Ecological site FX053A99X061
Riparian Woodland (RW)

Last updated: 11/22/2023
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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): 053A–Northern Dark Brown Glaciated Plains

The Northern Dark Brown Glaciated Plains, MLRA 53A, is a large, agriculturally and ecologically significant area. It consists of approximately 6.1 million acres and stretches 140 miles from east to west and 120 miles from north to south, encompassing portions of 8 counties in northeastern Montana and northwestern North Dakota. This region represents part of the southern edge of the Laurentide Ice Sheet during maximum glaciation. It is one of the driest and westernmost areas within the vast network of glacially derived prairie pothole landforms of the Northern Great Plains and falls roughly between the Missouri Coteau to the east and the Brown Glaciated Plains to the west. Elevation ranges from 1,800 feet (550 meters) to 3,300 feet (1,005 meters).

Soils are primarily Mollisols, but Inceptisols and Entisols 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 (Soller, 2001). Underlying the till is sedimentary bedrock largely consisting of Cretaceous shale, sandstone, and mudstone (Vuke et al., 2007). The bedrock is commonly exposed on hillslopes, particularly along drainageways. Significant alluvial deposits occur in glacial outwash channels and along major drainages, including portions of the Missouri, Poplar, and Big Muddy Rivers. Large eolian deposits of sand occur in the vicinity of the ancestral Missouri River channel east of Medicine Lake (Fullerton et al., 2004). The northwestern portion of the MLRA contains a large unglaciated area containing paleoterraces and large deposits of sand and gravel known as the Flaxville gravel.

Much of this MLRA was glaciated towards the end of the Wisconsin age, and the maximum glacial extent occurred approximately 20,000 years ago (Fullerton and Colton, 1986; Fullerton et al., 2004). Subsequent erosion from major stream and river systems has created numerous drainageways throughout much of the MLRA. The result is a geologically young landscape that is predominantly a dissected till plain interspersed with alluvial deposits and dominated by soils in the Mollisol and Inceptisol orders. Much of this area is typic ustic, making these soils very productive and generally well suited to production agriculture.

Dryland farming is the predominant land use, and approximately 50 percent of the land area is used for cultivated crops. Winter, spring, and durum varieties of wheat are the major crops, with over 48 million bushels produced annually (USDA-NASS, 2017). Areas of rangeland typically are on steep hillslopes along drainages. The rangeland is mostly native mixed grass prairie similar to the Stipa-Agropyron, Stipa-Bouteloua-Agropyron, and Stipa-Bouteloua faciations (Coupland, 1950, 1961). Cool-season grasses dominate and include rhizomatous wheatgrasses, needle and thread, western porcupine grass, and green needlegrass. Woody species are generally rare; however, many of the steeper drainages support stands of trees and shrubs, such as green ash and chokecherry. Seasonally ponded, prairie pothole wetlands may occur throughout the MLRA, but the greatest concentrations are in the east and northeast where receding glaciers stagnated and formed disintegration moraines with hummocky topography and numerous areas of poorly drained soils.

Classification relationships

NRCS Soil Geography Hierarchy
• Land Resource Region: Northern Great Plains
• Major Land Resource Area (MLRA): 053A Northern Dark Brown Glaciated Plains

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: Glaciated Northern Grasslands Section 331L
• Subsection: Glaciated Northern Grasslands Subsection 331La
• Landtype association/Landtype phase: N/A

National Vegetation Classification Standard (Federal Geographic Data Committee, 2008)
• Class: Mesomorphic Tree Vegetation Class (1)
• Subclass: Temperate & Boreal Forest & Woodland Subclass (1.B)
• Formation: Temperate Flooded & Swamp Forest Formation (1.B.3)
• Division: *Populus deltoides* - *Fraxinus pennsylvanica* - Acer saccharinum Flooded & Swamp Forest Division (1.B.3.Na)
• Macrogroup: *Populus deltoides* - *Fraxinus pennsylvanica* / Salix spp. Flooded Forest Macrogroup (1.B.3.Na.4)
• Group: *Populus deltoides* - *Fraxinus pennsylvanica* / Pascopyrum smithii Floodplain Forest

EPA Ecoregions
• Level 1: Great Plains (9)
• Level 2: West-Central Semi-Arid Prairies (9.3)
• Level 3: Northwestern Glaciated Plains (42)
• Level 4: Glaciated Dark Brown Prairie (42i)
Glaciated Northern Grasslands (42j)

Ecological site concept

Riparian Woodland is a common, extremely dynamic ecological site occurring flood plains and stream terraces. The distinguishing characteristics of this site are that it is located on flood plains and that it supports woody vegetation. Channel migration across the flood plain results in a continual cycle of erosion and deposition that drives soil development as well as plant succession. Flooding and sometimes ground water provide additional moisture for plant growth. Depth to a seasonal water table varies depending on the proximity to the channel. Soils for this ecological site are typically very deep (more than 60 inches), well drained, and derived from alluvium. Characteristic vegetation is plains cottonwood (*Populus deltoides*), redosier dogwood (*Cornus sericea*), western snowberry (*Symphoricarpos occidentalis*), and willow (Salix spp.). Green ash (*Fraxinus pennsylvanica*) and box elder (*Acer negundo*) may also be present in some areas.

Associated sites

FX053A99X150	**Subirrigated (Sb)** The Subirrigated site is adjacent to the Riparian Woodland site, typically on lower terraces where ground water is closer to the surface and riparian woody plants are rare or absent.
FX053A99X084	**Slough (Sl)** The Slough site is adjacent to the Riparian Woodland site, typically in oxbows or channels where flooding is very frequent and a water table is shallow and persistent.
FX053A99X713	**Saline Lowland (SLL)** The Saline Lowland site is adjacent to the Riparian Woodland site, typically on higher terraces and in areas where salts have accumulated due to geology, hydrology, or soil properties.
FX053A99X060	**Overflow (Ov)** The Overflow site is adjacent to the Riparian Woodland site, typically on higher terraces where flooding is less frequent and riparian woody plants are rare or absent.

Similar sites

FX053A99X060	**Overflow (Ov)** This site differs from the Riparian Woodland site in that it occupies higher terraces and is dominated by upland shrubs and herbaceous species. Trees are rare or absent.
FX053A99X150	**Subirrigated (Sb)** This site differs from the Riparian Woodland site in that it occupies lower terraces. Depth to a water table is 24 to 40 inches. Trees and shrubs are rare or absent.
FX053A99X756	**Woody Draw (WD)** This site differs from the Riparian Woodland site in that it does not receive disturbance from flooding. It is located in upland swales rather than on flood plains, has a higher proportion of facultative shrubs, and typically does not support cottonwoods.

Table 1. Dominant plant species

Tree	(1) *Populus deltoides ssp. monilifera*
Shrub	(1) *Cornus sericea* (2) *Symphoricarpos occidentalis*
Herbaceous	Not specified

Legacy ID

R053AY712MT

Physiographic features

This ecological site occurs on floodplain steps and alluvial fans on river valleys. Slopes typically range from 0 to 2 percent. All soils in this site concept are flooded for brief durations, but flooding frequency varies from frequent to rare depending on the proximity to the channel. This site occurs on all aspects.

Table 2. Representative physiographic features

Landforms	(1) River valley > Flood-plain step (2) River valley > Alluvial fan
Flooding duration	Brief (2 to 7 days)
Flooding frequency	Rare to frequent
Elevation	1,800–3,300 ft
Slope	0–2%
Aspect	Aspect is not a significant factor

Climatic features

The Northern Dark Brown Glaciated Plains is a semi-arid region with a temperate continental climate that is characterized by frigid winters and warm to hot summers (Coupland, 1958; Richardson and Hanson, 1977; Heidel et al., 2000). The majority of precipitation occurs as steady, soaking, frontal system rains in late spring to early summer. Summer rainfall comes mainly from convection thunderstorms that typically deliver scattered amounts of rain in intense bursts. These storms may be accompanied by damaging winds and large-diameter hail and result in flash flooding along low-order streams. Approximately 80 percent of the annual precipitation occurs during the growing season. June is the wettest month, followed by July and May (Richardson and Hanson, 1977; Heidel et al., 2000). Average annual precipitation ranges from 11 inches (280 mm) near Richey, Montana, to 15 inches (380 mm) in the Little Muddy drainage near Williston, North Dakota, but precipitation varies greatly from year to year. On average, severe drought and very wet years occur with the same frequency, which is 1 out of 10 years (Coupland, 1958; Heidel et al., 2000). Extreme climatic variations, especially droughts, have the greatest influence on species cover and production (Coupland, 1958, 1961; Biondini et al., 1998). The frost-free period for this ecological site ranges from 90 to 130 days, and the freeze-free period ranges from 115 to 155 days.

Table 3. Representative climatic features

Frost-free period (characteristic range)	90-130 days
Freeze-free period (characteristic range)	115-155 days
Precipitation total (characteristic range)	11-15 in
Frost-free period (average)	110 days
Freeze-free period (average)	135 days
Precipitation total (average)	13 in

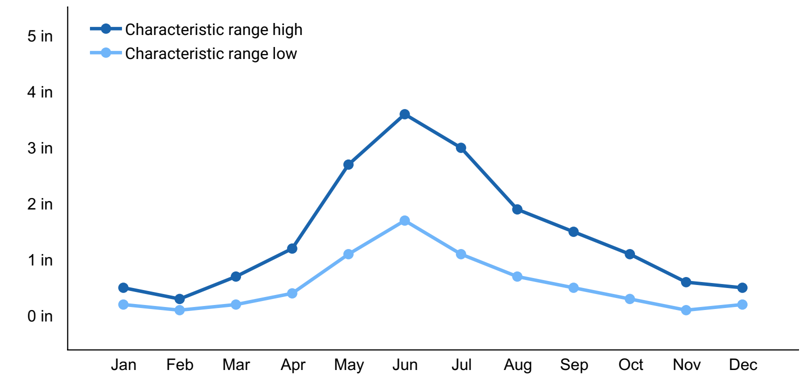


Figure 1. Monthly precipitation range

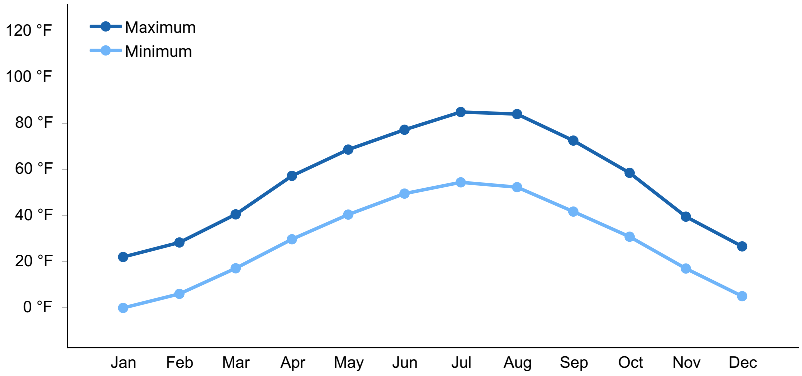


Figure 2. Monthly average minimum and maximum temperature

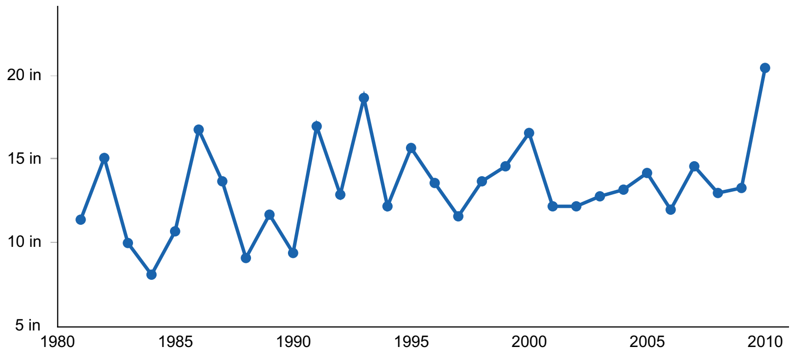


Figure 3. Annual precipitation pattern

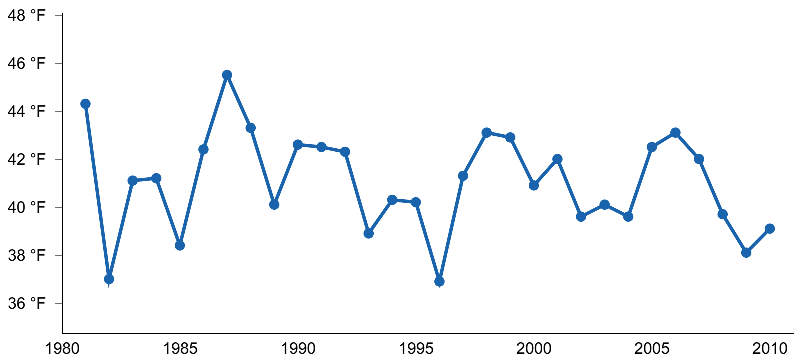


Figure 4. Annual average temperature pattern

Climate stations used

- (1) BREDETTE [USC00241088], Poplar, MT
- (2) CULBERTSON [USC00242122], Culbertson, MT
- (3) OPHEIM 10 N [USC00246236], Opheim, MT
- (4) OPHEIM 12 SSE [USC00246238], Opheim, MT
- (5) PLENTYWOOD [USC00246586], Plentywood, MT
- (6) SCOBEY 4 NW [USC00247425], Scobey, MT
- (7) SIDNEY [USC00247560], Sidney, MT
- (8) VIDA 6 NE [USC00248569], Vida, MT
- (9) WILLISTON SLOULIN INTL AP [USW00094014], Williston, ND

Influencing water features

This is a riparian site that receives additional moisture from stream overflow and from subsurface hydrology associated with the stream. Streamflow peaks in late spring to early summer and is lowest in fall and winter. During peak flows the site is sometimes flooded for brief durations, with flooding frequency greatest near the channel. Sometimes, a seasonal ground water table is present between 40 and 60 inches below the soil surface, but this varies depending on proximity to the channel.

Soil features

Soils for this ecological site are typically very deep (more than 60 inches), well drained, and derived from alluvium. They have a typic ustic moisture regime, which means that the soils are moist in some or all parts for either 180 cumulative days or 90 consecutive days during the growing season but are dry in some or all parts for over 90 cumulative days, and a frigid soil temperature regime (Soil Survey Staff, 2014).

Surface textures found on this site are commonly loam, sandy loam, or silt loam. The underlying horizons are typically comprised of stratified alluvial deposits, characterized by many thin layers of sediment deposited by past flood events. Textures in subsurface horizons are highly variable and may range from very gravelly loamy sand to silt loam. In the upper 20 inches, electrical conductivity is less than 4 and the sodium absorption ratio is less than 13. Calcium carbonate equivalent is typically less than 15 percent throughout the soil profile. Soil pH classes are neutral to moderately alkaline in the surface horizon and neutral to strongly alkaline in the subsurface horizons. Content of coarse fragments is extremely variable and ranges from 0 to 80 percent in the upper 20 inches of soil.

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Sandy loam (3) Silt loam
Drainage class	Well drained
Soil depth	60–72 in

Calcium carbonate equivalent (0-72in)	0–15%
Electrical conductivity (0-20in)	0–3 mmhos/cm
Sodium adsorption ratio (0-20in)	0–12
Subsurface fragment volume <=3" (0-20in)	0–80%
Subsurface fragment volume >3" (0-20in)	0–80%

Ecological dynamics

The information in this ecological site description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The Riparian Woodland provisional ecological site in MLRA 53A consists of four states: The Contemporary Reference State (1.0), the Herbaceous Understory State (2.0), the Invasive Tree State (3.0), and the Cropland State (4.0). Historically, plant communities associated with this ecological site evolved under the combined influences of climate, grazing, hydrology, and fire. Extreme climatic variability results in frequent droughts, which have the greatest influence on the relative contribution of species cover and production (Coupland, 1958, 1961; Biondini et al., 1998).

Hydrology, flooding in particular, is a crucial dynamic on this site. Annual flood events delivered water to the site, deposited sediment in some areas, and removed sediment in other areas. This natural erosion/deposition pattern facilitated a natural succession of plant communities. Pioneer species established on recent alluvial deposits, which gave way to more facultative and upland species as banks were built, soil developed, and water tables lowered. The process began anew when banks were eroded again and redeposited as the stream channel migrated back and forth across the flood plain. This natural cycle rejuvenated woodland stands, maintained high species diversity, and preserved the hydrologic function of the flood plain. Another phenomenon unique to this site are ice jams. In winter, the stream freezes over, then thaws during warmer weather, either during winter warming periods or spring thaw. The river ice breaks up into large pieces and floats downriver. When these ice flows are blocked by an obstruction, they accumulate and often are forced onto the floodplain. Ice jams can cause bank scouring and flooding, particularly on lower stream terraces. This creates bare sand and gravel bars which are colonized by pioneer species such as plains cottonwood.

The historic ecosystem experienced periodic lightning-caused fires with estimated fire return intervals of 6 to 25 years (Bragg, 1995). Historically, Native Americans also set periodic fires. The majority of lightning-caused fires occurred in July and August, whereas Native Americans typically set fires during spring and fall to correspond with the movement of bison (Higgins, 1986). The precise effects of the historic fire return interval are not definitive, but in general the mixed-grass ecosystem was resilient to fire. Potential effects are generally temporary and may include reduction of litter, fluctuations in production, and changes in species composition (Vermeire et al., 2011, 2014).

Native grazers also shaped these plant communities. American bison (Bison bison) were the dominant historic grazer, but pronghorn (Antilocapra americana), elk (Cervus canadensis), and deer (Odocoileus spp.) were also common. Additionally, small mammals such as prairie dogs (Cynomys spp.) and ground squirrels (Urocitellus spp.) influenced this plant community (Salo et al., 2004). Grasshoppers and periodic outbreaks of Rocky Mountain locusts (Melanoplus spretus) also played an important role in the ecology of these communities (Lockwood, 2004). The mixed-grass ecosystem was resilient to grazing, although localized areas could experience shifts in species composition due to heavy grazing.

The contemporary Riparian Woodland site is extremely altered, perhaps irreversibly, from its historic state. Following European settlement, fire was largely eliminated, domestic livestock replaced native ungulates as the primary grazers, and non-native species were introduced to the ecosystem. Additionally, most major rivers in MLRA

53A have been dammed for flood control, irrigation, or electric power generation, all of which significantly altered hydrology. Reduced flooding intensity and frequency have significantly reduced cottonwood regeneration. As a result, many stands are becoming decadent with very little seedling recruitment. Irrigation practices have removed water from streams and diverted it into canals. This has altered ground-water hydrology and stream recharge. Non-native vegetation is also commonplace. Field investigations by Hanson et al. in 1995 and by NRCS in 2008 and 2015 were unable to identify a predominantly native herbaceous community. Due to the extreme alteration of this site, a contemporary reference state rather than a historic reference state is modeled for this provisional ecological site description. The implications of this alteration are not fully understood and require further investigation.

In the early stages of succession, gravel and sand are deposited on alluvial bars by flooding or ice scouring. These bars are quickly colonized by pioneer species such as plains cottonwood (*Populus deltoides*) and sandbar willow (*Salix exigua*). In the absence of further disturbance, higher seral species will begin to establish and the plains cottonwood stand will begin to mature. Over time, banks will build up, the channel will migrate further from the site, and the water table will lower. A diverse understory with species such as redosier dogwood (*Cornus sericea*) will establish under a canopy of mature cottonwood trees. As the cottonwoods die out they are commonly replaced by green ash, box elder, or an upland shrub/herbaceous community. Disturbance in the form of flooding, ice scouring, or stand-replacing fire can return the site to a pioneer community. Flooding disturbance has been greatly reduced due to dams and flood-control practices and is generally infrequent and limited to the lowest sandbars and terraces.

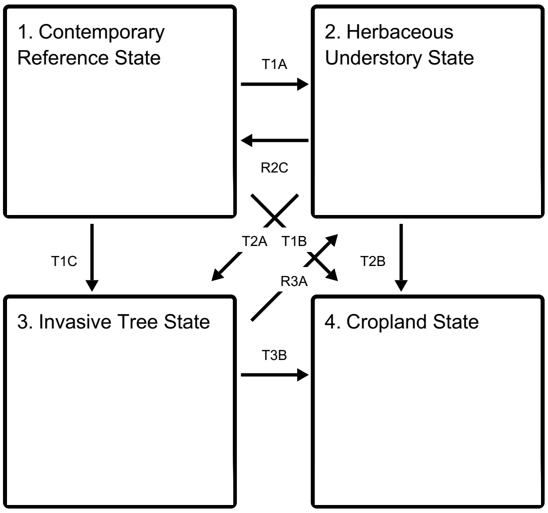
This site can be important for livestock grazing due to its high productivity and proximity to water. Improper grazing of this site can result in a reduction in the diversity of the understory and an increase in less palatable shrubs (Hansen et al., 1995). Improper grazing practices include any practices that do not allow sufficient opportunity for plants to physiologically recover from a grazing event or multiple grazing events within a given year and/or that do not provide adequate cover to prevent soil erosion over time. These practices may include, but are not limited to, overstocking, continuous grazing, and inadequate seasonal rotation moves over multiple years. The plant community will transition from a diverse shrub understory to one dominated by western snowberry. Prolonged severe grazing will eventually eliminate all shrubs and result in an herbaceous understory community. Once the stand has transitioned from a shrub-dominated understory to an herbaceous understory, returning it to its former state is very difficult (Hansen et al., 1995). Non-native and invasive species are common on this site. Introduced perennial grasses, such as Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*), are the most common grass species in all phases. Once established, they will displace native species and dominate the ecological functions of the site. Noxious weeds are a major concern on this site. Leafy spurge (*Euphorbia esula*), Canada thistle (*Cirsium arvense*), and Russian knapweed (*Acroptilon repens*), are common on this site and are capable of displacing native species. Russian olive (*Elaeagnus angustifolia*), an invasive tree species, is another common invader on this site. It will commonly establish in the understory, replace cottonwoods as they die out, become the dominant tree on the site, and prevent re-colonization by native tree species. Once established, Russian olive is very difficult to remove and may require extensive restoration practices, including tree removal, reestablishment of native tree/shrub species, and weed control.

The Riparian Woodland ecological site is often considered prime farmland. Many acres of this site have been cleared and converted to cropland, primarily irrigated hay. Common crop species include alfalfa, orchardgrass, and a grass/alfalfa mix. Annual crops, such as wheat, barley, and corn, are occasionally planted as part of a rotation or when renovating hay fields. Flood irrigation is common, and water is typically diverted from nearby streams and delivered to fields via canals. Irrigated cropland is extremely valuable in the region, and once the site is converted it is unlikely to be taken out of production.

The state-and-transition model (STM) suggests possible pathways that plant communities on this site may follow as a result of a given set of ecological processes and management. The site may also support states not displayed in the STM diagram. Landowners and land managers should seek guidance from local professionals before prescribing a particular management or treatment scenario. Plant community responses vary across this MLRA due to variability in weather, soils, and aspect. The reference community phase may not necessarily be the management goal. The lists of plant species and species composition values are provisional and are not intended to cover the full range of conditions, species, and responses for the site. Species composition by dry weight is provided when available and is considered provisional based on the sources identified in the narratives associated with each community phase.

State and transition model

Ecosystem states



T1A - Lack of flooding disturbance, lowered water table, prolonged improper grazing, or a combination of these factors

T1C - Establishment of invasive tree species (primarily Russian olive)

T1B - Clear cutting, tillage or herbicide application, and seeding of cultivated crops (frequently combined with irrigation practices)

R2C - Proper grazing management, tree/shrub planting, intensive weed management (management intensive and costly)

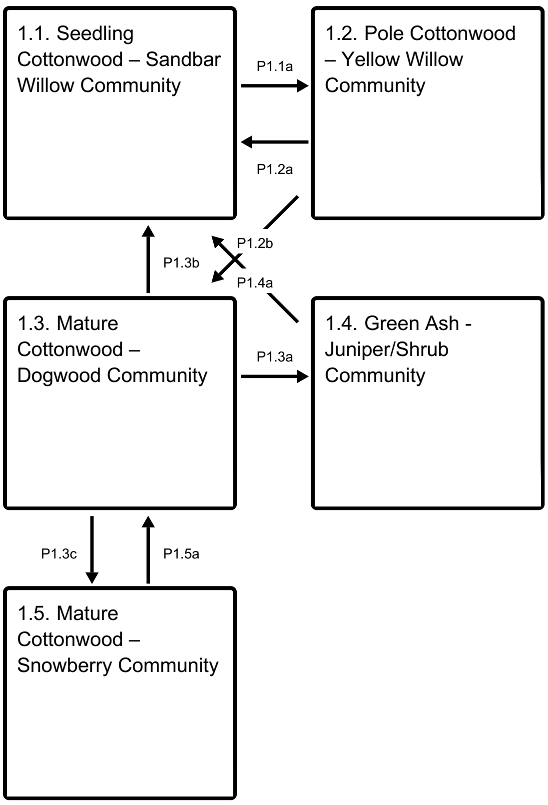
T2A - Establishment of invasive tree species (primarily Russian olive)

T2B - Clear cutting, tillage or herbicide application, and seeding of cultivated crops (frequently combined with irrigation practices)

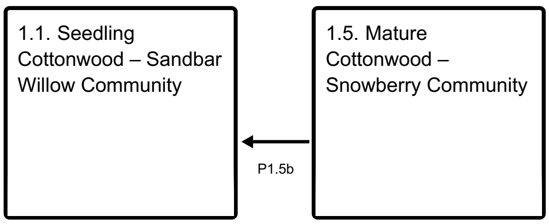
R3A - Removal of invasive tree species, sometimes combined with tree/shrub planting (management intensive and costly)

T3B - Clear cutting, tillage or herbicide application, and seeding of cultivated crops (frequently combined with irrigation practices)

State 1 submodel, plant communities



Communities 1 and 5 (additional pathways)



P1.1a - Lack of disturbance, natural plant growth, and bank building

P1.2a - Flooding, bank scouring, or a combination of these factors

P1.2b - Lack of disturbance, bank building, and lowering of water table

P1.3b - Major flooding or stand-replacing fire in combination with bank scouring/slumping

P1.3a - Lack of disturbance, lowering of water table, cottonwood mortality

P1.3c - Improper grazing management

P1.4a - Major flooding or stand-replacing fire in combination with bank scouring/slumping

P1.5b - Major flooding or stand-replacing fire in combination with bank scouring/slumping

P1.5a - Proper grazing management

State 2 submodel, plant communities

2.1. Native Tree/Smooth Brome Community

2.2. Native Tree/Noxious Weed Community

State 3 submodel, plant communities

3.1. Russian Olive/Shrub Community

3.2. Russian Olive/Noxious Weed Community

State 4 submodel, plant communities

4.1. Cropland Community

State 1
Contemporary Reference State

The Contemporary Reference State contains five community phases. This state is not considered to be the historic natural state but instead is an evaluation of contemporary conditions given the extreme alterations to the abiotic and biotic components of the ecosystem. Flooding disturbance is a key dynamic on this site, but it has been severely altered by manmade structures, most notably the Fort Peck dam. Frequent flooding created open alluvial bars where native cottonwood and willow species could colonize. Flood control measures typically limit such disturbances to the lowest-elevation terraces and major flooding only occurs in the most extreme of circumstances. In general, this state is resilient to grazing and fire, although these factors can influence species composition in localized areas. Woody vegetation consists of a tree overstory and a shrub understory. The principle tree species is plains cottonwood (*Populus deltoides*), but green ash (*Fraxinus pennsylvanica*) and juniper (*Juniperus scopulorum*) may also occur in later stages of development. Shrubs are characterized by redosier dogwood (*Cornus sericea*), chokecherry (*Prunus virginiana*), and willow species. Following disturbance, this state will exhibit an increase in seedling cottonwoods and sandbar willow (Hansen et al., 1995). Herbaceous understory has been significantly altered and is predominantly non-native species such as smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*). Noxious weeds are a common concern for all phases.

Community 1.1
Seedling Cottonwood – Sandbar Willow Community

The Seedling Cottonwood – Sandbar Willow Phase (1.1) is dominated by seedling cottonwoods and sandbar willow (*Salix exigua*). The understory is very dense. Sandbar willow is by far the most abundant species. Other shrub species that may be present at low cover are yellow willow (*Salix lutea*) and redosier dogwood. Common forbs include Canada goldenrod (*Solidago canadensis*) and American licorice (*Glycyrrhiza lepidota*). Graminoids are commonly dominated by non-native species, such as smooth brome, Kentucky bluegrass, and quackgrass (*Elymus repens*). Other graminoid species that may be present are woolly sedge (*Carex pellita*), Canada wildrye (*Elymus canadensis*), and rush (Juncus spp.) (Hansen et al., 1995).

Community 1.2
Pole Cottonwood – Yellow Willow Community

The Pole Cottonwood – Yellow Willow Phase (1.2) consists of mostly pole-stage cottonwoods and some sapling cottonwoods. In this phase, the stream channel has moved farther away and the ground-water table has lowered. The tree canopy is typically 60 to 80 percent, with tree diameters of 3 to 11 inches diameter at breast height (DBH). Higher seral species such as yellow willow dominate the understory, and redosier dogwood is becoming more common. Other shrub species that may be present are sandbar willow, Woods' rose (*Rosa woodsii*), and silver buffaloberry (*Shepherdia argentea*). The herbaceous understory is typically dominated by non-native species such as smooth brome and Kentucky bluegrass. Native species such as Canada wildrye may also be present.

Community 1.3
Mature Cottonwood – Dogwood Community

In the Mature Cottonwood – Dogwood Phase (1.3), the overstory consists of mature, old-growth cottonwoods. The tree canopy varies from 40 to 90 percent, with tree diameters of 12 inches or more DBH. The understory is characterized by a dense and diverse shrub layer. Common shrubs are redosier dogwood, chokecherry, Woods' rose, yellow willow, currant (Ribes spp.), and western snowberry (*Symphoricarpos occidentalis*). As time progresses, the cottonwoods begin to die off and the stand thins. Other native trees such as green ash begin to inhabit the understory and will eventually replace the cottonwood stand (Hansen et al., 1995). The herbaceous layer remains dominated by non-native species. The most common are smooth brome and Kentucky bluegrass, but quackgrass and annual bromes may also occur.

Community 1.4
Green Ash - Juniper/Shrub Community

The Green Ash - Juniper/Shrub Phase (1.4) occurs after extremely long periods without disturbance by flooding. The channel has migrated away from the site, the ground-water table is no longer a significant contributor to site moisture, and the site is on the verge of transitioning to a drier ecological site. Cottonwoods are rare or absent and the overstory is dominated by green ash and juniper. Common shrubs may include chokecherry, snowberry, or buffaloberry. Herbaceous species are dominated by non-native species but begin to shift to more drought-tolerant species, such as Kentucky bluegrass and field brome (*Bromus arvensis*). Unless the channel begins to migrate back toward the site, this phase will eventually transition to a drier site, such as Overflow or Swale.

Community 1.5
Mature Cottonwood – Snowberry Community

The Mature Cottonwood – Snowberry Phase (1.5) occurs due to improper grazing management of the Mature Cottonwood – Dogwood Phase (1.3). The diversity of the shrub understory is significantly reduced, and desirable species such as redosier dogwood have been replaced by less desirable species such as western snowberry and Woods' rose. The overstory consists of mature, old-growth cottonwoods. The tree canopy varies from 40 to 90 percent, with tree diameters of 12 inches or more DBH. As time progresses, the cottonwoods begin to die off and are replaced by other trees, such as green ash. The herbaceous layer is dominated by non-native species, particularly smooth brome.

Pathway P1.1a
Community 1.1 to 1.2

Lack of flooding disturbance, natural plant growth, bank building, or a combination of these factors shift the Seedling Cottonwood – Sandbar Willow Phase (1.1) to the Pole Cottonwood – Yellow Willow Phase (1.2). Time periods with little or no disturbances permit natural growth of the overstory. The stream channel typically is migrating away from the site at this time. Distance to the water table increases, and some shade-tolerant shrubs start to inhabit the understory.

Pathway P1.2a
Community 1.2 to 1.1

Flooding, bank scouring by ice jams, or a combination of these factors shift the Pole Cottonwood – Yellow Willow Phase (1.2) to the Seedling Cottonwood – Sandbar Willow Phase (1.1). Flood control has reduced the occurrence of this transition, and it is typically confined to lower terraces near the channel.

Pathway P1.2b
Community 1.2 to 1.3

Decades of low disturbance, bank building, and lowering of the water table transition the Pole Cottonwood – Yellow Willow Phase (1.2) to the Mature Cottonwood – Dogwood Phase (1.3). The cottonwood overstory matures and begins to self-thin. The canopy starts to open, promoting understory growth.

Pathway P1.3b
Community 1.3 to 1.1

Channel migration associated with major flooding or a stand-replacing fire transitions the Mature Cottonwood – Dogwood Phase (1.3) to the Seedling Cottonwood – Sandbar Willow Phase (1.1). A major flood event that causes the river channel to migrate or a stand-replacing fire that exposes the bank to scouring and collapse will effectively revert the site back to an alluvial bar and begin the process of succession over again.

Pathway P1.3a
Community 1.3 to 1.4

Extremely long periods of low disturbance, bank building, and lowering of the water table transition the Mature Cottonwood – Dogwood Phase (1.3) to the Green Ash - Juniper/Shrub Phase (1.4). The exact length of time required for this transition is unknown, but is estimated to be 80 to 100 years. The majority of the cottonwood stand has died out and has been replaced by green ash, juniper, and facultative shrubs. At this point, the site is transitioning to a more upland site rather than a riparian site.

Pathway P1.3c
Community 1.3 to 1.5

Improper grazing management transitions the Mature Cottonwood – Dogwood Phase (1.3) to the Mature Cottonwood – Snowberry Phase (1.5). Improper grazing management will reduce the diversity of the shrub understory, reducing canopy cover of redosier dogwood and chokecherry. The understory will become dominated by western snowberry and Wood's rose (Hansen et al., 1995).

Pathway P1.4a
Community 1.4 to 1.1

Channel migration associated with major flooding or a stand-replacing fire transitions the Green Ash - Juniper/Shrub Phase (1.4) to the Seedling Cottonwood - Sandbar Willow Phase (1.1). A major flood event that causes the river channel to migrate back to the site in combination with bank slumping or a stand-replacing fire that exposes the bank to scouring and collapse will effectively revert the site back to an alluvial bar and begin the process of succession over again.

Pathway P1.5b
Community 1.5 to 1.1

Channel migration associated with major flooding or a stand-replacing fire transitions the Mature Cottonwood – Snowberry Phase (1.5) to the Seedling Cottonwood – Sandbar Willow Phase (1.1). A major flood event that causes the river channel to migrate or a stand-replacing fire that exposes the bank to scouring and collapse will effectively revert the site back to an alluvial bar and begin the process of succession over again.

Pathway P1.5a
Community 1.5 to 1.3

Proper grazing management will return the Mature Cottonwood – Snowberry Phase (1.5) to the Mature Cottonwood

– Dogwood Phase (1.3).

State 2
Herbaceous Understory State

The Herbaceous Understory State (2) occurs when the shrub understory has been removed due to long-term improper grazing practices. The overstory typically consists of a mature, open cottonwood stand but may include other trees in some cases. The tree canopy is about 40 percent or less with tree diameters of 12 inches or more DBH. The understory consists primarily of non-native grasses, particularly smooth brome. Noxious weeds such as leafy spurge (*Euphorbia esula*) and Canada thistle (*Cirsium arvense*) may be prominent in some cases. Once the site has converted from a shrub-dominated understory to one dominated by introduced herbaceous species, returning it to its former state is very difficult. A drastic change in management is needed, and it most likely will be labor intensive and costly (Hansen et al., 1995).

Community 2.1
Native Tree/Smooth Brome Community

The Native Tree/Smooth Brome Phase (2.1) consists of a mature, open tree overstory with a non-native grass understory. The overstory is typically plains cottonwood but may also include green ash, juniper, box elder (*Acer negundo*), or other native tree species. The understory is dominated by the introduced grass smooth brome but may also include other species, such as Kentucky bluegrass and quackgrass.

Community 2.2
Native Tree/Noxious Weed Community

The Native Tree/Noxious Weed Phase (2.2) consists of a mature, open tree overstory with a noxious weed understory. This community develops when removal of the understory by improper grazing occurs in proximity to a noxious weed seed source. The overstory is typically plains cottonwood but may also include green ash, juniper, box elder (*Acer negundo*), or other native tree species. The understory is dominated by noxious weeds, particularly leafy spurge, Canada thistle, and Russian knapweed (*Acroptilon repens*).

State 3
Invasive Tree State

The Invasive Tree State (3) occurs when invasive tree species, particularly Russian olive, establish and dominate the site. Russian olive is a highly competitive tree native to southern Europe and western Asia. It is widely established and commonly forms dense thickets at the exclusion of native species (Hansen et al., 1995). In more open stands, Russian olive may occur in conjunction with widely scattered cottonwood stands and native shrubs, such as snowberry and Woods' rose. As the cottonwood stand dies out, Russian olive will replace it at the exclusion of the typical native tree species.

Community 3.1
Russian Olive/Shrub Community

The Russian Olive/Shrub Phase (3.1) occurs in open stands on older alluvial bars and terraces. The overstory is dominated by Russian olive; however, an open, decadent stand of cottonwoods may be present in some cases. The understory is sparse, and diversity is low. Primary understory species are snowberry and Woods' rose. Herbaceous species are dominated by non-native grasses, particularly smooth brome.

Community 3.2
Russian Olive/Noxious Weed Community

The Russian Olive/Noxious Weed Phase (3.2) occurs on flood plains and terraces, particularly where soils are slightly to moderately saline. Under these conditions, Russian olive typically forms a dense thicket at the exclusion of native tree species. The understory is extremely suppressed and is predominately noxious weeds. Canada thistle and leafy spurge are common understory species.

State 4
Cropland State

The Cropland State (4) occurs when land is put into cultivation. Deep, fertile soils and favorable moisture conditions make the Riparian Woodland ecological site prime farmland. Additionally, its proximity to perennial streams makes it ideal for irrigation. Because of this, many acres of the Riparian Woodland ecological site have been cleared and converted to farmland. It is commonly planted to non-native perennial species and irrigated for production of hay. Common species include alfalfa, orchardgrass, and grass/alfalfa mixes. Annual crops, such as wheat and barley, are commonly planted in rotation with perennial species. Silage corn is grown is some cases, but this crop is of limited extent. Flood irrigation is most common, but center pivot sprinklers are used in some areas. Cropping, irrigation projects, and the Fort Peck dam have vastly altered vegetation and hydrology on much of the Riparian Woodland ecological site. Once the site is converted to production agriculture, land values increase significantly, and it is unlikely that the site will be converted back to natural vegetation.

Community 4.1
Cropland Community

Typically non-native, perennial hay with annual, cool season cereal grains (such as wheat or barley) in rotation. Occasionally corn is grown for silage.

Transition T1A
State 1 to 2

Prolonged improper grazing management in combination with the absence of flooding disturbance transitions the Contemporary Reference State (1) to the Herbaceous Understory State (2). Prolonged improper grazing will eventually completely remove the shrub understory layer, leaving an understory of herbaceous vegetation. Long periods of low disturbance have built up banks and lowered the water table.

Transition T1C
State 1 to 3

Establishment of invasive tree species, particularly Russian olive, transitions the Contemporary Reference State (1) to the Invasive Tree State (3).

Transition T1B
State 1 to 4

Clearcutting, tillage or application of herbicide, and seeding of cultivated crops (such as wheat, barley or introduced hay) transitions the Contemporary Reference State (1) to the Cropland State (4).

Restoration pathway R2C
State 2 to 1

Proper grazing management, tree/shrub planting, and intensive weed management can transition the Herbaceous Understory State (2) back to the Contemporary Reference State (1). A change in management alone may not be sufficient. Replanting of desirable species and intensive weed management practices are generally needed in conjunction with proper grazing management. These restoration methods are labor intensive and costly and may not be a practical in all situations.

Conservation practices

Prescribed Grazing
Tree/Shrub Establishment
Herbaceous Weed Control

Transition T2A

State 2 to 3

Establishment of invasive tree species, particularly Russian olive, transitions the Herbaceous Understory State (2) to the Invasive Tree State (3).

Transition T2B
State 2 to 4

Clear cutting, tillage or application of herbicide, and seeding of cultivated crops (such as wheat, barley, or introduced hay) transitions the Herbaceous Understory State (2) to the Cropland State (4).

Restoration pathway R3A
State 3 to 2

Removal of invasive tree species transitions the Invasive Tree State (3) to the Herbaceous Understory State (2). Typically, tree/shrub planting is required to reestablish native woody species. When clearing the Russian Olive/Noxious Weed Phase (4.2), intensive weed management is critical. Removal of the overstory will release understory growth and cause noxious weed populations to increase exponentially. This transition is very costly and labor intensive and may not be practical in all situations.

Conservation practices

Brush Management
Tree/Shrub Establishment
Herbaceous Weed Control

Transition T3B
State 3 to 4

Clear cutting, tillage or application of herbicide, and seeding of cultivated crops (such as wheat, barley, or introduced hay) transitions the Invasive Tree State (3) to the Cropland State (4).

Additional community tables

Inventory data references

No field plots were available for this site. Information from existing ecological site documents, a review of the scientific literature, and professional experience were used to approximate the plant communities for this provisional ecological site. Information for the state-and-transition model was obtained from the same sources. All community phases are considered provisional based on these plots and the sources identified in this ecological site description.

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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)	
Contact for lead author	
Date	04/24/2024
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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):**

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:**

17. **Perennial plant reproductive capability:**