USDA Natural Resources Conservation Service

Ecological site R010XY012OR
Booth-Yellow 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

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

Ecological site concept

In reference condition, this riparian complex supports a plant community dominated by Booth (Salix boothii) and yellow willow (Salix lutea) dominance in the upper bank and overbank zones. Occupying depositional floodplains along rivers and streams, this site has slope angles of 0 to 4 percent and occurs on elevations between 3,400 to 4,700 ft. The soil climate of this site is mesic near frigid to frigid near mesic. The presence of well drained soils, yet an adequate depth to water table to support willow, contrast this site to other similar sites. 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. Alterations to vegetative structure can lead to geomorphic alterations to sinuosity, gradient, bank stability and stream width to depth ratio as well as stream shading.

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

R010XY001OR	**Cold Wet Meadow** Cold Wet Meadow (hydric soil, long duration seasonal water table at or near the surface, frigid soil temperature, anaerobic conditions, different composition - CAREX-DECE-JUNCU association)
R010XY002OR	**Cold Meadow** Cold Meadow (hydric soil, shorter duration seasonal water table near the surface, frigid soil temperature, anaerobic conditions, different composition - DECE-CAREX-JUNCU association)
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)
R010XY006OR	**Mountain Loamy Bottom** Mountain Loamy Bottom (greater depth to water table, higher terrace, frigid soil temperature, different composition – basin wildrye strongly dominant, mountain big sagebrush present)

Similar sites

R010XY013OR	**Booth-Geyer-Yellow Willow Riparian** Willow Riparian Complex (Booth-Geyer Willow) - (stream channel & bank position, frigid soil temperature regime, different composition– SABO2-SAGE2/CAREX complex)
R010XY010OR	**Coyote Willow Riparian** Willow Riparian Complex (Narrowleaf {coyote}Willow) – (stream channel & bank position, early succession state, mesic to frigid near mesic soil temperature regime, different composition– SAEX/CAREX complex)

Table 1. Dominant plant species

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

Physiographic features

This willow riparian site complex occurs along rivers and streams on depositional valley floodplains. It occupies three riparian zones, the toe zone, bank zone and over bank zone. In original condition or a high seral state the site complex forms a near continuous riparian buffer along a primary channel. Numerous discontinuous site groupings occur on secondary overflow channels, swales and abandon cut-off channels. The primary channel is well connected to the floodplain with a depth to the channel bottom of two feet or less on small streams and greater on larger streams and rivers. Sediment deposition on banks and adjoining floodplains is prevalent during flood events. Valley slopes typically range from 0 to 4 percent. Elevations vary from 3,400 to 4,700 feet (1,050 to 1,450 meters). A water table from 8 to 48 inches (20 to 120 cm) below the surface may occur from winter through spring. Historically, the hydrology, soil formation and biotic processes were often influenced by the presence of beaver.

As a site located in deposition areas along water courses the site occurs in both broad valleys and narrow upstream deposition reaches. Rivers and streams in broad valleys have a low gradient, meandering configurations (E type). Streams on narrow up stream deposition reaches develop with a steeper gradient and more of an elongated meander configurations (C type). In higher condition or states the banks are well vegetated, overhanging and largely stable. Stream shading by typical mid story willows averaging 15 feet in height is high. Overall stream shading on larger stream systems is low with mid day summer shade averaging about 9 percent on a 40 foot width east/west river. Shade from banks occupied by only herbaceous species is 0 to 2 percent.

Sediment transport and deposition in channels with well vegetated stable banks is limited to fine sediments and gravels with relatively little transportation except during periodic high flow events. Lateral movement of the primary channel during high flows continues to rework existing deposits, exposing them, and providing areas for colonization of herbaceous and woody species. Alluvial bars formed from silts to fine sands and gravels make up approximately 20 percent of the riparian area. They are rapidly vegetated and stabilized. Beaver presence enhances sediment deposition and the distribution of high flows into secondary channels.

Table 2. Representative physiographic features

Landforms	(1) Valley > Stream (2) Valley > Flood plain (3) Valley > Slough
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	Frequent to very frequent
Ponding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Ponding frequency	None to frequent
Elevation	1,036–1,433 m
Slope	0–4%
Ponding depth	0–5 cm
Water table depth	20–122 cm
Aspect	Aspect is not a significant factor

Climatic features

The annual precipitation ranges from 9 to 16 inches (225 to 400mm), most of which occurs in the form of snow during the months of November through March. Ample surface and subsurface flows from the perennial and seasonal streams systems augment the precipitation. The soil temperature regime is mesic near frigid to frigid near mesic with a mean air temperature of 45° F (7° C). Temperature extremes range from 90 to -10° F (32 to -23° C). The frost free period ranges from less than 90 to 120 days. The optimum growth period for plant growth is April through July. 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)	229-406 mm
Frost-free period (average)	100 days
Freeze-free period (average)	
Precipitation total (average)	330 mm

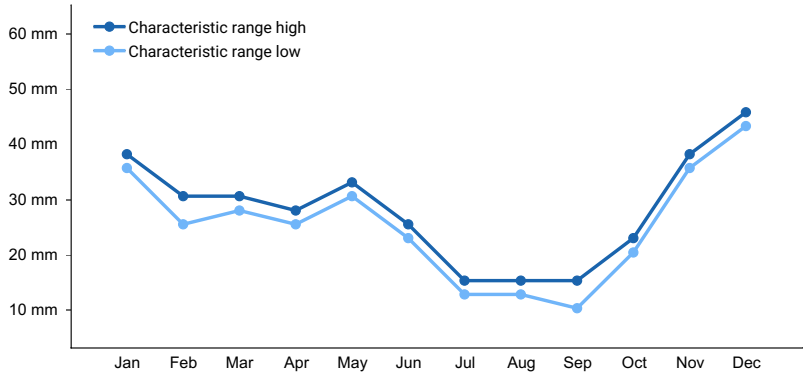


Figure 1. Monthly precipitation range

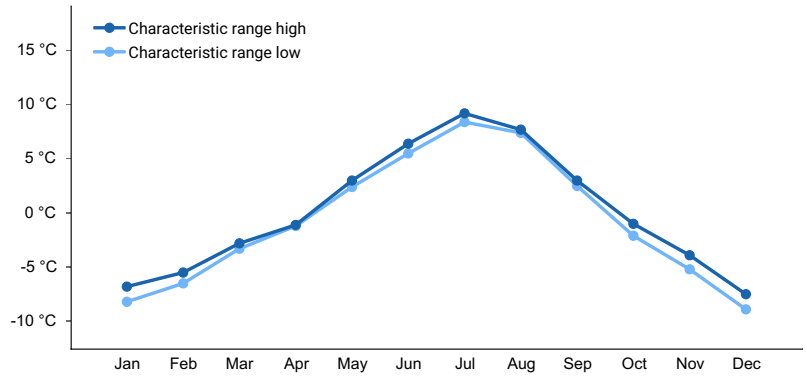


Figure 2. Monthly minimum temperature range

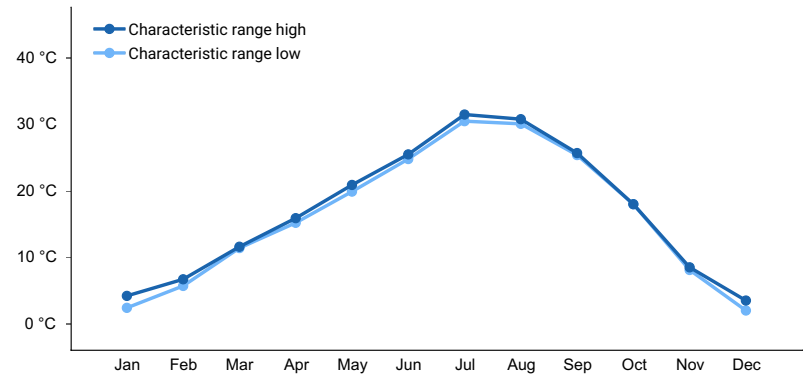


Figure 3. Monthly maximum temperature range

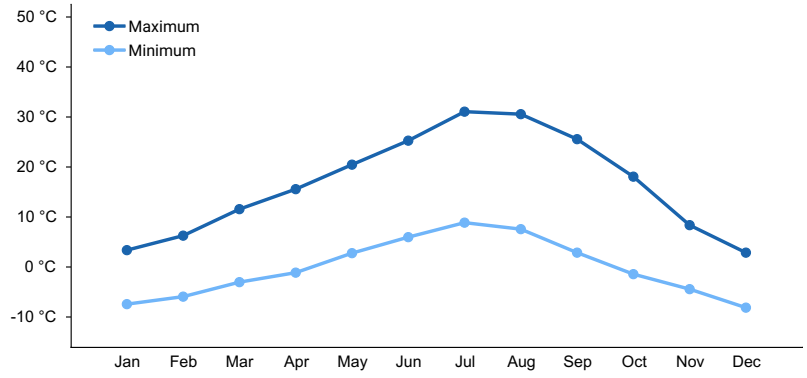


Figure 4. Monthly average minimum and maximum temperature

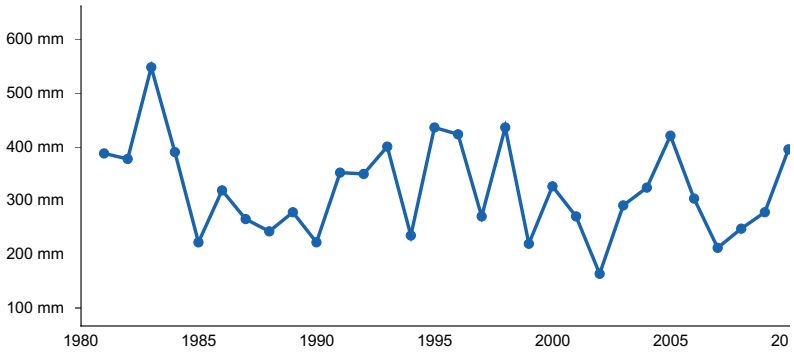


Figure 5. Annual precipitation pattern

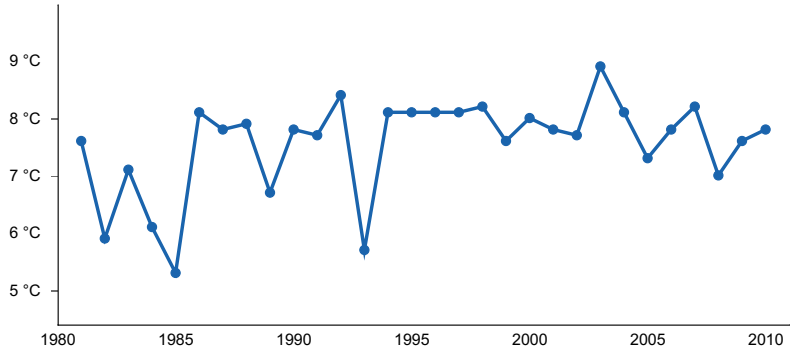


Figure 6. Annual average temperature pattern

Climate stations used

- (1) DREWSEY [USC00352415], Drewsey, OR
- (2) BARNES STN [USC00350501], Prineville, 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 defined.

Soil features

The soils of this site are typically recent, very deep, gravelly and well to moderately well drained. Surface textures are typically silt loams to fine sandy loam 8 to 10 inches thick. The subsoil texture ranges from gravelly silt loam to extremely gravelly loamy sand about. Stratification is common due to sediment deposition during periodic high flows. Depth to alluvial gravelly and cobbly sediments is highly variable averaging 30 to over 40 inches. Gravel and cobbly substratums are more extensive at the upper end of the deposition area near the transportation zone transition. These deposits are largely emplaced during major flood events. Soil permeability is moderate to rapid. The available water holding capacity (AWC) is about 6 to 8 inches for the profile. Perennial to seasonal subsurface flows augment the available water.

Table 4. Representative soil features

Parent material	(1) Alluvium–rhyolite (2) Flow deposits–basalt (3) Volcanic ash–diorite
Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Well drained to moderately well drained
Permeability class	Moderate to 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)	15.24–20.32 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)	5–40%

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. In the toe and bank zone, emergent sedge and spike rush dominated components are associated with the channel toe or shelf, alluvial bars and the lower bank (hydrology the bank full zone). Willow dominated plant community components in the overbank zone are associated with the upper bank, a variable low natural levee on top of the bank and a small portion of the adjacent active floodplain. It is a dynamic site with components responding to changes in channel configuration, sediment movement and flow regimes. The presence of beaver significantly contributes to the dynamic nature of the site promoting sediment deposition and water distribution.

The primary potential native plant community component located on the upper bank and over bank zone is dominated by willows. Periodic inundation and sediment deposition followed by flow subsidence and soil aeration provides ideal willow habitat. Soil aeration following inundation is a critical component for willow establishment and survival. The plant community is dominated by Booth’s willow. Yellow willow is secondary along with coyote willow and a variety other shrubs including redosier dogwood, rose and golden currant. Sedges made up a significant composition of the historic understory. The exact understory percentage is not presently known as reed canary grass and/or meadow foxtail readily invade. Vegetative composition of this component is approximately 70 percent shrubs, 25 percent grasses and 5 percent forbs. Approximate ground cover is 90 to 120 percent (basal and crown) with shrub canopy cover being 60-70 percent. Production averages 3000 lbs/acre in normal years. In the Cowardian system this primary plant community component is classified as a palustrine scrub/shrub wetland.

Two secondary potential plant community components on this site are located on alluvial gravel and silt point bars. Formed over time by annual inundation and sediment deposition they make up to 20 percent of the site complex. Silt portions of point bars are initially dominated by sedges and bulrush. Narrowleaf (coyote) willow, a rhizomatous species initially establishes on gravelly bars. These components are variable in production averaging 500 to over 800 lbs/acre in normal years. Bare ground on the bars is greater than 30 percent. These two plant community components are in a constant state of flux. In high seral state or condition they contribute significantly to stream aggradation, meander formation, channel stability and floodplain connectivity.

Located on narrow benches at the toe zone there is a third potential plant community component dominated by emergent vegetation. The narrow bench forms in areas where slow water velocities allow sediments to accumulates

over gravel. Located below the average water elevation or baseflow the bench supports a potential plant community dominated by sedges, panicled bulrush and spike rush. Adjacent to areas of high bank stress, vegetation stabilization of sediment and gravel accumulation in this zone is critical to preventing bank failure and sloughing. Production averages 200 to over 500 lbs/acre on these very narrow areas. These areas make up less than 5 percent of the site complex. Water sedge, lakeshore sedge, awl fruit (sawbeak) sedge, lakeshore sedge, swordleaf rush, toad rush, panicled bulrush, common (creeping) spike rush, ovate spikerush an annual, American sloughgrass and water whorlgrass (brookgrass) are common grass plants in these components.

Although not part of the riparian site complex it needs to be emphasized that poorly drained wet meadow inclusions are common in this site complex. Even though willows tolerate periods of inundation they require aeration in the upper root zone and cannot survive on poorly drained wet meadow soils. On a larger scale, the site typically occurs in association with poorly drained wet meadow sedge sites, slightly higher tufted hairgrass meadow sites and terraced basin wildrye loamy bottom sites.

Range in Characteristics:
The extent and duration of surface flows and groundwater have a major effect on site composition and production. Just slight differences in stream and subsurface water elevations often one foot or less produce these effects. Willow densities are highest along perennial stream banks and natural bank levees where flows last well into the growing season and aeration occurs as spring flows subside. Willows decrease as primary channel depths increase and in upper drainages where perennial streams become seasonal and the depth to available groundwater increases. Understory community composition expresses these same changes where obligate sedge species are replaced consecutively by facultative wet, facultative and upland species as the site becomes drier. This is most apparent on dry swales where basin wildrye sites occur.

On wetland or hydric soils were water is at or near the surface throughout the majority of the growing season willows do not survive. Sedges, rushes and wetland grasses are well adapted to these wetland soils. Willows are particularly susceptible to poor drainage. In a high seral state the willow riparian site complex is intermixed on the active floodplain with the more extensive wet meadow and meadow sites. It occurs as discontinuous groupings on aerated banks of overflow channels, depression areas and abandon floodplain channel remnants.

Response to Disturbance - States:
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. Both willow overstory and understory vegetation along with palatable channel toe and bar vegetation is reduced. Sedges and tufted hairgrass 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. Quackgrass and sod bluegrasses increase as the site becomes drier and the important channel stabilization function provided by willows and dense rooted sedges are lost.

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 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. Sod bluegrasses occupy the narrow moist incised floodplain. Basin big sagebrush, rabbitbrush, annuals and noxious deep rooted forbs and juniper when a seed source is present invade and occupy the higher isolated bank.

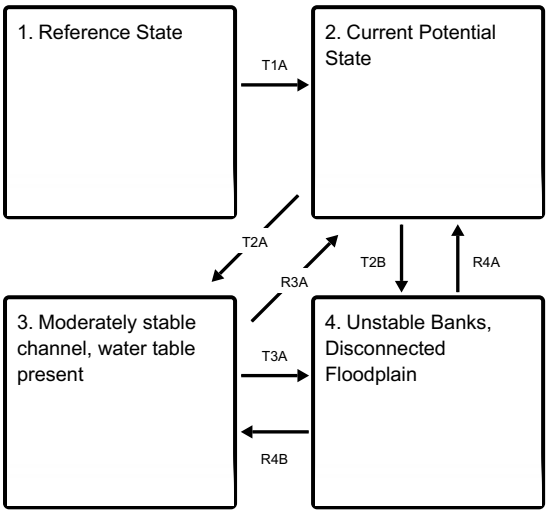
On lower elevation bottomlands channel straightening, deepening and drainage practices are often implemented to use the excellent floodplain soils for intense agriculture activities, transportation corridors and urban development. With a narrowed steeper reach, stabilization practices, revegetation, and channel alterations may be needed to support the progression of natural processes and promote the development of an entrenched stable narrow floodplain. The goal is to reduce the erosive force of high flood flows and contain flows within the channel. Upstream water storage and withdrawals for irrigation on the floodplain and adjoining terraces may also be modified to support rehabilitation.

In upland areas where intensive agriculture practices are not feasible or desired, the natural restoration of floodplain functions and production may be an alternative. If all structural and functional plant species are still on site, proper grazing management may help support the development of a well vegetated stable entrenched floodplain followed by slow aggregation and channel narrowing. Willows re-establish on the incised floodplain and with the maintenance of adequate fall vegetative cover on channel bars and toes sediment is retained during spring run-off. Banks are protected. In time and with adequate upstream sediment delivery the initial wide floodplain is reconnected.

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 and meadow foxtail into the site.

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

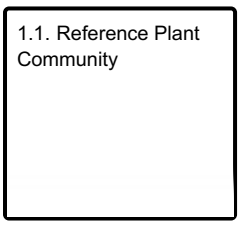
R3A - Restoration of hydrologic and biotic process and function

T3A - Alteration of hydrologic function

R4A - Restoration of hydrologic and biotic process and function

R4B - Time elapsed with adequate sediment loads and hydrologic function to support natural channel evolution processes

State 1 submodel, plant communities



State 1
Reference State

This represents the reference state in pristine conditions. 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
- sedge (*Carex*), grass

Community 1.1
Reference Plant Community

The reference native 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. In the toe and bank zone, emergent sedge and spike rush dominated components are associated with the channel toe or shelf, alluvial bars and the lower bank (hydrology the bank full zone). Willow dominated plant community components in the overbank zone are associated with the upper bank, a variable low natural levee on top of the bank and a small portion of the adjacent active floodplain. It is a dynamic site with components responding to changes in channel configuration, sediment movement and flow regimes. The presence of beaver significantly contributes to the dynamic nature of the site promoting sediment deposition and water distribution. The primary potential native plant community component located on the upper bank and over bank zone is dominated by willows. Periodic inundation and sediment deposition followed by flow subsidence and soil aeration provides ideal willow habitat. Soil aeration following inundation is a critical component for willow establishment and survival. The plant community is dominated by Booth’s willow. Yellow willow is secondary along with coyote willow and a variety other shrubs including redosier dogwood, rose and golden currant. Sedges made up a significant composition of the historic understory. The exact understory percentage is not presently known as reed canary grass and/or meadow foxtail readily invade. Vegetative composition of this component is approximately 70 percent shrubs, 25 percent grasses and 5 percent forbs. Approximate ground cover is 90 to 120 percent (basal and crown) with shrub canopy cover being 60 to 70 percent. Production averages 3000 lbs/acre in normal years. In the Cowardian system this primary plant community component is classified as a palustrine scrub/shrub wetland. Two secondary potential plant community components on this site are located on alluvial gravel and silt point bars. Formed over time by annual inundation and sediment deposition they make up to 20 percent of the site complex. Silt portions of point bars are initially dominated by sedges and bulrush. Narrowleaf (coyote) willow, a rhizomatous species initially establishes on gravelly bars. These components are variable in production averaging 500 to over 800 lbs/acre in normal years. Bare ground on the bars is greater than 30 percent. These two plant community components are in a constant state of flux. In high seral state or condition they contribute significantly to stream aggradation, meander formation, channel stability and floodplain connectivity. Located on narrow benches at the toe zone there is a third potential plant community component dominated by emergent vegetation. The narrow bench forms in areas where slow water velocities allow sediments to accumulates over gravel. Located below the average water elevation or baseflow the bench supports a potential plant community dominated by sedges, panicled bulrush and spike rush. Adjacent to areas of high bank stress, vegetation stabilization of sediment and gravel accumulation in this zone is critical to preventing bank failure and sloughing. Production averages 200 to over 500 lbs/acre on these very narrow areas. These areas make up less than 5 percent of the site complex. Water sedge, lakeshore sedge, awl fruit (sawbeak) sedge, lakeshore sedge, swordleaf rush, toad rush, panicled bulrush, common (creeping) spike rush, ovate spikerush an annual, American sloughgrass and water whorlgrass (brookgrass) are common grass plants in these components. Although not part of the riparian site complex it needs to be emphasized that poorly drained wet meadow inclusions are common in this site complex. Even though willows tolerate periods of inundation they require aeration in the upper root zone and cannot survive on poorly drained wet meadow soils. On a larger scale, the site typically occurs in association with poorly drained wet meadow sedge sites, slightly higher tufted hairgrass meadow sites and terraced basin wildrye loamy bottom sites.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	1569	2354	3138
Grass/Grasslike	560	841	1121
Forb	112	168	224
Total	**2241**	**3363**	**4483**

State 2
Current Potential State

This state is similar to the reference state yet includes a component of invasive species such as reed canary grass 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
- sedge (*Carex*), grass
- reed canarygrass (*Phalaris arundinacea*), grass
- meadow foxtail (*Alopecurus pratensis*), grass

State 3
Moderately stable channel, water table present

Relative to the Current Potential State, much of the willow cover and original understory has been lost, the primary channel is becoming unstable, and the floodplain is becoming disconnected yet the water table is still present. Chanel 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. With further deterioration, erosion and bank instability will increase and risk a transition 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

- reed canarygrass (*Phalaris arundinacea*), grass
- meadow foxtail (*Alopecurus pratensis*), 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 to persist. Plant communities within this state will vary depending on water table levels, past disturbance history, fire, drought and current management. Currently, insufficient data exists to model the dynamics between these communities but possible phases include: Quackgrass-Kentucky bluegrass (higher water table or irrigated); Basin big sagebrush/Kentucky bluegrass-Annuals (primary channel deeply incised, loss of floodplain connectivity and overland flows); Basin big sagebrush(western juniper)/Annuals (water table lowered, primary channel deeply incised, floodplain disconnected); Annuals-Deep rooted biennial and perennial forbs (water table lowered, primary channel deeply incised, floodplain disconnected);

Dominant plant species

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

Transition T1A
State 1 to 2

Invasion of reed canarygrass and meadow foxtail into the site.

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.

Restoration pathway R4B
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 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial, deep rooted sedges**			336–841	
	sedge	CAREX	*Carex*	336–841	–
2	**Perennial, moderately deep-rooted bunchgrass**			101–336	
	tufted hairgrass	DECE	*Deschampsia cespitosa*	101–336	–
4	**Other perennial grasses and grass-like**			67–605	
	bluegrass	POA	*Poa*	67–269	–
	rush	JUNCU	*Juncus*	0–168	–
	basin wildrye	LECI4	*Leymus cinereus*	0–168	–
Forb					
5	**Common perennial forb**			34–101	
	cinquefoil	POTEN	*Potentilla*	34–101	–
6	**Other perennial forbs**			101–168	
	common yarrow	ACMI2	*Achillea millefolium*	0–34	–
	white sagebrush	ARLUL2	*Artemisia ludoviciana ssp. ludoviciana*	0–34	–
	camas	CAMAS	*Camassia*	0–34	–
	cowparsnip	HERAC	*Heracleum*	0–34	–
	ballhead waterleaf	HYCA4	*Hydrophyllum capitatum*	0–34	–
	Rocky Mountain iris	IRMI	*Iris missouriensis*	0–34	–
	beardtongue	PENST	*Penstemon*	0–34	–
	buttercup	RANUN	*Ranunculus*	0–34	–
	false hellebore	VERAT	*Veratrum*	0–34	–
Shrub/Vine					
8	**Dominant , deciduous, sprouting shrub**			673–1009	
	Booth's willow	SABO2	*Salix boothii*	673–1009	–
9	**Sub-dominant, deciduous, sprouting shrub**			336–673	
	yellow willow	SALU2	*Salix lutea*	336–673	–
10	**Common, deciduous, sprouting shrub**			168–504	
	narrowleaf willow	SAEX	*Salix exigua*	168–504	–
11	**Other common shrubs**			202–673	
	redosier dogwood	COSE16	*Cornus sericea*	67–336	–
	golden currant	RIAU	*Ribes aureum*	67–168	–
	Woods' rose	ROWO	*Rosa woodsii*	67–168	–
12	**Other shrubs**			168–336	
	alder	ALNUS	*Alnus*	0–168	–
	Geyer willow	SAGE2	*Salix geyeriana*	0–168	–
	Geyer willow	SAGE2	*Salix geyeriana*	0–168	–

Animal community

Livestock Grazing:
This site is suitable for livestock grazing use in the late spring, summer and fall under a planned grazing system.

Use should be postponed until the soils are firm enough to prevent trampling damage and soil compaction. Grazing management should be keyed to willows and grass-like plants along banks and on alluvial bars. Late summer and fall use levels on willow are particularly critical. Consider use levels of no more than one-third of willow current year annual growth. Grass and grass-like fall residual growth on alluvial bars and banks should be adequate to prevent erosion and retain sediments during spring flow events (6 to 10 inches). The erosive forces of high spring flows are reduced with good vegetation roughness and by shallow water depths particularly when flows spread across banks to the floodplain. Deferred grazing or rest is recommended at least once every three years.

Wildlife:
This site is commonly used by beaver, mule deer, elk, rabbits, rodents, upland birds, neo-tropical birds, waterfowl and various predators. Mule deer and elk make excellent use of the site in the fall and winter for browse and cover. Neo-tropical birds utilize the site habitat extensively. It provides approximately 80% of the required habitat for nesting, food and cover. Excellent habitat is provided for fisheries in perennial streams from shade, insect population build-ups, stable well vegetated overhanging banks and emergent vegetation cover. Beaver historically used the site extensively, distributing flows on the floodplain and retaining sediment.

Hydrological functions

Watershed:
The soils of this site are located on banks of primary and secondary channels of depositional floodplains. When in good hydrologic condition the primary channel and bank are well connected to the floodplain. During spring flow events high flows spread across the top of the bank at shallow depths to the floodplain. With good vegetative cover velocities are reduced and sediment is deposited during these flood events, building up the low natural levee and accumulating on the floodplain. Under poor hydrologic conditions vegetative cover is reduced, velocities accelerate, erosion increases and the channel degrades, becoming wider and deeper in the process. Often the flows breach the bank and rapidly degrade a new channel on the floodplain. Water tables are lowered and soil moisture available for plant growth is reduced. Hydrologic cover is high when the willow primary component is greater than 70 percent of potential. With good vegetative cover soils have medium infiltration rates. The presence of beaver significantly contributes to the dynamic nature of the site promoting sediment deposition and water distribution. The soils are in hydrologic group B.

Other information

The soils of this site exhibit hydric soil characteristics. When incised channels are present, rehabilitation will markedly improve production and restore good hydrologic characteristics. On altered sites the reintroduction of shrubs and other desirable deep rooted plants may be needed to restore the site potential. Bioengineering techniques can be implemented to increase restoration response time. Consider using whip or pole cuttings for a 15 year response and/or clump planting if a faster response ex 5 years is needed.

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Approval

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

Indicators

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

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

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

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 5-15%

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

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

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

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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):** Moderately to slightly resistant to erosion with adequate cover: aggregate stability = 2-4

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Deep, well drained, with a silt loam to fine sandy loam surface about 32" thick: Low to moderate OM (2-5%)

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Significant ground cover (70-80%) and very gentle slopes (0-3%) effectively limit rainfall impact and overland flow

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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):** None

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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: Booth willow > Yellow willow > Narrowleaf willow > sedges > Western dogwood > other grasses > other shrubs > forbs

    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): normal decadence and mortality expected

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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):** Favorable: 3000, Normal: 2000, Unfavorable: 1000 lbs/acre/year at high RSI (HCPC)

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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:** 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.

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

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