USDA Natural Resources Conservation Service

Ecological site R010XY013OR
Booth-Geyer-Yellow Willow Riparian

Last updated: 12/13/2023
Accessed: 05/12/2024

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): 010X–Central Rocky and Blue Mountain Foothills

This MLRA is characterized by gently rolling to steep hills, plateaus, and low mountains at the foothills of the Blue Mountains in Oregon and the Central Rocky Mountains in Idaho. The geology of this area is highly varied and ranges from Holocene volcanics to Cretaceous sedimentary rocks. Mollisols are the dominant soil order and the soil climate is typified by mesic or frigid soil temperature regimes, and xeric or aridic soil moisture regimes. Elevation ranges from 1,300 to 6,600 feet (395 to 2,010 meters), increasing from west to east. The climate is characterized by dry summers and snow dominated winters with precipitation averaging 8 to 16 inches (205 to 405 millimeters) and increasing from west to east. These factors support plant communities with shrub-grass associations with considerable acreage of sagebrush grassland. Big sagebrush, bluebunch wheatgrass, and Idaho fescue are the dominant species. Stiff sagebrush, low sagebrush, and Sandberg bluegrass are often dominant on sites with shallow restrictive layers. Western juniper is one of the few common tree species and since European settlement has greatly expanded its extent in Oregon. Nearly half of the MLRA is federally owned and managed by the Bureau of Land Management. Most of the area is used for livestock grazing with areas accessible by irrigation often used for irrigated agriculture.

Classification relationships

No associated classifications or plant associations have been identified for this site.

Ecological site concept

In reference condition, this riparian site supports a plant community dominated by Booth's (Salix boothii), Geyer (Salix geyeriana) and yellow willow (Salix lutea). Occupying depositional floodplains along rivers and streams, this site has low slope angles of 0 to 3 percent, gradients of less than 0.2/100 ft and high sinuosity. The soil climate of this site is mesic near frigid. Historically, the prominence of willow would have helped to anchor and stabilize stream banks from excessive erosion. Lateral stream movement, and erosion/deposition processes would have been within a historical range of variation according to hydrologic disturbances such as floods, vegetation and channel alterations by beaver, and climate patterns that influence seasonal flows. Currently, much of this site has lost willow cover and has been invaded by meadow foxtail (Alopecurus pratensis) and reed canarygrass (Phalaris arundinacea). Additionally, much of this site has been impacted by alterations to associated streams resulting in geomorphic changes to sinuosity, gradient and stream width to depth ratio as well as reduced stream shading and loss of native vegetation.

This is a provisional ecological site whose accelerated development from a draft site was undertaken with little to no field verification and is subject to extensive review and revision before final approval. All data herein was developed using existing information and literature and should be considered provisional and contingent upon field validation prior to use in conservation planning.

Associated sites

R010XY003OR	**Wet Meadow** Wet Meadow (hydric soil, long duration seasonal water table at or near the surface, mesic to frigid near mesic soil temperature, anaerobic conditions, different composition - CAREX-DECE association)
R010XY004OR	**Meadow** Meadow (hydric soil, shorter duration seasonal water table near the surface, mesic to frigid near mesic soil temperature, anaerobic conditions, different composition - DECE-CAREX-JUNCU association)
R010XY005OR	**Loamy Bottom** Loamy Bottom (greater depth to water table, higher terrace, mesic to frigid near mesic soil temperature, different composition – basin wildrye strongly dominant, basin big sagebrush present)

Similar sites

R010XY012OR	**Booth-Yellow Willow Riparian** Stream channel & bank position, mesic to frigid near mesic soil temperature regime, different composition– SABO2-SALU2/CAREX complex)
R010XY010OR	**Coyote Willow Riparian** Narrowleaf willow dominant, mesic soil temperature regime
R010XY011OR	**Cottonwood-Willow-Riparian** Willow and cottonwood dominant, mesic soil temperature regime

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Salix boothii* (2) *Salix lutea*
Herbaceous	(1) *Carex*

Physiographic features

This site occurs on depositional floodplains along perennial streams and rivers. Slopes range from 0 to 3 percent. Elevation varies from 3,400 to 3,800 feet (1,050 to 1,050 meters). Streams are·sinuous with a meandering configuration (E type). They have flat, low energy gradients. Sinuosities are usually greater than 1.5 and gradients are less than 0.2/100 ft. Floodplains are well connected. Overhanging stable banks are prominent. Sediment transport and deposition is limited to fine sediments with relatively little gravel recruitment and transportation. Lateral movement of the channel continue to rework existing deposits, exposing them, and providing areas for colonization of herbaceous and woody species. Alluvial bars are formed from silts to fine sands and gravels. They make up approximately 20 percent of the riparian area. Shading of banks by the typical mid story willows averaging 15 feet in height is good. However, overall stream shading on larger stream systems is low. Mid-day summer shade would average about 9 percent on a 40 foot width east/west river. Shade from banks occupied by only herbaceous species is 0 to 2 percent. A water table may be present from 5 to 23 inches (25 to 60 cm) below the soil surface from winter through spring.

Table 2. Representative physiographic features

Landforms	(1) Valley > Flood plain
Flooding duration	Brief (2 to 7 days)
Flooding frequency	Occasional
Ponding frequency	None
Elevation	1,036–1,158 m
Slope	0–3%
Water table depth	13–58 cm
Aspect	Aspect is not a significant factor

Climatic features

Precipitation is 9 to 12 inches (225 to 300 mm) on average occurring primarily as rain and snow November through March. Soil temperature regimes are mesic near frigid. The frost-free period is 90 to 120 days. Climate graphs are based on the nearest available climate stations to representative site locations and are provided to indicate general climate patterns.

Table 3. Representative climatic features

Frost-free period (characteristic range)	90-120 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	229-305 mm
Frost-free period (average)	100 days
Freeze-free period (average)	
Precipitation total (average)	279 mm

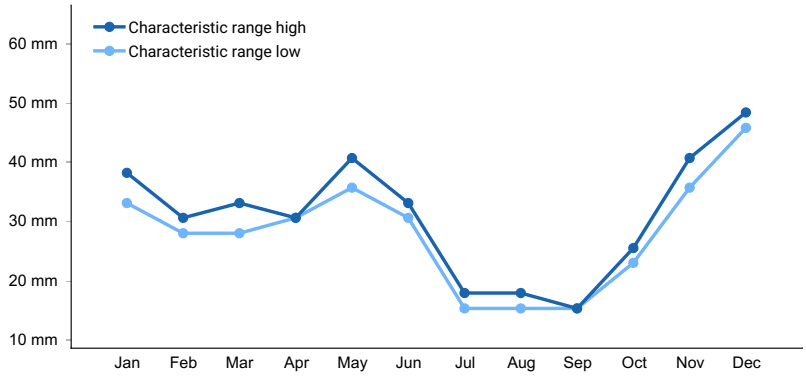


Figure 1. Monthly precipitation range

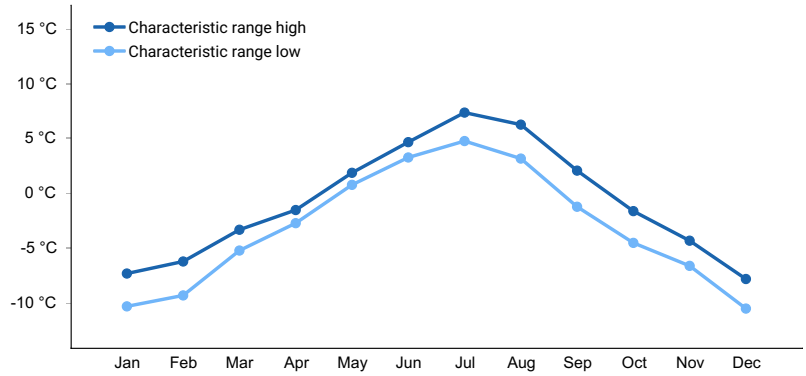


Figure 2. Monthly minimum temperature range

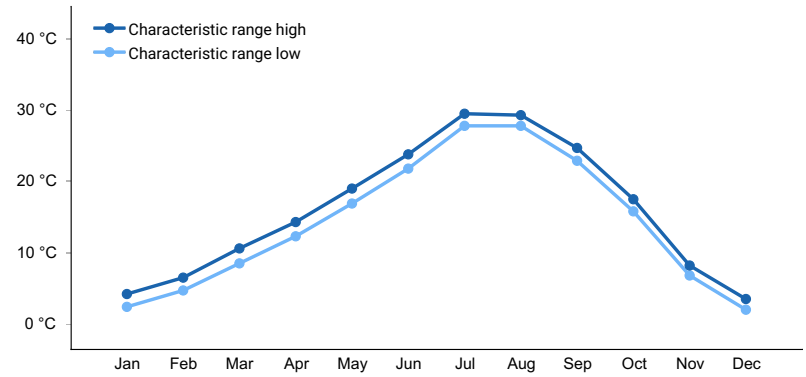


Figure 3. Monthly maximum temperature range

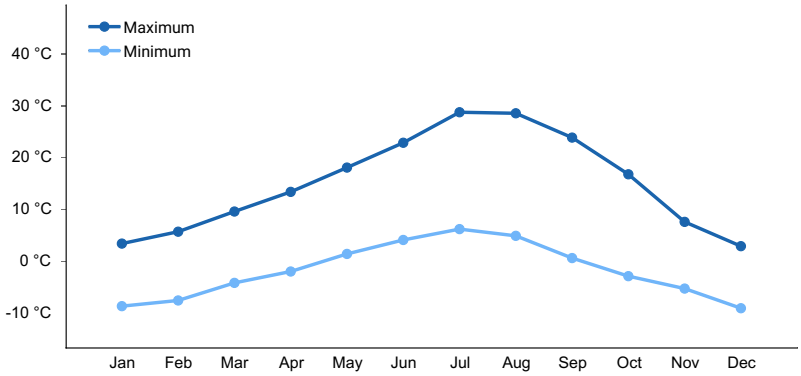


Figure 4. Monthly average minimum and maximum temperature

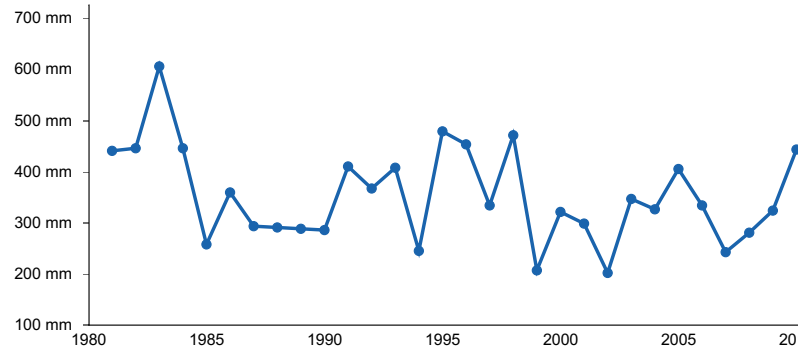


Figure 5. Annual precipitation pattern

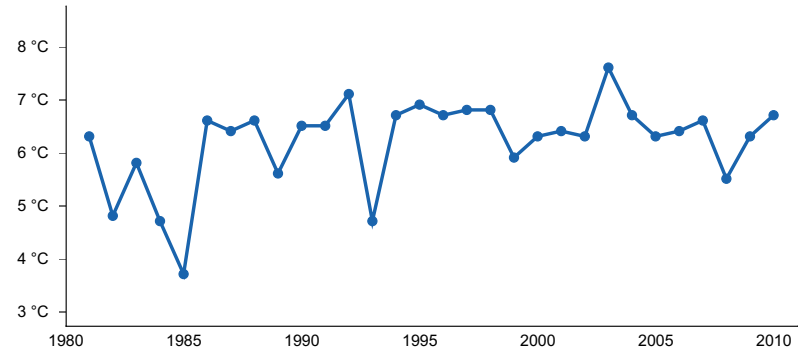


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SENECA [USC00357675], Seneca, OR
- (2) BARNES STN [USC00350501], Prineville, OR

Influencing water features

The water table of this site is influenced by the adjacent stream which in a natural functioning system is controlled by beavers, large woody debris inputs, and climate. Drought and other climate cycles influence the watershed snowpack and rainfall, and natural disturbances, such as fire, insects and disease, modify local and upland plant communities influencing the natural system function. Currently, stream levels and water tables are often modified by irrigation withdrawals, channel modifications, upland vegetation change, beaver removal, large woody debris removal, road construction and stream impoundment.

Wetland description

Not defined.

Soil features

The soils of this site are typically recent, very deep, and somewhat poorly to very poorly drained. Surface textures range from clay loam to sandy loam, 10 to 30 inches thick and may be influenced by volcanic ash. Due to prolonged saturation some surfaces may develop peaty or mucky textures. The subsoil texture ranges from gravelly sandy loam to extremely gravelly loamy sand about. Depth to alluvial gravelly and cobbly sediments is variable but averages 30 to over 40 inches. Soil permeability is moderately slow to rapid. See Luckybutte series for modal soil concept associated with this site.

Table 4. Representative soil features

Parent material	(1) Alluvium–volcanic rock
Surface texture	(1) Silt loam (2) Mucky silt loam
Family particle size	(1) Fine-loamy over sandy or sandy-skeletal
Drainage class	Somewhat poorly drained to very poorly drained
Permeability class	Moderately slow to rapid
Soil depth	203 cm
Surface fragment cover <=3"	0–30%
Surface fragment cover >3"	0–30%
Available water capacity (0-101.6cm)	10.16–20.32 cm
Soil reaction (1:1 water) (0-101.6cm)	6.6–7.8
Subsurface fragment volume <=3" (10.2-152.4cm)	10–45%
Subsurface fragment volume >3" (10.2-152.4cm)	0–20%

Ecological dynamics

This willow riparian site complex is composed of several distinct plant community components which are adapted to various channel and bank configurations based on the depth and duration of seasonal surface and subsurface flows. The site occupies three riparian zones, the toe zone, bank zone and over bank zone. Within the toe zone, silty point bars are initially dominated by sedges and bulrush while gray coyote willow, a rhizomatous species, occurs on gravelly bars. The extent and duration of surface flows and ground water have a major affect on site composition and production of these three plant community components.

When the condition of the site complex deteriorates as a result of improperly managed grazing, willows rapidly decrease along with palatable grasses and sedges. Willows are severely impacted by heavy late summer-fall use when the protein content and palatability is greater than maturing grasses and grass-like plants. Willows, and sedges decrease. Reed canarygrass and meadow foxtail rapidly invade as long as the primary stream is connected to the floodplain and a high water table is present.

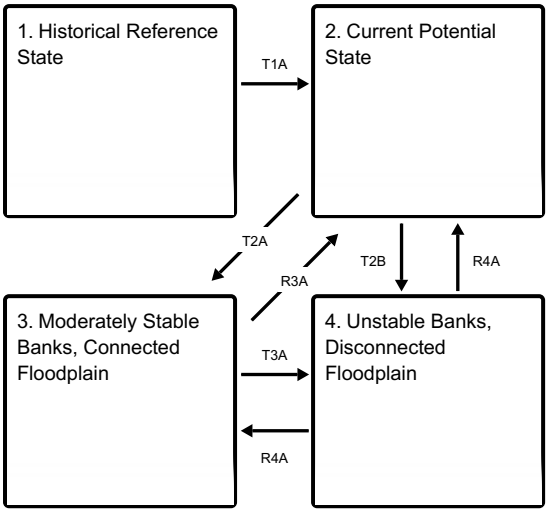
With loss of willows and lack of bank and toe cover, channels rapidly degrade during runoff events. Floodplain connectivity is lost, flows become concentrated, velocities increase and erosion is accelerates. The primary channel becomes deeper and wider in essence becoming a transportation reach. As the water table drops subsurface flows and storage of water for late season flows are reduced, the site becomes drier and production decreases. The initial rapid down cutting is followed by continued degradation as the incised channel widens. With widening of the incised channel an entrenched narrow flood plain slowly develops.

On lower elevation bottomlands channel straightening, deepening and drainage practices are often implemented to use the excellent floodplain soils for intense agriculture activities, transportation corridors and urban development. The hydrology effect is the conversion of a deposition reach with an active floodplain to a sediment transportation

reach. With a narrowed steeper reach, stabilization practices are needed in combination with natural processes to promote the development of an entrenched stable narrow floodplain.

State and transition model

Ecosystem states



T1A - Invasion of reed canarygrass and meadow foxtail

T2A - Improperly managed grazing during times of year when willow is most vulnerable to decline or most susceptible to overuse. Removal of willow by mechanical means.

T2B - Alteration of hydrologic function

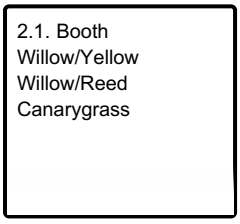
R3A - Restoration of hydrologic and biotic process and function

T3A - Alteration of hydrologic function

R4A - Restoration of hydrologic and biotic process and function

R4A - Time elapsed with adequate sediment loads and hydrologic function to support natural channel evolution processes

State 2 submodel, plant communities



State 1
Historical Reference State

Booth willow/Geyer willow/ Yellow willow/Unknown Understory This represents the reference state in pristine conditions. This state may be uncommon due to widespread invasion of reed canarygrass into this site. Erosion and deposition processes are within a historical range of variation, variability in depth to water table and seasonal fluctuations support native vegetation and vegetated communities include all historical functional and structural groups. The historical disturbance regime is intact and driven primarily by climate which influences drought and flood cycles. The resilience and resistance of the site is bolstered by negative feedbacks between vegetation establishment and hydrologic processes that maintains a dynamic equilibrium with geomorphological processes.

Dominant plant species

- Booth's willow (*Salix boothii*), shrub
- yellow willow (*Salix lutea*), shrub
- Geyer willow (*Salix geyeriana*), shrub
- sedge (*Carex*), grass

State 2

Current Potential State

This state is similar to the reference state yet includes a component of invasive species such as reed canarygrass and meadow foxtail. Ecological process and function have not been altered fundamentally by this low level of invasion, yet resistance and resilience is decreased. Erosion and deposition processes are still within a historical range of variation, yet are at risk of transitioning to a less stable state, variability in depth to water table and seasonal fluctuations support native vegetation and vegetated communities include all historical functional and structural groups, yet composition and richness may be reduced. The historical disturbance regime is intact and driven primarily by climate which influences drought and flood cycles. The resilience and resistance of the site is bolstered by negative feedbacks between vegetation establishment and hydrologic processes that maintains a dynamic equilibrium with geomorphological processes. This state is common due to widespread invasion of reed canary grass in the Western US.

Dominant plant species

- Booth's willow (*Salix boothii*), shrub
- yellow willow (*Salix lutea*), shrub
- Geyer willow (*Salix geyeriana*), shrub
- sedge (*Carex*), grass
- reed canarygrass (*Phalaris arundinacea*), grass
- meadow foxtail (*Alopecurus pratensis*), grass

Community 2.1
Booth Willow/Yellow Willow/Reed Canarygrass

Inside curves with point bars typically make up 20 percent of the associated mapping unit. Silty point bars are initially dominated by sedges and bulrush while coyote willow, a rhizomatous species occurs on gravelly bars. As willows decrease reed canarygrass becomes strongly dominant. In areas of low gradient, meandering, deep narrow streams with ready access to the floodplain, reed canarygrass holds overhanging banks together. In areas of straightened.or higher gradients lower successional states often occur with various degrees of bank erosion.

Dominant plant species

- Booth's willow (*Salix boothii*), tree
- yellow willow (*Salix lutea*), tree
- western dogwood (*Cornus sericea ssp. occidentalis*), shrub
- reed canarygrass (*Phalaris arundinacea*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	560	1121	1681
Tree	448	897	1345
Shrub/Vine	112	224	336
Forb	–	–	–
Total	**1120**	**2242**	**3362**

State 3
Moderately Stable Banks, Connected Floodplain

Relative to the current potential state, basin wildrye has decreased while bluegrasses increase or invade. With further deterioration, willow and other palatable shrubs decrease, unpalatable shrubs increase, annuals invade and bareground markedly increases. Reed canarygrass and meadow foxtail are common in community. Erosion and bank instability will increase and risk a transition to state 4. Typically, channel types are E, sinuosity is greater than 1.5, gradient is less than 0.2/100 ft and width to depth ratio is less than 12. Decreased bank stability make the site vulnerable to channel widening and incision during large runoff events and transitioning to state 4. Reed canarygrass may provide bank stability of overhanging banks, yet it declines where connectivity to the water table is

not available. This state also includes stable analogue channels that have reformed following channel incision, widening and the creation new floodplains.

Dominant plant species

- willow (*Salix*), shrub
- reed canarygrass (*Phalaris arundinacea*), grass
- meadow foxtail (*Alopecurus pratensis*), grass
- bluegrass (*Poa*), grass

State 4
Unstable Banks, Disconnected Floodplain

This state is characterized by straightened reaches with higher gradients, reduced sinuosity, unstable banks and disconnected floodplains. Chanel types are C, sinuosity is less than 1.5, gradient is greater than 0.2/100 ft and width to depth ratio is greater than 12. Reed canarygrass and meadow foxtail have become strongly dominant where willows and other woody riparian vegetation have been reduced. This leads to bank erosion and reduced stream shading (less than one percent in mid-summer). Channel widening and incision are common in this state as unstable banks and vegetation loss create a positive feedback loop that decreases resilience to runoff events. Point bars may still support narrowleaf willow and are characterized by gravels, as sand and silt has been lost. Abandoned floodplains transition into terraces and are dominated by drought adapted species that do not require a connection to the water table.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- reed canarygrass (*Phalaris arundinacea*), grass
- bluegrass (*Poa*), grass

Transition T1A
State 1 to 2

Invasion of reed canarygrass and meadow foxtail

Transition T2A
State 2 to 3

Improperly managed grazing during times of year when willow is most vulnerable to decline or most susceptible to overuse. Removal of willow by mechanical means.

Transition T2B
State 2 to 4

This transition may be the result of several disturbances that lower water tables beyond depths that support riparian woody vegetation, alter sediment supply and transport leading to scouring and channel incision, or directly increase flow velocities or flashiness. These may include: alteration of streamflow by irrigation or impoundment leading to a lowering of the water table during times of year when riparian woody vegetation is dependent; removal of beaver; direct manipulation of channel morphology (namely straightening for agricultural or development purposes); removal of large woody debris or large woody debris sources, from channels or adjacent forests and significant alterations of upland watershed vegetation altering peak discharge or sediment loads.

Restoration pathway R3A
State 3 to 2

Restoration of hydrologic and biotic process and function through rehabilitation of channel and vegetation structure may be possible but will require considerable inputs, time and cost. This may require the placement of large woody debris, creation or removal of impoundments, alteration of water withdrawals, management changes to adjacent agricultural or grazing practices, or mechanical manipulation of stream channel courses among other intensive

interventions. Restoration options will be highly site specific and may not be possible in many circumstances.

Transition T3A
State 3 to 4

This transition may be the result of several disturbances that lower water tables beyond depths that support riparian woody vegetation, alter sediment supply and transport leading to scouring and channel incision, destabilize banks, or directly increase flow velocities or flashiness. These may include: alteration of streamflow by irrigation or impoundment leading to a lowering of the water table during times of year when riparian woody vegetation is dependent; removal of beaver; direct manipulation of channel morphology (namely straightening for agricultural or development purposes); removal of large woody debris or large woody debris sources, from channels or adjacent forests; sustained improperly managed grazing for many seasons; and significant alterations of upland watershed vegetation altering peak discharge or sediment loads. This state will be more vulnerable to these changes compared to state 2 given less stable banks and lower cover of riparian woody vegetation.

Restoration pathway R4A
State 4 to 2

Restoration of hydrologic and biotic process and function through rehabilitation of channel and vegetation structure may be possible but will require considerable inputs, time and cost. This may require the placement of large woody debris, creation or removal of impoundments, alteration of water withdrawals, management changes to adjacent agricultural or grazing practices, or mechanical manipulation of stream channel courses among other intensive interventions. Restoration options will be highly site specific and may not be possible in many circumstances.

Transition R4A
State 4 to 3

Given time, if natural channel evolution processes are allowed to take place, and sediment loads are adequate, the stream will form an entrenched floodplain at a lower depth then the original. The original floodplain will become a terrace, disconnected from the water table and supporting drought adapted plant species. The resulting riparian area will be more confined and of significantly less extent than originally and the capacity of the basin to store water will be reduced considerably.

Additional community tables

Table 6. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Grasses/Grasslikes**			942–1793	
	reed canarygrass	PHAR3	*Phalaris arundinacea*	673–1121	–
	meadow foxtail	ALPR3	*Alopecurus pratensis*	224–448	–
	sedge	CAREX	*Carex*	45–224	–
2	**Other Perennial Grasses/Grasslikes**			22–45	
	panicled bulrush	SCMI2	*Scirpus microcarpus*	22–45	–
Forb					
4	**Forbs**			–	
Shrub/Vine					
7	**Shrubs**			135–45	
	western dogwood	COSEO	*Cornus sericea ssp. occidentalis*	45–224	–
	rose	ROSA5	*Rosa*	45–112	–
	golden currant	RIAU	*Ribes aureum*	45–112	–
Tree					
6	**Trees**			785–1457	
	Booth's willow	SABO2	*Salix boothii*	448–673	–
	yellow willow	SALU2	*Salix lutea*	224–448	–
	narrowleaf willow	SAEX	*Salix exigua*	112–336	–

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Contributors

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Approval

Kirt Walstad, 12/13/2023

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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	05/12/2024
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:**

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

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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):**

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

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

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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):**

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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:

    Sub-dominant:

    Other:

    Additional:

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

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state**

for the ecological site:

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17. **Perennial plant reproductive capability:**
