

## **Ecological site R052XN166MT Overflow (Ov) 10-14" p.z.**

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### **General information**

**Provisional.** A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

### **MLRA notes**

Major Land Resource Area (MLRA): 052X–Brown Glaciated Plains

The Brown Glaciated Plains, MLRA 52, is an expansive and agriculturally and ecologically significant area. It consists of around 14.5 million acres and stretches across 350 miles from east to west, encompassing portions of 15 counties in north-central Montana. This region represents the southwestern limit of the Laurentide Ice Sheet and is considered to be the driest and westernmost area within the vast network of glacially derived prairie pothole landforms of the northern Great Plains. Elevation ranges from 2,000 feet (610 meters) to 4,600 feet (1,400 meters).

Soils are primarily Mollisols, but Entisols, Inceptisols, Alfisols, and Vertisols are also common. Till from continental glaciation is the predominant parent material, but alluvium and bedrock are also common. Till deposits are typically less than 50 feet thick, and in some areas glacially deformed bedrock occurs at or near the soil surface (Soller, 2001). Underlying the till is sedimentary bedrock largely consisting of Cretaceous shale, sandstone, and mudstone (Vuke et al., 2007). It is commonly exposed on hillslopes, particularly along drainageways. Significant alluvial deposits occur along glacial outwash channels and major drainages, including portions of the Missouri, Teton, Marias, Milk, and Frenchman Rivers. Large glacial lakes, particularly in the western half of the MLRA, deposited clayey and silty lacustrine sediments (Fullerton et al., 2013).

Much of the western portion of this MLRA was glaciated towards the end of the Wisconsin age, and the maximum glacial extent occurred approximately 20,000 years ago (Fullerton et al., 2004). The result is a geologically young landscape that is predominantly a level till plain interspersed with lake plains and dominated by soils in the Mollisol and Vertisol orders. These soils are very productive and generally are well suited to dryland farming. Much of this area is aridic-ustic. Crop-fallow dryland wheat farming is the predominant land use. Areas of rangeland typically are on steep hillslopes along drainages.

The rangeland, much of which is native mixedgrass prairie, increases in abundance in the eastern half of the MLRA. The Wisconsin-age till in the north-central part of this area typically formed large disintegration moraines with steep slopes and numerous poorly drained potholes. A large portion of Wisconsin-age till occurring on the type of level terrain that would typically be optimal for farming has large amounts of less-suitable sodium-affected Natrustalfs. Significant portions of Blaine, Phillips, and Valley Counties were glaciated approximately 150,000 years ago during the Illinoian age. Due to erosion and dissection of the landscape, many of these areas have steeper slopes and more exposed bedrock than areas glaciated during the Wisconsin age (Fullerton and Colton, 1986).

While much of the rangeland in the aridic-ustic portion of MLRA 52 is classified as belonging to the “dry grassland” climatic zone, sites in portions of southern MLRA 52 may belong to the “dry shrubland” climatic zone. The dry shrubland zone represents the northernmost extent of the big sagebrush (*Artemisia tridentata*) steppe on the Great Plains. Because similar soils occur in both southern and northern portions of the MLRA, it is currently hypothesized that climate is the primary driving factor affecting big sagebrush distribution in this area. However the precise factors are not fully understood at this time.

Sizeable tracts of largely unbroken rangeland in the eastern half of the MLRA and adjacent southern Saskatchewan

are home to the Northern Montana population of greater sage-grouse (*Centrocercus urophasianus*), and large portions of this area are considered to be a Priority Area for Conservation (PAC) by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service, 2013). This population is unique among sage grouse populations because many individuals overwinter in the big sagebrush steppe (dry shrubland) in the southern portion of the MLRA and then migrate to the northern portion of the MLRA, which lacks big sagebrush (dry grassland), to live the rest of the year (Smith, 2013).

Areas of the till plain near the Bearpaw and Highwood Mountains as well as the Sweetgrass Hills and Rocky Mountain foothills are at higher elevations, receive higher amounts of precipitation, and have a typic-ustic moisture regime. These areas have significantly more rangeland production than the drier aridic-ustic portions of the MLRA and have enough moisture to produce crops annually rather than just bi-annually, as in the drier areas. Ecological sites in this higher precipitation area are classified as the moist grassland climatic zone.

## **Classification relationships**

### **NRCS Soil Geography Hierarchy**

- Land Resource Region: Northern Great Plains
- Major Land Resource Area (MLRA): 052 Brown Glaciated Plains
- Climate Zone: N/A

### **National Hierarchical Framework of Ecological Units (Cleland et al., 1997; McNab et al., 2007)**

- Domain: Dry
- Division: Temperate Steppe
- Province: Great Plains-Palouse Dry Steppe Province 331
- Section: Northwestern Glaciated Plains 331D
- Subsection: Montana Glaciated Plains 331Dh
- Landtype association/Landtype phase: N/A

### **National Vegetation Classification Standard (Federal Geographic Data Committee, 2008)**

- Class: Mesomorphic Shrub and Herb Vegetation Class (2)
- Subclass: Temperate and Boreal Grassland and Shrubland Subclass (2.B)
- Formation: Temperate Grassland, Meadow, and Shrubland Formation (2.B.2)
- Division: Great Plains Grassland and Shrubland Division (2.b.2.Nb)
- Macrogroup: *Hesperostipa comata* – *Pascopyrum smithii* – *Festuca hallii* Grassland Macrogroup (2.B.2.Nb.2)
- Group: *Pascopyrum smithii* – *Hesperostipa comata* – *Schizachyrium scoparium* – *Bouteloua* spp. Mixedgrass Prairie Group (2.B.2.Nb.2.c)
- Alliance: *Pascopyrum smithii* – *Nassella viridula* Northwestern Great Plains Herbaceous Alliance
- Association: *Pascopyrum smithii* - *Nassella viridula* Herbaceous Vegetation

### **EPA Ecoregions**

- Level 1: Great Plains (9)
- Level 2: West-Central Semi-Arid Prairies (9.3)
- Level 3: Northwestern Glaciated Plains (42)
- Level 4: North Central Brown Glaciated Plains (42o) & Glaciated Northern Grasslands (42j)

### **Montana Riparian and Wetland Sites (Hansen et. al, 1995)**

- *Artemisia cana*/*Agropyron smithii* Habitat Type

## **Ecological site concept**

Overflow is an extensive ecological site occurring throughout MLRA 52. It occurs on flood plains and stream terraces where flooding and surface runoff provide additional moisture for plant growth. Sometimes, but not always, a seasonal water table is present at a depth of more than 42 inches below the soil surface, especially during peak runoff periods.

The distinguishing characteristics of this site are that it is located on flood plains and that it receives additional moisture from surface water. Soils for this ecological site are typically very deep (more than 60 inches) and derived from alluvium. Soil textures in the upper 4 inches are typically loam, sandy loam, or clay loam. The soils typically

have an ochric epipedon and are commonly stratified (USDA-NRCS, 2016) due to deposition of sediment from multiple flood events. Characteristic vegetation is green needlegrass (*Nassella viridula*), western wheatgrass (*Pascopyrum smithii*), and silver sagebrush (*Artemisia cana*). In some cases, snowberry (*Symphoricarpos* spp.) also may occur on this site.

## Associated sites

R052XN163MT	<b>Sandy (Sy) 10-14" p.z.</b> Different landscape position, different species composition and soil texture.
R052XN168MT	<b>Silty-Steep (SiStp) 10-14" p.z.</b> Slopes >15%; less forage production; different species composition.
R052XN171MT	<b>Saline Overflow (SOv) 10-14" p.z.</b> Similar landscape position, receives additional run-in moisture from surrounding landscape; different species composition, saline or sodic affected, lower productivity.
R052XN178MT	<b>Shallow (Sw) 10-14" p.z.</b> Soil depth less than or equal to 20 inches to a restrictive layer; less forage production, different landscape position.
R052XN162MT	<b>Clayey (Cy) 10-14" p.z.</b> Different landscape position; different species composition and soil texture.

## Similar sites

R052XN169MT	<b>Subirrigated (Sb) 10-14" p.z.</b> Site not in floodplain, floods rarely, permanent water table at 24"-42", higher productivity.
R053AE072MT	<b>Saline Overflow (Sov) (Legacy) RRU 53AE</b> Increase in soil salinity; change in species composition and production.
R052XC209MT	<b>Saline Overflow (SOv) 10-14" p.z.</b> Increase in soil salinity; change in species composition and production.

**Table 1. Dominant plant species**

Tree	Not specified
Shrub	(1) <i>Prunus virginiana</i> (2) <i>Ribes aureum</i>
Herbaceous	(1) <i>Nassella viridula</i> (2) <i>Leymus cinereus</i>

## Physiographic features

This site usually occurs in swales, drainageways, low terraces and flood plains where it receives extra moisture from run-in from adjacent land. The site does not have a permanent water table within 42 inches of the soil surface. Slopes vary from 0-2% and occur on all exposures. Elevations generally range from 2,000 to 3,100 feet.

**Table 2. Representative physiographic features**

Runoff class	Negligible to low
Flooding duration	Very brief (4 to 48 hours) to long (7 to 30 days)
Flooding frequency	None to rare
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	2,000–3,100 ft
Slope	0–2%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding duration	Not specified
Flooding frequency	Not specified
Ponding duration	Not specified
Ponding frequency	Not specified
Elevation	1,875–3,100 ft
Slope	Not specified

Climatic features

A semi-arid, temperate climate characterizes the Glaciated Plains. The predominance of cool season species has evolved to take advantage of the precipitation regime that peaks in late spring-early summer (June). Seventy-five percent of the annual precipitation usually falls as steady, soaking, frontal system rains. Summer rains usually come with thunderstorms. Precipitation is the most important factor influencing production (Heitschmidt et al 2005). Severe drought occurs on average in two out of every ten years (Cooper, et al., 2001).

Table 4. Representative climatic features

Frost-free period (characteristic range)	85-123 days
Freeze-free period (characteristic range)	116-142 days
Precipitation total (characteristic range)	10-14 in
Frost-free period (average)	94 days
Freeze-free period (average)	125 days
Precipitation total (average)	12 in

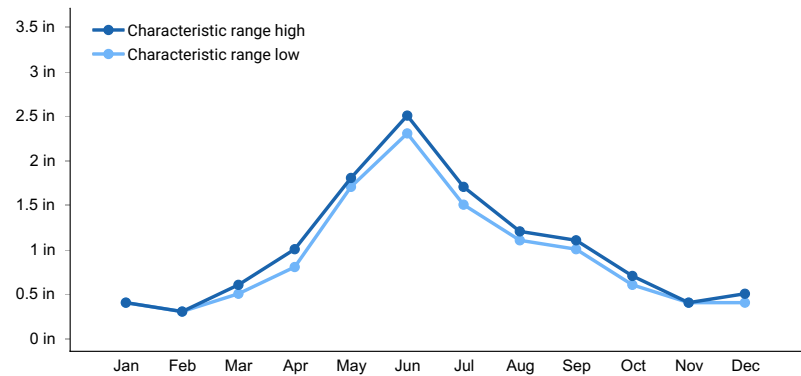


Figure 1. Monthly precipitation range

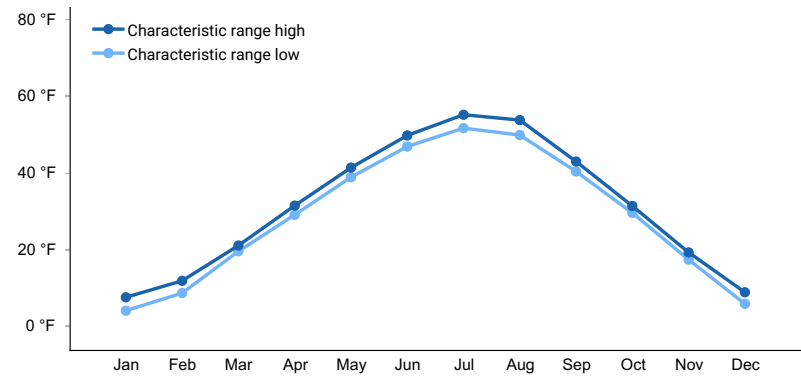
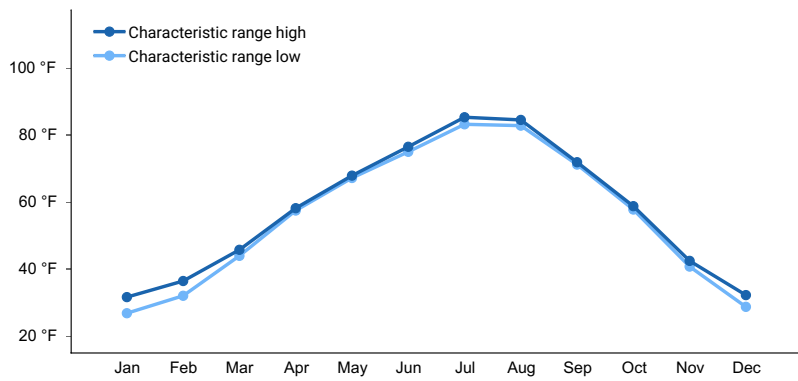
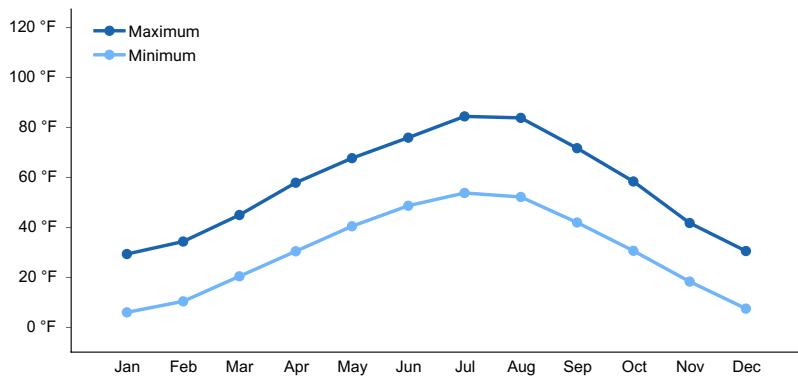


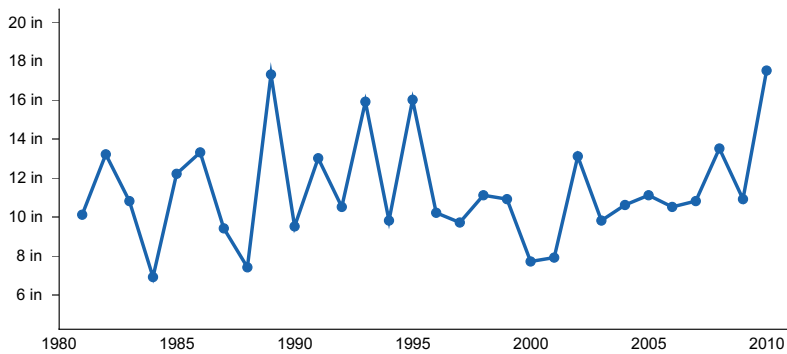
Figure 2. Monthly minimum temperature range



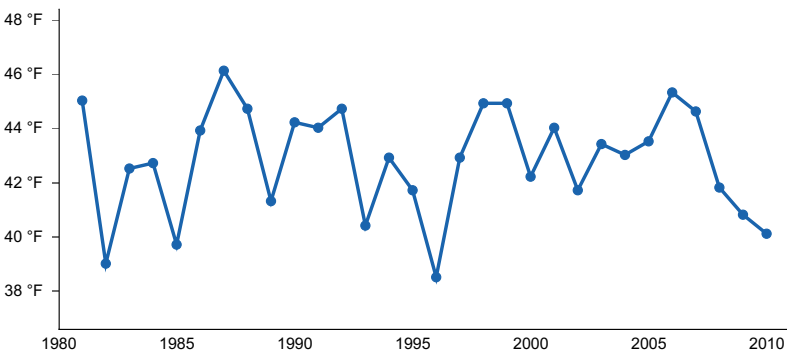
**Figure 3. Monthly maximum temperature range**



**Figure 4. Monthly average minimum and maximum temperature**



**Figure 5. Annual precipitation pattern**



**Figure 6. Annual average temperature pattern**

## Climate stations used

- (1) CHESTER [USC00241692], Chester, MT
- (2) GLASGOW [USW00094008], Glasgow, MT
- (3) HAVRE CITY CO AP [USW00094012], Havre, MT

- (4) SHELBY [USC00247500], Shelby, MT

## Influencing water features

The run-in moisture to this site occurs following rain or snowmelt. This site is not influenced by water from streams.

## Wetland description

This site is not influenced by water from wetlands.

## Soil features

Soils are well drained and more than 60 inches deep to bedrock. Permeability varies from moderate to very slow. The surface layer of these soils vary from 0-12 inches in depth and are typically a loam, silt loam, clay loam, silty clay loam or fine sandy loam. Textures of underlying layers also vary since these are alluvial soils, having been deposited by flowing water. Soil ph varies from 6.1-8.4. Soils such as Trembles and Cherry are non-hydric. However, soils (such as Dimmick and Nishon) that are typically found in depressions are hydric. Lallie is another hydric soil. It is typically found in old oxbows that have been cut off from the main stream channel.

**Table 5. Representative soil features**

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Sandy loam (3) Clay loam
Family particle size	(1) Fine-loamy
Drainage class	Moderately well drained to excessively drained
Permeability class	Moderately rapid to very slow
Soil depth	20–78 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	6–8 in
Calcium carbonate equivalent (Depth not specified)	0–10%
Electrical conductivity (Depth not specified)	0–4 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–8
Soil reaction (1:1 water) (Depth not specified)	6.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–5%
Subsurface fragment volume >3" (Depth not specified)	0–2%

## Ecological dynamics

This ecological site developed under Northern Great Plains climatic conditions, geological materials, fire, plants and animals. At the time that North America was settled by Europeans, the Glaciated Plains was the home of nomadic tribes of Native Americans and large numbers of bison, prairie dog, elk, pronghorn, bighorn sheep and deer. These herbivores have been present on the plains since the retreat of the Pleistocene glaciers and greatly influenced the mixed grass prairie ecosystem. However, research consistently shows that precipitation is the principal factor altering productivity on ecological sites in the Northern Great Plains (Heitschmidt et al. 2005). The same authors

concluded that grazing reduces herbage standing crop, whereas its effects on above ground net primary production varies with timing of grazing and precipitation events, along with the functional and structural composition of the plant community.

It is theorized that these lands burned on a natural interval of 5-7 years, either as a result of lightning or Native Americans (Frost 1998). Most of the species present in the historic climax plant community (HCPL) are fire tolerant. The HCPC is the basis for plant community interpretations. It is the plant community that is best adapted to the unique combination of factors associated with this ecological site. This site is highly resistant and resilient to disturbance. The HCPC has been determined by evaluating rangeland relic areas, and other areas protected from excessive disturbance.

The HCPC is dominated by a mixture of tall and medium height cool and warm season grasses and grasslike species. About 90% of the annual production is from grasses and grasslike plants. Forbs and shrubs each contribute about 5% to total annual production. Total vegetative production averages 2500 lbs/ac in normal years, 2000 lbs/ac in “unfavorable” years, and 3000 lbs/ac in “favorable” years.

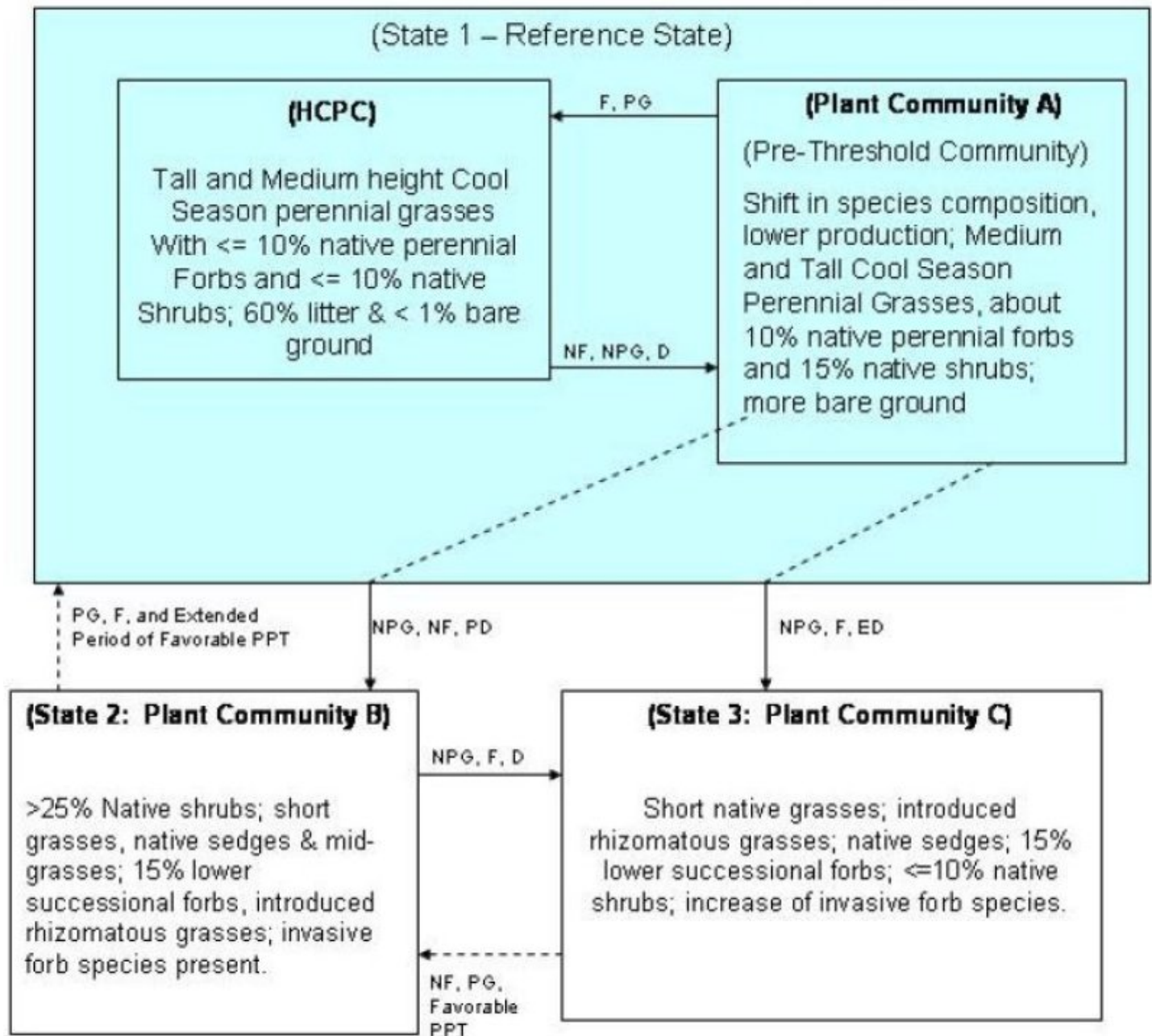
Changes in the HCPC are brought about by frequency, timing and intensity of past grazing use, series of dry or wet years, or disturbances by fire, insect infestations, noxious weed colonization and recruitment, etc. Continual adverse impacts to the site over a period of years results in regression to lower seral stages. The deep-rooted cool season perennial grasses are replaced by warm season grasses (blue grama, sandberg bluegrass, etc), fringed sagewort, hoods phlox, threadleaf sedge, hairy goldaster, and annual grasses and forbs. The dominance of these short grasses, warm season forbs and half-shrubs, and low seral species in the plant community disrupts ecological processes, impairs the biotic integrity of the site, and adversely affects resiliency. The system’s ability to recover to higher seral states is restricted or impeded.

#### State and Transition Diagram

Traditional theories of plant succession leading to a single climax community can not satisfactorily describe the complex successional pathways of this site (Briske et al. 2005). As the HCPC regresses to an early seral state, it is theorized that a threshold is crossed somewhere within the mid-to-low seral state. Plant communities below this threshold are in a steady state. A “state” is an alternative, persistent vegetation community that is not simply reversible in the linear successional framework (Stringham 2003). States are depicted as seral stages, while pathways between states are “transitions.”

Two important plant communities and associated successional pathways for the reference state (State 1), are illustrated below for an Overflow 10-14” p.z. site in the Glaciated Plains. The transition from Plant Community A (State 1) across a threshold to Plant Community B (State 2), and the transition from Community B to Community C (State 3) are also shown.

#### State and transition model

**Overflow 10-14" p.z.****RRUs 52XN, 52XC, 53AE****Legend:**

NF – No Fire

F – Fire (natural interval 5-7 yrs)

NPG – Non-prescribed grazing

PG – Prescribed grazing

PPT -- Precipitation

D - Drought (3-5 years)

PD – Prolonged Drought (5-7 years)

ED – Extended drought (&gt; 7 years)

S - Seeding

State 1  
Reference State

Community 1.1



## Historic Climax Plant Community (HCPC) Tall- and medium-height cool-season perennial grasses with less than or equal to 10% native perennial forbs and less than or equal to 10% native shrubs, 60% litter and less than 1% bare ground

Tall- and medium-height cool-season perennial grasses with less than or equal to 10 percent native perennial forbs and less than or equal to 10 percent native shrubs, 60 percent litter and less than 1 percent bare ground The interpretive plant community for this site is the Historic Climax Plant Community (HCPC). Cool season tall and mid-grasses (such as green needlegrass, western wheatgrass, thickspike wheatgrass, slender or bearded wheatgrass, basin wildrye and needle and thread grass) dominate the HCPC. These cool season grasses represent about 70% of the total annual plant production in the community. Warm and cool season short grasses and sedges (prairie junegrass, upland sedges, plains reed grass and blue grama) make up 10% of the total annual production. Goldenrods, scurfpeas, maximilian sunflower, cudweed sagewort, and western yarrow are important warm season forbs. American vetch, cinquefoil and penstemon are common cool season forbs. American vetch, milk vetch, prairie thermopsis, and scurfpea are important nitrogenous-fixing legumes. Total forb production normally represents less than 10% of the total annual production. Western snowberry, prairie rose, buffalo berry and chokecherry are common cool season shrubs. Silver sagebrush and fringed sagewort are common warm season shrubs. Overall, shrubs account for about 10% of the annual plant production. Annual production averages 2500 lbs/ac during "normal" years. Range inventory data collected (in 2001 and 2004) on the Fort Peck and Fort Belknap Indian Reservations indicate total above ground production averaged 2132 lbs/ac in plant communities associated with similarity indices of 45-65. Therefore, the 2500 lb/ac estimate is reasonable for the HCPC. Annual production is expected to increase and decrease, respectively on more mesic and xeric portions of the Glaciated plains. This plant community is well adapted to the Glaciated plains. Precipitation and run-in water are the most important factors influencing production. The functional and structural diversity of plant species (annuals, perennials, cool and warm season grasses, forbs and shrubs) optimize the capture of solar energy and maximize subsequent plant growth through the efficient use of available soil water and nutrient cycling. Continued adverse disturbances reduce the competitiveness of perennial plants, and precipitate the replacement of high successional species with lower successional grasses, forbs, shrubs, and annual species. With proper grazing management and non-drought conditions, more species found at HCPC will replace these lower successional species within a few years. Litter is in contact with 60% of the soil surface. Plant litter remains in place and is not moved by erosional forces. Plant basal canopy cover averages 40%. Less than 1% of the soil surface should be bare, or unprotected by litter, rock, moss, and plant canopy. Rills should not be present and water flow patterns should be barely observable. The major plant species composition and production by dry weight are shown for the HCPC in the following table. Total annual production has been derived from several sources, and has been adjusted to represent a typical annual moisture cycle.

**Table 6. Annual production by plant type**

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1600	2000	2400
Forb	200	250	300
Shrub/Vine	200	250	300
<b>Total</b>	<b>2000</b>	<b>2500</b>	<b>3000</b>

**Table 7. Ground cover**

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0-1%
Biological crusts	0-1%
Litter	50-60%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0-2%

Bedrock	0%
Water	0%
Bare ground	0-1%

**Table 8. Soil surface cover**

Tree basal cover	0%
Shrub/vine/liana basal cover	5-10%
Grass/grasslike basal cover	30-40%
Forb basal cover	5-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

**Table 9. Canopy structure (% cover)**

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	—	0-5%	0-10%	0-40%
>0.5 <= 1	—	0-35%	0-30%	0-50%
>1 <= 2	—	0-30%	0-40%	0-8%
>2 <= 4.5	—	0-15%	0-20%	0-2%
>4.5 <= 13	—	0-15%	—	—
>13 <= 40	—	—	—	—
>40 <= 80	—	—	—	—
>80 <= 120	—	—	—	—
>120	—	—	—	—

## Community 1.2

### **Plant Community A - Pre-threshold Community Shift in species composition, lower production, medium and tall cool-season perennial grasses, about 10 percent native perennial forbs and 15 percent native shrubs, more bare ground**

Shift in species composition, lower production, medium and tall cool-season perennial grasses, about 10 percent native perennial forbs and 15 percent native shrubs, more bare ground Total plant production averages about 1700 lbs/ac in this Plant Community. The tall, cool season grasses (green needlegrass, basin wildrye, switchgrass, big bluestem, and prairie cordgrass) persist in the community but have lost vigor with little evidence of successful regeneration. Western wheatgrass, prairie junegrass, blue grama and needle and thread grass have increased and contribute about 40% of the total annual production. Exact response of western wheatgrass and these lower successional species vary with the kind of disturbance (drought, grazing, etc.) and with precipitation (amount and timing). Production of native forbs increases relative to the HCPC and now accounts for more than 10% of the total production. Dotted gayfeather and American vetch tend to be replaced by cudweed sagewort, hoods phlox, etc. Shrubs account for about 15% of the total annual production. Species such as snowberry, fringed sagewort and silver sagebrush increase at the expense of chokecherry, golden currant and American plum. SI indices from 35-

65% are associated with this community. Litter cover decreases to 50% and bare ground increases to 5 – 10 %. In contrast to the HCPC, range conservationists have slight to moderate concerns regarding lower infiltration rates and potentially higher runoff rates, plant functional/structural group shifts, decreasing amount of litter, and increased presence of lower successional plants. The tall cool season grasses have poor vigor with little seed production. Most of the seedlings and young plants appear to represent short grasses and warm season forbs. Plant Community A is not highly resistant to disturbance. It can readily regress to a lower state from which upward succession is restricted. Because it is the “pre-threshold” community, it is critical that this community be recognized and strategies implemented to prevent further regression (UDSA and USDI, 2000).

### **Pathway 1.1A**

#### **Community 1.1 to 1.2**

No fire, non-prescribed grazing, drought (3 to 5 years) Successional pathways from the HCPC are influenced by frequency, timing and intensity of grazing, precipitation patterns, fire, insect infestations, noxious weed colonization and recruitment, etc. As communities regress from HCPC, medium and short warm season grasses increase at the expense of mid and tall cool season grasses.

### **Pathway 1.2A**

#### **Community 1.2 to 1.1**

Fire (natural interval 5 to 7 years), prescribed grazing Successional processes can readily return Plant Community A to the HCPC. The process can be facilitated by prescribed grazing, the incorporation of the natural fire regime into the system, etc.

## **State 2**

### **Shrub State**

#### **Community 2.1**

#### **Plant Community B Greater than 25 percent native shrubs, short grasses, native sedges and mid-grasses, 15 percent lower successional forbs, introduced rhizomatous grasses, invasive forb species present.**

Greater than 25 percent native shrubs, short grasses, native sedges and mid-grasses, 15 percent lower successional forbs, introduced rhizomatous grasses, invasive forb species present. Native shrubs such as snowberry, silver sagebrush, fringed sagewort, and prairie rose account for 25% or more of total annual production. A few western wheatgrass and green needlegrass plants persist with low vigor in the community. Needleandthread, blue grama, prairie junegrass, sandberg bluegrass and upland sedges dominate the graminoids, and represent about 30% of the total annual production. Cinquefoil, prairie thermopsis, scurfpeas, western yarrow, cudweed sagewort, and other native low successional forbs make up about 20% of the total annual production. Dandelions, salsify, cocklebur, hounds tongue, Canada thistle, and other noxious forbs are usually conspicuous in the community. SI indices for this community vary from 1-34%. Total vegetative production declines to about 900 lbs/ac in a normal precipitation year. Litter provides cover for about 15% of the ground, while bare ground increases to about 25%. Rills, water flow patterns and litter movement are evident on the site.

## **State 3**

### **Short Grass State**

#### **Community 3.1**

#### **Plant Community C Short native grasses, introduced rhizomatous grasses, native sedges, 15 percent lower successional forbs, greater than or equal to 10 percent native shrubs, increase of invasive for forb species.**

Short native grasses, introduced rhizomatous grasses, native sedges, 15 percent lower successional forbs, greater than or equal to 10 percent native shrubs, increase of invasive for forb species. Plant Community C (State #3) is dominated by Kentucky and Canada bluegrass, blue grama, prairie junegrass, sandberg bluegrass, and needle and thread. Although some western wheatgrass persists as single shoots with few seed stalks, it is difficult to find green needlegrass or any other high successional grass that dominated the HCPC. Japanese brome and cheatgrass often

colonize disturbed sites (rodent mounds, etc.) in this community. Woolly plantain, hood's phlox, hairy goldenaster and western yarrow are common forbs. These low successional forbs contribute about 20% of the annual production. Fringed sagewort usually increases while snowberry and silver sagebrush decrease in abundance. There are very few seedlings of desirable species. SI indices of 0-34% are associated with Community C. Soil erosion is not a serious problem because of the cover provided by the introduced rhizomatous and short native warm and cool season grasses. However, the loss of the tall cool season bunchgrasses results in a simplification of the compositional and structural plant communities. The hydrologic cycle (capture, storage and redistribution of precipitation), energy flow, and nutrient cycles are believed to be adversely impacted. Total vegetative production averages about 800 lbs/ac. In contrast to the reference state, range conservationists express moderate to extreme concerns about plant community composition, functional/structural groups, litter, annual production, and noxious plants. Each of the primary processes: 1) hydrology (the capture, storage and redistribution of precipitation), 2) energy capture (conversion of sunlight to plant and animal matter), and 3) nutrient cycling (the cycle of nutrients through the physical and biotic components of the environment) has been degraded beyond the point of self-repair within a reasonable length of time. For example, when tall, high producing, cool season grasses are replaced by short grasses (Kentucky bluegrass, blue grama, and prairie junegrass), the ability of the plant community to maximize the conversion of solar energy to plant biomass and efficiently utilize available precipitation are impaired. Less solar energy is captured and converted to carbohydrates for plant growth. Plant growth declines, and there is less plant canopy and less litter to protect the soil. As bare ground increases, infiltration decreases and/or surface runoff and soil evaporation increases. Because ecological processes of the site are no longer balanced and sustained, shallow-rooted, warm season species continue to gain a competitive advantage over the deep rooted, cool season species. The biotic integrity of the site is compromised.

## **Transition T1A**

### **State 1 to 2**

Non-prescribed grazing, no fire, prolonged drought (5 to 7 years) Prolonged drought, non-prescribed grazing, and the removal of fire in the system will result in retrogression to State 2. The effects of drought and poor grazing management are readily apparent with careful observation. However, the influence of fire is more difficult to verify. Because of the continual interaction of these environmental factors, regression from State 1 may culminate in two distinct communities (Community B or C). Community B is dominated by snowberry, fringed sagewort, and silver sagebrush.

## **Transition T1B**

### **State 1 to 3**

Non-prescribed grazing, fire (natural interval 5 to 7 years), extended drought (greater than 7 years) Extended drought, non-prescribed grazing, with natural fire in the system will result in retrogression to State 3. The effects of drought and poor grazing management are readily apparent with careful observation. However, the influence of fire is more difficult to verify. Because of the continual interaction of these environmental factors, regression from State 1 may culminate in two distinct communities (Community B or C). Community C is comprised of mostly short grasses, Kentucky bluegrass and low successional forbs.

## **Restoration pathway R2A**

### **State 2 to 1**

Prescribed grazing, fire (natural interval 5 to 7 years), and extended period of favorable precipitation The implementation of prescribed grazing and a favorable precipitation pattern normally will not induce succession from State 2 to State 1. Succession normally requires significant economic inputs. However, the Overflow 10-14" p.z. ecological site is productive. It is theorized that succession from Community B to State #1 may occur with the combination of a natural fire regime, prescribed grazing, and an extended period of favorable precipitation. This potential is depicted as a dashed arrow in the state and transition model. The Overflow 10-14" p.z. is a productive site with deep soils on landscapes with less than 2% slope. Although the potential of using mechanical treatments to promote plant succession is limited because this site often occurs as small and irregularly shaped tracts, mechanical treatments are feasible in some places (See NRCS Conservation Practice 548). Following mechanical treatment, it is critical that grazing is deferred one or two growing seasons. Length of grazing deferment varies with precipitation and response of vegetation. Furthermore, prescribed grazing must be implemented following the deferment. Failure to do will result in economic losses and potential ecological damage to the site. With prescribed

grazing and plant succession, the effective life of treatment should be greater than 10 years. Prescribed burning may be a useful tool for promoting succession in the State 2 Plant Communities. Fire would reduce the shrubs in Community B, and also adversely impact the shallow-rooted Kentucky and Canada bluegrasses in Community C. The opening of the community will favor the establishment of new plants, if seed (and/or rhizomes) of desired plants are available. If not, range seeding may be necessary following mechanical treatment or fire.

## Transition T2A

### State 2 to 3

Non-prescribed grazing, fire (natural interval 5 to 7 years), drought (3 to 5 years) Plant communities B & C are not a precise assemblage of species that remain constant from place to place or from year to year. Variability is apparent in productivity and occurrence of individual species. However, dominant status is less variable. Changes in climate, fire patterns and frequency, and grazing all play a role in determining which of the plant communities will be expressed. Plant Community B regresses to Community C with non-prescribed grazing and/or a wildfire that removes the dominant shrubs from the community.

## Restoration pathway R3A

### State 3 to 2

No fire, prescribed grazing, favorable precipitation Plant communities B & C are not a precise assemblage of species that remain constant from place to place or from year to year. Variability is apparent in productivity and occurrence of individual species. However, dominant status is less variable. Changes in climate, fire patterns and frequency, and grazing all play a role in determining which of the plant communities will be expressed. The shift from Community C to Community B might occur with a combination of a natural fire regime, prescribed grazing and an extended period of favorable precipitation. The possibility of this succession is depicted with a dashed arrow in the state and transition diagram.

## Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
<b>Grass/Grasslike</b>					
1	<b>Cool-season Grasses</b>			750–1500	
	green needlegrass	NAVI4	<i>Nassella viridula</i>	375–750	–
	basin wildrye	LECI4	<i>Leymus cinereus</i>	250–500	–
	bluegrass	POA	<i>Poa</i>	125–250	–
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0–125	–
2	<b>Warm-season Grasses</b>			250–750	
	Canada wildrye	ELCA4	<i>Elymus canadensis</i>	125–250	–
	prairie cordgrass	SPPE	<i>Spartina pectinata</i>	125–250	–
	switchgrass	PAVI2	<i>Panicum virgatum</i>	0–125	–
	big bluestem	ANGE	<i>Andropogon gerardii</i>	0–125	–
3	<b>Rhizomatous Wheatgrasses</b>			500–1000	
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	375–750	–
	slender wheatgrass	ELTR7	<i>Elymus trachycaulus</i>	65–125	–
	bearded wheatgrass	ELCA11	<i>Elymus caninus</i>	65–125	–
4	<b>Miscellaneous Grasses</b>			0–250	
	threadleaf sedge	CAFI	<i>Carex filifolia</i>	0–125	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0–125	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0–125	–
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0–125	–

	plains reedgrass	CAMO	<i>Calamagrostis montanensis</i>	0–125	–
	Grass, native	2GN	<i>Grass, native</i>	0–125	–
	Grass-like (not a true grass)	2GL	<i>Grass-like (not a true grass)</i>	0–125	–
<b>Forb</b>					
5	<b>Dominant Forbs</b>			125–250	
	dotted blazing star	LIPU	<i>Liatris punctata</i>	125–250	–
	Maximilian sunflower	HEMA2	<i>Helianthus maximiliani</i>	125–250	–
	American vetch	VIAM	<i>Vicia americana</i>	125–250	–
6	<b>Miscellaneous Forbs</b>			0–250	
	Missouri goldenrod	SOMI2	<i>Solidago missouriensis</i>	125–250	–
	common yarrow	ACMI2	<i>Achillea millefolium</i>	125–250	–
	aster	ASTER	<i>Aster</i>	125–250	–
	scarlet globemallow	SPCO	<i>Sphaeralcea coccinea</i>	125–250	–
	scurfpea	PSORA2	<i>Psoraleidium</i>	125–250	–
	hairy false goldenaster	HEVI4	<i>Heterotheca villosa</i>	125–250	–
	white sagebrush	ARLU	<i>Artemisia ludoviciana</i>	125–250	–
	prairie thermopsis	THRH	<i>Thermopsis rhombifolia</i>	125–250	–
	pussytoes	ANTEN	<i>Antennaria</i>	125–250	–
	bastard toadflax	COUM	<i>Comandra umbellata</i>	125–250	–
	milkvetch	ASTRA	<i>Astragalus</i>	125–250	–
	beardtongue	PENST	<i>Penstemon</i>	125–250	–
	spiny phlox	PHHO	<i>Phlox hoodii</i>	125–250	–
	buckwheat	ERIOG	<i>Eriogonum</i>	125–250	–
	northern bedstraw	GABO2	<i>Galium boreale</i>	125–250	–
	Forb, native	2FN	<i>Forb, native</i>	125–250	–
<b>Shrub/Vine</b>					
7	<b>Dominant Shrubs</b>			90–250	
	chokecherry	PRVI	<i>Prunus virginiana</i>	90–200	–
	golden currant	RIAU	<i>Ribes aureum</i>	90–200	–
	American plum	PRAM	<i>Prunus americana</i>	70–100	–
8	<b>Miscellaneous Shrubs</b>			0–250	
	snowberry	SYMPH	<i>Symphoricarpos</i>	0–125	–
	rose	ROSA5	<i>Rosa</i>	0–125	–
	silver sagebrush	ARCA13	<i>Artemisia cana</i>	0–125	–
	prairie sagewort	ARFR4	<i>Artemisia frigida</i>	0–125	–
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–1	–
	Shrub (>.5m)	2SHRUB	<i>Shrub (&gt;.5m)</i>	0–1	–

## Animal community

### Livestock Management

This site evolved with trampling, defoliation (ungulates, grasshoppers and jackrabbits, and other herbivores), fire and drought. Potholes in ephemeral drainages tend to store run-off water following storm events, which would be accessible to animals grazing on adjacent sites. Therefore, it is theorized that this site evolved with more animal impact than did the adjacent upland ecological sites. This site is highly resistant to disturbances which may alter its

ecological processes. Within the Reference State (State 1) it is also resilient. Following perturbations such as drought, which allows blue grama and other warm season, lower successional species to increase at the expense of the mid and tall cool season grasses, succession occurs with subsequent rainfall and run-in. Thus, the HCPC and Community A may be present at any given time in State 1. The site has the potential to produce 2000 – 3000 lbs of vegetation per acre.

Annual production shows far greater variations in response to changes in annual precipitation than to different grazing intensities (Hutchings and Stewart 1953). However, proper stocking rates and prescribed grazing are needed to ensure that the site remains in a high seral or HCPC state. Without proper grazing management the mid-to-tall grass community regresses to a blue grama, prairie junegrass, Kentucky bluegrass and low-successional forb community. Data from the recent range inventories indicate a significant Kentucky bluegrass population on nearly 20% of these sites.

Kentucky bluegrass may be a mixed blessing. It produces high quality forage (but not much of it), it grows as a sod and its rhizomes protect the soil from erosion (but it provides less protection than species in the HCPC). Unless stressed by drought, the Kentucky bluegrass is resistant to grazing systems with limited rest periods. Additional ecological concerns are its tendencies to form a monoculture and persist as a steady state. Plant succession is slow to non-existent in Kentucky bluegrass communities on the Overflow site. In comparison to the high seral state, suggested stocking rates on sites dominated by Kentucky bluegrass represent a 2-fold reduction. Prescribed grazing is recommended to prevent further deterioration in States 2 and 3. Non-prescribed grazing reduces plant cover and litter, increases surface runoff, and often leads to gully formation and active head cutting. Down-cutting lowers water tables and/or reduces the effectiveness of run-in moisture. Thus, the Overflow site crosses a conservation threshold, where most or all of its ecological processes are severely impacted. Once the ecological processes (hydrologic cycle, nutrient cycling, and conversion of solar energy into carbohydrates for plant growth) are disrupted, significant plant succession will not occur within a reasonable time period.

Death camas, horsetail, milkvetch and a few additional species of plants occurring on this site may be poisonous to livestock. However, livestock losses are unusual unless the range is overstocked and livestock are forced to consume the poisonous plants.

This site is suitable for livestock grazing from May through October. Because of topographic position, proximity to water, and species composition, the site is better-suited for cattle, rather than sheep grazing.

#### Wildlife Interpretations

The Overflow 10-14" p.z. ecological site creates biodiversity in the Glaciated Plains. The run-in moisture and diversity of shrubs, grasses and forbs provides food and cover for resident and migratory wildlife species. The narrow irregular, meandering landforms serve as a corridor allowing big game and other species to move between adjacent upland habitats.

State 1 (reference state) includes the HCPC and one additional community. This state supports the highest abundance of insects, invertebrates, amphibians, reptiles, upland game birds and small mammals. It also provides forage for mule deer and antelope during most of the year.

Communities that are in States 2 and 3 are much less suitable for big game, upland birds and most species of small mammals. The simplification of the plant community reduces the number of wildlife habitat niches. Because of less plant growth and litter, soil surface temperatures rise and soil moisture decreases. As the site becomes more xeric the insect and invertebrate population becomes less diverse, there is less cover, structure and food resources for upland birds and mammals. Springs and seeps may partially dry up.

### Hydrological functions

Soils associated with this ecological site are in Hydrologic Soil Groups A, B, C and D. Infiltration rates are generally moderate. The runoff potential is usually negligible to very low, but varies with landscape and ground cover.

Good hydrologic conditions exist on these sites when they are either in the Reference State (HCPC or Community A). Canopy cover (grass, forbs and shrubs) is greater than 90% in these communities, which is conducive to high infiltration rates and minimizes runoff and erosion.

Communities B & C are generally considered to be in poor hydrologic condition. Concerns are valid, not because of the amount of bare ground, but because the short grass sod restricts the ability of the desirable tall and mid-grasses to utilize available moisture. When rills develop into a gully, erosion threatens resource productivity. Therefore, it is recommended that grazing management strategies be implemented to address the problem of rills and litter movement -- do not wait until the formation of gullies to change management strategies.

### Recreational uses

Hunters are probably the most common recreational user of this ecological site. The site is also used by hikers and photographers.

## **Wood products**

This site has no significant value for wood products.

## **Inventory data references**

Data Source Number of Records Sample Period State County  
SCS-Range-417 2 (#515, #520) 1991, 1992 MT Phillips  
ECS-1  
Modified Double Sampling 24 2001-2004 MT Blaine, Roosevelt, Sheridan,  
Phillips, Valley  
USDA-SCS-MT. 1981. Technical Range Site Description

## **Other references**

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Frost, Cecil C. 1998. Presettlement fire frequency regimes of the United States: a first approximation. Pages 70-81 in Teresa L. Pruden and Leonard A. Brennan (eds.). *Fire in ecosystem management: shifting the paradigm from suppression to prescription*. Tall Timbers Fire Ecology Conference Proceedings, No. 20. Tall Timbers Research Station, Tallahassee, FL.  
Heitschmidt, R. K., K. D. Klement, and M. R. Haferkamp. 2005. Interactive effects of drought and grazing on Northern Great Plains rangelands. *Rangeland Ecol. Manage.* 58:11-19.  
Stringham, T. K., W. C. Krueger, and P. L. Shaver. 2003. State and transition modeling: an ecological process approach. *J. Range Manage.* 56(2):106-113.  
USDI BLM USGS and USDA NRCS. 2000. Interpreting indicators of rangeland health. Tech. Ref. 1734-6.

## **Contributors**

Kirt Walstad

## **Approval**

Kirt Walstad, 1/24/2024

## **Acknowledgments**

### **Site Description Revisions**

The 2005 Overflow 10-14" p.z. ecological site description replaces earlier dated versions of the Overflow 10-14" p.z. description in Rangeland Resource Unit 52XN. This 2005 revision incorporates the State and Transition Model theory, additional data on site productivity, and an improved understanding of many rangeland health indicators.

### **Site Description Approval**

This ecological site description is approved with the understanding that it is no more than another step in our continual effort to update the NRCS technical guide. In order to facilitate the process, NRCS field personnel are encouraged to forward existing information and/or new data that can be used to improve the utility of this site description. Please forward the information and data to the State Rangeland Management Specialist.

### **Authors Date Approval Date**

Dr. John Lacey 02/28/2005 Loretta J. Metz 03/19/2005

Maxine Rasmussen, Area RMS, Glasgow, MT

Jon Siddoway, Area RMS, Great Falls, MT

Rick Bandy, Area RSS, Great Falls, MT

Greg Snell, Area RSS, Glasgow, MT



## Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Siddoway/Bandy
Contact for lead author	Great Falls Area Office, Great Falls, MT Reference site used? No
Date	04/19/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

- 1. Number and extent of rills:** Slopes on this site are between 0 – 2% and with 99 - 100% of the soil surface well-covered there are no rills even with the most extreme convection storms.

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- 2. Presence of water flow patterns:** Due to the soil surface being well covered and minimal slope there is no evidence of past or current soil deposition or erosion for this site.

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- 3. Number and height of erosional pedestals or terracettes:** Wind and water erosion will not be evident on this site, so pedestals and terracettes will not be present.

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- 4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground should be less than 1% on this site.

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- 5. Number of gullies and erosion associated with gullies:** Gully erosion will not be evident on this site.

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- 6. Extent of wind scoured, blowouts and/or depositional areas:** Appearance or evidence of these erosional features on the landscape would not be present on this site.

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- 7. Amount of litter movement (describe size and distance expected to travel):** Because there is little bare ground, litter movement will be minimal at most. Because the site is dominated by the taller bunchgrasses and rhizomatous grasses, litter size will reflect the height and diameter of the reproductive culms and leaves of these grasses as well as the lesser dominate mid-size grasses.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Resistance to erosion will be high with soil stability values of 6; rare areas of bare soil on this site may have values less than 5 if not under plant canopy.
- 
9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface structure is granular; A horizon depth is 4 – 8”.
- 
10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Dominance of taller, deep rooted bunchgrasses will maximize infiltration and minimize runoff throughout the site.
- 
11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Will not be present generally, but there may be areas that have “healed” from former bison trails and wallows as well as more current livestock trails which could have a compaction layer below the soil surface.
- 
12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**
- Dominant:
- Sub-dominant:
- Other:
- Additional: Cool season, taller bunchgrasses (Green needlegrass, Basin wildrye) = cool season rhizomatous grasses (Western wheatgrass) >> cool season mid grasses (needleandthread) = cool season short grasses (Sandberg bluegrass) = perennial forbs = shrubs > warm season shortgrass (Blue grama).
- 
13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Will be low for all functional groups in a given year. Prolonged droughts which last more than 3 years may show increases in mortality and decadence for all plant groups.
- 
14. **Average percent litter cover (%) and depth ( in):**
- 
15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2000 - 3000 #/acre. This would be the expected production for the reference state during adequate moisture years. 2500 pounds would be the expected production in a 12 inch precipitation zone.
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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that**

become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is **NOT** expected in the reference state for the ecological site: Kentucky and/or Canada bluegrass, cudweed sagewort, pussytoes, a variety of annual or biennial weedy forbs, fringed sagewort, broom snakeweed, japanese brome, cheatgrass, leafy spurge, houndstongue.

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17. **Perennial plant reproductive capability:** During adequate moisture years bunchgrasses will generally produce seeds, however the cool season rhizomatous grasses may not necessarily produce seed even with adequate moisture.
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