Ecological site R010XY011OR
Cottonwood-Willow-Riparian

Last updated: 12/13/2023
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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): 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

This site may encompass many of the warmer, low elevation plant associations that include an overstory dominated by black cottonwood. These may include:

Riparian and Wetland Vegetation of Central and Eastern Oregon (Crowe, Kovalchik and Kerr 2004):

Populus balsamerifera ssp. trichocarpa – Alluvial Bar Association

Populus balsamerifera ssp. trichocarpa-Alnus rhombifolia Association - CEGL000668

Populus balsamerifera ssp. trichocarpa/Crataegus douglasii Association - CEGL000673

Populus balsamerifera ssp. trichocarpa/Betula occidentalis Association

Populus balsamerifera ssp. trichocarpa/Philadelphus lewisii Association

Ecological site concept

This is a riparian site dominated by a plant community that includes black cottonwood (Populus balsamifera ssp. trichocarpa) and a shrub and herbaceous layer dominated by willow (Salix spp.) and great basin wildrye (Leymus cinereus). Occupying floodplains along rivers and streams, this site has gentle slopes of 0 to 3 percent. In contrast to other sites occupying bottomland areas and supporting few woody species, this site has gravelly soils and higher water tables. The soil temperature regime of this site is mesic. Historically, the prominence of riparian woody

species 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. This site may be vulnerable to the effects of long-term improper grazing management leading to loss of woody vegetation and resulting stream bank instability. 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

R010XY010OR	**Coyote Willow Riparian** Narrowleaf willow dominant, cottonwood absent
R010XY012OR	**Booth-Yellow Willow Riparian** Booth and yellow willow dominant, mesic to frigid near mesic soil temperature regime
R010XY013OR	**Booth-Geyer-Yellow Willow Riparian** Booth, yellow and geyer willow dominant, mesic near frigid soil temperature regime

Table 1. Dominant plant species

Tree	(1) *Populus balsamifera ssp. trichocarpa*
Shrub	(1) *Salix*
Herbaceous	(1) *Leymus cinereus*

Physiographic features

This site occurs on floodplains of perennial streams and rivers. It is adjacent to channels occupying gravelly overflow areas and primary stream terraces. Slopes range from 0 to 3 percent. Elevations range from 500 to 4,000 feet (150 to 1,200 meters). A water table from 42 to 72 inches (100 to 180 cm) below the surface may occur from winter through spring.

Table 2. Representative physiographic features

Landforms	(1) Valley > Flood plain
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	Rare to frequent
Ponding frequency	None
Elevation	152–1,219 m

Slope	0–3%
Water table depth	107–183 cm
Aspect	Aspect is not a significant factor

Climatic features

The annual precipitation ranges from 9 to 16 inches (225 to 400mm), which occurs in the form of rain and snow during the months of November through March. A perennial supply of subsurface moisture augments the precipitation. Localized convection storms occasionally occur during the summer. The soil temperature regime is mesic with a mean annual air temperature of 52° F (11° C). Temperature extremes range from 100 to -10° F (38 to -23° C). The frost-free period ranges from 90 to 150 days. The optimum period for plant growth is from April through August. 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)	90-150 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	229-406 mm
Frost-free period (average)	110 days
Freeze-free period (average)	
Precipitation total (average)	330 mm

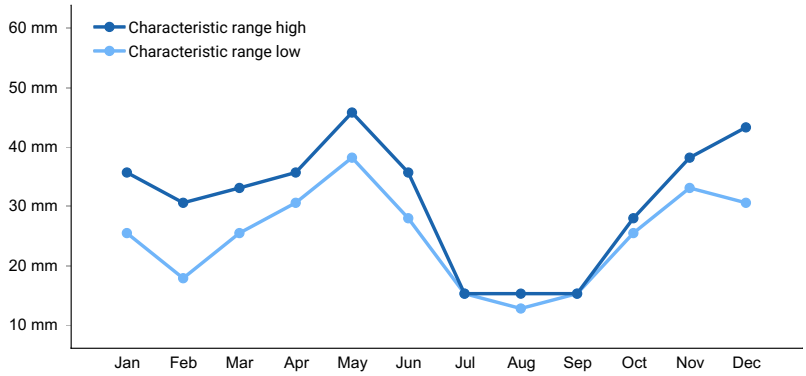


Figure 1. Monthly precipitation range

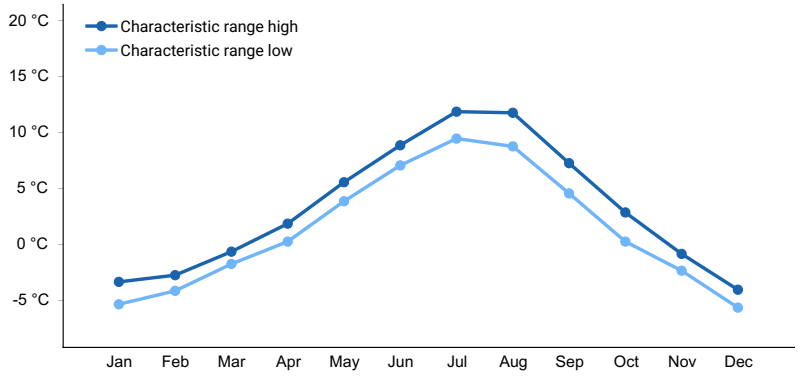


Figure 2. Monthly minimum temperature range

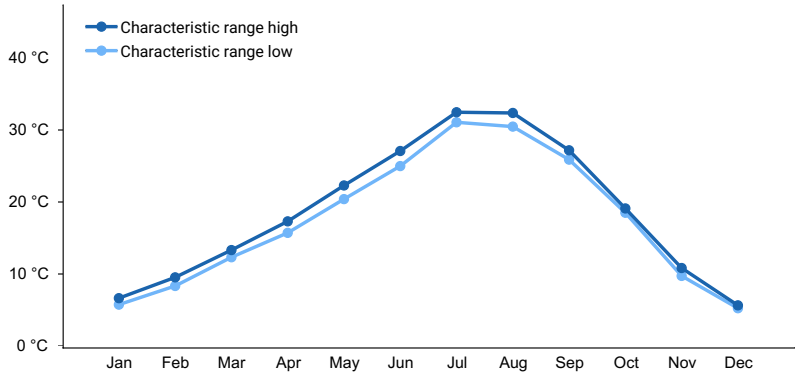


Figure 3. Monthly maximum temperature range

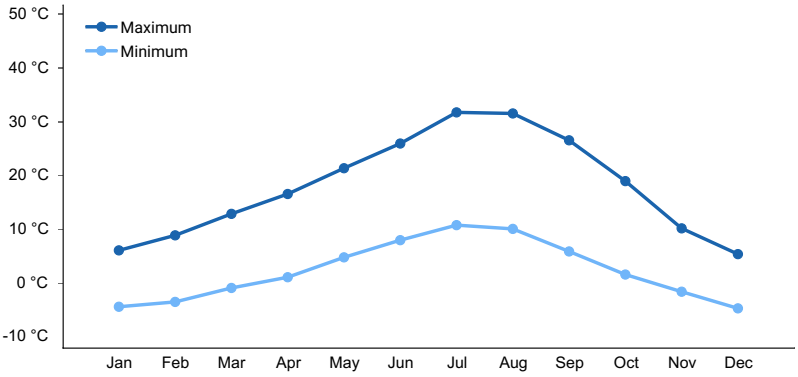


Figure 4. Monthly average minimum and maximum temperature

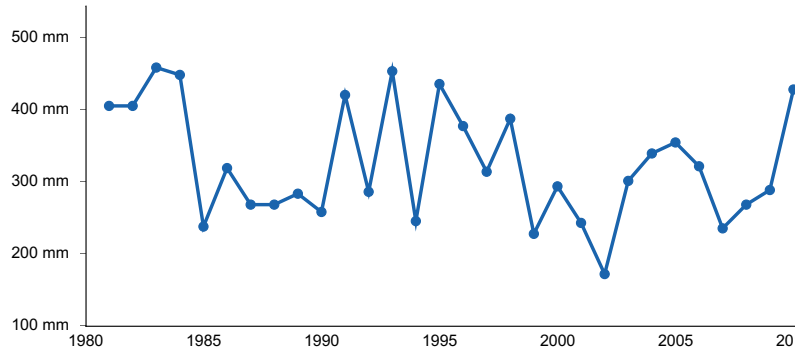


Figure 5. Annual precipitation pattern

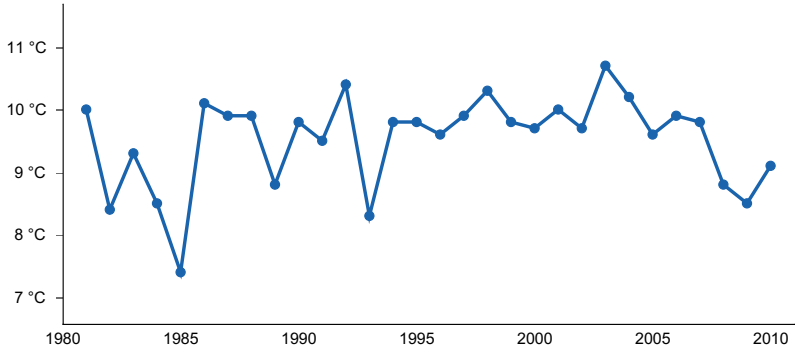


Figure 6. Annual average temperature pattern

Climate stations used

- (1) JOHN DAY [USC00354291], John Day, OR
- (2) BARNES STN [USC00350501], Prineville, OR
- (3) JOHN DAY 35 WNW [USW00004125], Mitchell, OR

- (4) MONUMENT 2 [USC00355711], Monument, OR
- (5) MITCHELL 2 NW [USC00355641], Mitchell, OR

Influencing water features

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

Soils of this site consist of very deep alluvium. Surfaces textures are typically silt loam to fine sandy loam. Depth to higher energy sands, gravels, and cobbles is typically 25 to 50 cm. Subsurface textures are typically sandy loam to sand with 30 to 90 percent coarse fragments. See Psuni series for a typical soil concept associated with this site.

Table 4. Representative soil features

Parent material	(1) Alluvium–volcanic and sedimentary rock
Surface texture	(1) Silt loam (2) Fine sandy loam (3) Loam
Family particle size	(1) Sandy-skeletal (2) Coarse-loamy over sandy or sandy-skeletal
Drainage class	Well drained to somewhat poorly drained
Permeability class	Moderate to very rapid
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)	10.16–15.24 cm
Soil reaction (1:1 water) (0-101.6cm)	6.1–7.3
Subsurface fragment volume <=3" (10.2-152.4cm)	15–60%
Subsurface fragment volume >3" (10.2-152.4cm)	0–60%

Ecological dynamics

The density of shrubs increase with good aeration and drainage next to a perennial high water table. This is typical along the edges of perennial streams. On upper drainages where streams are more seasonal in nature, both cottonwood and taller willows decrease. As the depth to the water table increases basin wildrye will increase. With a decrease in depth to the water table, sedges (Carex spp.) and bluegrass (Poa spp.) increase in the understory.

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.

If the condition of the site deteriorates as a result of overgrazing, basin wildrye decreases while bluegrasses increase and/or invade. With further deterioration, willow and other palatable shrubs decrease, unpalatable shrubs increase, annuals invade and bareground markedly increases. Sedges and riparian woody vegetation may be replaced by meadow foxtail (*Alopecurus pratensis*) and reed canarygrass (*Phalaris arundinacea*). Streambanks become unstable from loss of vegetation and the channel degrades becoming deeper and wider in the process. Subsurface flows are affected. The water table drops and storage of water for the late season flows is reduced. Plants well adapted to a drier climatic regime increase or invade and production drops.

Black cottonwood requires bare mineral soil and the scour or deposition of new sedimentation alluvial bards, streambanks and low floodplains in order to become established. Their small seeds require sustained moisture until they are able to grow roots to the water table (Crowe et al 2004). Once established, cottonwood may provide important ecological structure and function by shading streams, providing instream wood and habitat for a host of wildlife species. 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).

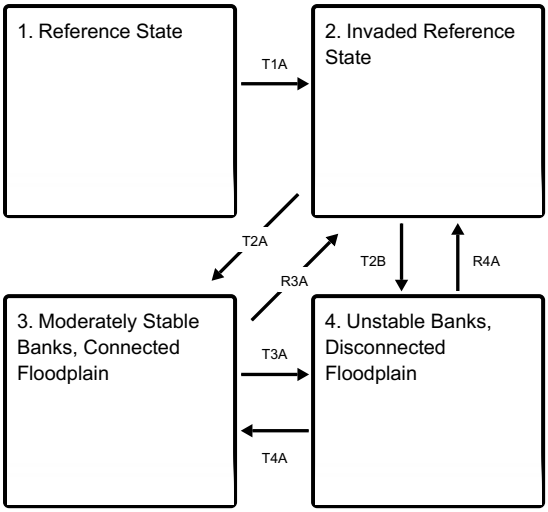
With loss of riparian woody vegetation and lack of bank and toe cover, channels rapidly degrade during runoff events. Floodplain connectivity is lost, flows become concentrated, velocities increase and erosion is accelerates. As the water table drops subsurface flows and storage of water for late season 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.

Site hydrology may also be altered by modifications to the stream channel by disturbances such as impoundment, removal of beaver, flow alteration for irrigation, channel straightening or terrace modifications for agricultural use. 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.

The state and transition model below represents an approximation of ecological states resulting from the disturbance dynamics described above. Further work is needed to better understand the transitions and thresholds that result in these alternative states.

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 function

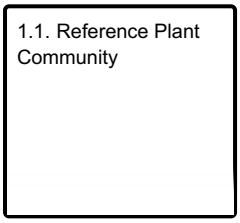
R3A - Restoration of hydrologic and biotic process and function

T3A - Alteration of hydrologic function

R4A - Restoration of hydrologic and biotic process and function

T4A - Time elapsed in the presence of sufficient sediment loads

State 1 submodel, plant communities



State 1
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 feedback between vegetation establishment and hydrologic processes that maintains a dynamic equilibrium with geomorphological processes.

Dominant plant species

- black cottonwood (*Populus balsamifera ssp. trichocarpa*), tree
- willow (*Salix*), shrub
- basin wildrye (*Leymus cinereus*), grass

Community 1.1
Reference Plant Community

The reference native plant community is dominated by black cottonwood and tall willows. Various short willows are common. Alder, hawthorn, rose and basin wildrye are present. Vegetative composition of the community is approximately 30 percent grasses, 2 percent forbs, and 70 percent shrubs. The approximate ground cover is 90 to 100 percent (basal and crown).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2825	4595	6366
Shrub/Vine	359	605	852
Forb	45	67	90
Total	**3229**	**5267**	**7308**

State 2
Invaded Reference 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 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. 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 climatic influences such as drought and flood cycles. The resilience and resistance of the site is bolstered by negative feedback between vegetation establishment and hydrologic processes that maintains a dynamic equilibrium with geomorphological processes. This state is common due to widespread invasion of reed canarygrass in the Western United States.

Dominant plant species

- black cottonwood (*Populus balsamifera ssp. trichocarpa*), tree
- willow (*Salix*), shrub
- basin wildrye (*Leymus cinereus*), grass

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 increases. Erosion and bank instability will increase and is at risk of transitioning to State 4. 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

- black cottonwood (*Populus balsamifera ssp. trichocarpa*), tree
- willow (*Salix*), shrub
- bluegrass (*Poa*), grass
- reed canarygrass (*Phalaris arundinacea*), grass

State 4
Unstable Banks, Disconnected Floodplain

Streambanks have become unstable from loss of vegetation and the channel degrades becoming deeper and wider in the process. Subsurface flows are affected. The water table drops and storage of water for the late season flows is reduced. Plants well adapted to a drier climatic regime increase or invade and production drops. Reed canarygrass has become strongly dominant where woody riparian vegetation has been reduced. 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. 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 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial, Deep-rooted, Dominant**			448–897	
	basin wildrye	LECI4	*Leymus cinereus*	448–897	–
2	**Perennial, Deep-rooted, Sub-Dominant**			135–359	
	sedge	CAREX	*Carex*	135–359	–
3	**Perennial, Other (PPGG), All**			90–224	
	rush	JUNCU	*Juncus*	30–75	–
	bluegrass	POA	*Poa*	30–75	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	30–75	–
Forb					
4	**Perennial, Other (PPFF), ALL**			45–90	
	common yarrow	ACMI2	*Achillea millefolium*	9–18	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	9–18	–
	iris	IRIS	*Iris*	9–18	–
	beardtongue	PENST	*Penstemon*	9–18	–
	cinquefoil	POTEN	*Potentilla*	9–18	–
Shrub/Vine					
5	**Perennial, Deciduous, Dominant**			135–359	
	rose	ROSA5	*Rosa*	135–359	–
6	**Perennial, Deciduous, sub-dominant**			224–493	
	redosier dogwood	COSE16	*Cornus sericea*	45–90	–
	mock orange	PHILA	*Philadelphus*	45–90	–
	golden currant	RIAU	*Ribes aureum*	45–90	–
	wax currant	RICE	*Ribes cereum*	45–90	–
7	**Perennial, Other(SSSS), ALL**			45–135	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	15–45	–
	rabbitbrush	CHRYS9	*Chrysothamnus*	15–45	–
	chokecherry	PRVI	*Prunus virginiana*	15–45	–
Tree					
8	**Perennial, deciduous, dominant**			583–1255	
	willow	Salix	*Salix*	448–897	–
	cottonwood	POPUL	*Populus*	135–359	–
9	**Perennial, deciduous, sub-dominant**			135–359	
	alder	Alnus	*Alnus*	45–135	–
	hawthorn	CRATA	*Crataegus*	45–135	0–
	water birch	BEOC2	*Betula occidentalis*	45–90	–

Animal community

Wildlife-
This site will offer food and cover for mule deer, elk, rodents and a variety of birds. This site is an important wintering area for mule deer and elk.

Livestock grazing-
This site is suited to use by cattle, sheep and horses in spring, summer and fall. Limitations in the spring are saturated wet soils and unstable banks. Use should be postponed until the soils are firm enough to prevent trampling damage and soil compaction, yet while soil moisture is adequate to allow for completion of the plant growth cycle. Improvement and/or maintenance of willow, popular and herbaceous species for bank protection should be considered during all seasons. This is particularly necessary in the fall for winter and spring high flow periods.

Hydrological functions

Watershed-
The soils are in hydrologic group B. The soils of this site have moderately low runoff potential. This site is potentially subject to three high flow periods: Low elevation snowmelt, high elevation snowmelt, and summer cloudburst flow.

Other information

The soils of this typically reflect hydric soil characteristics. When incised channels are present, rehabilitation will markedly improve production and restore good hydrologic characteristics. On altered sites the reintroduction of desirable deep rooted plants may be needed to full restore the site potential.

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Contributors

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Approval

Kirt Walstad, 12/13/2023

Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	05/12/2025
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:**