USDA Natural Resources Conservation Service

Ecological site R010XB023OR
JD Shallow 9-12 PZ

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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

US National Vegetation Classification System (closest approximation of reference plant community):
Division:
3.B.1.Ne - Western North American Cool Semi-Desert Scrub & Grassland
Macrogroup:
M169 - Great Basin-Intermountain Tall Sagebrush Steppe & Shrubland
Association:
CES304.778 - Inter-Mountain Basins Big Sagebrush Steppe

Landfire BPS model:
0711250 - Inter-Mountain Basins Big Sagebrush Steppe

Ecological site concept

In reference condition, this ecological site supports a plant community dominated by basin big sagebrush (*Artemisia tridentata* ssp. tridentata), Thurber's needlegrass (*Achnatherum thurberianum*) and bluebunch wheatgrass (*Pseudoroegneria spicata*). Abiotically, this site is typified by gentle slope aspects and shallow, clayey soils formed in tuffaceous cenozoic sediments. The soil climate is Mesic/Aridic. Historical ecological dynamics would have been driven by infrequent fire, insect outbreaks and periodic drought. Presently, livestock grazing and exotic plant invasion have altered ecological dynamics and influence the composition of many of these communities.

Associated sites

R010XB022OR	**JD Clayey 9-12 PZ** Adjacent sites with moderately deep clayey subsoils not heavy enough to restrict root penetration

Similar sites

R010XB035OR	**JD Shallow North 9-12 PZ** North aspect, steeper slopes
R010XB043OR	**JD Droughty Clayey South 9-12 PZ** South aspect, steeper slopes, soils shallow to deep
R010XB051OR	**JD Shallow South 9-12 PZ** South aspect, steeper slopes, lower production
R010XB052OR	**JD Droughty Shallow South 9-12 PZ** South aspect, steeper slopes, lower production
R010XB057OR	**JD Mahogany Rockland 9-12 PZ** Steeper slopes, areas of rockland common, very shallow soils
R010XB064OR	**JD North 9-12 PZ** South aspect, steeper slopes, soils shallow to deep, higher production
R010XB065OR	**JD Droughty Clayey North 9-12 PZ** North aspect, primarily steeper slopes very shallow soils

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. tridentata*
Herbaceous	(1) *Achnatherum thurberianum* (2) *Pseudoroegneria spicata*

Physiographic features

This site occurs on the tops of low elevation terraces, plateaus and fan remnants composed of early Cenezoic tuffaceous sediments. Slopes typically range from 2 to 12 percent but may occur as steep as 20 percent. Elevation typically varies from 1,800 to 3,000 feet (400 to 900 meters) but may range from 1,300 to 3,800 feet (550 to 1,150 meters). This site occurs on all aspects. No water table is present within the soil profile and the site is not subject to ponding or flooding.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Fan remnant (2) Foothills > Hill
Flooding frequency	None
Ponding frequency	None
Elevation	549–914 m
Slope	2–12%
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	396–1,158 m
Slope	2–20%

Climatic features

This site generally has an aridic soil moisture regime and a mesic soil temperature regime. Mean annual precipitation ranges from 9 to 12 inches (230 to 300mm) and falls primarily as rain from November through April. The frost-free period ranges from 90 to 150 days. Localized convection storms occasionally occur during the summer. Climate graphs are based on the nearest available climate stations to representative site locations and are provided to indicate general climate patterns.

Table 4. Representative climatic features

Frost-free period (characteristic range)	90-150 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	229-305 mm
Frost-free period (average)	120 days
Freeze-free period (average)	
Precipitation total (average)	279 mm

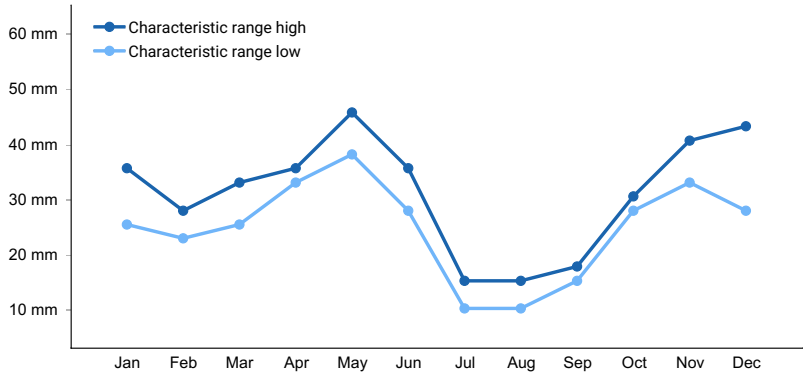


Figure 1. Monthly precipitation range

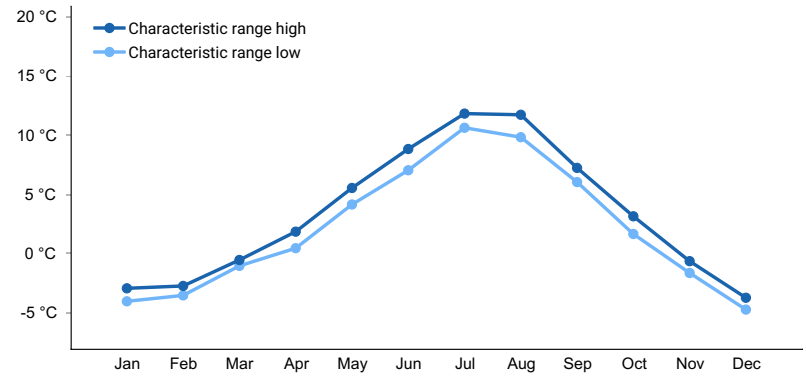


Figure 2. Monthly minimum temperature range

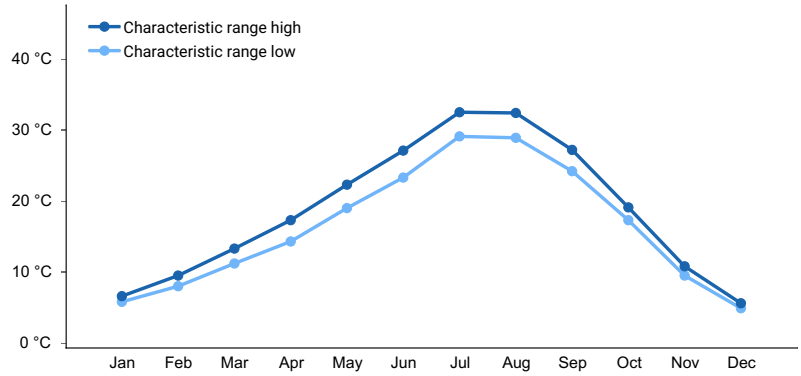


Figure 3. Monthly maximum temperature range

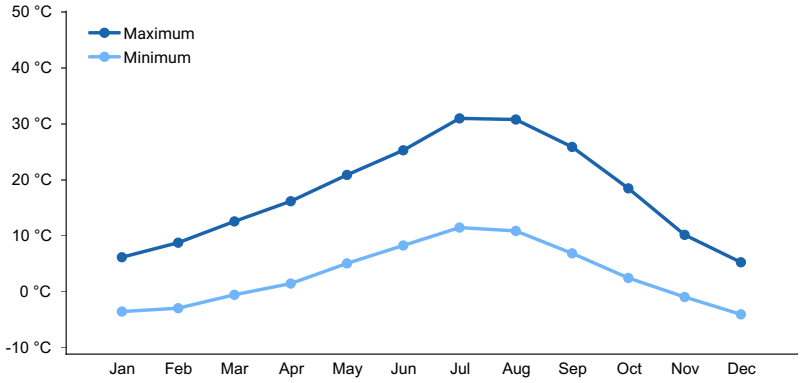


Figure 4. Monthly average minimum and maximum temperature

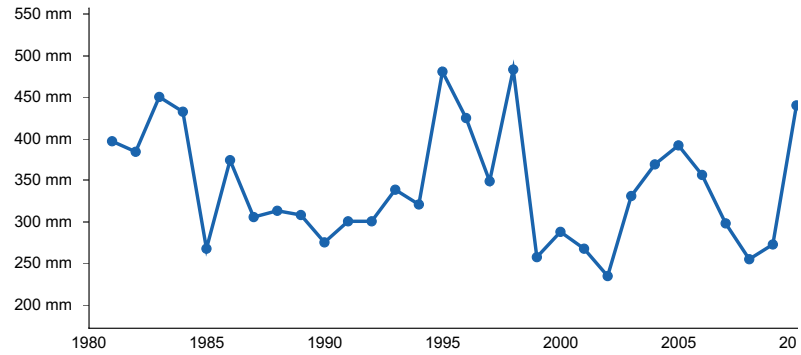


Figure 5. Annual precipitation pattern

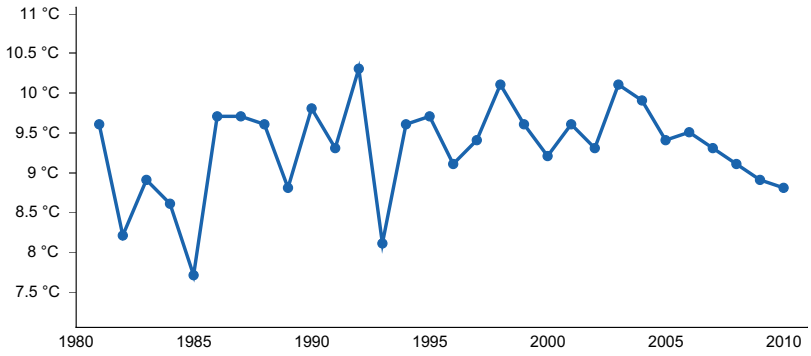


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MITCHELL 2 NW [USC00355641], Mitchell, OR
- (2) MITCHELL 2 E [USC00355638], Mitchell, OR
- (3) JOHN DAY 35 WNW [USW00004125], Mitchell, OR

- (4) ANTELOPE 6 SSW [USC00350197], Antelope, OR
- (5) MONUMENT 2 [USC00355711], Monument, OR

Influencing water features

This site is not influenced by or associated with water features.

Wetland description

N/A

Soil features

Soils on this site are Mollisols with predominantly very stony to cobbly loam surface textures. The soils are shallow to a duripan or lithic contact, with medium textures and well drained. These soils are typically formed from cenezoic tuffaceous sediments of the John Day (mid-Oligoceme) or Clarno (late Eocene) geological formations or basalt. The major taxonomic units correlated to this site include Xeric Argidurids and Xeric Haplargids. Soil components associated with this site concept include: Brisbois very cobbly clay loam, 2 to 15 percent slopes; Buffaran very cobbly loam, 2 to 15 percent slopes; and Reywat very stony loam, 2 to 15 percent slopes.

Table 5. Representative soil features

Parent material	(1) Residuum–sedimentary rock (2) Colluvium–basalt
Surface texture	(1) Cobbly loam (2) Very stony loam
Family particle size	(1) Clayey (2) Loamy-skeletal
Drainage class	Well drained
Permeability class	Slow to very slow
Depth to restrictive layer	25–51 cm
Soil depth	25–51 cm
Surface fragment cover <=3"	15–30%
Surface fragment cover >3"	15–20%
Available water capacity (0-50.8cm)	2.79–5.08 cm
Calcium carbonate equivalent (0-50.8cm)	0%
Electrical conductivity (0-50.8cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-50.8cm)	0
Soil reaction (1:1 water) (0-50.8cm)	6.6–8.4
Subsurface fragment volume <=3" (10.2-50.8cm)	0–10%
Subsurface fragment volume >3" (10.2-50.8cm)	0–50%

Ecological dynamics

The historic reference community of this site supports a grassland-shrub community. The potential grass understory is dominated by Thurber's needlegrass (*Achnatherum thurberianum*) with bluebunch wheatgrass (*Pseudoroegneria*

spicata) and minor amounts of Sandberg bluegrass (*Poa secunda*) also common. Basin big sagebrush (*Artemisia tridentata* ssp. tridentata) is the most common shrub. Broom snakeweed (*Gutierrezia sarothrae*) and rabbitbrush (Chrysothamnus spp.) may also occur and may be more common on disturbed sites. Forbs may include members of the buckwheat (Eriogonum spp.), yarrow (Achillea spp.) and astragalus (Astragalus spp.) genera.

Basin big sagebrush is a fire intolerant species that is readily killed by most fires and does not resprout, it will often be reduced on a site following fire and may be eliminated with frequent fires. Periodic insect outbreaks of Aroga moth (Aroga websteri) are an important component of the natural disturbance regime for big sagebrush, resulting in complete or partial mortality of sagebrush plants and potentially impacting thousands of acres.

Gutierrezia is typically associated with disturbed habitats and early seral conditions in the sagebrush biome (Tirmstein 1999). It can rapidly invade following improperly managed grazing. Broom snakeweed is highly drought tolerant and tends to rapidly increase in density following drought periods as well as fire. While broom snakeweed is typically killed by fire, seeds are often unharmed and rapid colonization from nearby sites is common. It has been found to increase following fire in Great Basin sagebrush communities where it often appears by the sixth year but may require up to 25 years to become dominant. While it effectively competes with many grasses (similar rooting depth and possible allelopathy) it is often out-competed by other shrubs overtime.

Thurber's needlegrass is a common bunchgrass in the sagebrush steppe of Eastern Oregon, especially within the 8 to 10 inch precipitation zone (Archer 2000). Considered to be the least fire-resistant needlegrass, Thurber's is often damaged by moderately severe fire. It recovers slowly following fire and regenerates primarily by seed rather than resprouting from crowns.

Bluebunch wheatgrass is considered to be a highly fire adapted grass species with low buds often protected from fire. Recovery following fire is rapid and it often increases relative to other plants post fire, especially after spring burning. While burning may improve the nutritional quality of bluebunch, defoliation during the regeneration period can be very detrimental to the stand and grazing should be avoided immediately after.

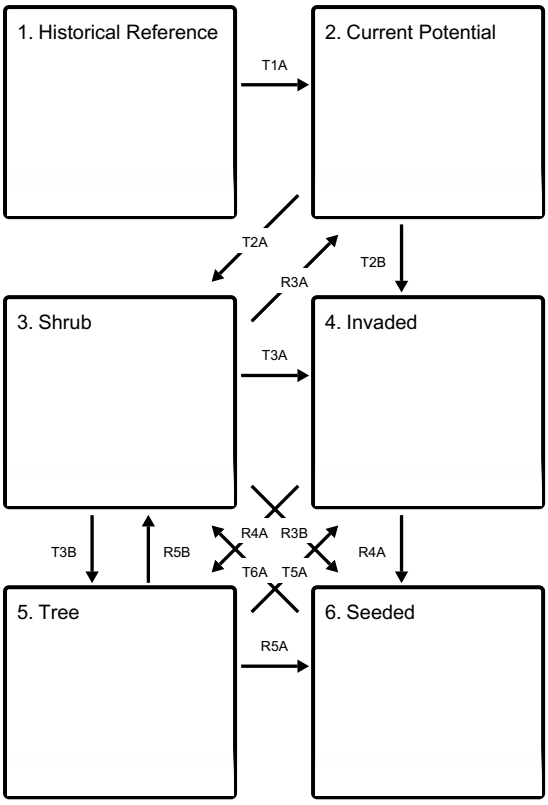
Western juniper (*Juniperus occidentalis*) is a native conifer species in western North America but its density and range have dramatically increased since the late 1800s likely due to a combination of factors, namely: reductions in fire frequency; heavy livestock grazing; and increased atmospheric carbon dioxide (Fryer and Tirmenstein 2019). Juniper is sensitive to fire and most young trees are killed by even low severity fire. As Juniper trees mature and bark thickens, however, they become resistant to low severity fire yet are still killed by crown fires or high severity surface fires.

Climate cycles would have been an important driver of ecological dynamics historically, with drought periods possibly leading to reductions in sagebrush cover and wet years increasing fire occurrence due to increased perennial grass production and fine fuels loads. Historically these communities would have likely encountered infrequent mixed and replacement severity fires with an average fire return interval of 50 years (yet with a high degree of variability depending on the site) (Landfire 2007). Livestock grazing has altered the plant community composition of much of the extent of this site. Increases in shrub and juniper cover and decreases in perennial grass cover may result from chronic improperly managed grazing. Given an altered disturbance regime and degraded site conditions, invasions of exotic forb species and annual grass species may occur on this site. Exotic annual grasses such as cheatgrass (*Bromus tectorum*) and medusahead (*Taeniatherum caput-medusae*) may invade and become problematic. Exotic annual grass invasion may increase the frequency of fires and extend the season when fires are likely by augmenting early season fine fuel loads and fuel continuity. Sites may be particularly fire prone following years of above average precipitation during which invasive annual grass production can increase dramatically (Pilliod et al. 2017). In addition to exotic species, native shrub species such as broom snakeweed and rabbitbrush may also increase following disturbance and may be important members of early seral communities.

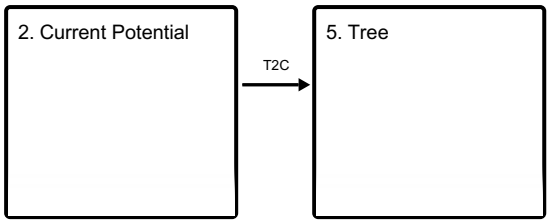
An understanding of the site specific ecological dynamics for this site are incomplete. Thresholds between states and phases have yet to be quantified and restoration pathways and outcomes are poorly understood. Current and anticipated effects of climate change are not included in this model, yet this site may experience significant impacts as climate continues to change. The model below represents an approximation of ecological dynamics informed by group 4 of (Stringham 2007) and is likely to undergo refinements and revisions as more data becomes available. The reference plant community described below has been determined by study of rangeland relic areas or areas protected from excess disturbance.

State and transition model

Ecosystem states



States 2 and 5 (additional transitions)



T1A - Introduction of non-native annual plants

T2A - Chronic improperly managed grazing or prolonged time without fire

T2B - Catastrophic fire, soil disturbing treatments or prolonged improperly managed grazing in the presence of non-native annual species

T2C - Time and lack of disturbance or management action

R3A - Shrub management and seeding of native species coupled with minimal soil disturbance

T3A - Catastrophic fire, soil disturbing treatments or prolonged improperly managed grazing in the presence of non-native annual species

T3B - Time and a lack of disturbance or management action

R3B - Brush management such as mowing, coupled with seeding of deep rooted non-native wheatgrasses

R4A - Reduction of annual grasses through management actions such as herbicide, prescribed grazing, or mowing, and seeding of desired species

R4A - Seeding of deep-rooted bunchgrasses

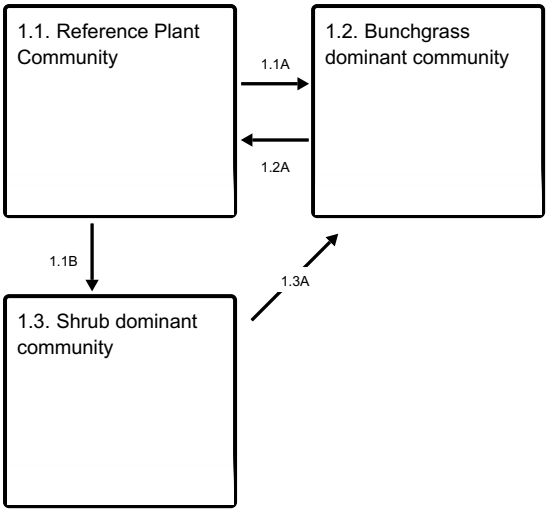
R5B - Tree removal practices with minimal soil disturbance

T5A - Catastrophic, stand replacing fire or inappropriate tree removal practices with soil disturbance

R5A - Tree removal and seeding of desired non-native wheatgrass species

T6A - Repeated, heavy, growing season grazing, severe fire

State 1 submodel, plant communities



1.1A - Fire occurs with enough severity to kill most of the shrub community

1.1B - Time and lack of disturbance, such as fire

1.2A - Time and lack of disturbance, such as fire

1.3A - Fire occurs with enough severity to kill most of the shrub and tree community

State 1
Historical Reference

The Reference State is representative of the natural range of variability for the site under pristine conditions. The reference state is a bunchgrass shrubland. State dynamics are maintained by interactions between climatic patterns and disturbance regimes. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These are maintained by ecosystem processes and structural elements such as the presence of all structural and functional plant groups, the retention of organic matter and the maintenance of plant community cover. Plant community phase changes are primarily driven by infrequent fire and/or periodic drought.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Thurber's needlegrass (*Achnatherum thurberianum*), grass

Community 1.1
Reference Plant Community

Bunchgrasses and sagebrush dominate this site. The reference plant community consists of basin big sage and Thurber's needlegrass with bluebunch wheatgrass and some Sandberg bluegrass. Broom snakeweed and rabbitbrush occur in minor amounts. Young western juniper may be present in very small amounts. Ground cover is approximately 60 to 70 percent.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- Thurber's needlegrass (*Achnatherum thurberianum*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	572	762	953
Forb	73	101	123
Shrub/Vine	28	34	45
Total	**673**	**897**	**1121**

Community 1.2
Bunchgrass dominant community

This community represents an early seral phase following disturbance and is dominated by perennial grasses such as Thurber's needlegrass and bluebunch wheatgrass. Sprouting shrubs will decrease following fire but will soon increase in abundance while non-sprouting shrubs will take longer to recolonize. Western juniper will be reduced or eliminated following fire but may be returning as saplings in this community.

Dominant plant species

- Thurber's needlegrass (*Achnatherum thurberianum*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass

Community 1.3
Shrub dominant community

Following a lack of fire for an extended period, basin big sagebrush and western juniper will increase in abundance while perennial grasses will decrease.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub

Pathway 1.1A
Community 1.1 to 1.2

Fire occurs with enough severity to kill most of the shrub community.

Pathway 1.1B
Community 1.1 to 1.3

Time and lack of disturbance, such as fire, facilitates an increase in the shrub and tree overstory.

Pathway 1.2A
Community 1.2 to 1.1

Time and lack of disturbance, such as fire, allows for regeneration of the shrub community.

Pathway 1.3A
Community 1.3 to 1.2

Fire occurs with enough severity to kill most of the shrub and tree community.

State 2
Current Potential

This state is similar to the Reference State. Ecological function has not changed fundamentally, however the resiliency of the site has been reduced by the presence of invasive plants. Additionally, livestock herbivory may be

present as a disturbance process and changes in climate may be altering ecological dynamics. Non-native plant species may increase in abundance but will not become dominant or control ecological processes within this state. These species can be highly flammable and can promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These are maintained by ecosystem processes and structural elements such as the presence of all structural and functional groups, and retention of organic matter and nutrients. Positive feedbacks driven by plant community invasion decrease ecosystem resilience and stability of the state. These include exotic plant species' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate, and adaptations for seed dispersal. Plant community phase changes are primarily driven by infrequent fire, periodic drought and ungulate herbivory. Current potential plant communities mirror those of the above Reference State 1.0 yet with the addition of a low level of invasive exotic plant invasion and influences of livestock herbivory. Livestock herbivory may result in decreases in deep rooted perennial grasses, and related increases in shallow rooted perennial grasses (such as Sandberg's bluegrass) and shrubs, among other changes.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Thurber's needlegrass (*Achnatherum thurberianum*), grass
- Sandberg bluegrass (*Poa secunda*), grass

State 3
Shrub

Within this state, site resources are primarily controlled by shrub species and western juniper. Native perennial grass composition has been reduced considerably. Sprouting and non-sprouting shrubs as well as western juniper are present. Exotic herbaceous species are often present. Multiple plant community phases are likely within this state, influenced by livestock herbivory and fire. Sagebrush cover exceeds site concept and may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants. Sprouting species such as rabbitbrush and broom snakeweed as well as non-sprouting species such as big sagebrush may be dominant. The dominance of site resources by the shrub overstory and Sandberg bluegrass understory leads to a temporal redistribution of soil water, nutrient capture, nutrient cycling and soil organic matter. Western juniper may increase and begin to influence the understory vegetation.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- yellow rabbitbrush (*Chrysothamnus viscidiflorus*), shrub
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- Sandberg bluegrass (*Poa secunda*), grass

State 4
Invaded

Within this state, site resources are primarily controlled by exotic annual and perennial herbaceous species. Native perennial grass composition has been greatly diminished. Shrub species and western juniper may also be present. Overtime, with increasing invasion, soil stabilizing perennial root biomass will be decreased. Bare ground will increase potentially increasing erosion even on this low slope site during extreme weather events. Multiple plant communities are possible within this state, all of which are dominated by invasive annual grasses such as cheatgrass and medusahead as well as invasive annual and perennial forbs. Invader shrub species such as broom snakeweed may also be common

Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- cheatgrass (*Bromus tectorum*), grass
- medusahead (*Taeniatherum caput-medusae*), grass

State 5

Tree

This state is characterized by a dominance of young juniper (less than 100 years old) in the overstory. Big sagebrush and perennial bunchgrasses may still be present, but they are no longer controlling site resources. Soil moisture, soil nutrients and soil organic matter distribution and cycling have been spatially and temporally altered due to competition from Juniper as well as altered community structure. Juniper encroachment can decrease cover of grasses and shrubs by reducing light availability and altering site hydrology through increased interception of precipitation, reduced infiltration and increased erosion. Bare ground will increase and erosion may be increased even on this low slope site during extreme weather events. Multiple plant community phases may occur within this state, defined in part by the degree of juniper encroachment and the relative composition of other structural and functional groups. Non-native annual plants are likely present in all phases.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree

State 6
Seeded

Within this state, site resources are primarily controlled by introduced range grasses such as crested wheatgrass (*Agropyron cristatum*). Multiple community phases may occur within this state and will include different compositions of native and invasive shrub and grass species and western juniper. Similar to ecological dynamics within other states of this site, shrub species and western juniper will increase with greater time since fire and herbivory pressure. While introduced range grasses may provide some analogous ecological functions to native perennial grasses, they may outcompete native grasses in the long-term.

Dominant plant species

- crested wheatgrass (*Agropyron cristatum*), tree

Transition T1A
State 1 to 2

Trigger(s): This transition is caused by the introduction of non-native annual plants, such as cheatgrass, medusahead, and mustards. Slow variables: Over time the annual non-native species will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site.

Constraints to recovery. Altered Processes/Feedback Mechanisms: Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

Transition T2A
State 2 to 3

Trigger(s): Chronic improperly managed grazing or prolonged time without fire sufficient enough for the deep rooted perennial grass seedbank to diminish, and grazing resistant and/or fire intolerant shrubs to increase. Slow variables: Long term decrease in deep-rooted perennial grass density. Altered Processes/Feedback Mechanisms: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter.

Transition T2B
State 2 to 4

Trigger(s): Catastrophic fire, soil disturbing treatments or prolonged improperly managed grazing in the presence of non-native annual species; competitive increase in medusahead through lack of active management. Slow variables: Increased production and cover of non-native annual species; increased production and cover of medusahead as a percentage of the non-native total annual grass production and total cover. Altered Processes/Feedback Mechanisms: Loss of deep-rooted perennial bunchgrasses and shrubs truncates, spatially and

temporally, nutrient capture and cycling within the community.

Constraints to recovery. Increased, continuous fine fuels from annual non-native plants modify the fire regime by changing intensity, size and spatial variability of fires.

Transition T2C
State 2 to 5

Trigger(s): Time and lack of disturbance or management action allows for western juniper to dominate. Slow variables: Over time the abundance and size of trees will increase. Altered Processes/Feedbacks: Trees dominate ecological processes.

Context dependence. This may be coupled with grazing management that favors tree establishment by reducing understory herbaceous competition for site resources.

Restoration pathway R3A
State 3 to 2

Shrub management and seeding of native species coupled with minimal soil disturbance, potentially requiring the use of herbicide.

Context dependence. Risk of failure may be high due to droughty nature of the site, shallow soils and low resilience.

Transition T3A
State 3 to 4

Trigger(s): Catastrophic fire, soil disturbing treatments or prolonged improperly managed grazing in the presence of non-native annual species; competitive increase in medusahead through lack of active management. Slow variables: Increased production and cover of non-native annual species; increased production and cover of medusahead as a percentage of the non-native total annual grass production and total cover. Altered Processes/Feedback Mechanisms: Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and sagebrush truncate energy capture spatially and temporally thus impacting nutrient cycling and distribution.

Constraints to recovery. Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires

Transition T3B
State 3 to 5

Trigger(s): Time and a lack of disturbance or management action allows for western juniper to dominate site. This may be coupled with grazing management that favors tree establishment by reducing understory herbaceous competition for site resources. Slow variables: Over time the abundance and size of trees will increase. Altered Processes/Feedback Mechanisms: Trees dominate ecological processes.

Restoration pathway R3B
State 3 to 6

Brush management such as mowing, coupled with seeding of deep rooted non-native wheatgrasses. Targeted herbicide treatments may be necessary to facilitate this restoration pathway.

Context dependence. If non-native annual grasses are present, restoration attempts causing soil disturbance will likely initiate a transition to an annual state

Restoration pathway R4A

State 4 to 5

Reduction of annual grasses through management actions such as herbicide, prescribed grazing, or mowing, and seeding of desired species.

Context dependence. Risk of failure may be high due to droughty nature of the site and low resilience.

Restoration pathway R4A
State 4 to 6

Seeding of deep-rooted bunchgrasses. Targeted herbicide treatments are often necessary to facilitate this restoration pathway.

Context dependence. The probability of success is extremely low due to the low resilience of the site.

Restoration pathway R5B
State 5 to 3

Tree removal practices with minimal soil disturbance.

Transition T5A
State 5 to 4

Trigger(s): Catastrophic, stand replacing fire or inappropriate tree removal practices with soil disturbance will cause a transition to the Invaded State. Slow variables: Increased production and cover of non-native annual species under tree canopies. Altered Processes/Feedback Mechanisms: Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and sagebrush truncate energy capture and impact nutrient cycling and distribution.

Constraints to recovery. Closed tree canopy with non-native annual species dominant in the understory changes the intensity, size and spatial variability of fires.

Restoration pathway R5A
State 5 to 6

Tree removal and seeding of desired non-native wheatgrass species. Tree removal practices with minimal soil disturbance are recommended. Herbicide treatment may be necessary.

Context dependence. Probability of success declines with increased presence of non-native annual species.

Transition T6A
State 6 to 3

Trigger(s): Repeated, heavy, growing season grazing will decrease or eliminate deep rooted perennial bunchgrasses, increase Sandberg bluegrass and favor shrub growth and establishment. Severe fire will remove sagebrush overstory, decrease perennial bunchgrasses and enhance Sandberg bluegrass. Slow variables: Long term decrease in deep-rooted perennial grass density. Altered Processes/Feedbacks: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Grasses**			646–1031	
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	448–628	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	179–359	–
	Sandberg bluegrass	POSE	*Poa secunda*	18–45	–
	squirreltail	ELEL5	*Elymus elymoides*	–	–
Forb					
4	**Forbs**			73–161	
	buckwheat	ERIOG	*Eriogonum*	0–27	–
	common yarrow	ACMI2	*Achillea millefolium*	0–27	–
	milkvetch	ASTRA	*Astragalus*	0–27	–
	purple clover	TRPU15	*Trifolium purpureum*	0–27	–
	fleabane	ERIGE2	*Erigeron*	0–27	–
	onion	ALLIU	*Allium*	0–27	–
Shrub/Vine					
7	**Shrubs**			2–81	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	18–45	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–18	–
	rabbitbrush	CHRYS9	*Chrysothamnus*	0–18	–

Animal community

Grazing Livestock- Grazing is suitable for this site as long as management objectives include the improvement or maintenance of this site. It is easy to overuse this site and cause a shift in vegetation this is difficult to change. This site has the potential to produce a moderate amount of forage. Management should be aimed at harvesting the forage as quickly as possible, letting the site recover from the grazing event prior to fall dormancy. Initial stocking rate will be based on forage preference ratings. Bluebunch wheatgrass is considered moderately grazing tolerant during dormancy, and is very sensitive to damage from defoliation during periods of active growth and is deferment of grazing is suggested until at least the late boot stage by some. Thurber's needlegrass has been found to decrease under heavy grazing and increase when protected from grazing, although the opposite has been found to occur in one instance (Archer 2000). It can be toxic to livestock in large quantities and generally provides little browse. While broom snakeweed may be used by livestock it can be toxic in large quantities and generally provides little browse.

Wildlife- The main wildlife species of concern on this site are large herbivores. These are mule deer and elk. Being an open grassland, this site is home to a variety of small herbivores, birds and their associated predators. This site is mainly a foraging area for the larger wildlife. This site will offer food and cover for mule deer, rodents, and a variety of birds. It is an important wintering area for mule deer. Big sagebrush leaves and seeds provide high forage value for numerous large mammals and is especially important to wildlife during winter in many areas. Many birds, small mammals and invertebrates depend on sagebrush for habitat and feed as well. Thurber's needlegrass provides forage for livestock and wildlife including large ungulates and small mammals. Bluebunch wheatgrass is one of the most important perennial grasses for forage for livestock and wildlife in the Western US (Zlatnik 1999).

Wood products

This site is susceptible to an increase in western juniper. Where this has occurred, the site will yield fence posts, firewood and specialty products.

Type locality

Location 1: Grant County, OR	
Township/Range/Section	T7S R19E S35
General legal description	NW1/4 NE1/4 Sec35 T7SR19E WM Ridge top, 3/4 miles east of Camp Hancock (90% SI)
Location 2: Grant County, OR	
Township/Range/Section	T10S R21E S32
General legal description	NE1/4 SE1/4 Sec32 T10S R21E WM East of picnic area Painted Hills Unit (90% SI)

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Contributors

Jennifer Moffitt - minor updates for PES
Cici Brooks
Ed Petersen, Alan Bahn
JPR
Andrew Neary 2021 update and model

Approval

Kirt Walstad, 2/14/2025

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	08/06/2012
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 to severe sheet & rill erosion hazard

2. **Presence of water flow patterns:** None to some

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):** 10-20%

5. **Number of gullies and erosion associated with gullies:** None

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

7. **Amount of litter movement (describe size and distance expected to travel):** Fine - 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: aggregate stability = 4-6

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Shallow t very shallow, well drained very stony to very cobbly loams to andesite or hardpan: low OM (1-2%)

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Moderate ground cover (60-70%) and gentle slopes (2-12%) moderately 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: Thurber needlegrass > Bluebunch wheatgrass > forbs > other grasses > other 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: 1000, Normal: 800, Unfavorable: 600 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:** Perennial brush species will increase with deterioration of plant community. Western Juniper readily invades the site. Cheatgrass and Medusahead invade sites that have lost deep rooted perennial grass functional groups.

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