighter textured soils occur. Protecting wildlife habitat and preserving the quality of surface water and ground water are additional concerns in many parts of this region.



M-2: Riparian buffer in an area of Land Resource Region M

MLRA 107B - Iowa and Missouri Deep Loess Hills

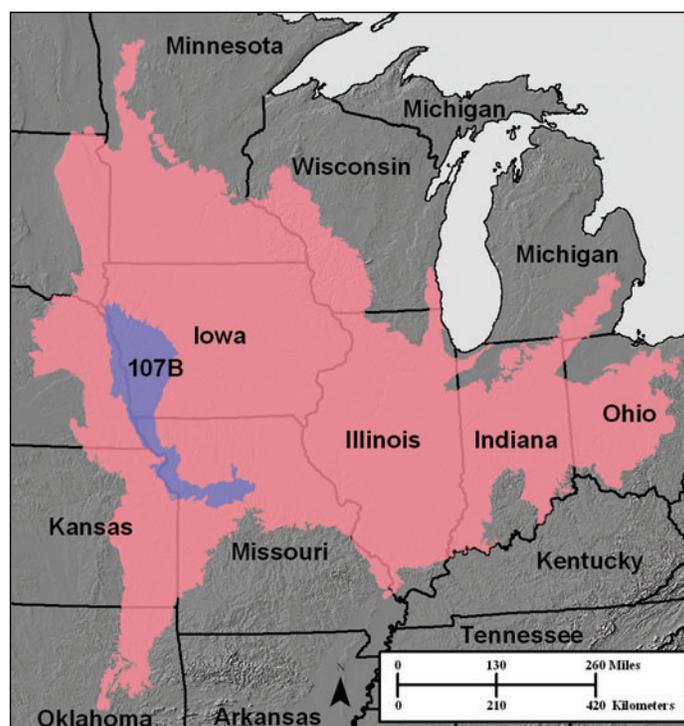


Figure 107B-1: Location of MLRA 107B in Land Resource Region M

Introduction

This area (shown in fig. 107B-1) is in Iowa (53 percent), Missouri (32 percent), Nebraska (12 percent), and Kansas (3 percent). It makes up about 14,410 square miles (37,335 square kilometers). It includes the cities or towns of Atlantic, Council Bluffs, and Sioux City, Iowa; St. Joseph, Kansas City, Independence, and Marshall, Missouri; Atchison, Leavenworth, and Kansas City, Kansas; and Omaha, Nebraska. Interstates 29, 35, 70, and 80 cross different parts of this area. Fort Leavenworth Military Reservation and parts of the Winnebago and Omaha Indian Reservations are in this MLRA. A number of State parks are throughout the area, and a number of national wildlife refuges are in the area, especially along the Missouri River.

Physiography

This area is almost entirely in the Dissected Till Plains Section of the Central Lowland Province of the Interior Plains. The farthest southern part of the area in Missouri is in the Osage Plains Section of the same province and division. Slopes are mostly rolling to hilly, but some broad ridgetops are nearly level to undulating. Slopes bordering the major stream valleys are steep. Nearly level, broad valley floors are along a few large rivers. Elevation ranges from 600 feet (185 meters) where the Missouri River exits the area to 1,565 feet (475 meters) on the highest ridges. Local relief is mainly 10 to 100 feet (3 to 30 meters), but valley floors can be 80 to 300 feet (25 to 90 meters) below the adjacent uplands. Also, some upland flats and valley floors have local relief of only 3 to 6 feet (1 to 2 meters).

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-Nishnabotna (1024), 45 percent; Missouri-Little Sioux (1023), 33 percent; Lower Missouri (1030), 15 percent; Des Moines (0710), 2 percent; Platte (1020), 2

percent; Chariton-Grand (1028), 2 percent; and Missouri-Big Sioux (1017), 1 percent. A small part of the Kansas (1027) and Elkhorn (1022) Hydrologic Unit Areas also occur in this MLRA. The Missouri River forms the “centerline” of this MLRA. The major tributaries that join the Missouri River in this area include, from north to south, the Floyd, Little Sioux, Soldier, Boyer, Platte (Nebraska), Nishnabotna, Little Nemaha, Tarkio, Big Nemaha, Nodaway, Platte and Little Platte (Missouri), Kansas, Grand, and Thompson Rivers.

Geology

This area includes the Missouri Alluvial Plain, the Loess Hills, and part of the Southern Iowa Drift Plain landform regions of Iowa. Most of the area is overlain by loess deposits that reach a thickness of 65 to 200 feet (20 to 60 meters) in the Loess Hills and thin to about 20 feet (6 meters) in the eastern part of the area. The loess is underlain by pre-Illinoian till, which was deposited more than 500,000 years ago and has since undergone extensive erosion and dissection. In the Loess Hills, Holocene cycles of erosion and deposition, or “cut and fill,” have produced deeply incised gullies and fine grained alluvial deposits. The Quaternary overburden ranges from 150 to 450 feet (45 to 135 meters) in thickness throughout most of the area, but it is generally less than 150 feet (45 meters) thick in the southeastern part of the area. The glacial materials are underlain by Pennsylvanian and Cretaceous bedrock, which consists of shale, mudstones, and sandstones.

Climate

The average annual precipitation in this area is 26 to 41 inches (660 to 1,040 millimeters). Most of the rainfall occurs as convective thunderstorms during the growing season. About 10 percent of the precipitation occurs as snow in the winter. The average annual temperature is 46 to 56 degrees F (8 to 13 degrees C). The freeze-free period averages about 190 days and ranges from 155 to 220 days.

Water

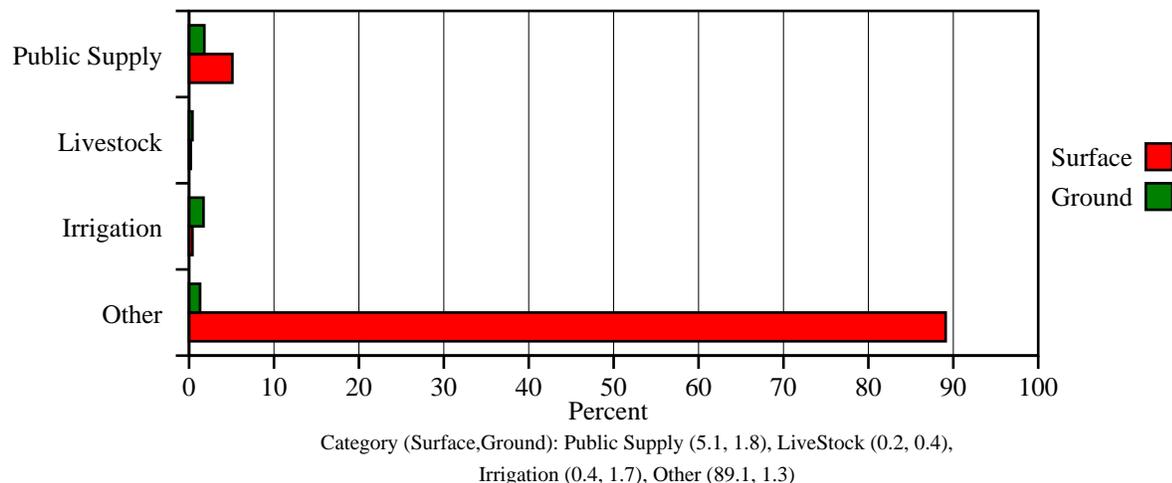
The total withdrawals average 4,210 million gallons per day (15,935 million liters per day). About 5 percent is from ground water sources, and 95 percent is from surface water sources. Sediment, nutrients, and pesticides from agricultural activities impair many of the major streams and rivers in this area (not including the Missouri River). The surface water is used mainly for cooling thermoelectric power plants along the Missouri River. The Missouri River also provides most of the municipal and industrial water for the major cities in the area. Other streams and rivers provide some surface water for livestock, irrigation, and public supplies in parts of the area.

The principal sources of ground water in the area are glacial drift, alluvial aquifers along the major streams, buried valley aquifers, the Dakota Sandstone, and Paleozoic rocks. Glacial drift aquifers supply many rural homeowners with domestic water. The buried channels are sources of moderate or moderately large supplies of generally good-quality water. The mineral content of the water may be high if this aquifer is hydraulically connected to bedrock aquifers beneath it. Alluvial deposits are extensive across the broad flood plain along the Missouri River. This aquifer is used for public supplies in Missouri. It has very hard water that contains a median level of 467 parts per million (milligrams per liter) total dissolved solids. The other shallow aquifers in Iowa have water very similar in quality to that in the Missouri River alluvium. They provide water for domestic use, livestock, some irrigation, and public supply.

The Cretaceous-age Dakota Sandstone is at a shallow or moderate depth in the northern half of this area. It is tapped by many domestic and livestock wells. A few irrigation wells tap this aquifer. In areas where more shallow aquifers do not occur, a number of communities obtain their public supplies from this aquifer. Locally, the base of the Dakota Sandstone has beds of gravel from which moderately large yields can be obtained. The median level of total dissolved solids in the aquifer in Iowa and Nebraska is 824 and 840 parts per million (milligrams per liter), respectively, and the water is very hard.

The Jordan aquifer is the most extensively used aquifer in Iowa. It consists of Ordovician-Cambrian sandstone and dolomite beds. Its water has a median level of total dissolved solids that exceeds 800 parts per million (milligrams per liter) and may contain levels of radium that exceed the national standards for drinking water. Some communities in the part of this area in Iowa depend on this aquifer for public supplies, even though the wells are very deep. Paleozoic units serve as aquifers in the parts of this area in southeastern Nebraska and northwestern Missouri. Water from these aquifers has a median level of total dissolved solids of 1,300 parts per million (milligrams per liter) in Nebraska. Many farmers and communities in Missouri have abandoned wells in these units because of high levels of dissolved salts.

MLRA 107B Water Use by Category



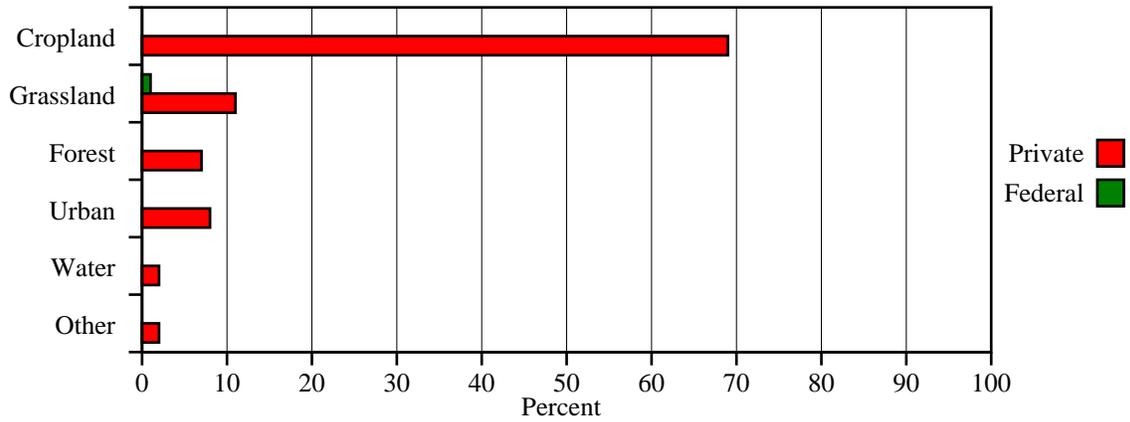
Land Use

Historically, 92 percent of this MLRA was prairie. Forests made up 4 percent of the area; savannas, 2 percent; rivers and streams, 1 percent; wetlands, 1 percent; ponds and lakes, 0.2 percent; and shrub land, 0.2 percent. The increase in the forested acreage from 4 percent of the historic landscape to 7 percent of the current landscape occurred mainly on the loess hills, where the forested acreage increased significantly because of fire suppression.

Farms currently make up nearly all of this area. They produce cash and grain crops and livestock.

The major resource concerns are water erosion, depletion of organic matter in the soils, and poor water quality. Conservation practices on cropland generally include systems of crop residue management (especially no-till, strip-till, and mulch-till systems), cover crops, pest and nutrient management, grassed waterways, terraces, manure management, pasture and hayland planting, and grade-stabilization structures.

MLRA 107B Land Use by Category



Category (Private,Federal): Cropland (69.0, 0.0), Grassland (11.0, 1.0), Forest (7.0, 0.0),
Urban (8.0, 0.0), Water (2.0, 0.0), Other (2.0, 0.0)

MLRA 102A - Rolling Till Prairie

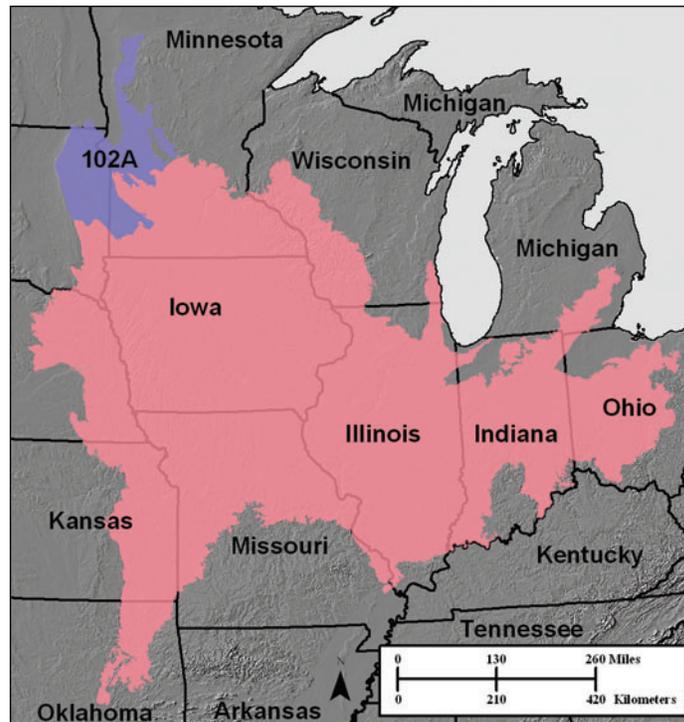


Figure 102A-1: Location of MLRA 102A in Land Resource Region M

Introduction

This area (shown in fig. 102A-1) is mostly in Minnesota (58 percent) and South Dakota (42 percent). A small part is in North Dakota. This MLRA makes up about 16,545 square miles (42,870 square kilometers). It includes the cities or towns of Fergus Falls, Marshall, Montevideo, and Morris, Minnesota, and Brookings, Milbank, and Watertown, South Dakota. The town of Willmar, Minnesota, is on the southeast boundary of the area. Interstates 29 and 94 cross parts of the MLRA. The Pipestone National Monument is in the part of this area in Minnesota. The eastern edge of the Central Flyway and the western edge of the Atlantic Flyway are in this MLRA, so numerous migrating waterfowl occur in the area. The MLRA has many public wildlife areas.

Physiography

Most of this area is in the Western Lake Section of the Central Lowland Province of the Interior Plains. The center of the Prairie Coteau, in northeastern South Dakota, is in the Dissected Till Plains Section of the same province and division. This MLRA is an area of nearly level to rolling topography that has many depressions and ill-defined drainages. "Prairie pothole" lakes and ponds are common. The steeper slopes occur on the sides of drainages and on breaks adjacent to some of the larger tributaries. Elevation generally ranges from 1,000 to 1,350 feet (305 to 410 meters) on lowlands and from 1,350 to 1,650 feet (410 to 505 meters) on uplands. Isolated highs on the Prairie Coteau, in northeastern South Dakota, are at an elevation of more than 2,000 feet (610 meters). The Prairie Coteau is one of the more prominent landforms in North America. The northern tip of this wedge-shaped highland is in North Dakota. This high area split the last continental ice sheet into the Des Moines and James Lobes.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Minnesota (0702), 42 percent; Missouri-Big Sioux (1017), 25 percent; Red (0902), 17 percent; James (1016), 10 percent; Mississippi Headwaters (0701), 5 percent; and Des Moines (0710), 1 percent. The headwaters of the Red River of the North (draining into Hudson Bay) and the Minnesota River (draining into the Mississippi River) are in this area. The part of the Minnesota River in the southeast corner of this area is a National Wild and Scenic River. Some of the major tributaries to the Red River are the Sand Hill, Poplar, Marsh, Wild Rice, Buffalo, Otter Tail, Mustinka, and Bois de Sioux Rivers. The major tributaries to the Minnesota River are the Chippewa, Pomme de Terre, Whetstone, Lac qui Parle, Yellow Medicine, and Cottonwood Rivers. The Big Sioux River begins in this area, near Watertown, South Dakota. Lake Traverse and Big Stone Lake are on the border between South Dakota and Minnesota. These lakes are on the continental divide where streams drain either north to Hudson Bay or south to the Gulf of Mexico. Lakes, ponds, and marshes are common in the area.

Geology

The dominant landforms in this area are stagnation moraines, end moraines, glacial outwash plains, terraces, and flood plains. The MLRA is dominated by till-covered moraines. The stagnation moraines are gently undulating to steep and have many depressions and poorly defined drainages. The steepest slopes are on escarpments adjacent to some of the larger tributaries. Small outwash areas are adjacent to the watercourses. The Cretaceous Pierre Shale underlies the till in most of the area. Precambrian rocks also occur at depth. Granite is quarried at Milbank, South Dakota, and outcrops of Sioux Quartzite are common. Layers of silt in the quartzite near Pipestone, Minnesota, were quarried by Native Americans, and the stone was carved for pipe bowls.

Climate

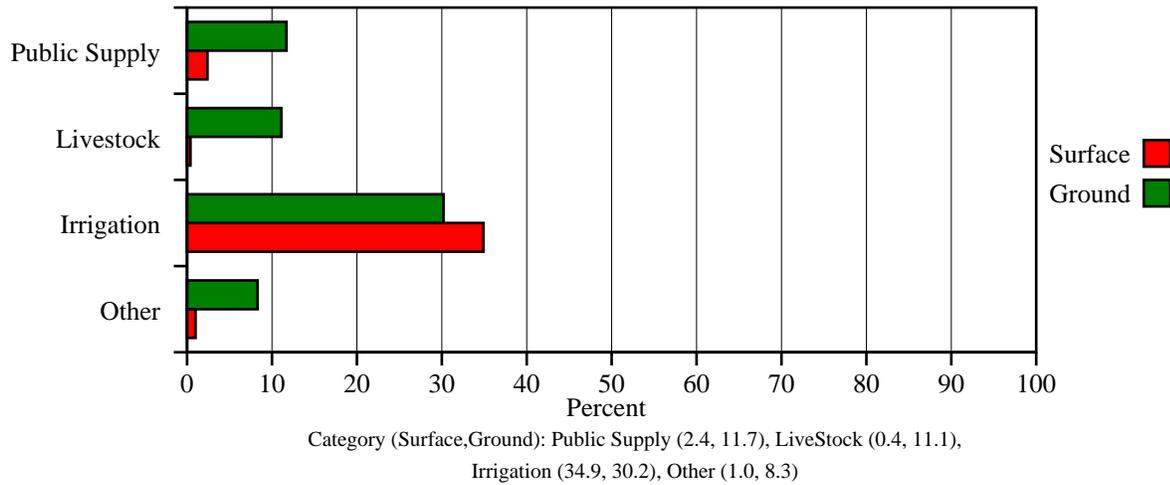
The average annual precipitation in this area is 19 to 29 inches (485 to 735 millimeters). Half or more of the precipitation falls during the growing season. Rainfall typically occurs as high-intensity, convective thunderstorms during the summer. Precipitation in winter occurs mostly as snow. The average annual temperature is 38 to 45 degrees F (4 to 7 degrees C). The freeze-free period averages about 155 days and ranges from 140 to 175 days. In the western part of the MLRA, rainfall is less abundant and is not always adequate for full maturation of crops.

Water

The total withdrawals average 145 million gallons per day (550 million liters per day). About 61 percent is from ground water sources, and 39 percent is from surface water sources. Precipitation is the principal source of moisture for crops. In some years it is inadequate for maximum crop production. Small ponds and shallow wells are the principal sources of water for livestock. Both surface water and ground water are used for some irrigation in the area. Many natural glacial lakes are in the northern part of the area, and many of the larger ones are used for recreation. The water in the lakes and larger streams is generally suitable for all uses. The quality of the water in the smaller streams is generally poor. The water is slightly saline at low flows.

Shallow wells in glacial outwash deposits, primarily sand and gravel, provide water for livestock, domestic use, and irrigation in this area. This water is hard but is of good quality. The median level of total dissolved solids is 350 parts per million (milligrams per liter). Ground water also is available in deep wells in the Precambrian bedrock in this area or in the Dakota Sandstone. These aquifers are seldom utilized in this area because of an abundance of shallow glacial deposits and surface water.

MLRA 102A Water Use by Category

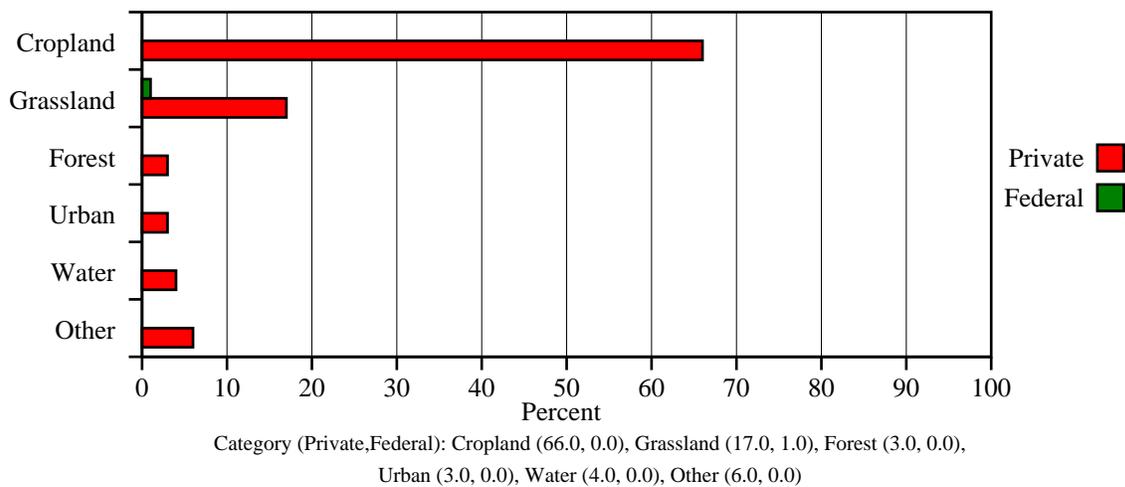


Land Use

Most of this area is in farms, and about two-thirds is cropland used for crops grown for sale or for feeding livestock. The principal crops are corn, soybeans, alfalfa, spring wheat, and oats. Wooded areas generally occur as narrow bands along streams and rivers or as helterbelts around farmsteads. Recreational hunting and fishing are important land uses around the many natural lakes in the northern part of the area.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, soil wetness, and management of soil moisture. Conservation practices on cropland generally include systems of crop residue management, especially no-till or other conservation tillage systems that conserve moisture and contribute to soil quality. Other practices include terraces, vegetative wind barriers, grassed waterways, and nutrient management.

MLRA 102A Land Use by Category



MLRA 102B - Till Plains

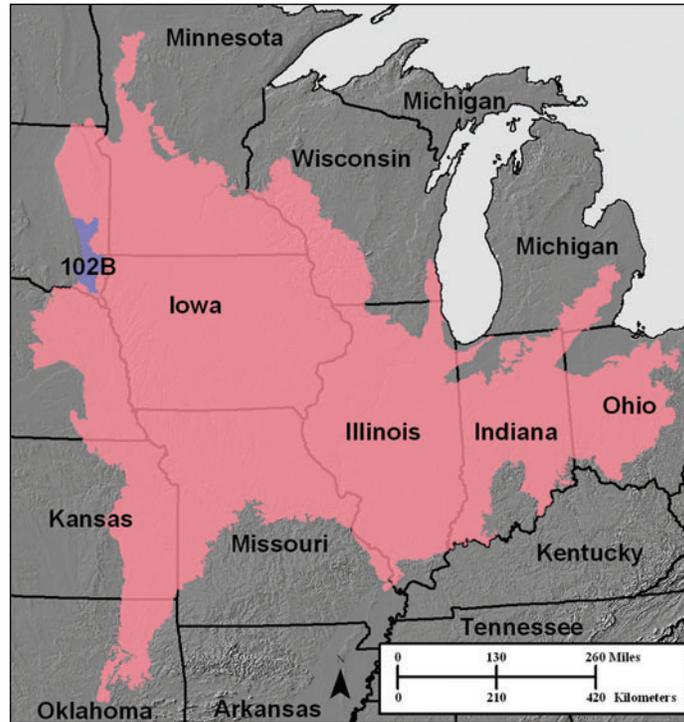


Figure 102B-1: Location of MLRA 102B in Land Resource Region M

Introduction

This area is entirely in South Dakota (fig. 102B-1). It makes up about 2,215 square miles (5,735 square kilometers). The towns of Madison, Canton, and Parker are in this MLRA. Vermillion is on the southern edge of the area, and parts of Sioux Falls are on the eastern edge. Interstate 90 bisects the area from east to west, and Interstate 29 parallels the east edge of the area, crossing it at the north and south ends.

Physiography

This area is in the Western Lake Section of the Central Lowland Province of the Interior Plains. It is characterized by glaciated, nearly level to hilly plains. It has many depressions and ill-defined drainageways. Elevation ranges from 1,140 feet (350 meters) on the edge of the bottom land along the Missouri River in the southern part of the area to 1,880 feet (575 meters) in central Lake County.

The only Hydrologic Unit Area (identified by a four-digit number) that makes up this MLRA is Missouri-Big Sioux (1017). The Vermillion River is just outside the western boundary of the MLRA, and the Big Sioux River is just outside the eastern boundary.

Geology

The major landforms in this MLRA are stagnation moraines, end moraines, glacial outwash terraces, and flood plains. The area is dominated by drift-covered moraines. The stagnation moraines generally are nearly level to gently rolling and have many depressions and ill-defined drainageways. The steeper slopes are on end moraines and on breaks adjacent to some of the larger tributaries. Small outwash areas are adjacent to the minor moraines. The dominant parent materials are silty drift, glacial till, glacial outwash, and alluvium.

Climate

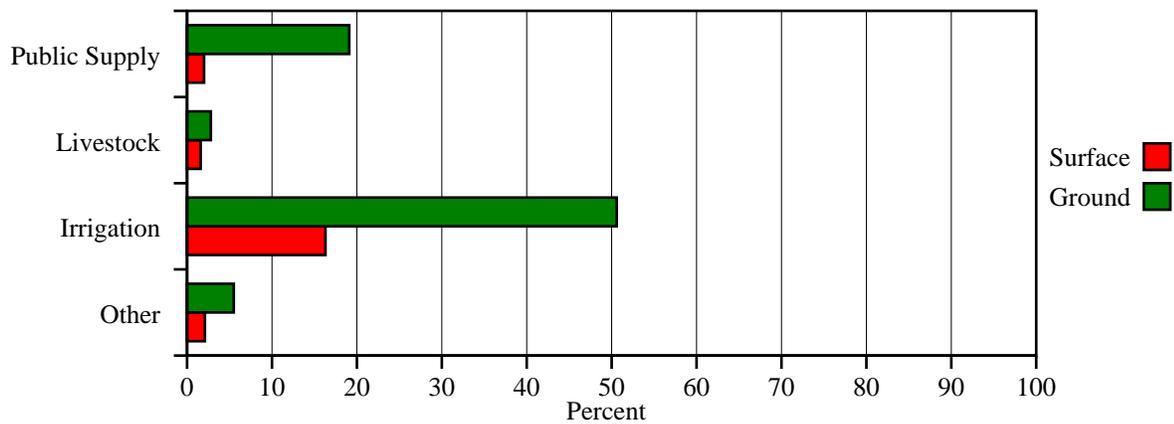
The average annual precipitation in this area is 23 to 26 inches (585 to 660 millimeters). Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. Winter precipitation typically occurs as snow. The annual snowfall is 23 to 46 inches (60 to 120 centimeters). The average annual temperature is 43 to 49 degrees F (6 to 9 degrees C). The freeze-free period averages about 165 days and ranges from 155 to 175 days.

Water

The total withdrawals average 61 million gallons per day (230 million liters per day). About 78 percent is from ground water sources, and 22 percent is from surface water sources. Precipitation is the principal source of moisture for crops. In some years it is inadequate for maximum crop production. Surface water is not plentiful in this area. Rural water systems supply domestic water to an increasing number of farms and communities in the area. The Missouri River, south of this area, has the best quality water in this region, so it is increasingly being used by rural water systems in the area.

A limited supply of ground water is in the glacial drift and alluvial aquifers near the surface in this area. These aquifers consist of unconsolidated sand and gravel. They provide fresh or saline water that is hard and is a calcium-magnesium, bicarbonate, and sulfate type. The median level of total dissolved solids, 670 parts per million (milligrams per liter), exceeds the national secondary (esthetic) standard for drinking water. The ground water is used primarily for domestic purposes and livestock, but some irrigation development has occurred in areas where the water supply is more abundant. Some public supplies are obtained from the shallow aquifers in the area. Many private wells have high levels of nitrate plus nitrite. Most of this contamination occurs because the wells are located downslope from septic tank absorption fields, feedlots, barnyards, or fertilizer storage areas.

MLRA 102B Water Use by Category



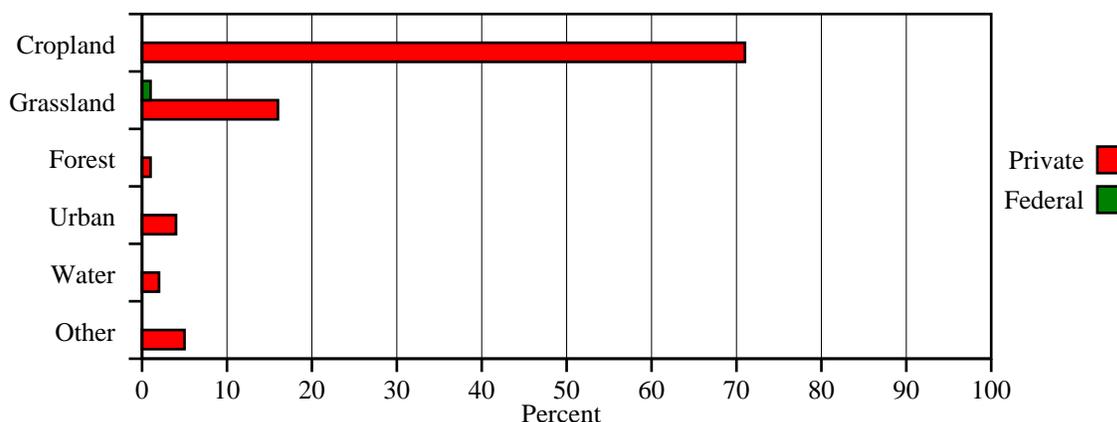
Category (Surface,Ground): Public Supply (2.0, 19.1), LiveStock (1.6, 2.8),

Land Use

Most of this area is in farms, and about 70 percent is cropland used for crops grown for sale or for feeding livestock. Corn, soybeans, alfalfa, and oats are the principal crops. Wooded areas generally occur as narrow bands along streams and rivers or as shelterbelts around farmsteads. Irrigation systems are used on droughty soils in areas where water supplies are available. Urban development is expanding around some of the larger towns.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, wetness, and management of soil moisture. Conservation practices on cropland generally include systems of crop residue management, especially no-till or conservation tillage systems that conserve moisture and contribute to soil quality. Other practices include terraces, vegetative wind barriers, grassed waterways, and nutrient management.

MLRA 102B Land Use by Category



Category (Private,Federal): Cropland (71.0, 0.0), Grassland (16.0, 1.0), Forest (1.0, 0.0), Urban (4.0, 0.0), Water (2.0, 0.0), Other (5.0, 0.0)

MLRA 102C - Loess Uplands

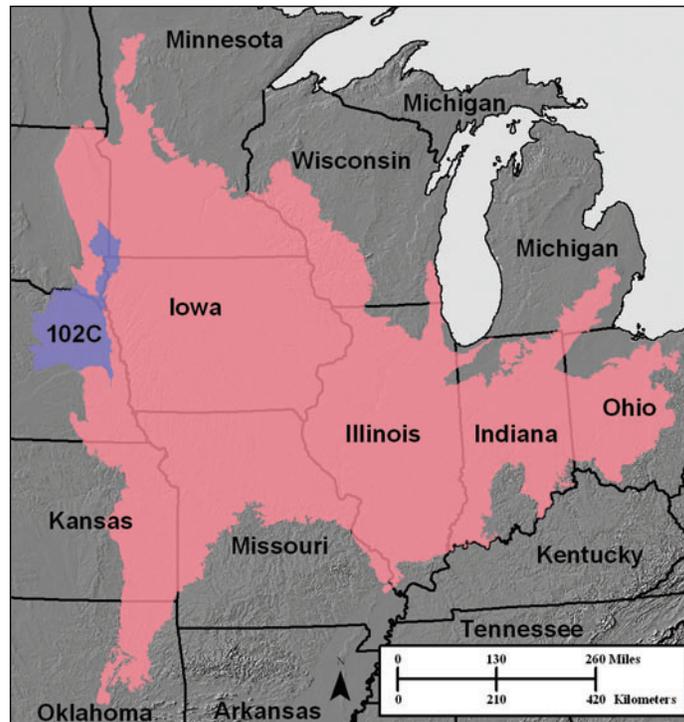


Figure 102C-1: Location of MLRA 102C in Land Resource Region M

Introduction

This area (shown in fig. 102C-1) is in Nebraska (77 percent), South Dakota (13 percent), Iowa (6 percent), and Minnesota (4 percent). It makes up about 11,445 square miles (29,655 square kilometers). It includes the towns or cities of Albion, Bloomfield, Hartington, Wayne, Norfolk, West Point, Columbus, and Fremont, Nebraska; Yankton, Sioux Falls, and Vermillion, South Dakota; Canton, Iowa; and Luverne, Minnesota. Interstates 29 and 90 cross parts of this MLRA. Parts of the Santee, Winnebago, and Omaha Indian Reservations are in this area.

Physiography

Most of this area is in the Dissected Till Plains Section of the Central Lowland Province of the Interior Plains. The southwestern third is in the High Plains Section of the Great Plains Province of the Interior Plains. This MLRA has broad, undulating to rolling ridgetops and hilly to steep valley sides. The valleys are generally narrow, but broad flood plains and terraces are along the major rivers and the large tributaries. Elevation ranges from 1,100 to 2,000 feet (335 to 610 meters), increasing from southeast to northwest. Local relief is commonly 5 to 30 feet (2 to 9 meters).

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Elkhorn (1022), 44 percent; Missouri-Big Sioux (1017), 36 percent; Loup (1021), 9 percent; Platte (1020), 8 percent; Missouri-Little Sioux (1023), 2 percent; and Niobrara (1015), 1 percent. The Big Sioux River forms the boundary between Iowa and South Dakota and joins the Missouri River in this area. The Missouri River is designated as a National Wild and Scenic River near Vermillion, South Dakota. The Elkhorn River, a major tributary to the Platte River in Nebraska, occurs in this area.

Geology

Loess covers most of this area. It consists of pale brown or light grayish brown, calcareous, silty material deposited by the wind. The loess is mainly of Peorian age. It ranges from 6 to 70 feet (2 to 20 meters) in thickness. Deposits of glacial till underlie the loess in most of the area. The till is more than 200 feet thick (60 meters) in some areas. Where no glacial deposits occur, bedrock generally is at or near the surface, except in areas where deposits of Pleistocene sand and gravel fill the principal stream valleys. The glacial till is underlain by deposits of Pleistocene sand and gravel in some buried bedrock valleys. It rests directly on bedrock, however, throughout much of the area. The Dakota Sandstone, a bedrock formation of Cretaceous age, underlies all but the southeastern part of the area, where rocks of Pennsylvanian age are at or near the surface. The Dakota Sandstone is exposed in many areas along the eastern boundary of the area for a distance of 50 miles south from the town of Ponca. Westward from a north-south line through Ponca, however, it is progressively more deeply buried.

Climate

The average annual precipitation in this area is 23 to 30 inches (585 to 760 millimeters). Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The maximum precipitation occurs from the middle of spring to early in autumn. Precipitation in winter occurs as snow. The annual snowfall ranges from about 24 inches (60 centimeters) in the southern part of the area to 34 inches (85 centimeters) in the northern part. The average annual temperature is 43 to 51 degrees F (6 to 11 degrees C). The freeze-free period averages about 170 days and ranges from 150 to 190 days, increasing in length from northwest to southeast.

Water

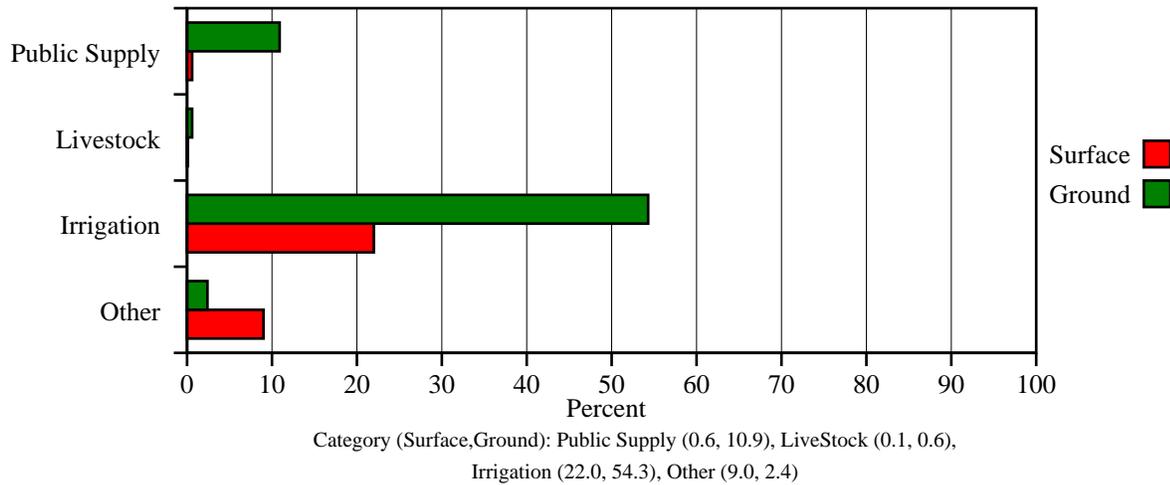
The total withdrawals average 1,135 million gallons per day (4,295 million liters per day). About 68 percent is from ground water sources, and 32 percent is from surface water sources. Precipitation is the principal source of moisture for crops. In some years it is inadequate for maximum crop production. The water in the Missouri River is of very good quality and is suitable for most uses with minimal treatment. Sediment, nutrients, and pesticides from agricultural activities impair the other major rivers in this area, but the surface water is still used for livestock, irrigation, public supply, and industry in parts of the area.

Ground water is obtained from shallow alluvial and glacial meltwater deposits of unconsolidated sand and gravel throughout most of this area. The water in these shallow aquifers has a median level of total dissolved solids of 350 to 390 parts per million (milligrams per liter) in the part of this area in Nebraska and 690 parts per million (milligrams per liter) in the part in South Dakota. It is typically a calcium-magnesium-bicarbonate type of water that is very hard. The glacial till is a poor source of ground water; yields to wells are small to negligible, and the water is commonly highly mineralized. Locally thick deposits of Pleistocene sand and gravel yield moderate or moderately large supplies of good-quality water to wells. The ground water in this MLRA is used for domestic purposes, livestock, irrigation, public supply, and industry.

The Cretaceous-age Dakota Sandstone is at a shallow or moderate depth in the eastern part of this area. It is tapped by many domestic and livestock wells. Not very many irrigation wells tap this aquifer, but a number of communities in eastern Nebraska obtain their public supplies from it. Locally, the Dakota Sandstone has beds of gravel at its base. Moderately large yields can be obtained from these beds. Water quality varies in this bedrock aquifer, depending on whether the aquifer is being recharged locally, whether it has been leached of salts, and whether the residence time of the water within the aquifer has been long. Calcium is the principal cation in the ground water where the Dakota Sandstone is being recharged locally or where it has been leached. Sodium is the dominant cation in the water of poorer quality where no local recharge occurs, the salts in the aquifer have not been leached, or the water has been in the aquifer for a long time. The water from

the Dakota Sandstone is very hard. Other bedrock formations in the area are generally poor sources of water.

MLRA 102C Water Use by Category

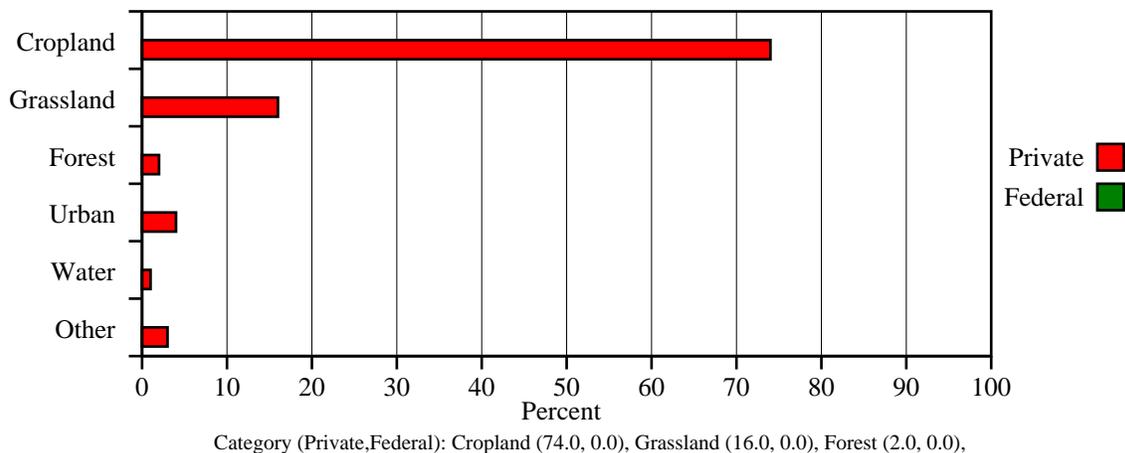


Land Use

Nearly all of this area is farmed. More than 70 percent of the area is cropland used mainly for corn and soybeans. Feed grains and hay crops also are widely grown. About 20 percent of the area is irrigated. Corn, alfalfa, small grains, and grass hay are grown extensively in the irrigated areas. The areas consisting of hilly and steep slopes bordering the drainageways support native grasses and shrubs used for grazing.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and tilth of the soils, and soil moisture management. Soils that formed in Peorian Loess are highly susceptible to water erosion. Pasture and rangeland are subject to wind erosion and water erosion when the plant cover is depleted by overgrazing. Conservation practices on cropland generally include high-residue crops in the cropping system, systems of crop residue management (such as no-till and mulch-till systems), level terraces, contour farming, contour stripcropping, irrigation water management, and nutrient management. Conservation practices on pasture and rangeland generally include fences and proper grazing management.

MLRA 102C Land Use by Category



Urban (4.0, 0.0), Water (1.0, 0.0), Other (3.0, 0.0)