## Summary Table: Characteristics of Ecoregions of North Dakota and South Dakota

Level IV Ecoregio	n	Physiography	Geology		Soil			Climate		Potential Natural Vegetation	Land Use and Land Cover
	Area (square miles)		Elevation / Surficial Material and Bedrock (feet)	Order (Great Groups)	Common Soil Series	Temperature / Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max, (°F)		
17a. Black Hills Foothills	900	Unglaciated. A ring of foothills surrounding the Black Hills' mountainous core. The Dakota Hogback separates the foothills from the plains. The Red Valley (Racetrack) inside the Hogback encircles the Black Hills dome.	3300-4900 Mesozoic sandstone and shale. The Hogback is composed of Lakota Sandstone, Fall River Sandstone, Fuson Shale, and Minnewasta Limestone. The Red Valley is composed of the Spearfish Formation, a red sandy shale.	Entisols (Torriorthents), Mollisols (Argiustolls, Haplustolls)	Butche, Canyon, Enning, Nevee, Spearfish, Grummit, Tilford, Vale, Rekop	Mesic/ Ustic	15-17	110-140	10/36; 57/86	Ponderosa pine woodlands with grass understory of little bluestem, grama grasses, and leadplant. Some burr oak in the north and Rocky Mountain juniper in the south.	Cattle grazing, ranching. Suburban development in the eastern Black Hills. Ponderosa pine savannah.
17b. Black Hills Plateau	1507	Unglaciated. Plateau topography with broad ridges, entrenched canyons. In metamorphic areas, highly dissected, tilted rock faces, steep canyon slopes. In limestone areas caves, springs, consistent yearly streamflow.	3500-5500 Paleozoic limestone of the Englewood Formation, Devonian Period, and Madison of the Mississippian Period. Sandstone and dolomite shales of Deadwood, Whitewood and Minnelusa formations. Lower elevation metamorphic and granite outcrops.	Alfisols (Eutroboralfs), Mollisols (Haploboralls), Inceptisols (Eutrochrepts)	Citadel, Vanocker, Grizzly Buska, Pactola, Mocmont, Paunsaugunt, rock outcrop	Frigid/ Ustic, Udic	16-18	40-100	6/34; 56/83	Ponderosa pine forest dominant. Aspen, paper birch, some spruce in drainages and wet meadows. Understory little bluestem, buffaloberry, chokecherry, snowberry.	Grazing and farming, recreation, hunting, some timber production, woodland grazing. Ponderosa pine forest with farms and ranches in valley bottoms and prairie openings.
17c. Black Hills Core Highlands	688	Mountainous topography with highly eroded outcrops and broad valleys. Limestone plateau above 5500 feet. Granitic intrusions form the major peaks including Bear Mountain, Terry Peak, Custer Peak, and Harney Peak, the highest point in South Dakota at 7242 feet.	5500-7242   Precambrian igneous and sedimentary rock and metamorphic schist, slates, quartzite; granite and pegmatite. Higher elevation limestones.	Alfisols (Cryoboralfs, Eutroboralfs)	Stovho, Trebor, Virkula, Mocmont, rock outcrop, Pactola, Buska	Frigid, Cryic/ Udic	19-24	30-80	5/33; 55/80	Mostly ponderosa pine with white spruce, paper birch and aspen on north facing slopes, moist areas, and higher elevations. Understory: sedges, bearded wheatgrass, juniper, snowberry, Oregon grape, bearberry.	Mining in the metamorphic areas. Recreation, hunting, timber production, woodland grazing. Pine and spruce forests, high meadows and granitic rock outcrops.

25. Level IV Ecoregion	WESTERN HIGH PL Physiography	AIN	S Geology		Soil			Climate		Potential Natural Vegetation	Land Use and Land Cover
	Area (square miles)	Elevation / Local Relief (feet)	Surficial Material and Bedrock	Order (Great Groups)	Common Soil Series	Temperature / Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max, (°F)	ğ	
25a. Pine Ridge Escarpment	965 Unglaciated. Alternating ridges and valleys with entrenched channels. Elevations increasing from northeast to southwest. Rock outcrops.	3000-3700 / 50-700	Miocene sandstone (Arikaree Formation).	Entisols (Torriorthents), Mollisols (Argiustolls, Haplustolls)	Ogallala, Canyon, Kadoka, Epping, Rock outcrops	Mesic/ Ustic	16-17	120-140	58/91	Ponderosa pine savannah with eastern redcedar, western snowberry, skunkbush sumac, chokecherry, and rose. Grassland: little bluestem, western wheatgrass, green needlegrass, prairie sandreed.	crops, and some timber cutting. Pine savannah.

Level IV Ecoregion	1	Physiography		Geology		Soil			Climate		Potential Natural Vegetation	Land Use and Land Cover
	Area (square miles)		Elevation / Local Relief (feet)	Surficial Material and Bedrock	Order (Great Groups)	Common Soil Series	Temperature / Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max, (°F)		
42a. Missouri Coteau		Glaciated. Hummocky, rolling stagnation moraine. Stream drainage absent or uncommon. Numerous pothole wetlands between mounds of glacial till.	/	Thick glacial till over Tertiary sandstone and shale in the north and Cretaceous Pierre Shale in the south.	Mollisols (Haploborolls, Argiaquolls, Argiborolls, Calciborolls)	Barnes, Buse, Parnell, Svea Williams, Bowbells, Zahl	Frigid/ Udic, Ustic	15-19	110-130	-3/16; 57/84	Western wheatgrass, bluestem, needleandthread, green needlegrass. Prairie cordgrass, northern reedgrass near wetlands.	Cattle grazing on steeper land mixed with tilled agriculture of hay and spring wheat. Native prairie remaining on unbroken rangeland. Wetlands provide wildlife habitat.
42b. Collapsed Glacial Outwash	1771	Glaciated. Irregular plains left by glacial outwash deposited over stagnant ice. Broad, shallow, brackish wetlands and lakes.	1650-2100 / 30-120	Late Wisconsinan glacial outwash deposits over Tertiary sandstone and shale and Cretaceous Pierre Shale.	Mollisols (Natraquolls, Haploborolls, Calciaquolls, Haplaquolls, Argiaquolls)	Ruso, Bowdle, Lehr, Wabek, Telfer, Lihen, Sioux, Parshall, Arvilla, Southam, Divide, Harriet	Frigid/ Udic, Ustic	15-19	110-130	-2/20; 59/86	Needleandthread, plains muhly, prairie junegrass, blue grama. Saltgrass in alkaline areas.	Small grains, sunflowers, alfalfa, and corn on deeper soils. Grazing land on shallow soils over gravel. Sand and gravel quarries. Wetlands provide wildlife habitat.
42c. Missouri Coteau Slope	5793	Glaciated. Level to gently rolling plain sloping to Missouri River. Sparse drainage pattern; few wetlands.	/	Wisconsinan glacial till over Tertiary sandstone and shale and Cretaceous Pierre Shale.	Mollisols (Haploborolls, Argiborolls, Argiaquolls, Calciborolls)	Williams, Max, Zahl, Bowbells, Parnell	Frigid/ Ustic	15-18	110-130	-2/20; 59/86	Western wheatgrass, needleandthread, prairie junegrass, green needlegrass.	Mainly tilled agriculture of spring wheat, barley, alfalfa, silage corn. Some grazing on steep and saline or wet areas.
42d. Northern Missouri Coteau	1697	Glaciated. Hummocky, rolling terrain. Stream drainage absent or uncommon. Numerous pothole wetlands.	2100-2350 / 10-250	Wisconsinan glacial till over Tertiary sandstone and shale.	Mollisols (Argiborolls, Haploborrolls, Argiaquolls)	Zahl, Williams, Parnell, Bowbells	Frigid/ Udic, Ustic	15-16	100-120	-6/14; 54/82	Western wheatgrass, green needlegrass, little bluestem, and needleandthread. Green ash and aspen on broken terrain.	Mainly cattle grazing and some haylands. Level areas are culivated.
42e. Southern Missouri Coteau	2382	Glaciated. Gently undulating topography. Scattered areas of high wetland density.	1500-2100 / 10-400	Wisconsinan glacial till over Cretaceous Pierre Shale.	Mollisols (Haplustolls, Natrustolls, Argiustolls, Calciborolls)	Eakin, Highmore, Java, Beadle, Dudley, DeGrey, Zahl	Mesic/ Ustic	19-21	130-150	4/28; 60/89	Western wheatgrass, green needle- grass, needleandthread, and porcupine grass. Prairie cordgrass and northern reedgrass in poorly drained areas.	Dominantly cropland. Corn, small grains, grain sorghum, and alfalfa.
42f. Southern Missouri Coteau Slope		Glaciated. Level to rolling uplands sloping westward to Missouri River. Simple stream drainage.	1400-2200 / 40-200	Wisconsinan glacial till and loess over Cretaceous Pierre Shale.	Mollisols (Argiustolls, Haplustolls)	Highmore, Mobridge, Houdek, Ethan	Mesic/ Ustic	19-21	130-150	9/30; 64/89	Western wheatgrass, green needle- grass, big bluestem and needleand- thread.	Dominantly cropland, corn, small grains, grain sorghum, and alfalfa.
42g. Ponca Plains	969	Unglaciated. Level to gently rolling plains. Preglacial stream drainage.	1900-2350 / 80-140	Miocene soft sandstone (Arikaree Formation) and Cretaceous Pierre Shale.	Mollisols (Argiustolls, Calciustolls)	Reliance, Anselmo, Holt, Jansen	Mesic/ Ustic	20-22	130-160	7/32; 60/89	Mixed-grass prairie: Little bluestem, prairie sandreed, green needlegrass and needleandthread.	Intensive rowcrop agriculture for soybeans, corn, sunflowers, and alfalfa. Some grazing on Anselmo and Holt Soils.
42h. Southern River Breaks		Lightly glaciated. Dissected hills and canyons with slopes of high relief bordering major rivers and associated alluvial plains.	1250-2000 / 250-700	Cretaceous Pierre Shale.	Mollisols (Argiustolls) Entisols (Ustorthents)	Tuthill, Sansarc, Okaton, Manter	Mesic/ Ustic	20-22	135-160	7/32; 60/89	Deciduous woodland: cottonwood, green ash, peachleaf willow, boxelder, eastern redcedar, buffaloberry, sumac. Grassland: western wheatgrass, little bluestem, sideoats grama.	
42i. Glaciated Dark Brown Prairie		Glaciated. Level to gently rolling plain sloping to Missouri River. Established drainage pattern. Lack of wetlands.	1950-3000 / 50-200	Glacial till over Tertiary sandstone and shale.	Mollisolls (Argiborolls, Haploborolls)	Williams, Bowbells, Zahl	Frigid/ Udic, Ustic	14-16	110-130	-5/15; 54/82	Western wheatgrass, needleandthread, green needlegrass and blue grama. Little bluestem on thin soils. Some sage on droughty soils.	Tilled mainly for durum or spring wheat and other small grains. Some irrigation near the Missouri River.

Level IV Ecoregio	n Physiography		Geology		Soil			Climate		Potential Natural Vegetation	Land Use and Land Cover
	Area (square miles)	Elevation / Local Relief (feet)	Surficial Material and Bedrock	Order (Great Groups)	Common Soil Series	Temperature / Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max, (°F)		
43a. Missouri Plateau	20000 Unglaciated. Moderately dissected level to rolling plains with isolated sandstone buttes.	50-500	Tertiary sandstone, shale and some coal. In South Dakota, Ludlow, Fox Hills, and Fort Union Formations; in North Dakota, Ludlow, Cannonball, Slope, Bullion Creek, and Sentinel Butte Formations.	Mollisols (Haploborolls, Calciborolls, Argiborolls, Natriborolls), Entisols (Ustorthents, Ustipsamments)	Vebar, Chama, Amor, Williams, Rhoades, Belfield, Cabba, Flasher, Reeder, Regent, Parshall, Golva, Zahl	Frigid/ Ustic	15-17	95-130	-3/21; 55/83	Blue grama, wheatgrass/needlegrass association, little bluestem, prairie sandreed.	Dryland farming and cattle grazing. Spring wheat a predominant crop with acreage of barley, oats, and sunflowers Native areas consist of mixed grasses.
43b. Little Missouri Badlands	Unglaciated. Highly dissected erosional landscape of conical hills. Mass wasting and slumping widespread. Most streams ephemeral. Flowing streams carry heavy sediment loads.	1	Paleocene sediments of the Bullion Creek and Sentinel Butte Formations.	Entisols (Ustorthents, Ustifluvents, Ustipsamments), Mollisols (Haploborolls)	Cabbart, Fleak, Zeona, Boxwell, Dogtooth Maltese, Patent, Havre, Glendive, Wolfpoint	Frigid/ Ustic (Aridic inter-grade)	14-16	110-120	1/24; 56/85	Shortgrass prairie: western wheat- grass, blue grama, little bluestem, prairie sandreed. Rocky Mountain juniper in draws and on north slopes. Scattered cottonwood in riparian areas.	Cattle ranching, wildlife habitat and recreation. Bare hills with scattered junipers; grasslands in bottomlands.
43c. River Breaks	10517 Unglaciated. Highly dissected hills and uplands bordering major rivers and associated alluvial plains.	200-500	In North Dakota, Tertiary sandstone and shale (Fort Union Formation). In South Dakota, Cretaceous Pierre Shale, on the west side of the Missouri River, on the east side of the Missouri River, breaks eroded through glacial till to Tertiary and Cretaceous foundation.	Mollisols (Calciborolls, Haploborolls), Entisols (Ustorthents, Ustipsam- ments, Fluvaquents), Aridisols (Natrargids), Vertisols (Haplusterts), Inceptisols (Ustochrepts)	Sansarc, Opal, Bullock, Cabba, Amor, Flasher, Vebar, Temvik, Mandan, Cherry, Chama, Zahl, Lallie, McKeen	Frigid (north), Mesic (south of Moreau River)/Ustic	16-18	80-125 (north); 100-130 (south)	-3/21; 56/87 (north) 3/27; 60/91 (south)	Blue grama, western wheatgrass, buffalograss, and some bluestem. Juniper and deciduous trees on northfacing slopes. Cottonwood gallery forests on the floodplain.	Steep slopes restrict landuse to cattle grazing. Land cover is mostly rangeland and native grasses. Remnant woodlands in draws and on existing (unimpounded) alluvial flats.
43d. Forested Buttes	232 Unglaciated. Prominent buttes with steep vertical sides. Source of springs and drainage headwaters.	1	Sandstone with concretions and local quartzite (Arikaree Formation).	Entisols (Ustorthents), Alfisols (Eutroboralfs)	Cabba, Cabbart, Reva, Rockoa, Cohagen, rock outcrop	Frigid/ Ustic	13-14	90-120	3/26; 55/86	Ponderosa pine, Rocky Mountain juniper, snowberry. Green ash in drainages. Little bluestem dominates the grasslands.	Logging, grazing on National Forest land.
43e. Sagebrush Steppe	2457 Unglaciated. Level to rolling plains with occasional buttes, badland formations, scoria (burnt coal) mounds and salt pans.	3000-3475 / 50-350	Upper Cretaceous sandstone and shale (Hell Creek Formation and Pierre shale).	Aridisols (Natrargids), Inceptisols (Ustochrepts), Entisols (Ustipsamments, Ustorthents), Mollisols (Natriborolls, Haploborolls)	Archin, Parchin, Twilight, Zeona, Bullock, Cabbart, Boxwell, Rhoades, Patent Maltese, Rhame, Dilts	Frigid/ Ustic (Aridic inter-grade)	13-14	90-120	3/26; 55/86		Cattle grazing and wildlife habitat. Grassland and shrub cover.
43f. Subhumid Pierre Shale Plains	7544 Unglaciated. Undulating plain. Steep-sided, incised stream channels.	1700-2800 / 50-500	Cretaceous Pierre shale.	Mollisols (Argiustolls, Haplustolls), Inceptisols (Ustochrepts), Entisols (Ustorthents, Torriorthents), Vertisols (Haplusterts)	Millboro, Lakoma, Opal, Promise, Sansarc, Midway, Ottumwa	Mesic/ Ustic	15-17	110-135	4/29; 60/91	Wheatgrass, grama grass, needlegrass, porcupine grass, needleandthread.	Cattle grazing, dryland farming. Winter wheat, alfalfa and sorghum.
43g. Semiarid Pierre Shale Plains	3853 Unglaciated. Undulating to rolling plains. Steep-sided, incised stream channels.	2500-3700 / 100-300	Cretaceous Pierre shale.	Aridisols (Camborthids), Mollisols (Argiustolls), Entisols (Torriorthents)	Pierre, Samsil, Lismas, Satanta, Nunn	Mesic/ Aridic, Ustic	14-15	125-140	6/29; 57/87	Shortgrass prairie grasses such as western wheatgrass, green needlegrass, blue grama and buffalograss.	Cattle grazing, rangeland. Dryland farming of winter wheat and alfalfa.
43h. White River Badlands	1913 Unglaciated. Highly dissected landscape of eroded walls and escarpments, isolated tablelands and buttes. Dense, dendritic drainage pattern; ephemeral streams highly erosive.	/	Oligocene Brule and Chadron claystone formations (White River Group) over Cretaceous Pierre Shale.	Aridisols (Camborthids), Entisols (Torriorthents), Inceptisols (Ustochrepts)	Conata, Epping, Imlay, Orella, Bufton	Mesic/ Ustic, Aridic	16-17	120-140	9/35; 60/91	Sand sagebrush, silver sagebrush, western wheatgrass, grama grass and buffalograss.	Cattle grazing. Range and hayland.
43i. Keya Paha Tablelands	3451 Unglaciated. Level to rolling, sandy plains. Dissected near streams.	/	Eolian and alluvial sand and silt over Miocene soft sandstone (Ogallala Formation).	Mollisols (Argiustolls, Haplustolls), Entisols (Torriorthents)	Anselmo, Kadoka, Keith, Manter, Rosebud, Epping, Keota, Ronson, Vetal	Mesic/ Ustic	16-20	120-140	9/34; 59/89	Blue grama, sideoats grama, western wheatgrass, little bluestem, and needleandthread.	Cattle ranching predominates north wit some dryland farming for alfalfa and winter wheat. Corn and sugar beets in irrigated areas south. Mixed prairie range with cropland.
43j. Moreau Prairie	4138 Unglaciated. Level to rolling plains with occasional buttes, badland formations, and salt pans.	2100-3200 / 120-250	Upper Cretaceous sandstone and shale (Hell Creek Formation).	Aridisols (Natrargids), Alfisols (Natrustalfs), Mollisols (Natriborolls, Argiborolls, Haploborolls), Inceptisols (Ustochrepts)	Bullock, Parchin, Absher, Rhoades, Sorum, Reeder, Amor, Ekalaka, Janesburg, Moreau, Twilight	Frigid, Mesic/ Ustic, Aridic	14-16	115-130	6/30; 58/87	Mixed prairie of western wheatgrass, green needlegrass, blue grama and buffalograss.	Mostly cattle and sheep ranching. Occasional dryland farming of wheat and alfalfa.
43k. Dense Clay Prairie	1378 Unglaciated. Rolling prairie. Intermittent streams in shallow valleys.	2700-3500 / 150-450	Cretaceous Pierre shale.	Vertisols (Haplusterts, Torrerts), Aridisols (Natrargids), Entisols (Torriorthents)	Kyle, Pierre, Winler, Swanboy, Hisle, Lismas	Mesic/ Ustic, Aridic	13-15	120-130	6/30; 58/87	Western wheatgrass with no shortgrass understory.	Sheep and cattle ranching. Fragile grassland cover.

Level IV Ecoreg	ion	Physiography		Geology		Soil			Climate		Potential Natural Vegetation	Land Use and Land Cover
	Area (square miles)		Elevation / Local Relief (feet)	Surficial Material and Bedrock	Order (Great Groups)	Common Soil Series	Temperature / Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max, (°F)	G	
14a. Nebraska Sand Hills		Sand sheets and extensive fields of barchanoid, parabolic, and domal sand dunes. High water table, interdune wetlands.		and over Miocene soft sandstone	Entisols (Ustipsamments)	Valentine	Mesic/ Ustic	16-17	140-150	58/91	Sand associated grasses: Sand bluestem, little bluestem, prairie sandreed. Big bluestem and switchgrass in wetter interdune areas.	Cattle ranching, some hayland. Grassland cover.

Level IV Ecoregion	1	Physiography		Geology		Soil			Climate		Potential Natural	Land Use and Land Cover
	Area (square miles)		Elevation / Local Relief (feet)	Surficial Material and Bedrock	Order (Great Groups)	Common Soil Series	Temperature / Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max, (°F)	Vegetation	
46a. Pembina Escarpment		Glaciated. Steep, dissected escarpment. High gradient perennial streams.	` ′	Glacial till over Tertiary sandstone and shale.	Mollisols (Haploborolls, Argiborolls, Calciborolls), Alfisols (Eutroboralfs)	Rollette, Olga, Kloten, Waukon, Kelvin, Buse, Walsh, Edgeley	Frigid/ Udic	18-20	95-125	-10/10; 53/80	Burr oak dominant; some aspen and paper birch. Understory plants: beaked hazel, highbush cranberry (pembina), service berry, red osier dogwood.	On steep slopes, woodland retained f woodland grazing and wildlife habita In flatter areas, cleared areas used for small grain, sunflowers and flax.
46b. Turtle Mountains	409	Glaciated. Platform of hummocky, rolling terrain above surrounding drift plains. Stream network lacking. High concentration of large lakes and wetlands.	2000-2550 / 40-180	Glacial till over Tertiary sandstone and shale.	Mollisols (Haploborolls, Argiborolls, Calciborolls), Alfisols (Eutroboralfs)	Bottineau, Buse, Rolla, Kelvin, Metigoshe	Frigid/ Udic	16-22	95-120	-10/10; 53/80	Burr oak dominant on side slopes, aspen on top. Other species present: green ash, paper birch, boxelder, sumac, serviceberry, snowberry.	Native woodland and pasture clearing Some hay and small grains on gentler soils.
46c. Glacial Lake Basins		Glaciated. Very level glacial lake floors. Low wetland density.	1300-1585	Glacial lake deposits	Mollisols (Calciaquolls, Endoaquolls, Haploborolls, Natriborolls)	Hegne, Fargo, Bearden, Overly, Embden, Gardena, Glyndon, Great Bend, Aberdeen	Frigid/ Udic	16-19 (north) 20-22 (south)	95-120 (north) 120-140 (south)	-10/10; 54/80 (north) 1/21; 60/85 (south)	Western wheatgrass, needleandthread, blue grama, green needlegrass.	Extensively tilled for durum and spri wheat, sunflowers, and flax. Corn and soybeans south.
l6d. Glacial Lake Deltas	1877	Glaciated. Flat sheets of sand and gravel or rolling sand dunes. Paucity of stream channels.	1290-1595 . / 6-85	Sand and gravel deposited over glacial lake floor	Mollisols (Haploborolls, Calciaquolls, Endoaquolls), Entisols (Udipsamments, Psammaquents)	Hecla, Ulen, Arvilla, Sioux, Serden, Rosewood, Lohnes, Bantry, Hamar	Frigid/ Udic	16-19 (north) 19-21 (south)	95-120 (north) 120-140 (south)	-10/10; 54/80 (north) 4/19; 58/85 (south)	Prairie sandreed, little bluestem, indiangrass, switchgrass, sand bluestem.	Droughty soils mostly used for native pasture. When tilled, used for small grains, flax and fall-planted rye (nort or small grains, sunflowers, and corn (south). Some irrigation.
16e. Tewaukon Dead Ice Moraine		Glaciated. Lower elevation extension of Prairie Coteau. Closely spaced hummocks, high wetland density.	1100-1380 / 5-75	Wisconsinan glacial till over Cretaceous Pierre Shale	Mollisols (Argiborolls, Haploborolls, Argiaquolls, Calciborolls)	Forman, Aastad, Buse, Parnell	Frigid/ Udic	19-21	120-140	-2/19; 58/85	Western wheatgrass, green needle- grass, blue grama, needleandthread, sideoats grama.	Mostly used for small grains and hay Wetlands provide wildlife habitat.
46f. End Moraine Complex		Glaciated. A diverse area of hummocky stagnation moraine, parallel end moraine ridges, and other glacial features such as eskers, kames and thrust ridges.	1450-1790 / 20-170	Wisconsinan glacial till and outwash	Mollisols (Haploborolls, Argiborolls, Calciborolls, Calciaquolls)	Heimdal, Emrick, Esmond, Barnes, Buse, Bottineau, Aastad, Edgeley, Hamerly	Frigid/ Udic	18-20	90-120	-7/13; 55/82	Tallgrass/midgrass prairie: western wheatgrass, green needlegrass, big and little bluestem, blue grama. Forest vegetation of burr oak and aspen associated with Devils Lake.	Mixed range and cropland depending upon slope and presence of rocks in soil. Spring wheat, oats, barley, flax, and hay.
l6g. Northern Black Prairie		Glaciated. Generally flat, with occasional "washboard" undulations. High concentrations of temporary and seasonal wetlands. Simple drainage pattern.	1500-1970 / 5-200	Glacial till over Cretaceous Pierre Shale (check west) and Tertiary Ft. Union Formation.	Mollisols (Haploborolls, Natriborolls, Calciaquolls, Calciborolls, Argiaquolls)	Barnes, Svea, Cresbard, Hamerly, Buse, Parnell	Frigid/ Udic	16-20	95-120	-10/10; 54/80	Northern prairie: western wheatgrass, green needlegrass, little bluestem, blue grama, and rough fescue.	Extensively tilled to durum and sprin wheat, other small grains, sunflower and alfalfa.
46h. Northern Dark Brown Prairie		Glaciated. Generally flat, with occasional "washboard" undulations. High concentrations of temporary and seasonal wetlands. Simple drainage pattern.	1980-2220 / 8-100	Glacial till over Tertiary Ft. Union Formation.	Mollisols (Argiborolls, Natriborolls, Calciborolls, Argiaquolls)	Williams, Bowbells, Zahl, Noonan, Hamerly, Parnell	Frigid/ Ustic	15-16	100-120	-6/14; 54/82	Western wheatgrass, green needlegrass, little bluestem and needleandthread. Aspen and green ash in drainages.	Extensively tilled to durum and spring wheat, other small grains, sunflower alfalfa. Saline areas used for range of wildlife.
6i. Drift Plains		Glaciated. Generally flat, with occasional "washboard" undulations. High concentrations of temporary and seasonal wetlands. Simple drainage pattern.	1080-2000 / 0-200	Glacial till over Cretaceous Pierre Shale and Fox Hills Formations.	Mollisols (Haploborolls, Calciaquolls, Natriborolls, Calciborolls, Argiaquolls)	Barnes, Svea, Buse, Hamerly, Cresbard, Parnell	Frigid/ Udic	17-19	95-125	-5/16; 56/83	Western wheatgrass, big and little bluestem, switchgrass, and indiangrass.	Extensively tilled to spring wheat ar other small grains, sunflowers, and alfalfa.
6j. Glacial Outwash		Glaciated. Flat to slightly rolling. Ancient channel depressions, relict lakes.	1300-1550 / 0-50	Sand and plane-bedded gravel, sediments of glacial meltwater rivers	Mollisols (Haploborolls, Natraquolls), Entisols (Udipsamments)	Brantford, Claire, Totten, Renshaw, Arvilla, Fordville, Sioux	Frigid/ Udic	16-18	110-130	-6/14; 55/81	Little bluestem, needleandthread, blue grama, prairie junegrass. Elm, ash, burr oak in river bottoms.	Cattle grazing on droughtiest soils. Tillable land produces wheat, oats, barley, rye and alfalfa.
6k. Prairie Coteau		Glaciated. Platform of hummocky, rolling terrain raised above surrounding drift plains. Stream network lacking. High concentration of large lakes and wetlands.	1500-2010 / 50-150	Glacial till over Cretaceous Shales	Mollisols (Argiborolls, Haploborolls, Argiaquolls)	Forman, Aastad, Buse, Poinsett, Waubay, Parnell	Frigid/ Udic	20-22	110-140	1/21; 60/85	Big and little bluestem, switchgrass, indiangrass, blue grama; woodland surrounding wetlands in northeast section.	Rolling areas in pastureland. Flatter areas tilled for small grains, corn, an soybeans.
6l. Prairie Coteau Escarpment		Glaciated. Dissected topography along face of 300-600 ft. escarpment, incised by high gradient perennial streams.	1250-2000 / 250-600	Thin glacial till over Cretaceous limey shale (Niobrara Formation)	Mollisols (Argiborolls, Calciborolls)	Peever, Forman, Sieche, Buse	Frigid/ Udic	20-22	110-135		Burr oak, green ash, elm, aspen, basswood, chokecherry, sumac with openings of little bluestem, green needlegrass, western wheatgrass, and blue grama.	Steepest areas in native woodland, u for pasture. Flatter areas tilled for sn grains, corn, sunflowers, and alfalfa used for pasture.
6m. Big Sioux Basin	1539	Only lightly glaciated. Erosional, rather than depositional landscape. Rolling, with incised stream drainage network, few wetlands.	1625-1990 / 20-200	Glacial till over Cretaceous Pierre Shale	Mollisols (Haploborolls)	Brookings, Kranzburg, Vienna, Lismore	Frigid/ Udic	20-22	110-140	2/22; 60/85	Tallgrass prairie: big and little blue- stem, switchgrass, and indiangrass, sideoats grama, lead plant. Riparian vegetation: willows and cordgrass north; more hardwoods south.	Extensively tilled for small grains, c sunflowers, and soybeans.
6n. James River Lowland		Glaciated. Level to slightly rolling plain composed of glacial drift. Dense concentrations of temporary and seasonal wetlands.	1200-1850 / 10-150	Glacial till over Cretaceous Pierre Shale and sandstone of Niobrara Formation.	Mollisols (Argiustolls, Haplustolls, Natrustolls)	Beadle, Dudley, Hand, Bonilla, Houdek, Prosper	Mesic	18-20	115-140	1/22; 60/87	Western wheatgrass, green needlegrass, big bluestem, blue grama.	Extensively tilled for spring wheat, sunflowers, corn, and soybeans.
60. Minnesota River Prairie		Glaciated. Level to gently rolling plain. Moderate wetland density.	1050-1300 / 50-100	Glacial till over undivided Cretaceous sediments (Dakota Sandstone, Carlile and Pierre Shale).	Mollisols (Haploborolls), Entisols (Udorthents)	Heimdal, Svea, Sisseton	Frigid/ Udic	20-22	110-140	60/85	Big and little bluestem, green needlegrass, western wheatgrass, blue grama. Elm, boxelder, and green ash along river bottoms.	Extensively cultivated to small grai corn, soybeans, and alfalfa.

Level IV Ecoregion	evel IV Ecoregion Physiography		Geology	Soil				Climate		Potential Natural Vegetation	Land Use and Land Cover
	Area (square miles)		Elevation / Local Relief (feet) Surficial Material and Bedrock	Order (Great Groups)	Common Soil Series	Temperature / Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max, (°F)		
47a. Loess Prairies		Gently rolling in the northern section, more dissected in the southern section. Streams have a quartzite substrate providing diverse habitat for aquatic life.	1200-1700 Loess deposits over Cretaceous sandstone, shale (Niobrara Formation and Carlile Shale), and Sioux quartzite.	Mollisols (Haplustolls)	Moody, Nora, Trent	Mesic/ Udic	23-25	135-165	63/88	Tallgrass prairie: big and little bluestem, indiangrass, green needlegrass. In southern section on steeper slopes needleandthread and prairie dropseed, and deciduous woodland.	Intensive row crop agriculture (corn, soybeans, alfalfa, grain sorghum). Son terracing. Some urban development. Deciduous woodland in the southern section.
47d. Missouri Alluvial Plain		Level floodplain alluvium. Riparian wetlands largely drained.	1100-1200 Alluvial deposits over Cretaceous sandstone and shale (Carlile Shale and Dakota Sandstone).	Entisols (Fluvaquents, Udipsamments, Udifluvents), Mollisols (Haplaquolls, Endoaquolls)	Lamo, Luton, Albaton, Haynie, Sarpy	Mesic/ Udic	23-25	135-165		Northern floodplain forest of cottonwood, green ash, boxelder, and elm; shrubs and woody vines in the understory.	Intensively farmed for corn and soybeans. Transportation corridor.

Level IV Ecoregio	on	Physiography		Geology		Soil			Climate		Potential Natural Vegetation	Land Use and Land Cover
	Area (square miles)		Elevation / Local Relief (feet)	Surficial Material and Bedrock	Order (Great Groups)	Common Soil Series	Temperature / Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max, (°F)	, .g	
48a. Glacial Lake Agassiz Basin	5137	Extremely flat glacial lake plain. Streams and rivers sluggish, meandering, and highly turbid with large sediment loads. Ditching and channelization common.	790-1200 / 1-50	Thick beds of glacial drift, averaging 150-300 ft. overlain by up to 95 ft. of silt and clay lacustrine deposits from glacial Lake Agassiz. Bedrock geology: Cretaceous shales and sandstones, Ordovician and Precambrian basement rocks.	Mollisolls (Calciaquolls, Endoaquolls, Haploborolls, Natriaquolls)	Bearden, Hegne, Glyndon, Ulen, Fargo, Gardena, Embden, Ryan	Frigid/ Udic	18-21	95-125	-7/12; 56/82	Tallgrass prairie: big and little bluestem, switchgrass, and indiangrass. Cottonwood, willow, green ash, burr oak and American elm in riparian areas and on the Pembina Delta.	soybeans, corn, and wheat in the sou
48b. Sand Deltas and Beach Ridges	1616	Parallel ridges up to several miles wide composed of medium sand to medium gravel. Deltas comprised of lenses of fine to coarse sands. Thickest sand deposits windblown into dunes. Stream substrates, sand or gravel riffles, contrast with clay and silt-bottom streams elsewhere in Red River Valley.	40-250	Stratified sand and gravel beach and strand line deposits sorted from lacustrine silts. Sandy deltaic deposits.	Mollisols (Haploborolls, Calciaquolls, Endoaquolls), Entisols (Udipsamments, Psammaquents)	Embden, Inkster, Hamar, Wyndmere, Arvilla, Hecla, Searden, Renshaw, Vang, Arveson, Bantry	Frigid/ Udic	18-21	95-125	-7/12; 56/82	Tallgrass prairie with patches of oak savannah in delta areas.	Sunflowers, potatoes, small grains of beach ridges. Mainly grazing on del sands. Corn on sandy loams. Some irrigation.
48c. Saline Area	348	Glacial lake plain with saline ground water welling to the surface.	820-870 / 3-25	Silt and clay lacustrine deposits over Cretaceous shale and sandstone.	Mollisols (Calciaquolls)	Bearden, Antler, Ojata	Frigid/ Udic	18-21	95-125	-7/12; 56/82	Tallgrass prairie, salt tolerant western wheatgrass, saltgrass.	Grazing land on strongly saline soils Where salinity levels are moderate, sunflowers, barley, sugarbeets, and potatoes are grown. Brackish wetlan habitat.

MAJOR NORTH DAKOTA AND SOUTH DAKOTA SOURCES:

Agriculture Canada, 1992, Soil landscapes of Canada, Saskatchewan: Canada Soil Inventory, Centre for Land and Biological Resources Research, Ottawa, Ontario, Publication 5243/B, 55 p., 1 map, scale 1:1,000,000.

Agriculture Canada, 1989, Soil landscapes of Canada, Manitoba: Canada Soil Inventory, Centre for Land and Biological Resources Research, Ottawa, Ontario, Publication 5242/B, 22 p., 1 map, scale 1:1,000,000.

Bailey, R.M., and Allum, M.O., 1962, Fishes of South Dakota: Ann Arbor, Michigan, Museum of Zoology, University of Michigan, 131 p.

Baumberger, R., 1977, Rangeland resources of South Dakota: Society for Range Management, Old West Regional Range Program, 150 p.

Bleed, A., and Flowerday, C., eds., 1990, An atlas of the Sand Hills: Conservation and Survey Division, Institute of Agriculture and Natural Resources, Lincoln, Nebraska, University of Nebraska, Resource Atlas no. 5a, 265 p.

Bluemle, J.P., 1991, The face of North Dakota: Bismarck, ND, North Dakota Geological Survey, Educational Series 21, 177 p.

Clayton, L., and Freers, T.F., eds., 1967, Glacial geology of the Missouri Coteau and adjacent areas: Grand Forks, ND, North Dakota Geological Survey, Miscellaneous Series 30, 168 p.

Clayton, L., Moran, S.R., and Bluemle, J.P., 1980, Explanatory text to accompany the geologic map of North Dakota: Fargo, ND, North Dakota Geological Survey, Report of Investigation no. 69, 93 p.

Fenneman, N.M., 1931, Physiography of the western United States: New York, McGraw-Hill Book Co., 714 p.

Flint, R.F., 1955, Pleistocene geology of eastern South Dakota: Washington, D.C., U.S. Geological Survey, U.S. Government Printing Office, Professional Paper 262, 173 p.
Froiland, S.G., 1990, Natural history of the Black Hills and Badlands: Sioux Falls, South Dakota, The Center for Western Studies, 225 p.

Fullerton, D.S. (Ed.), 1995, Quaternary geologic map of the Dakotas quadrangle, United States, Compiled by Fullerton, D.S., Bluemle, J.P., Clayton, L., Steece, F.V., Tipton, M.J., Bretz, R., and Goebel, J.E., United States: U.S. Geological Survey, Miscellaneous Investigations Series, Map I-1420 (NL-14), scale 1:1,000,000.

Griffith, G.E., Omernik, J.M., Wilton, T.F., and Pierson, S.M., 1994, Ecoregions and subregions of Iowa: A framework for water quality assessment and management: Journal of the Iowa Academy of Sciences 101(1):5-13.

Hoffman, G.R., Alexander, R.R., 1987, Forest vegetation of the Black Hills National Forest of South Dakota and Wyoming: a habitat type classification: Fort Collins, CO, U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Res. Paper RM-276, 48 p.

Howard, A.D., 1960, Cenozoic history of northeastern Montana and northwestern North Dakota with emphasis on the Pleistocene: Washington, D.C., U.S. Geological Survey, U.S. Government Printing Office, Geological Survey Professional Paper 326, 107 p. with 5 folded maps in pocket.

Hunt, C.B., 1967, Natural regions of the United States and Canada: San Francisco, W.H. Freeman and Company, 725 p.

Kantrud, H.A., Krapu, G.L., Swanson, G.A., 1989, Prairie basin wetlands of the Dakotas: A community profile: U.S. Department of the Interior, Fish and Wildlife Service, Biological Report 85 (7.28). 116 p.

Kuchler, A.W., 1964, Potential natural vegetation of the conterminous United States: New York, American Geographical Society, Special Publication no. 36, 116 p., scale 1:3,168,000.

LeBlanc, A., Dudek, D.J., and Allegretti, L.F., 1991, Disappearing ducks: The effect of climate change on North Dakota's waterfowl: New York, New York, Environmental Defense Fund, 35 p.

Lemke, R.W., Laird, W.M., Tipton, M.J., and Lindvall, R.M, 1965, Quaternary geology of the northern Great Plains: In The Quaternary of the United States: Princeton, NJ, Princeton University Press, p. 15-27.

Richmond, G.M., ed., 1994, Quaternary geologic map of the Platte River quadrangle, United States, compiled by Swinehart, J.B., Dreeszen, V.H., Richmond, G.M., Tipton, M.J., Bretz, R., Steece, F.V., Hallberg, G.R., and Goebel, J.E.: U.S. Geological Survey, Miscellaneous Investigations Series, Map I-1420 (NK-14), scale 1:1,000,000.

Stewart, R.E., and Kantrud, H.A., 1973, Ecological distribution of breeding waterfowl populations in North Dakota: Journal of Wildlife Management v. 37, no. 1, p. 39-50.

Stoner, J.D., Lorenz, D.L., Wiche, G.J., and Goldstein, R.M., 1994, Red River of the North basin, Minnesota, North Dakota, and South Dakota: American Water Resources Association, Water Resources Bulletin, v. 29, no. 4, p. 575-613.

U.S. Department of Agriculture - Natural Resources Conservation Service (formerly the Soil Conservation Service), various county soil surveys of North and South Dakota.

U.S. Department of Agriculture - Soil Conservation Service, 1981, Land resource regions and major land resource areas of the United States: U.S. Department of Agriculture - Soil Conservation Service, Agriculture Handbook 296, 156 p. with folded map in pocket.

Weaver, J.E., Albertson, F.W., 1950, Grasslands of the Great Plains: Lincoln, Nebraska, Johnson Publishing Co., p. 318-326.

Willard, D.E., 1926, The story of the prairies or The landscape geology of North Dakota, State Agricultural College, Fargo, North Dakota, 371 p.