USDA Natural Resources Conservation Service

Ecological site EX044B01Y081
Riparian Subirrigated (RSb) LRU 01 Subset Y

Last updated: 9/07/2023
Accessed: 05/09/2024

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): 044B–Central Rocky Mountain Valleys

Major Land Resource Area (MLRA) 44B, Central Rocky Mountain Valleys, is nearly 3.7 million acres of southwest Montana. This MLRA borders two other MLRAs: 43B, Central Rocky Mountains and Foothills, and 46, Northern and Central Rocky Mountain Foothills.
The major watersheds of this MLRA are the Missouri and Yellowstone Rivers and their associated headwaters, such as the Beaverhead, Big Hole, Jefferson, Ruby, Madison, Gallatin, and Shields Rivers. Limited portions of the MLRA are west of the Continental Divide along the Clark Fork River. These waters allow for extensive irrigation for crop production in an area that is generally only compatible with rangeland and grazing. The Missouri River and its headwaters are behind several reservoirs used for irrigation water, hydroelectric power, and municipal water.

The primary land use of this MLRA is production agriculture (grazing, small grain production, and hay) with limited mining. Urban development is high, with large expanses of rangeland being converted to subdivisions for a rapidly growing population.

MLRA 44B consists of one Land Resource Unit (LRU) and seven climate-based LRU subsets. Annual precipitation ranges from a low of 9 inches to a high of near 24 inches. The driest areas tend to be in the valley bottoms of southwest Montana, in the rain shadow of the mountains. The wettest portions tend to be near the edges of the MLRA, where it borders MLRA 43B. Frost-free periods also vary greatly, with less than 30 days in the Big Hole Valley to approximately 110 days in the warm valleys along the Yellowstone and Missouri Rivers.

MLRA 44B's plant communities are highly variable but are dominated by a cool-season grass and shrub-steppe community on the rangeland and a mixed coniferous forest in the mountains. Warm-season grasses occupy an extremely limited extent and number of species in this MLRA. Most subspecies of big sagebrush are present, to some extent, across the MLRA.

LRU notes

The LRU 01 Subset Y central concept is being used as an ubiquitous system where sites have access to additional moisture, reducing their reliance on precipitation. Sites that receive reduced precipitation have the ability to produce similar plant communities as those that receive more precipitation.

Classification relationships

EPA Ecoregions of Montana, Second Edition:
Level I: Northwestern Forested Mountains
Level II: Western Cordillera
Level III: Middle Rockies & Northern Great Plains
Level IV: Paradise Valley
Townsend Basin

Dry Intermontane Sagebrush Valleys
Shield-Smith Valleys

National Hierarchical Framework of Ecological Units:
Domain: Dry
Division: M330 – Temperate Steppe Division – Mountain Provinces
Province: M332 –Middle Rocky Mountain Steppe – Coniferous Forest – Alpine Meadow
Section: M332D – Belt Mountains Section
M332E – Beaverhead Mountains Section
Subsection: M332Ej – Southwest Montana Intermontane Basins and Valleys
M332Dk – Central Montana Broad Valleys

Montana Natural Heritage Program:
- Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland
- Rocky Mountain Subalpine-Montane Riparian Shrubland
- Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland
- Alpine-Montane Wet Meadow

Ecological site concept

• Site receives additional effect moisture
• Site located in a floodplain
• Soil not saline (EC less than 4 within the surface 4 inch mineral soil
• Site not in closed depression
• Seasonal high water table 24 to 40 inches from ground surface
• Soil not considered organic (less than 8 inch thick organic layer above mineral soil)

Associated sites

R044BP801MT	**Bottomland** The Bottomland ecological grouping is a broader collection of several potential ecological sites that exist on the same landscape.
EX044B01Y080	**Riparian Meadow (RM) LRU 01 Subset Y** The Riparian Meadow ecological site is often a neighboring site that primarily expresses herbaceous vegetation. The Riparian Meadow has a water table 12 to 24 inches below the soil surface.

Similar sites

R044BP801MT	**Bottomland** The Bottomland ecological grouping is a broader collection of several potential ecological sites that exist on the same landscape. One state of the Bottomland Group is very similar to the Riparian Subirrigated.

Table 1. Dominant plant species

Tree	(1) *Populus angustifolia* (2) *Betula occidentalis*
Shrub	(1) *Salix* (2) *Dasiphora fruticosa*
Herbaceous	(1) *Deschampsia cespitosa* (2) *Carex nebrascensis*

Legacy ID

R044BY081MT

Physiographic features

This site occurs within the floodplain adjacent to perennial streams, rivers, and flowing springs. Slopes tend to be nearly level to four percent; however, some instances of steeper slopes of up to 15 percent may exist on lower-order streams. This site has a permanent water table with a depth of 24 to 40 inches below the soil surface. The site may also receive additional moisture from stream overflow events. While this site is frequently flooded, it is not inundated for long periods of time.

Table 2. Representative physiographic features

Landforms	(1) Intermontane basin > Flood plain (2) Intermontane basin > Flood-plain step (3) Intermontane basin > Stream terrace
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Occasional to frequent
Ponding frequency	None
Elevation	1,219–2,073 m
Slope	1–4%
Water table depth	61–102 cm
Aspect	Aspect is not a significant factor

Climatic features

The Central Rocky Mountain Valleys MLRA has a continental climate. Fifty to sixty percent of the annual long-term average total precipitation falls between May and August. Most of the precipitation in the winter is snow on frozen ground. Average precipitation for this MLRA is slightly more than 14 inches, and the frost-free period averages 52 days. Precipitation is highest in May and June, although winter and spring snowstorms also contribute. Some of Montana’s driest areas are located in sheltered mountain valleys because of the rain-shadow effects on the leeside of some ranges.

Table 3. Representative climatic features

Frost-free period (characteristic range)	24-77 days
Freeze-free period (characteristic range)	62-115 days
Precipitation total (characteristic range)	279-432 mm
Frost-free period (actual range)	3-96 days
Freeze-free period (actual range)	36-125 days
Precipitation total (actual range)	254-559 mm
Frost-free period (average)	52 days
Freeze-free period (average)	92 days
Precipitation total (average)	356 mm

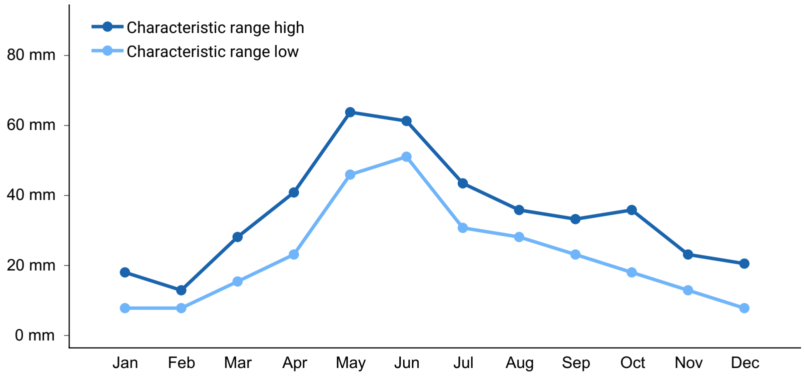


Figure 1. Monthly precipitation range

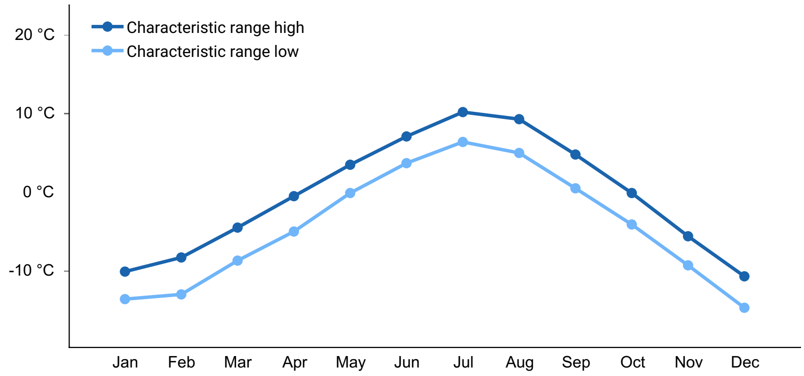


Figure 2. Monthly minimum temperature range

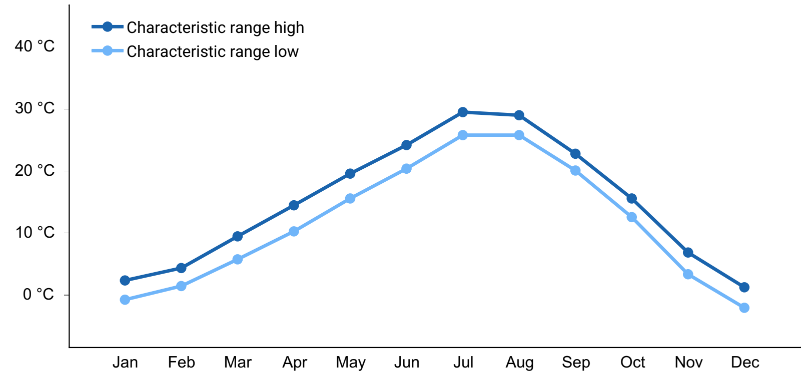


Figure 3. Monthly maximum temperature range

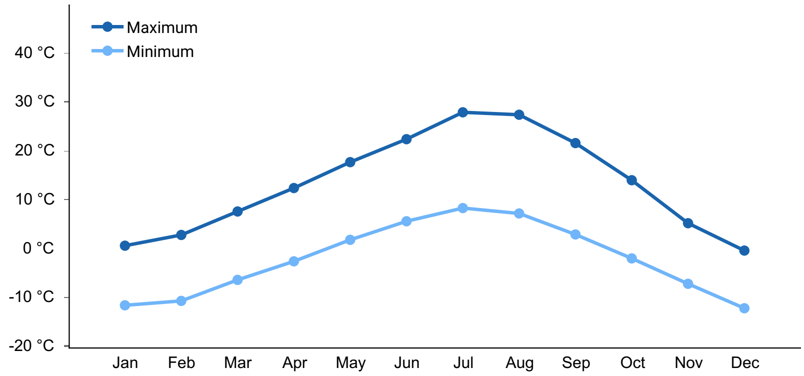


Figure 4. Monthly average minimum and maximum temperature

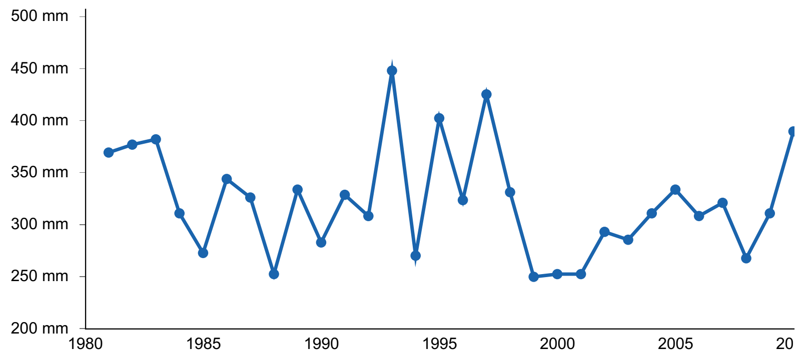


Figure 5. Annual precipitation pattern

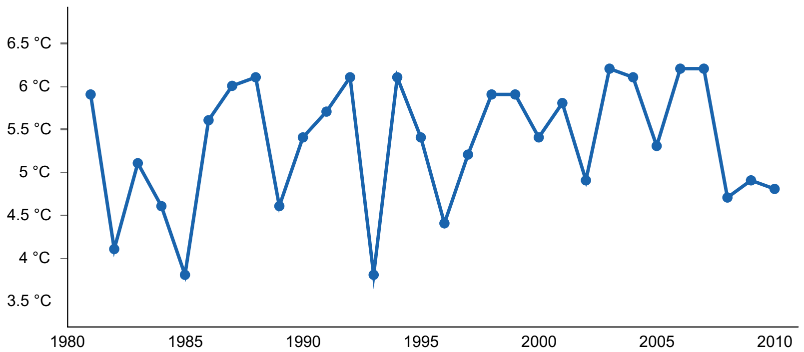


Figure 6. Annual average temperature pattern

Climate stations used

- (1) HEBGEN DAM [USC00244038], West Yellowstone, MT
- (2) LAKEVIEW [USC00244820], Lima, MT
- (3) BOZEMAN GALLATIN FLD [USW00024132], Belgrade, MT
- (4) DEER LODGE 3 W [USC00242275], Deer Lodge, MT
- (5) DILLION U OF MONTANA WESTERN [USC00242409], Dillon, MT
- (6) GLEN 2 E [USC00243570], Dillon, MT
- (7) ENNIS [USC00242793], Ennis, MT
- (8) BOULDER [USC00241008], Boulder, MT
- (9) GARDINER [USC00243378], Gardiner, MT
- (10) TOWNSEND [USC00248324], Townsend, MT
- (11) TRIDENT [USC00248363], Three Forks, MT
- (12) TWIN BRIDGES [USC00248430], Sheridan, MT
- (13) WHITE SULPHUR SPRNGS 2 [USC00248930], White Sulphur Springs, MT
- (14) DILLON AP [USW00024138], Dillon, MT
- (15) HELENA RGNL AP [USW00024144], Helena, MT
- (16) DIVIDE [USC00242421], Wise River, MT
- (17) WISDOM [USC00249067], Wisdom, MT
- (18) JACKSON [USC00244447], Jackson, MT
- (19) LIVINGSTON MISSION FLD [USW00024150], Livingston, MT
- (20) LIVINGSTON 12 S [USC00245080], Livingston, MT
- (21) VIRGINIA CITY [USC00248597], Virginia City, MT
- (22) WEST YELLOWSTONE [USC00248857], West Yellowstone, MT
- (23) BIG SKY 2WNW [USC00240775], Gallatin Gateway, MT
- (24) WILSALL 8 ENE [USC00249023], Wilsall, MT
- (25) BUTTE BERT MOONEY AP [USW00024135], Butte, MT

Influencing water features

The Riparian Subirrigated (RSb) ecological site is associated with perennial streams, rivers, and flowing springs. This site has a permanent water table between 24 and 40 inches below the soil surface. It is occasionally to frequently flooded from streambank overflow; however, periods of inundation are brief. Typically, flooding is associated with spring snowmelt from March to early June.

Wetland description

The Riparian Subirrigated Ecological Site is directly associated with multiple Rosgen Classified Streams. The primary Rosgen Classification stream types include: B4, B5, B6, C2, C3, C4, C5, C6, DA4, DA5, DA6.

B-classified streams are described as being moderately entrenched and moderately graded (2 to 3.9 percent slope) channel with frequent pools. This type of stream has a bed that is very stable, with stable banks. Examples of this type of stream are often tributary streams found throughout the MRLA. Often, but not always, these systems will be named creeks.

C-class streams are described as low-gradient systems (less than 2 percent slope) with point-bars and riffle-pool channels with well-defined flood plains. These systems occur in broad valleys that have alluvial and colluvial fans. These streams have active lateral movement. An example of this type of stream is the Beaverhead River.

DA-classified streams have multiple narrow and often deep channels that are sinuous with gentle relief (less than 0.5 percent slope). DA-classified streams have large vegetated floodplains and associated wetlands. These are often formed in fine alluvium or lacustrine deposits. An example of this system is the Upper Big Hole River.

Information sourced directly from the NRCS National Engineering Handbook (part 654 Technical Supplement 3E).

Soil features

The soils of this ecological site are alluvium of mixed origin with highly variable surface textures. These soils are hydric due to the permanent water table and frequent flooding events; however, the coarse texture of the subsurface soil may not directly express traditional redoximorphic features associated with such sites. Soils tend to be deep or very deep. Surface textures tend to be loamy, silty loam, fine sandy loam, and, in some cases, gravelly loam. As previously stated, subsurface horizons will often be coarse-grained, allowing for moderate to rapid permeability. These sites tend to be classified as somewhat poorly to poorly drained due to the presence of a permanent water table.

Common soil series in this ecological site include Dillon, Foxgulch, and Copperbasin. These soils may exist across multiple ecological sites due to natural variations in slope, texture, rock fragments, and pH.

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Fine sandy loam (3) Silt loam (4) Gravelly loam
Drainage class	Excessively drained to very poorly drained
Permeability class	Moderate to rapid
Soil depth	254 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	3.05–16.26 cm
Soil reaction (1:1 water) (0-101.6cm)	4.5–7.4
Subsurface fragment volume <=3" (25.4-50.8cm)	0–40%

Subsurface fragment volume >3" (25.4-50.8cm)	0–18%

Ecological dynamics

The reference plant community is dominated by multiple willow species with obligate and facultative wetland grasses, sedges, and forbs. As defined by the US Fish and Wildlife Service, obligate wetland species almost always exist in wetlands, while facultative wetland species exist primarily in wetlands but may also exist in non-wetland sites. The primary species include Nebraska sedge, Northwest Territory sedge, tufted hairgrass, Drummond's willow, sandbar willow, and Booth's willow.

The Riparian Subirrigated ecological site occurs across a relatively large landscape; slight variations within the plant community occur due to elevation, stream size, seasonal water table depth, and frost-free days. Structurally, these systems function very similarly: deep-rooted herbaceous plants and rhizomatous willows create stable riparian systems able to dissipate stream energy, trap sediment, and store water.

Natural disturbances such as flooding and fire are common. The Reference plant community is typically resistant to these impacts, but repeated grazing events may reduce its resilience, which can trigger changes within the community and cause it to transition to other states.

The Riparian Subirrigated ecological site is considered resistant to invasion; however, non-native species will invade if not managed. Non-native grass species are often the most common invaders, such as Kentucky bluegrass, creeping meadow foxtail, smooth brome, quackgrass, and redtop bentgrass. Noxious weeds that may invade include Canada thistle, whitetop, houndstongue, and leafy spurge. This is not a comprehensive list of species, and others may occur.

Plant Communities and Transitional Pathways
A state and transition model for this ecological site is depicted below. Thorough descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field data, field observations, and interpretations by experts. It is likely to change as knowledge increases.

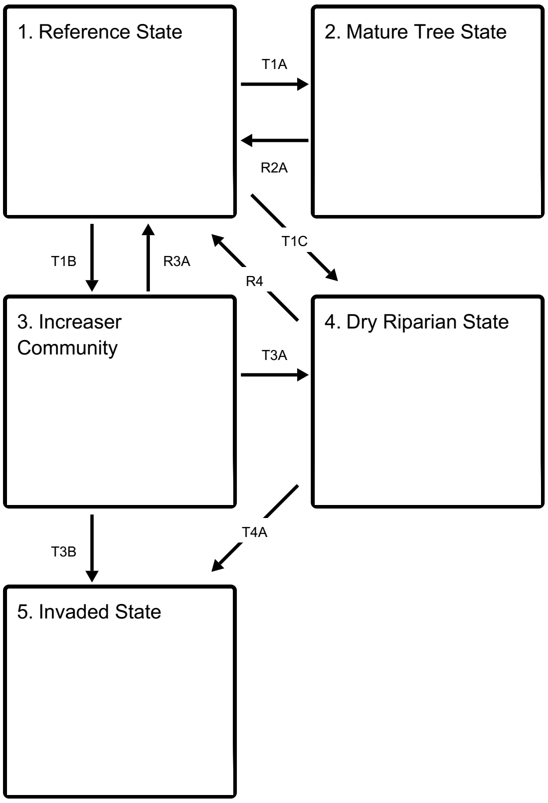
The plant communities within the same ecological site will differ across the MLRA due to the naturally occurring variability in weather, soils, and aspect. The biological processes on this site are complex; therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are intended to cover the core species and the known range of conditions and responses.

Both percent species composition by weight and percent canopy cover are referenced in this document. Canopy cover drives the transitions between communities and states because of the influence of shade, the interception of rainfall, and competition for available water. Species composition by dry weight remains an important descriptor of the herbaceous community and of the community as a whole. Woody species are included in the species composition for the site. Calculating the similarity index requires species composition by dry weight.

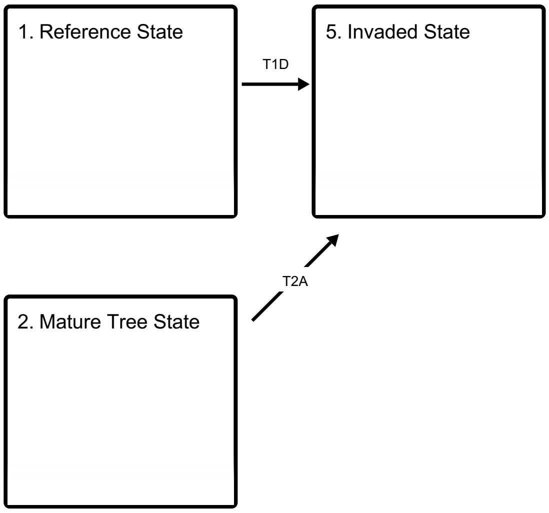
Although there is considerable qualitative experience supporting the pathways and transitions within the STM, no quantitative information exists that specifically identifies threshold parameters between grassland types and invaded types in this ecological site. For information on STMs, see the following citations: Bestelmeyer et al. (2003), Bestelmeyer et al. (2004), Bestelmeyer and Brown (2005), and Stringham et al. (2003).

State and transition model

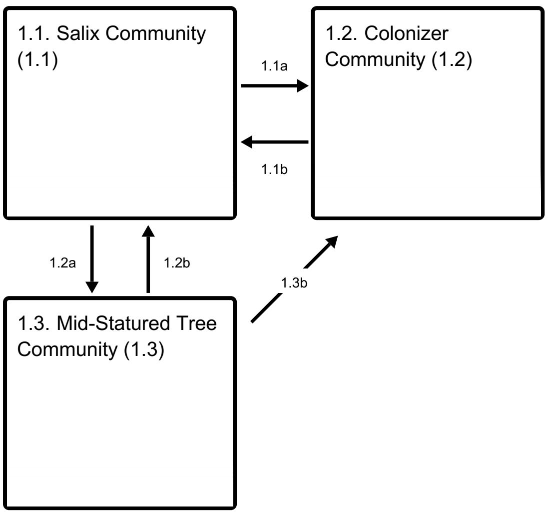
Ecosystem states



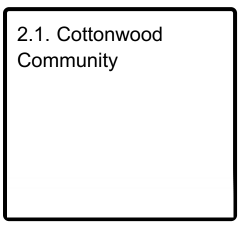
States 1, 5 and 2 (additional transitions)



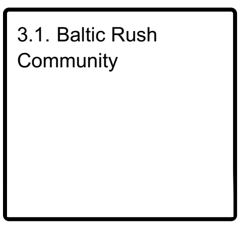
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities

4.1. Dry Riparian Community

State 5 submodel, plant communities

5.1. Invaded Community (5.1)

State 1
Reference State

The Reference State (1) is defined by a high diversity of plants in the floodplain of an active riparian area. This state consists of three potential communities: the Salix Community (1.1), the Colonizer Community (1.2), and the Mid-Statured Tree Community (1.3). All communities tend to contain high amounts of willow species, grasses, sedges, and rushes. This ecological site is not forested, and tree cover by cottonwoods (Populus spp.) is restricted to small stands of only a few trees. Due to the extreme variability and dynamics of this ecological site, it is common for multiple communities to exist within a relatively small area. The Salix Community (1.1) would be most common and stable throughout the MLRA. The Salix Community (1.1) is considered the reference plant community for this State.

Community 1.1
Salix Community (1.1)

The Salix Community (1.1) is a very diverse community comprised of nearly equal amounts of shrubs and herbaceous growth (45 and 45 to 50 percent, respectively). Willows (Salix spp.) dominate the shrub community; however, the exact combination of willow species may vary across the MRLA. Primary willows include sandbar (Coyote), yellow, Booth, and Geyer willows. The shrub component of this community often includes water birch (*Betula occidentalis*), redosier dogwood (*Cornus sericea*), and Woods' rose (*Rosa woodsii*). Tall sedges and bunchgrasses comprise approximately 45 to 50 percent of the Salix Community. Common sedges include Northwest Territory sedge (*Carex utriculata*), Nebraska sedge (Carex nebraskensis), and water sedge (*Carex aquatilis*). Frequent grasses are tufted hairgrass (*Deschampsia cespitosa*), slender wheatgrass (*Elymus trachycaulus*), Arctic rush (*Juncus arcticus* ssp. littoralis), and slimstem reedgrass (*Calamagrostis stricta*). As with the shrubs and grasses, forbs are also quite variable, but several species repeat across this site, such as field mint (*Mentha arvensis*), mountain goldenbanner (*Thermopsis montana*), Rocky Mountain iris (*Iris missouriensis*), and slender cinquefoil (*Potentilla gracilis*). The Salix Community is considered to be a very stable plant community due to the deep rooting of the sedges, rushes, and grasses. This contributes to a functioning riparian ecosystem by being able to absorb and dissipate high-energy stream flows. These plants trap sediment, often acting as a temporary sponge during runoff events. It is also considered to be resilient to disturbance; however, repeated heavy grazing events will affect this system, which will rapidly disrupt the hydrologic function of the ecological site. This particular plant community is considered important grazing for livestock as well as providing critical winter browse and escape habitat for native wildlife.

Dominant plant species

- cottonwood (*Populus*), tree
- willow (*Salix*), shrub
- birch (*Betula*), shrub
- silver buffaloberry (*Shepherdia argentea*), shrub
- Nebraska sedge (*Carex nebrascensis*), grass
- tufted hairgrass (*Deschampsia cespitosa*), grass
- water sedge (*Carex aquatilis*), grass

- Northwest Territory sedge (*Carex utriculata*), grass
- lousewort (*Pedicularis*), other herbaceous
- mountain goldenbanner (*Thermopsis montana*), other herbaceous
- wild mint (*Mentha arvensis*), other herbaceous
- cinquefoil (*Potentilla*), other herbaceous

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2326	2522	2690
Shrub/Vine	1861	2018	2421
Forb	233	252	269
Total	**4420**	**4792**	**5380**

Table 6. Ground cover

Tree foliar cover	0-10%
Shrub/vine/liana foliar cover	20-35%
Grass/grasslike foliar cover	55-70%
Forb foliar cover	5-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	45-65%
Surface fragments >0.25" and <=3"	0-1%
Surface fragments >3"	0-1%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Soil surface cover

Tree basal cover	0-2%
Shrub/vine/liana basal cover	5-10%
Grass/grasslike basal cover	25-30%
Forb basal cover	1-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	45-65%
Surface fragments >0.25" and <=3"	0-1%
Surface fragments >3"	0-1%
Bedrock	0%
Water	0%
Bare ground	0%

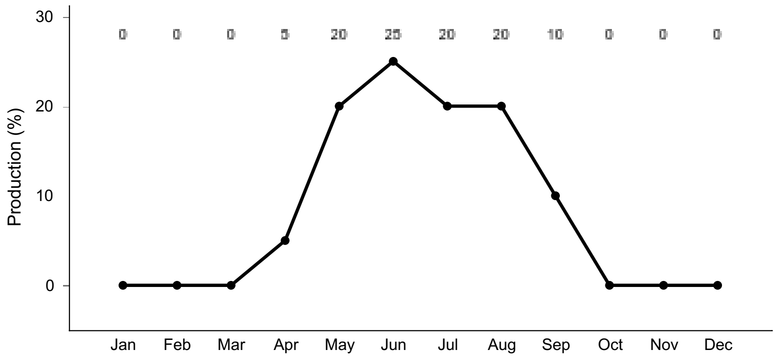


Figure 8. Plant community growth curve (percent production by month). MT0816, Permanent water table. All sites with a permanent water table..

Community 1.2
Colonizer Community (1.2)

This plant community is primarily composed of colonizing sedges, rushes, and grasses such as creeping spikerush (*Eleocharis palustris*) and brookgrass (*Catabrosa aquatica*). Willows that exist on this site tend to be in very small clumps or individual stems, mostly sandbar willow (*Salix exigua*) and yellow willow (*Salix lutea*). Typically, this community exists as part of a dynamic system formed on areas of newly deposited sediment or removal of the surface as a result of large flooding events and migration of the stream channel. Short-rooted grasses and sedge stabilize this site as other plants slowly fill the voids between plant bases. This site's post-scouring also initiates cottonwood cloning and sprouting from neighboring sites as well as creating new seeding sites in recent sediment. Note: If the flood event is powerful and exceeds the root strength of the plants, this community may be skipped completely, and a new ecological site known as Wet Gravelly (WGr) is created where soil is primarily replaced by stabilized gravel. Future iterations of Riparian Subirrigated and Wet Gravelly ecological sites may be combined as a more broadly grouped site to account for stream hydrology dynamics and rapid transitions between potential sites.

Community 1.3
Mid-Statured Tree Community (1.3)

As the Salix Community (1.1) matures, the site stabilizes to allow for mid-statured trees like water birch and cottonwood to increase in size, creating small galleries of trees in the Mid-Statured Tree Community (1.3). This is often in response to a slight drying trend as part of natural stream dynamics. This community is not a result of human-created water control structures such as dams and diversions. These cottonwood galleries will vary in size but rarely exceed an acre and are often less than 10 to 15 percent tree canopy. This community will have increased dry shrub growth such as silver buffaloberry (Sheperdia argentea), chokecherry (*Prunus virginiana*), and shrubby cinquefoil (*Dasiphora fruticosa*), and the willow species will decline. Grass and grasslike species will trend drier, with basin wildrye replacing tufted hairgrass as the dominant grass species. This community may not be expressed in all riparian systems and is often associated with larger creek and river systems.

Pathway 1.1a
Community 1.1 to 1.2

The Salix Community (1.1) experiences flooding that exceeds the rooting strength of the plant community. Heavy grazing may have affected the health of the plant community, which reduced rooting depth.

Pathway 1.2a
Community 1.1 to 1.3

Site becomes more stable over time (often several decades), stream dynamics change, which causes the floodplain to shift to a drier site. Occasional flood deposits of sediment offer seedbed areas for cottonwood seedlings. The drying trend is a natural event, not caused by man-made water control structures such as dams and diversions.

Pathway 1.1b
Community 1.2 to 1.1

The site becomes more stable over time. Deeper-rooted plants help stabilize this community. The Colonizing Community (1.2) site tends to be closest to the active stream or river channel and will accumulate sediment during high water events, creating nutrient-laden seeding sites for transition to the Salix Community (1.1).

Pathway 1.2b
Community 1.3 to 1.1

The site experienced catastrophic flooding often associated with extreme weather events and/or ice jams. This transition is less intense when compared to Pathway 1.3b, in which the site is scoured and regains the hydrology best suited for willows. Cottonwoods may be removed by the flooding or ice jam event or are not replaced after the trees die of old age.

Pathway 1.3b
Community 1.3 to 1.2

The site experiences catastrophic flooding, often associated with extreme weather events and/or ice jams. The Mid-Statured Tree Community (1.3) is very resistant to erosion, so the events of transition to the Colonizer Community tend to be high-energy, often causing the stream or river to abandon its current channel and create a new one or temporarily scour an area.

State 2
Mature Tree State

Mature Tree State (2) consists of one community. This state exists primarily in response to man-made control structures removing hydrology and/or as stream or river downcuts in the current channel. A large cottonwood gallery exists in dry condition. This state exists primarily on larger watersheds but can exist on smaller stream systems.

Community 2.1
Cottonwood Community

Mature cottonwoods dominate tree canopy with some water birch existing. Grass controls the understory along with dry shrubs such as chokecherry, snowberry, silver buffaloberry, and shrubby cinquefoil. Long term loss of hydrology will allow Rocky mountain juniper, Douglas fir, and ponderosa pine to encroach onto the site. This plant community is susceptible to invasion by non-native pasture grasses particularly smooth brome. Noxious weeds (namely Canada thistle and houndstongue) also readily invade this community as these dry cottonwood sites are often utilized as loafing sites by livestock. The increased grazing pressure and bare ground offer easy seeding sites for these species. This triggers a transition to State 5 (Invaded State). This community is directly related to loss of hydrology as a result of stream/river downcutting and/or a man made water control structure such as a dam which reduces the impact of high runoff events from spring snowmelt or thunderstorms. If the hydrology continues to be lost, this community will transition to a new ecological site as it loses the ability to transition back to the Reference State. This transition is not readily realized and requires changes to multiple ecological processes. Hydrology, soil, climate, stream morphology, fire frequency, and grazing all influence the potential of the new site. Often the new site will exist on the landform position above the contemporary Riparian subirrigated site.

State 3
Increaser Community

This state contains a single plant community dominated by increaser plants. This state exists in response to unmanaged grazing.

Community 3.1
Baltic Rush Community

The Baltic Rush Community (3.1) is in response to unmanaged grazing of the Reference State. The grasses transition from tufted hairgrass dominated community to one with meadow barley (*Hordeum brachyantherum*), smallwing sedge (Carex microcarpa), silverweed cinquefoil, and Baltic rush. Wood's rose and gooseberries also increase. The increaser species in this community are generally considered poor suitability for grazing. Hydrology of this community is severely affected as deep rooted plants are replaced with short rooted plants. The once dominant willow is often hedged to small clumps or rare single plants. This combination reduces infiltration and can increase runoff. Often associated with this community are small hummocks caused by either livestock trampling or cryogenic process such as frost heave/uplift. Both are likely a result of increased grazing use and dominance of short rooted increaser species

State 4
Dry Riparian State

The Dry Riparian State is a site dominated by native grasses and dry shrubs as a result of loss of hydrology due to downcutting of streams or stream meandering. Basin wildrye and tufted hairgrass are dominant herbaceous species. Transitions exist between the Salix Community (1.1) and the Colonizer Community (1.2). Many small riparian systems are not suited for tree growth; as a result, this differs from the Mature Tree State (2).

Community 4.1
Dry Riparian Community

The Dry Riparian Community (4.1) is characterized by a general loss of hydrology associated with downcutting of a stream or stream meandering. The drying of the Salix Community (1.1) and/or Colonizer Community (1.2). This results in a grass dominated community with drier shrubs. No trees exist in this community either as a result of lack of seed source or lack of potential (many smaller riparian systems are not capable of supporting tree growth). Basin wildrye, tufted hairgrass, slender wheatgrass, and reedgrass will be dominant however remnants of wetland species such as Baltic rush, meadow barley, and beaked sedge will also be present in limited amounts. This state is at risk of becoming invaded by non-native species especially pasture species associated with neighboring pasture and hayland. This state can return to the Reference State (1) if hydrology is returned. This typically requires a stream to meander back to it's previous path. In the situation where the stream has downcut, the transition is irreversible and the trend is toward creation of a new ecological site once it has cut far enough.

State 5
Invaded State

The Invaded State (5) includes many non-native species that have come to dominate riparian areas. Some species may include: orchard grass, timothy, Kentucky bluegrass, non-native thistles, Russian olive, leafy spurge, spotted knapweed, houndstounge, foxtail barley, and whitetop mustard. Often, sites are a combination of pasture grasses and invading weeds. The site is considered to be in a terminal state, meaning these sites are likely to never return to Reference, regardless of management.

Community 5.1
Invaded Community (5.1)

Communities in this state may be structurally indistinguishable from the Reference state except that invasive/noxious species exceed 20% of species composition by dry weight. Although there is no research to document the level of 20%, this is estimated to be the point in the invasion process following the lag phase based on interpretation of Masters and Sheley 2001. For aggressive invasive species (i.e., spotted knapweed) a 20% threshold could be less than 10 percent. Early in the invasion process there is a lag phase where the invasive plant populations remain small and localized for long periods before expanding exponentially (Hobbs and Humphries 1995). Production in the invaded community may vary greatly. A site dominated by Canada thistle, where soil fertility and chemistry remain near potential, may have production near that of the reference community. While a site with degraded soils may produce only 10 to 20 percent of the reference community. Once invasive species dominate the site, either in species composition by weight or in their impact on the community the threshold has been crossed to the Invaded State (5). As invasive species such as spotted knapweed, cheatgrass, and leafy spurge become established, they become very difficult to eradicate. Therefore considerable effort should be placed in preventing plant communities from crossing a threshold to the Invaded State (5) through early detection and proper management. Preventing new invasions is by far the most cost-effective control strategy, and typically places an emphasis on education. Control measures used on the noxious plant species impacting this ecological site include chemical, biological, and cultural control methods. The best success has been found with an integrated pest management (IPM) strategy that incorporates one or several of these options along with education and prevention efforts (DiTomaso 2000).

Transition T1A
State 1 to 2

Typically, the progression to this state is a long, linear process in which the Salix Community (1.1) transitions to the Mid-Statured Tree Community (1.3), given time and the loss of hydrology due to stream downcutting or the implementation of water control structures. Lack of flooding has created a very stable community.

Transition T1B
State 1 to 3

Improper grazing changes the plant community to a shorter grass and grasslike community. This affects site stability and hydrology (reduced infiltration and increased runoff). Soil compaction may also be present if alluvium is of fine particle size.

Transition T1C
State 1 to 4

Natural stream dynamics create a dry site that was once wetter. Improper grazing creates accelerated stream downcutting and bank erosion.

Transition T1D
State 1 to 5

Sites are invaded by noxious weeds or introduced pasture grasses. Pasture grasses may be planted or a result of invasion from neighboring sites. Improper grazing may be a trigger for invasion, but flooding may transport seeds to freshly deposited alluvium.

Restoration pathway R2A
State 2 to 1

The site experiences a catastrophic flooding event often associated with extreme weather events and/or ice jams.

Transition T2A
State 2 to 5

Sites are invaded by noxious weeds or introduced pasture grasses. Pasture grasses may be planted or a result of invasion from neighboring sites. Improper grazing may be a trigger for invasion, but flooding may transport seeds to freshly deposited alluvium.

Restoration pathway R3A
State 3 to 1

Improved grazing practices (change of season of use, conservative stocking rates), tree and shrub establishment, and water impoundments (beaver dams, log jams, or dam analogs). The Bureau of Land Management Dillon Field Office is experimenting with methods of restoring hummocked sites by crushing the hummocks with an excavator during the dry period in the summer. The results have not yet been evaluated.

Transition T3A
State 3 to 4

Drying of the system as a result of loss of hydrology and an increase in drier shrub species encroaching.

Transition T3B
State 3 to 5

Sites are invaded by noxious weeds or introduced pasture grasses. Pasture grasses may be planted or a result of invasion from neighboring sites. Improper grazing may be a trigger for invasion, but flooding may transport seeds to freshly deposited alluvium.

Restoration pathway R4
State 4 to 1

Grazing management (timing and amount to improve shrub and tree establishment), brush management to remove unwanted dry species. As stream dynamics return, the increased soil moisture will allow wetland species to return over time.

Transition T4A
State 4 to 5

Sites are invaded by noxious weeds or introduced pasture grasses. Pasture grasses may be planted or a result of invasion from neighboring sites. Improper grazing may be a trigger for invasion, but flooding may transport seeds to freshly deposited alluvium.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall sedges and grasses**			2085–2421	
	tufted hairgrass	DECE	*Deschampsia cespitosa*	504–807	–
	Northwest Territory sedge	CAUT	*Carex utriculata*	224–538	–
	Nebraska sedge	CANE2	*Carex nebrascensis*	224–538	–
	water sedge	CAAQ	*Carex aquatilis*	112–538	–
	bluejoint	CACA4	*Calamagrostis canadensis*	224–404	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	112–269	–
	slimstem reedgrass	CAST36	*Calamagrostis stricta*	112–269	–
2	**Increaser sedges/grasses**			233–269	
	mountain rush	JUARL	*Juncus arcticus ssp. littoralis*	45–224	–
	meadow barley	HOBR2	*Hordeum brachyantherum*	45–112	–
	smallwing sedge	CAMI7	*Carex microptera*	0–90	–
	water whorlgrass	CAAQ3	*Catabrosa aquatica*	0–90	–
Shrub/Vine					
3	**Shrubs**			1861–2421	
	Booth's willow	SABO2	*Salix boothii*	448–1009	–
	Geyer willow	SAGE2	*Salix geyeriana*	0–538	–
	narrowleaf willow	SAEX	*Salix exigua*	235–538	–
	yellow willow	SALU2	*Salix lutea*	112–404	–
	Drummond's willow	SADR	*Salix drummondiana*	0–224	–
	water birch	BEOC2	*Betula occidentalis*	0–56	–
	redosier dogwood	COSES	*Cornus sericea ssp. sericea*	0–56	–
	northern black currant	RIHU	*Ribes hudsonianum*	0–56	–
Forb					
4	**Forbs**			233–269	
	mountain goldenbanner	THMO6	*Thermopsis montana*	0–224	1–5
	wild mint	MEAR4	*Mentha arvensis*	45–168	2–5
	slender cinquefoil	POGR9	*Potentilla gracilis*	0–112	0–3
	willowherb	EPILO	*Epilobium*	0–67	0–2
	lousewort	PEDIC	*Pedicularis*	0–67	0–1
	Rocky Mountain iris	IRMI	*Iris missouriensis*	0–45	0–1
	largeleaf avens	GEMA4	*Geum macrophyllum*	0–45	0–1

Animal community

Livestock grazing is suitable on this site. This site has the potential to produce a large amount of high-quality forage but is sensitive to improper grazing management. Management objectives should include maintenance or improvement of the vegetation community. Shorter grazing periods and adequate re-growth after grazing are recommended for plant recovery and to protect stream banks against high-flow events.

Management considerations can include: rotation grazing, rest, prescribed utilization levels, off-site water development, varying the season of use, developing riparian pastures, providing alternative forage sources (i.e., new seedings or special use pastures, brush management, prescribed burning, and using supplements as ways to attract livestock to other areas of a pasture), stocking rates, stock density, armored water gaps, using a different breed or class of livestock, culling animals that spend too much time in the riparian area, alternating pasture entry locations, and herding. Season-long use of this site can be detrimental and will alter the plant community over time.

Because of the wet soils often associated with this ecological site, soil compaction and/or streambank shearing can result from improper grazing.

The herbaceous component can be increased by providing rest on a regular basis, followed by late-season use the next year. This treatment helps restore the plant's vigor and aids seed dispersal.

The shrub and tree component can be increased by providing rest during the critical growing period, managing the livestock to avoid a switch from grazing to browsing, grazing for a shorter period of time, or providing rest (generally 3 to 5 years) to promote seedling development and growth. Grazing a pasture when the upland vegetation is green and of higher quality may help reduce livestock use of this site.

Avoiding or limiting use during the hotter part of the year is also recommended. Recommended grazing periods for the hot season (generally July 1 through September 15) should be no more than 14 days. During other times of the grazing season, the recommended grazing period is up to 28 days. A switch to browse use can indicate the need to move livestock from this site to maintain or improve the shrub and tree community.

Management strategies discussed above apply best to plant communities that are near or similar to their potential composition. When the dominant community is comprised of non-native grasses, additional rest often helps with the re-establishment of the native species. Often, extra rest will help restore some of the stability and natural hydrology of the site. Extra rest is intended to maintain more above-ground production. This growth then helps trap sediment during flood or overflow events. Over time, the trapped sediment restores the stream banks and begins to restore or enlarge the riparian area. The stream's cross section often becomes narrower and deeper as riparian areas are expanded. This often results in raising the water column or water table in the system. Restoring hydrology (i.e., making the site wet again) will cause a shift back to the native herbaceous component of the site.

In situations where the stream has been incised and there is minimal potential for restoring original hydrology, yet there is still a significant component of willows and other woody species that are desirable to maintain, rest needs to be included in the management plan to aid with the maintenance of the woody species and to establish several age classes. Without frequent flooding to provide habitat for new seedling establishment, these plants will depend on vegetative means for reproduction. Rest allows that to happen. The rest period needs to be long enough to allow the new sprouts to grow out of reach of the grazing or browsing animal. These areas can often be safely utilized at a time of year when the herbaceous component is lush. The stream's cross section often changes as riparian areas are expanded. Consider techniques that help draw the animals out of these areas.

A site dominated by a low seral plant community will need rest annually until the site has stabilized and the plant community begins to move towards mid-seral. The rest treatment maintains more above-ground production, which in turn traps more sediment during overflow events. The additional sediment rebuilds banks and helps restore the riparian area to its potential extent. Often, a change in the stream's width/depth ratio results in raising the water table. As the water table level rises, the plants will shift to primarily obligate species. Mid- to late-seral species on this ecological site are predominantly obligate or facultative-wet.

Sites with mainly over-mature and decadent willows need a treatment strategy that will allow for the establishment of younger plants. Often, depending on the site and situation, treatments in addition to grazing management may be necessary.

Drought management and monitoring plans should be included as part of a comprehensive plan provided to the land owner or decision-maker. Control of noxious and other undesirable weeds should also be a part of the plan. Management of this ecological site needs to be included as part of a plan for all grazing lands.

This ecological site provides important habitat for many wildlife species. It is an important source of forage for grazing animals (i.e., herbivores). The seeds produced by the sedges and other plants are an important source of food for waterfowl and other birds. The willows and other shrubs provide shelter, cover, and nesting sites.

The type of wildlife is somewhat dependent on site factors such as the size of the stream and the surrounding area. It is critical habitat for ducks, geese, and other migratory waterfowl. The site will be used for resting during migration and for nesting and rearing if there is open water available for a long enough time period.

These sites often provide a critical source of protein during migration. If the stream this site is associated with is large enough, animals such as muskrats may also use the site.

There have been no species identified with special emphasis specific to this site. However, bald eagles and peregrine falcons will use the habitats provided by this ecological site, adjacent sites, and the associated stream for portions of their life cycle. As additional information becomes available, it will be included in this description.

Hydrological functions

The soils associated with this ecological site are generally in Hydrologic Soil Group B. The infiltration rates for these soils will normally be moderate. The runoff potential for this site is low. Runoff curve numbers generally range from 61 to 79.

This ecological site typically receives and generates runoff. The site is typically wet, receiving the majority of its moisture from its hydrologic connection with streamflow and water table fluctuations.

Runoff is characterized by frequent surface flooding from overbank flows. On-site precipitation is generally considered a minor source of runoff at this site. As the streamflow subsides, runoff typically becomes subsurface return flows.

Any condition that would cause an increased instantaneous runoff peak (e.g., poorly designed clearcutting in the watershed) could degrade the channel, causing headcutting. An incised stream (Rosgen G or F type) is often the result.

Downcutting (incisement) would be a catastrophic event for this ecosystem. Channel downcutting will increase subsurface drainage, lower the seasonal water table, reduce the frequency of overbank flow, and reduce the duration of near-surface saturation. Bank erosion will increase.

The stream, in time, will adjust to a lower base elevation. However, the result of downcutting will be a new floodplain at a lower elevation, a lower water table elevation, a less floodprone width, and a smaller adjacent riparian and wetland area. The dominant vegetation in the previous riparian/wetland area will change (i.e., from Obligate and Facultative-wet to Facultative, etc.). Given enough time, these conditions will eventually result in this site becoming either a Stream Terrace, or an upland site, depending on the resulting depth of the water table.

The vegetative community can also be changed for other reasons, such as if the water table drops during the growing season due to a lowering of the base elevation of adjacent streams or several years of drought conditions.

Plant cover affects overbank flow and runoff in several ways. The foliage and litter maintain the soil's infiltration potential by preventing the impact of raindrops from sealing the soil surface. Some of the precipitation will be intercepted by the plants and withheld from the initial runoff. Vegetation, including litter, forms numerous barriers to water flow, lengthening the time of concentration, dissipating energy, and reducing the peak discharge.

The hydrologic condition of this site has a significant effect on overbank flow. The hydrologic condition considers the effects of cover, including litter, and management on infiltration. Good hydrologic conditions indicate that the site usually has a lower runoff potential. A good hydrologic condition for this site also indicates that the site should remain stable and functional after high-flow events.

Erosion is minor for sites with high similarities. Sites with high similarity generally have enough cover and litter to optimize infiltration, minimize runoff and erosion, minimize streambank erosion, and have a good hydrologic condition. The deep root systems of the willows, sedges, and grasses in the reference community will help maintain or improve site stability and function, as well as reduce erosion.

Sites with low similarity are generally considered to be in less-than-good hydrologic condition. Sites with low similarity may have a high percentage of coverage. The cover is often from shallow-rooted species (e.g., Kentucky bluegrass, redtop) that cannot hold the banks together during high-flow events, etc.

For rangelands in this MLRA/MLRU, good hydrologic conditions exist if cover (grass, litter, and brush canopy) is greater than 70 percent. Fair conditions exist when cover is between 30 and 70 percent, and poor conditions exist when cover is less than 30 percent. This site description provides some general values for cover. However, cover is best determined on site by measurement, such as with a line transect. The transect must be located so that it does not cross into different ecological sites.

On-site precipitation will seldom be necessary to keep the root zone at field capacity during the growing season. The root zone should have free water available from stream overflow in the early part of the growing season and from the water table within 3.5 feet of the surface the remainder of the year. Plant cover and litter help retain soil moisture for use by the plants.

(reference: Engineering Field Manual, Chapter 2 and Montana Supplement 4)

Recreational uses

This site provides some limited recreational opportunities for hiking, horseback riding, big game hunting, and bird hunting. This site is known to produce forage crops such as wild onion and mushrooms. Some plants have flowers that appeal to photographers. This site provides valuable open space.

Wood products

Large cottonwood trees may exist on this ecological site. Though not common in Montana, these large trees may be harvested for lower quality wood need such as for pallets.

Other products

none

Inventory data references

Information presented was derived from the site's Range Site Description (Riparian Subirrigated, Northern Rocky Mountain Valleys, South, East of Continental Divide), NRCS clipping data, literature, field observations, and personal contacts with range-trained personnel (i.e., used professional opinion of agency specialists, observations of land managers, and outside scientists).

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Approval

Kirt Walstad, 9/07/2023

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)	Grant Petersen
Contact for lead author	grant.petersen@usda.gov
Date	09/12/2019
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Not present

2. **Presence of water flow patterns:** Water flow patterns as a result of flooding may be present and are part of the natural dynamics of the system. These flow patterns tend to stabilize quickly as a result of deep rooted

3. **Number and height of erosional pedestals or terracettes:** Not Present

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Due to high amounts of plant production and litter amounts, bare ground will be zero.

5. **Number of gullies and erosion associated with gullies:** Not Present

6. **Extent of wind scoured, blowouts and/or depositional areas:** Wind movement of soil particles will not occur on this site.

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7. **Amount of litter movement (describe size and distance expected to travel):** Typically litter movement is not associated with this site; however under exceptional flooding conditions, all size classes of litter may move hundreds of feet to areas of small debris dams.

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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):** This site is considered to have high resistance to erosion and will not have canopy gaps. Site Stability readings of 5 or 6. Root mats are common.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A horizon is 8-11 inches thick and sometimes under an organic root mat (Oe horizon). Colors can be variable due to mixed origins of alluvium however are considered dark with Munsell Color Values typically 4 or less with Chromas of 2 or less. This suggests high organic matter content. Several soils common on this site will have thin organic layers up to 3 inches above mineral A horizon. Structure of the A horizon is medium granular however in areas that receive more frequent water inundation the granular structure may part to a weak platy structure as a result of eluviation.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The high amounts of fine to coarse fibrous roots from the grasses and sedges combined with the deep coarse roots of the shrubs creates areas of moderate to rapid infiltration. Runoff is typically very low. Site often absorbs runoff from neighboring sites. Organic horizons offer buffering capacity also.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Site will not have a compaction layer. Areas that receive frequent inundation may express a platy E horizon or have weak platy structure in the A horizon. These characteristics may be mistaken for compaction. Compaction layers on this site are often associated with site hummocking and often exhibit massive (sometimes known called structureless) subsoil.

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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: Shrubs (primarily Salix spp) = Tall Sedges and grasses

    Sub-dominant: Forbs = increaser grasses and grasslikes > Trees

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** No mortality is evident in any functional group under reference conditions.

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14. **Average percent litter cover (%) and depth (in):** Litter amounts will be high and can exceed 65%. Litter depth will be at least 1" deep

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual production is 4150 to 4800lbs per acre of above ground species.

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:** Non-native species common on this site include (but not limited to): Kentucky bluegrass, Canada bluegrass, smooth brome, creeping meadow foxtail, houndstongue, leafy spurge, Canada thistle, whitetop, sulphur cinquefoil, purple loosestrife, Russian olive, salt ceder (Tamarisk), and paleyellow iris

    Native species capable of indicating degraded states however presence alone does not imply degradation includes: cottonwood (Populus spp.), ponderosa pine, Rocky Mountain juniper, Arctic rush, smallwing sedge

17. **Perennial plant reproductive capability:** Capability very high. Density of plants indicates that plants reproduce at level sufficient to fill available resource. No restriction on seed or vegetative reproductive capacity.