USDA Natural Resources Conservation Service

Ecological site R010XY010OR
Coyote 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

Riparian and Wetland Vegetation of Central and Eastern Oregon (Crowe, Kovalchik and Kerr 2004):
CEGL001200 - Salix exigua (S. exigua ssp. exigua)-Dry Alluvial Bar Association
Salix exigua/Eleocharis palustris-Schoenoplectus americanus Association

Ecological site concept

In reference condition, this riparian site supports a plant community dominated by narrowleaf willow (Salix exigua). Occupying depositional floodplains along low to moderate gradient rivers and streams, this site has low slope angles of 0 to 3 percent and variable sinuosity. The soil temperature regime of this site is mesic. Historically, the prominence of coyote 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 drought, flooding, vegetation and channel alterations by beaver, and climate patterns that influence seasonal flows. Currently, much of this site has been impacted by alterations to associated streams and/or invaded by reed canarygrass (Phalaris arundinacea) 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

R010XY009OR	**Sandy Bottom** Adjacent sandy bottomlands on upper terraces

Similar sites

R010XY011OR	**Cottonwood-Willow-Riparian** Cottonwood common
R010XY012OR	**Booth-Yellow Willow Riparian** Booth and yellow willow dominant, mesic to frigid near mesic soil temperature regime
R010XY014OR	**Clayey Bottom** Booth, yellow and geyer willow dominant, mesic near frigid soil temperature regime

Table 1. Dominant plant species

Tree	(1) *Salix exigua*
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

This site occurs on depositional floodplains along perennial streams and rivers. Slopes range from 0 to 3 percent. Elevation varies from 1,300 to 3,000 feet (400 to 900 meters). Associated streams and rivers usually have flat, low energy gradients of less than 0.3ft/l00ft. Sinuosity is variable from a meandering system having a sinuosity greater than 1.5 to confined river systems with sinuosities less than 1.5. Floodplains are well connected. Overhanging stable banks are prominent. Sediment transport and deposition is variable from fine sediments to gravels. Lateral movement of the channel continues 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. A water table may occur at 24 to 72 inches (60 to 180 cm) below the surface during spring and winter months.

Table 2. Representative physiographic features

Landforms	(1) Valley > Flood plain
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Rare to occasional
Ponding frequency	None
Elevation	396–914 m
Slope	0–3%
Water table depth	61–183 cm
Aspect	Aspect is not a significant factor

Climatic features

This site receives 9 to 12 inches (225 to 300mm) of mean annual precipitation occurring primarily as rain and snow November through March. Soil temperature regimes are mesic. 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)	105 days
Freeze-free period (average)	
Precipitation total (average)	279 mm

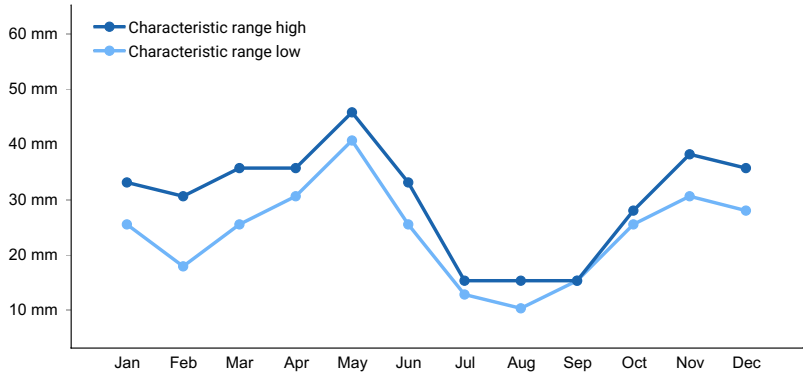


Figure 1. Monthly precipitation range

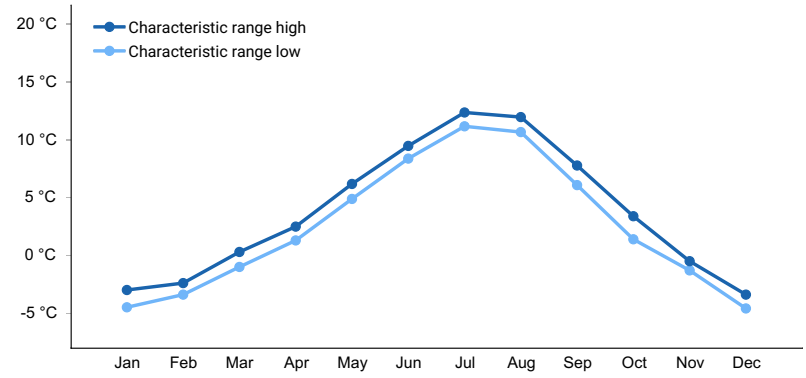


Figure 2. Monthly minimum temperature range

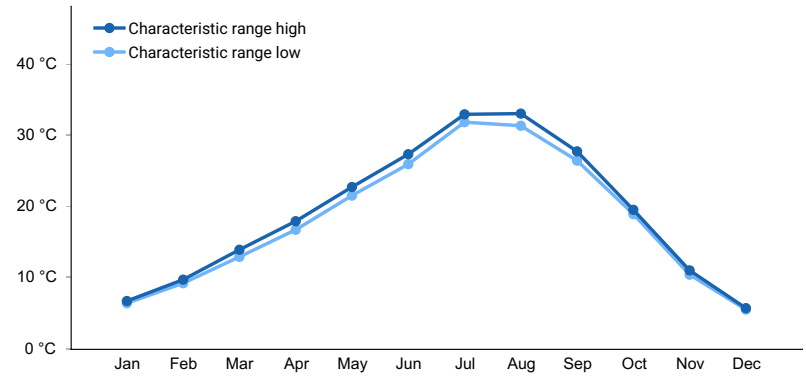


Figure 3. Monthly maximum temperature range

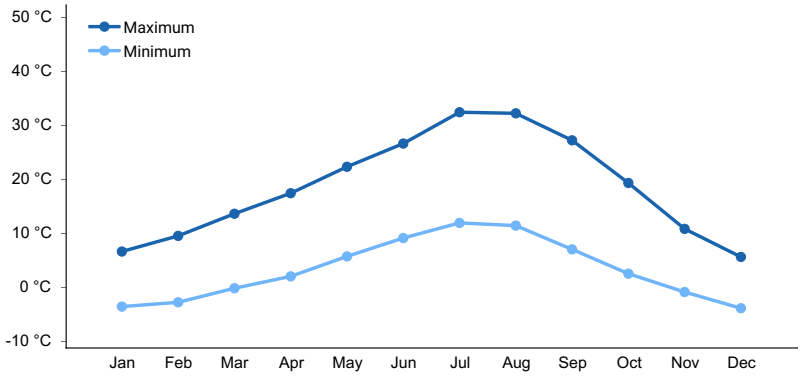


Figure 4. Monthly average minimum and maximum temperature

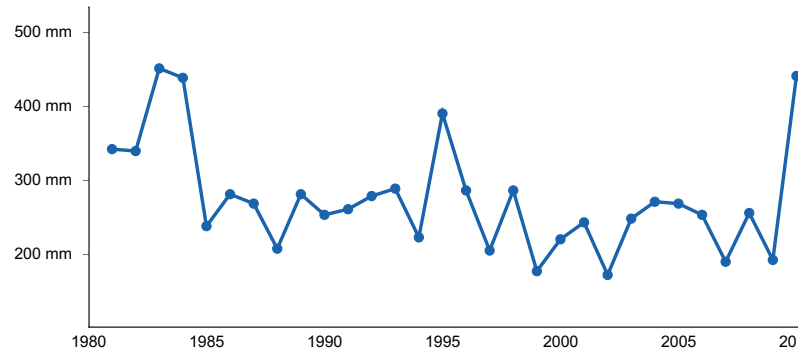


Figure 5. Annual precipitation pattern

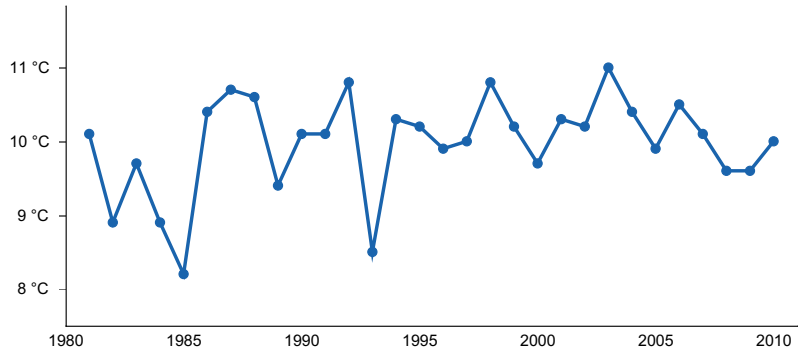


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MITCHELL 2 NW [USC00355641], Mitchell, OR
- (2) JOHN DAY 35 WNW [USW00004125], Mitchell, OR
- (3) MONUMENT 2 [USC00355711], Monument, OR

Influencing water features

The water table of this site is influenced by the adjacent stream course which in a natural functioning system is controlled by drought, beavers, large woody debris inputs, climate cycles that influence watershed snowpack and rainfall, and natural disturbances that modify local and upland plant communities such as fire, insects and disease. 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 described.

Soil features

Soils of this site consist of very deep, gravelly alluvium that are well to excessively drained. Soil textures range from fine sandy loam to sand and typically have 15 to 90 percent coarse fragments.

Table 4. Representative soil features

Parent material	(1) Alluvium–volcanic and sedimentary rock
Surface texture	(1) Silt loam (2) Sandy loam
Family particle size	(1) Loamy-skeletal (2) Sandy-skeletal
Drainage class	Moderately well drained
Permeability class	Moderate to moderately slow
Depth to restrictive layer	152–203 cm
Soil depth	152–203 cm
Surface fragment cover <=3"	0–30%
Surface fragment cover >3"	0–30%
Available water capacity (0-101.6cm)	5.08–15.24 cm
Soil reaction (1:1 water) (0-101.6cm)	7.9–8.4
Subsurface fragment volume <=3" (10.2-152.4cm)	15–45%
Subsurface fragment volume >3" (10.2-152.4cm)	15–45%

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 narrowleaf willow, a rhizomatous species, occurs on gravelly bars. The extent and duration of surface flows and groundwater have a major effect on site composition and production of these three plant community components.

Narrowleaf willow is very flood tolerant, very frost tolerant and drought resistant (Anderson 2006). Narrowleaf willow may respond to fluctuating water tables and floods by increasing secondary root growth and increasing root elongation. Vegetative sprouting from roots is an important form of reproduction and narrowleaf willow can often form large clonal colonies. Following fire, narrowleaf willow will often resprout from roots, root crowns and basal stems. As a flood adapted species, narrowleaf willow is adapted to continue growing through recently deposited sediment or reestablish where broken twigs are redeposited. Narrowleaf willow can be an important source of browse for livestock. One study in Oregon found combined utilization on gravel bars ranging from 27 to 48 percent for yellow and narrowleaf willow (Kauffman et al. 1983). It is also browsed by elk and heavily used by beaver. Narrowleaf willow’s rapid growth and spreading habit make it ideal for restoring many riparian areas. Heavy livestock grazing may reduce the density of willow in riparian areas and trampling may reduce establishment. It may re-establish quickly following grazing release if it has not been severely degraded (Anderson 2006).

An obligate wetland plant, reed canarygrass may reproduce rapidly through spreading rhizomes which may form a dense sod (Waggy 2010). This habit also allows the species to regrow following the removal of aboveground biomass by low to moderate severity fire, mechanical means or herbivory. Reed canarygrass can also spread into new sites from seed, which may form a soil seed bank that can resist flooding. Growth may be reduced by shading and can be severely reduced beneath an overstory canopy, such as that created by mature willow or riparian tree species. While there is debate on whether reed canarygrass is native or non-native to North America, invasive

populations of non-native strains or hybrids are widespread in the northwestern US (Waggy 2010). Reed canarygrass has been associated with decreased biodiversity in many wetland and riparian habitats. Additionally, the species may alter hydrologic flow of streams by forming a dense thatch and increase deposition by collecting entrained sediment (Waggy 2010).

Historically, the ecological dynamics of the site would have been influenced largely by climate cycles affecting seasonal runoff, droughts and flood. These processes would have been partly controlled by the type and cover of upland vegetation throughout the watershed which would have modified water capture, storage and sediment loads. These upland dynamics would have been altered by historical fire regimes and subsequently vegetation succession, erosion and runoff.

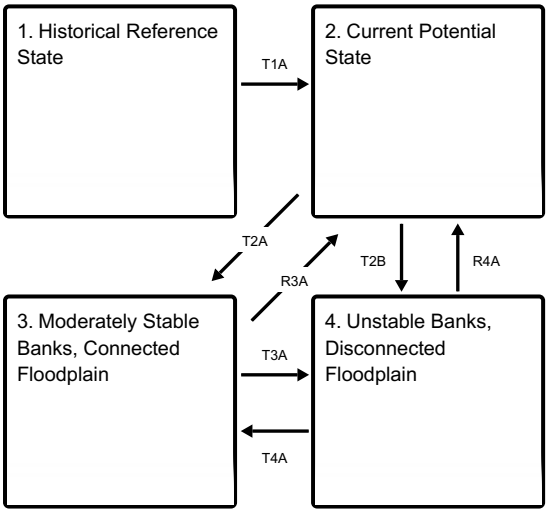
When the condition of the site complex deteriorates as a result of improperly managed grazing, willows rapidly decrease along with palatable grasses and sedges. Willows are severely impacted by heavy late summer-fall use when the protein content and palatability is greater than maturing grasses and grass-like plants. Willows, and sedges decrease. 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.

With loss of willows and lack of bank and toe cover, channels rapidly degrade during run-off 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

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

T2B - Alteration of hydrologic processes

R3A - Restoration of hydrologic and biotic process and function

T3A - Alteration of hydrologic processes

R4A - Restoration of hydrologic and biotic process and function

T4A - Time elapsed under sufficient sediment loads to form an entrenched floodplain

State 2 submodel, plant communities

2.1. Coyote Willow/Reed Canarygrass

State 1
Historical Reference State

This represents the historical 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

- narrowleaf willow (*Salix exigua*), shrub

State 2
Current Potential State

SAEX/PHAR3 - Coyote Willow/Reed Canarygrass This State is similar to the reference state with the exception of invasion of reed canary grass into the site. Erosion and deposition processes are still within a historical range of variation, yet are at risk of transitioning to a less stable state. All structural and functional plant groups are still present, 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

- narrowleaf willow (*Salix exigua*), shrub
- reed canarygrass (*Phalaris arundinacea*), grass

Community 2.1
Coyote Willow/Reed Canarygrass

Inside curves with point bars typically make up 20 percent of this site's mapping unit. Silty point bars are initially dominated by sedges and bulrush while narrowleaf willow, a rhizomatous species, occurs on gravelly bars.

Dominant plant species

- narrowleaf willow (*Salix exigua*), tree
- reed canarygrass (*Phalaris arundinacea*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	1295	1945	2589
Grass/Grasslike	891	1334	1782
Shrub/Vine	56	84	112
Forb	–	–	–
Total	**2242**	**3363**	**4483**

State 3
Moderately Stable Banks, Connected Floodplain

(PHAR3/ALPR3) Reed canarygrass/Meadow foxtail This State is characterized by a low gradient, meandering, deep and narrow stream with ready access to the floodplain. Chanel types are E and C, gradient is less than 0.2/100 ft, width to depth ratio is less than 12 and banks are moderately stable. Composition of willow and other native woody riparian vegetation has been reduced significantly, reducing mid summer shade to less than one percent and making 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. Point bars are characterized by sand, silt and gravels supporting sedge, bulrush and narrowleaf willow. This state also includes stable analogue channels that have reformed following channel incision, widening and creating new floodplains.

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), grass
- meadow foxtail (*Alopecurus pratensis*), grass

State 4
Unstable Banks, Disconnected Floodplain

PHAR3 - Reed canarygrass 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 variable. Reed canarygrass has 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

- reed canarygrass (*Phalaris arundinacea*), grass

Transition T1A
State 1 to 2

Invasion of reed canarygrass

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.

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 T4A
State 4 to 3

Given time, if natural channel evolution processes are allowed to take place, and sediment loads are sufficient, 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 Grass/Grasslikes**			1311–2387	
	reed canarygrass	PHAR3	*Phalaris arundinacea*	1009–1681	–
	sedge	CAREX	*Carex*	168–336	–
	panicled bulrush	SCMI2	*Scirpus microcarpus*	67–168	–
	common spikerush	ELPA3	*Eleocharis palustris*	34–101	–
2	**Other Perennial Grass/Grasslikes**			–	
	widefruit sedge	CAAN15	*Carex angustata*	–	–
	smoothsheath sedge	CALA14	*Carex laevivaginata*	–	–
	softstem bulrush	SCTA2	*Schoenoplectus tabernaemontani*	–	–
	bearded flatsedge	CYSQ	*Cyperus squarrosus*	–	–
Forb					
4	**Forbs**			–	
	leather flower	CLEMA	*Clematis*	–	–
	burdock	ARCTI	*Arctium*	–	–
	plantain	PLANT	*Plantago*	–	–
	desertparsley	LOMAT	*Lomatium*	–	–
	miner's lettuce	CLPE	*Claytonia perfoliata*	–	–
	monkeyflower	MIMUL	*Mimulus*	–	–
	mustard	BRASS2	*Brassica*	–	–
	trumpet	COLLO	*Collomia*	–	–
	speedwell	VERON	*Veronica*	–	–
Shrub/Vine					
7	**Shrubs**			67–168	
	rose	ROSA5	*Rosa*	67–168	–
8	**Other Shrubs**			–	
	western dogwood	COSEO	*Cornus sericea ssp. occidentalis*	–	–
	golden currant	RIAU	*Ribes aureum*	–	–
	Lewis' mock orange	PHLE4	*Philadelphus lewisii*	–	–
Tree					
6	**Trees**			2354–3026	
	narrowleaf willow	SAEX	*Salix exigua*	2354–3026	–

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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	08/07/2012
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None, moderate sheet & rill erosion hazard

2. **Presence of water flow patterns:** Very frequent flooding with seasonal high water table

3. **Number and height of erosional pedestals or terracettes:** None

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 0-10%

5. **Number of gullies and erosion associated with gullies:** Very poor resistance to erosion when cover is lacking. Subject to incision and downcutting

6. **Extent of wind scoured, blowouts and/or depositional areas:** None, slight wind erosion hazard

7. **Amount of litter movement (describe size and distance expected to travel):** Fine to moderately coarse - limited movement

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Moderately resistant to erosion with adequate cover: aggregate stability = 3-4

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Deep, well drained with a fine sandy loam to a silt loam surface: Low to moderate OM (2-5%)

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Significant ground cover (80-90%) and very gentle slopes (0-3%) effectively limit rainfall impact and overland flow

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

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: Narrowleaf willow > sedges > other grasses > forbs > shrubs

    Sub-dominant:

    Other:

    Additional:

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

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):** Favorable: 4000, Normal: 3000, Unfavorable: 2000 lbs/acre/year at high RSI (HCPC)

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:** Grass, grass-like, and perennial forb species will increase with deterioration of plant community. Reed canarygrass and meadow foxtail invade sites that have lost deep rooted perennial grass functional groups.

17. **Perennial plant reproductive capability:** All species should be capable of reproducing annually