USDA Natural Resources
Conservation Service

Ecological site R023XY006NV
LOAMY 8-10 P.Z.

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Accessed: 04/14/2026

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.

Ecological site concept

Currently there is only a draft of the initial concept for this ecological site. The initial concept for this site places it within the Clayey Mesic Plateaus 8-14 PZ Wyoming Big Sagebrush and Thurber's Needlegrass Ecological Site Group. To view the General STM and other information available for this ESG please go to https://edit.jornada.nmsu.edu/catalogs/esg/023X/R023XY909OR

The Loamy 8-10” ecological site is the modal site for this group as it has the most acres mapped. This site occurs on summits and sideslopes of hills and piedmont slopes on all exposures. Slopes range from 2 to 30 percent, but slope gradients of 4 to 15 percent are most typical. Elevations range from 4500 to 5500 feet. Average annual precipitation is 8 to 10 inches. The soils in this site typically have a sub-surface layer that is restrictive to root development within 12 to 20 inches of the soil surface. Some soils have light colored, vesicular surface layers. The plant community is dominated by Thurber’s needlegrass and Wyoming big sagebrush. Indian ricegrass and Webber needlegrass (Achnatherum webberi) are important species associated with this site. Annual production is 600 lb/ac in normal years.

Associated sites

R023XY020NV	**LOAMY 10-12 P.Z.**
R023XY051NV	**SANDY 8-12 P.Z.**
R023XY059NV	**GRAVELLY CLAYPAN 10-12 P.Z.**

Similar sites

R023XY040NV	**GRANITIC FAN 8-10 P.Z.** Soils >20 inches deep and coarse textured; LECI4-ACTH7 codominant
R023XY038NV	**DROUGHTY LOAM 8-10 P.Z.** ACSP12 dominant grass; GRSP codominant shrub
F024XY051NV	**Pinus monophylla-Juniperus osteosperma/Artemisia nova/Achnatherum thurberianum** ACHY-HECO26 codominant grasses; typically on sand sheets
R023XY020NV	**LOAMY 10-12 P.Z.** PSSPS-ACTH7 codominant grasses; more productive site
R023XY030NV	**SOUTH SLOPE 8-12 P.Z.** ACSP12-PSSPS codominant grasses; EPHED and SADOI important shrubs

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata var. wyomingensis*
Herbaceous	(1) *Achnatherum thurberianum* (2) *Achnatherum hymenoides*

Physiographic features

This site occurs on summits and sideslopes of hills, fan remnants, and piedmont slopes on all exposures. Slopes range from 2 to 30 percent, but slope gradients of 2 to 15 percent are most typical. Elevations are 4300 to 7000 feet.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Fan piedmont (3) Fan remnant
Elevation	4,300–7,000 ft
Slope	2–30%
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is semiarid and characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 8 to 10 inches. Mean annual air temperature is 45 to 53 degrees F. The average growing season is about 80 to 110 days.

Nevada’s climate is predominantly arid, with large daily ranges of temperature, infrequent

severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada's climate: continentality, latitude, and elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. The prevailing winds are from the west, and as the warm moist air from the Pacific Ocean ascend the western slopes of the Sierra Range, the air cools, condensation occurs and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt not only in the West but throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The temperature regime is also affected by the blocking of the inland-moving maritime air. Nevada sheltered from maritime winds, has a continental climate with well-developed seasons and the terrain responds quickly to changes in solar heating. Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure in subtropical latitudes, with a center over the Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).

Average annual precipitation is 16 to over 20 inches. Mean annual air temperature is 41 to 44 degrees F. The average growing season is about 50 to 70 days.

Mean annual precipitaion at the Bear Creek, Nevada SNOTEL station (170501020301) is 37.69 inches.

monthly mean precipitation is:
January 3.84; February 3.75; March 4.38; April 4.9;
May 3.99; June 2.82; July .95; August 1.66;
September 1.22; October 2.12;
November 3.67; December 4.38.

Table 3. Representative climatic features

Frost-free period (average)	95 days
Freeze-free period (average)	
Precipitation total (average)	9 in

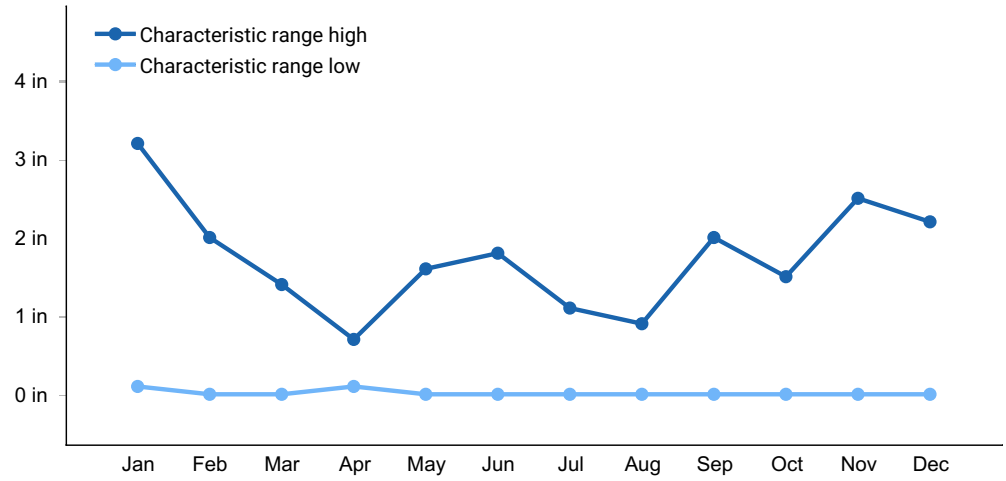


Figure 1. Monthly precipitation range

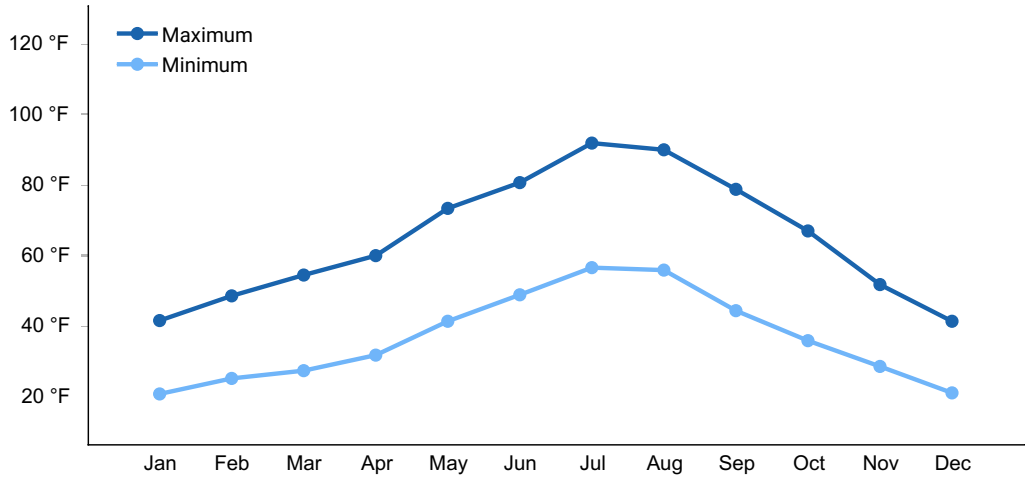


Figure 2. Monthly average minimum and maximum temperature

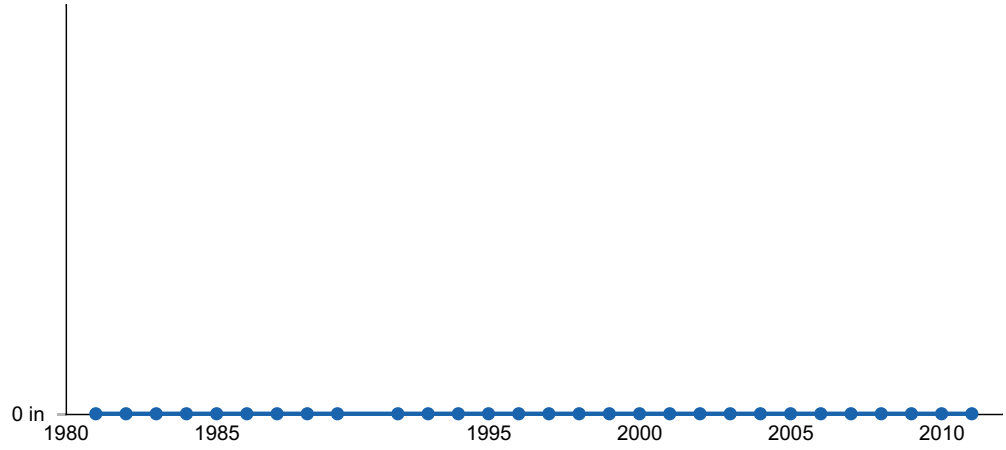


Figure 3. Annual precipitation pattern

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this site typically have a sub-surface layer that is restrictive to root development within 12 to 20 inches of the soil surface. Some soils have light colored, vesicular surface layers. The available water capacity is very low to moderate and permeability is very slow to moderately rapid. The soil moisture regime is aridic bordering on xeric and the temperature regime is mesic. The soils typically have an ochric epipedon and an argillic horizon. The soil series associated with this site include: Bombadil, Buffaran, Burrita, Chill, Corral, Dewar, Hangrock, Haybourne, Hunnton, Langston, McWatt, Midraw, Old Camp, Saraph, Schamp, Soughe, Trunk, and Veta.

A representative soil series is Old Camp a loamy-skeletal, mixed, superactive, mesic, Lithic Xeric Haplargid. An ochric epipedon occurs from the soil surface to 5 cm and an argillic horizon occurs from 5 to 36 cm.

Table 4. Representative soil features

Surface texture	(1) Very gravelly loam (2) Gravelly loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Very slow to moderately rapid
Soil depth	10–20 in
Surface fragment cover <=3"	20–50%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	1.5–5 in
Calcium carbonate equivalent (0-40in)	0–5%
Electrical conductivity (0-40in)	0–8 mmhos/cm
Sodium adsorption ratio (0-40in)	0–30
Soil reaction (1:1 water) (0-40in)	6.8–7.6
Subsurface fragment volume <=3" (Depth not specified)	15–45%
Subsurface fragment volume >3" (Depth not specified)	0–20%

Ecological dynamics

The plant communities of this site are dynamic in response to changing weather patterns and disturbance regimes. The reference plant community is dominated by Wyoming big sagebrush (*Artemisia tridentata* subsp. wyomingensis) and deep-rooted cool season perennial bunchgrasses such as Thurber's needlegrass (*Achnatherum thurberianum*)and Indian ricegrass (*Achnatherum hymenoides*). This site inherently has low resistance to invasion by non-natives and low resilience following invasion by non-natives. In Great Basin ecosystems, inherent resilience typically increases with elevation due to higher levels of water, nutrients, and annual biomass production. Wyoming sagebrush ecosystems are the most vulnerable to cheatgrass (*Bromus tectorum*) invasion due to the combination of low resilience to disturbances such as fire and low resistance to cheatgrass invasion (Chambers et al. 2012). Management activities should be prioritized based on the relative resilience and resistance of a specific ecological site.

Wyoming big sagebrush is the most drought tolerant of the three major big sagebrush subspecies. The root system is deep and well-developed with many laterals and one or more taproots. The majority of the roots are in the upper foot of soil with tap roots extending up to 6 feet in depth. The roots are infected with the vesicular-arbuscular mycorrhizae (VAM) Glomus microcarpus and Gigaspora spp. Wyoming big sagebrush is a long-lived species with maximum ages to 150 years old (Howard 1999). Mycorrhizas (‘fungus-roots’) are the result of a symbiotic relationship between specialized soil organisms and plants roots. Wyoming big sagebrush seedlings exhibit greater drought resistance when inoculated with VAM. Average soil water potential resulting in death of Wyoming big sagebrush seedlings infected with VAM was 0.45 MPa lower than seedlings that were not infected with VAM (Stahl et al. 1998). A number of beneficial changes in the water relations of arbuscular mycorrhizal plants including altered rates of water uptake, hydraulic conductivity, leaf and stem water potentials, stomatal resistance and transpiration rates have been observed by researchers. Stahl et al. (1998) found VAM to be vitally important during the early stages of seedling establishment. Improved ability to extract soil nutrients and improve drought tolerance in Wyoming big sagebrush seedlings may have important consequences for restoration of degraded sagebrush habitat.

Sagebrush species set seed in the late summer and fall. Seeds ripen from September through October and fall from the plant. Cold, moist conditions and exposure to light increase germination in the spring (Johnson 2000). Seeds of sagebrush species are best adapted to germinate in habitats with conditions similar to that of the collection site. Survival of sagebrush seedlings is dependent on adequate moisture conditions. Young plants are susceptible to less than desirable condition for several years following germination.

Sagebrush species are generally long-lived; therefore, it is not necessary for new individuals to recruit every year for perpetuation of the stand. Infrequent large recruitment events and simultaneous low, continuous recruitment is the foundation of population maintenance (Noy-Meir 1973). Mature properly functioning sagebrush communities have

higher infiltration rates and lower sediment production, than degraded systems. Reoccurring disturbances, natural or anthropogenic, will result in decreased sagebrush cover and increased cover of disturbance tolerant shrubs and non-natives. Loss of structural and functional groups affects ecosystem functioning and can result in soil loss.

The accumulation and decomposition of litter increase nutrient concentrations under sagebrush shrub canopies. The breakdown of aging roots also contributes to organic matter and nutrient cycling in the sagebrush system. Carbon and nitrogen concentration are higher under sagebrush canopies when compared to interspaces (Chen and Stark 2000). The root systems of sagebrush maximizes water uptake with a deep taproot and shallow branching roots. The combination of deep and shallow roots also provides excellent soil stabilization.

Variability in plant community composition and production depends on soil surface texture and depth. Thurber's needlegrass will increase on gravelly surfaces, whereas Indian ricegrass will increase with sandy soil surfaces. An argillic horizon will promote production of bluebunch wheatgrass. Production increases with soil depth. The amount of sagebrush in the plant community is dependent upon fire frequency, which would be highly infrequent.

Inappropriate grazing can lead to an increase in sagebrush and a decline in understory plants like Thurber's needlegrass and Indian ricegrass. Squirreltail (*Elymus elymoides*) will increase temporarily with further degradation. Invasion of annual non-native invasive forbs and cheatgrass could occur with further grazing degradation, leading to a decline in squirreltail and an increase in bare ground. Wetter sites are more resistant to degradation and may result in sagebrush and Sandberg's bluegrass dominating the site. A combination of overgrazing and prolonged drought leads to soil erosion, increased bare ground and a loss in plant production.

Where site degradation has been fire-induced, broom snakeweed (*Gutierrezia sarothrae*) and rabbitbrush (*Chrysothamnus viscidiflorus*) often dominate the site. Repeated burning of the plant community at intervals less than 10 to 15 years results in complete site dominance by non-native annuals (primarily cheatgrass, halogeton (*Halogeton glomeratus*), Russian thistle (*Salsola tragus*), fiddleneck (Amsinkia spp.), and tansy mustard (Descurainia spp.)and the near total absence of woody plants, including sagebrush.

Fire Ecology:
Prior to Euro-American settlement, Wyoming big sagebrush communities historically had low fuel loads, and patchy fires that burned in a mosaic pattern were common at 10 to 70 year return intervals (Young et al. 1979, West and Hassan 1985, Bunting et al. 1987). Davies et al. (2007) suggest pre Euro-American settlement fire return intervals in Wyoming big sagebrush communities were around 50 to 100 years. The introduction and expansion of cheatgrass has dramatically altered the fire return intervals and restoration potential of Wyoming big sagebrush communities.

Fire is the principal means of renewal for decadent stands of Wyoming big sagebrush. Wyoming big sagebrush plants of all ages are killed by fire. Depending on site conditions prior to wildfire, perennial grasses and forbs will dominate initially after wildfire. Wyoming big sagebrush establishes afterwards from soil stored seed and from seed produced by remnant plants that escaped fire. Prolific seed production from nearby unburned plants coupled with high germination and survival rates is required to ensure establishment following fire. The VAM upon which Wyoming big sagebrush depends on for healthy growth are usually harmed by fire and may take several years to recover. Typically, fewer VAM are killed by low-intensity wildfire than by more severe fire intensities (Howard 1999).

Spiny hopsage (*Grayia spinosa*) is considered to be somewhat fire tolerant and often survives fires that kill sagebrush. Mature spiny hopsage generally resprout after fire. Spiny hopsage is reported to be less susceptible to fire during summer dormancy.

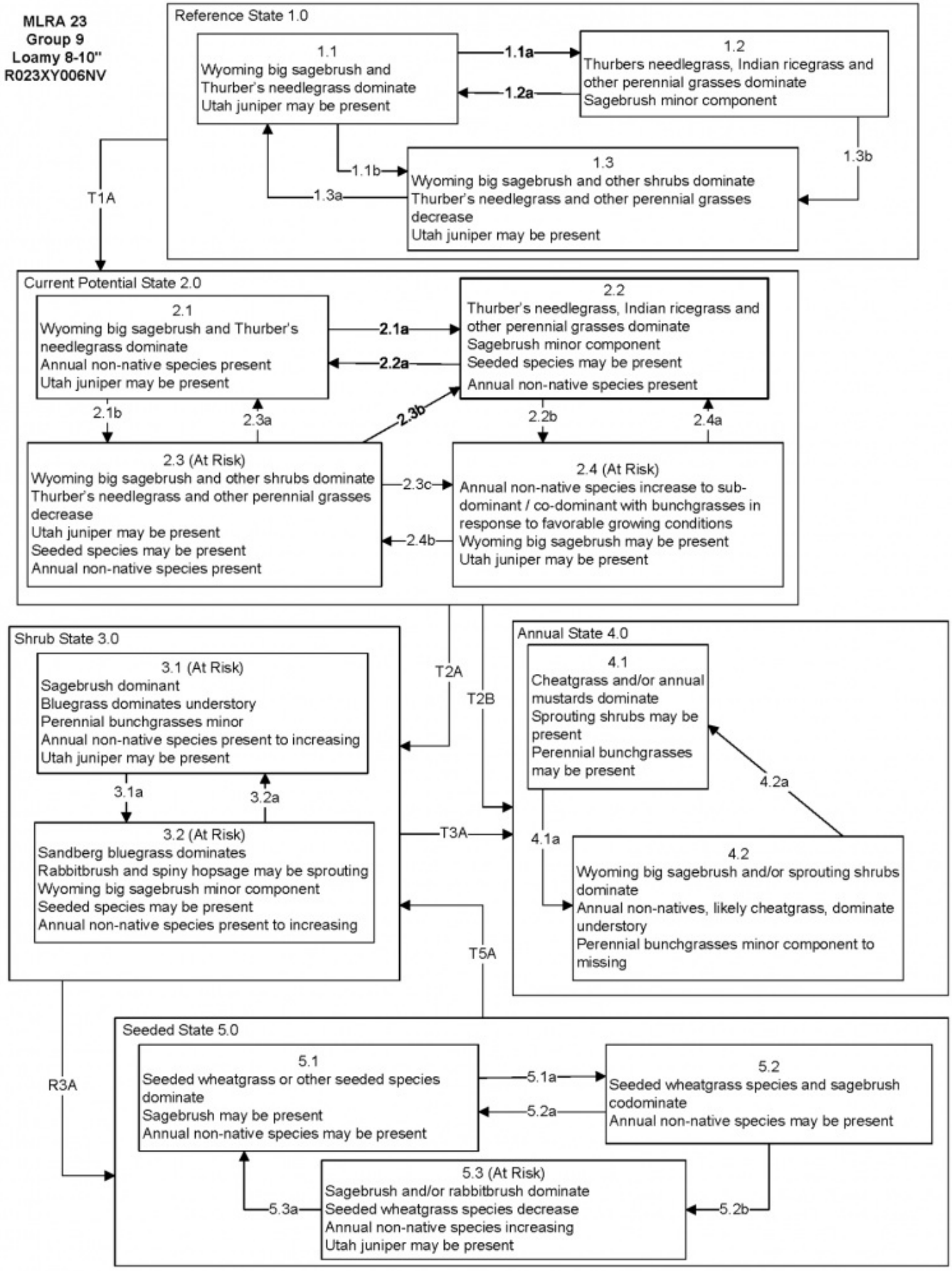
Thurber's needlegrass is classified as moderately resistant, but depending on season of burn, phenology, and fire severity, it is moderately to severely damaged by fire. Burning has been found to decrease the vegetation and reproductive vigor. Early season burning is more damaging to this needlegrass than late season burning.

Burning bluebunch wheatgrass may remove most of the aboveground biomass but does not usually result in plant mortality. Bluebunch wheatgrass is generally favored by burning. Burning stimulates flowering and seed production. However, season of burning affects mortality.

Indian ricegrass can be killed by fire, depending on severity and season of burn. Indian ricegrass reestablishes on burned sites through seed dispersed from adjacent unburned areas. There is some speculation that Indian ricegrass may sprout from tillers after fire, especially if plant mortality was incomplete. Due to low culm density and below ground plant crowns, this is a fairly fire tolerant species Webber's needlegrass is damaged by burning due to dense plant material that can burn slowly and long, charring to the growing points. Late summer and early fall fires are the least harmful. Sandberg bluegrass is generally unharmed by fire. It produces little litter, and its small bunch size and sparse litter reduces the amount of heat transferred to perennating buds in the soil. Its rapid maturation in the spring also reduces fire damage, since it is dormant when most fires occur.

Where management results in abusive livestock use, palatable perennial grass and forb species will decrease while shrub species increase. Species likely to invade this site are cheatgrass, tansy mustard, Russian thistle, and other annual grasses and forbs. Fire on this site, when in lower ecological condition, can result in cheatgrass monocultures. Juniper readily invades this site where it occurs adjacent to these forestlands.

State and transition model


MLRA 23
Group 9
Loamy 8-10"
R023XY006NV
Reference State 1.0
1.1
Wyoming big sagebrush and
Thurber's needlegrass dominate
Utah juniper may be present
1.1a
1.2a
1.2
Thurbers needlegrass, Indian ricegrass and
other perennial grasses dominate
Sagebrush minor component
1.1b
1.3a
1.3
Wyoming big sagebrush and other shrubs dominate
Thurber's needlegrass and other perennial grasses
decrease
Utah juniper may be present
1.3b
T1A
Current Potential State 2.0
2.1
Wyoming big sagebrush and Thurber's
needlegrass dominate
Annual non-native species present
Utah juniper may be present
2.1a
2.2a
2.2
Thurber's needlegrass, Indian ricegrass and
other perennial grasses dominate
Sagebrush minor component
Seeded species may be present
Annual non-native species present
2.1b
2.3a
2.3b
2.2b
2.4a
2.3 (At Risk)
Wyoming big sagebrush and other shrubs dominate
Thurber's needlegrass and other perennial grasses
decrease
Utah juniper may be present
Seeded species may be present
Annual non-native species present
2.3c
2.4b
2.4 (At Risk)
Annual non-native species increase to sub-
dominant / co-dominant with bunchgrasses in
response to favorable growing conditions
Wyoming big sagebrush may be present
Utah juniper may be present
Shrub State 3.0
3.1 (At Risk)
Sagebrush dominant
Bluegrass dominates understory
Perennial bunchgrasses minor
Annual non-native species present to increasing
Utah juniper may be present
3.1a
3.2a
3.2 (At Risk)
Sandberg bluegrass dominates
Rabbitbrush and spiny hopsage may be sprouting
Wyoming big sagebrush minor component
Seeded species may be present
Annual non-native species present to increasing
T2A
T2B
T3A
T5A
Annual State 4.0
4.1
Cheatgrass and/or annual
mustards dominate
Sprouting shrubs may be
present
Perennial bunchgrasses
may be present
4.2a
4.1a
4.2
Wyoming big sagebrush and/or sprouting shrubs
dominate
Annual non-natives, likely cheatgrass, dominate
understory
Perennial bunchgrasses minor component to
missing
R3A
Seeded State 5.0
5.1
Seeded wheatgrass or other seeded species
dominate
Sagebrush may be present
Annual non-native species may be present
5.1a
5.2a
5.2
Seeded wheatgrass species and sagebrush
codominate
Annual non-native species may be present
5.3a
5.3 (At Risk)
Sagebrush and/or rabbitbrush dominate
Seeded wheatgrass species decrease
Annual non-native species increasing
Utah juniper may be present
5.2b

MLRA 23
Group 9
Loamy 8-10"
R023XY006NV
KEY

Reference State 1.0 Community Phase Pathways
1.1a: Low severity fire and/or Aroga moth infestation creates grass/sagebrush mosaic.
1.1b: Time and lack of disturbance such as fire. Excessive herbivory and/or drought will reduce perennial bunchgrasses.
1.2a: Time and lack of disturbance and/or herbivory that allows for shrub regeneration.
1.3a: Low severity fire or Aroga moth infestation resulting in a mosaic pattern.
1.3b: High severity fire and/or severe Aroga moth infestation significantly reduces sagebrush cover leading to early/mid-seral community.

Transition T1A: Introduction of non-native species such as cheatgrass.

Current Potential State 2.0 Community Phase Pathways
2.1a: Low severity fire and/or Aroga moth infestation creates grass/sagebrush mosaic; non-native annual species present.
2.1b: Time and lack of disturbance such as fire. Inappropriate grazing and/or drought will reduce perennial bunchgrasses.
2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
2.2b: Fall and spring growing conditions that favors the germination and production of non-native, annual grasses. Pathway typically occurs 3 to 5 years post-fire and 2.4 may be a transitory plant community.
2.3a: Low severity fire or Aroga moth infestation creates sagebrush/grass mosaic. Brush management (aerial herbicide application), late-fall/ winter grazing causing mechanical damage to sagebrush.
2.3b: High severity fire and/or severe Aroga moth infestation significantly reduces sagebrush cover leading to early mid-seral community.
2.3c: Fall and spring growing season conditions that favors the germination and production of non-native annual grasses. 2.4 may be a transitory plant community.
2.4a: Growing season conditions favoring perennial bunchgrass production and reduced cheatgrass production.
2.4b: Growing season conditions favoring perennial bunchgrass production and reduced cheatgrass production.

Transition T2A: Inappropriate grazing management favoring shrub dominance and reducing perennial bunchgrasses and/or drought (3.1). Fire (3.2).
Transition T2B: Fire (4.1) or inappropriate grazing management in the presence on non-native annual species (4.2).

Shrub State 3.0 Community Phase Pathways
3.1a: Fire, Aroga moth, brush management (aerial herbicide application), and/or late-fall/winter grazing causing mechanical damage to sagebrush.
3.2a: Time and lack of disturbance (an unlikely/slow transition).

Annual State 4.0 Community Phase Pathways
4.1a: Time and lack of disturbance (an unlikely/slow transition).
4.2a: Fire.

Transition T3A: Fire (4.1) or inappropriate grazing management (4.2).
Restoration R3A: Brush management, combined with seeding of desired species.

Seeded State 5.0 Community Phase Pathways
5.1a: Time and lack of disturbance may be coupled with inappropriate grazing management.
5.2a: Low severity fire.
5.2b: Inappropriate grazing management reduces bunchgrasses and increases density of sagebrush; usually a slow transition.
5.3a: Fire or brush treatment with minimal soil disturbance.

Transition T5A: Inappropriate grazing management favoring shrub dominance and reducing perennial bunchgrasses will lead to phase 3.1.
Soil disturbing treatments and/or fire will lead to phase 3.2.

State 1
Reference State

The reference state is representative of the natural range of variability prior to Euro-American settlement conditions. State dynamics are maintained by interactions between climatic patterns and disturbance regimes. The reference state has three general community phases a perennial grass dominant phase, a perennial grass-shrub mixture and a shrub-dominant phase. Disturbance favors the grass-dominated and grass-shrub phases and less frequent disturbance favors the shrub-dominated phase. Community phase changes are primarily driven by time, infrequent wildfires, periodic drought and insect or disease attack.

Community 1.1
Community Phase

The reference plant community is dominated by Wyoming big sagebrush and Thurber needlegrass. Indian ricegrass and Webber ricegrass are important species associated with this site. Utah juniper may be present. Potential vegetative composition is about 60% grasses, 5% forbs and 35% shrubs and trees. Approximate ground cover (basal and crown) is about 20 to 30 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	240	360	480
Shrub/Vine	132	198	264
Forb	20	30	40
Tree	8	12	16
Total	**400**	**600**	**800**

Community 1.2
Community Phase

Community 1.3
Community Phase

Pathway b
Community 1.1 to 1.3

Pathway a
Community 1.2 to 1.1

Pathway b
Community 1.2 to 1.3

Pathway a
Community 1.3 to 1.1

State 2
Current Potential State

State 2 This state is similar to the Reference State (1) and the same three community phases occur. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of non-native invasive species (5-15% by weight). Low frequency and low intensity disturbances favor the grass-dominant and grass-shrub mixture phases but the presence of non-natives is favored if frequency and severity of disturbances change from historic conditions. Prescribed grazing and infrequent fire (50-100 year return interval) maintain state dynamics. Prescribed grazing and/or release from drought may reverse declines in Thurber’s needlegrass and Indian ricegrass production.

Community 2.1
Community Phase

Community 2.2
Community Phase

Community 2.3
Community Phase (at risk)

Pathway a
Community 2.1 to 2.2

Pathway b
Community 2.1 to 2.3

Pathway a
Community 2.2 to 2.1

Pathway a
Community 2.3 to 2.1

Pathway b
Community 2.3 to 2.2

State 3
Shrub State

State 3. State 3 has two community phases. One phase is a dense overstory of decadent Wyoming big sagebrush and an understory of Sandberg's bluegrass, a shallow-rooted cool season perennial bunchgrass. The second community phase is dominated by Sandberg’s bluegrass with non-native annuals in the plant community. A trace of deep-rooted perennial bunchgrasses remains in the plant community. Non-native annual grasses and forbs are abundant in the understory. A biotic threshold has been crossed and site resiliency has been reduced with the loss of the deep rooted perennial bunchgrasses. Feedbacks contributing to the stability of this state include the loss of structural and functional groups (deep-rooted perennial bunchgrasses and shrub seedlings), resulting in decreased herbaceous production and reduced organic matter inputs. Changes in infiltration and runoff rates contribute to reduced soil moisture availability thereby reducing reproductive potential of native species.

Community 3.1
Community Phase (at risk)

Community 3.2
Community Phase (at risk)

State 4
Annual State

State 4. State 4 has two community phases. One phase is dominated by non-native annual species, primarily cheatgrass, halogeton, Russian thistle, fiddleneck, and annual mustards. Sandberg's bluegrass and squirreltail may also occur. The second community phase is dominated by fire tolerant shrubs and non-native annuals. An abiotic threshold has been crossed and state dynamics are now driven by fire and time. The length of time between fires creates two potential community phases with broom snakeweed and rabbitbrush increasing with fire return intervals >10 years. This alternative stable state is persistent due to strong feedbacks, including presence of non-natives; competition from non-native species for soil moisture and nutrients prevent germination and establishment of native species. Fine-fuel loading supports a modified fire regime too narrow for the successful establishment of Wyoming big sagebrush and favors an increase of non-native invasive annuals. Biogeochemical cycling is altered by dominance of cheatgrass modifying the soil environment. Cheatgrass monocultures have low VAM fungal populations, increasing the difficulty of reestablishing sagebrush and native bunchgrasses that require these mycorrhizae.

Community 4.1
Community Phase

Community 4.2
Community Phase

Pathway a
Community 4.1 to 4.2

Pathway a
Community 4.2 to 4.1

State 5
Seeded State

The seeded state that has three community phases; a grass dominated phase, a shrub-grass co-dominated phase and a shrub phase. The seeded species may be native or non-native. Annual non-native species may also be present. Following wildfire, range plantings help to stabilize the soil surface, reduce erosion and provide competition for non-native annuals. Seeded species may include native and non-native species. Annual non-natives may be present. Typically there is an overall lack of native perennial forbs. However, some seeded forbs, like western yarrow (*Achillea millefolium*), may do quite well. Feedbacks contributing to the stability of this state include competitive ability and vigor of seed species. Seeded perennial grasses reduce the availability of critical resources to non-native annuals, reducing fire frequency.

Community 5.1
Community Phase

Community 5.2
Community Phase

Community 5.3
Community Phase (at risk)

Pathway a
Community 5.1 to 5.2

Pathway a
Community 5.2 to 5.1

Pathway b
Community 5.2 to 5.3

Pathway a
Community 5.3 to 5.1

Transition A

State 1 to 2

Transition A
State 2 to 3

Transition B
State 2 to 4

Transition A
State 3 to 4

Restoration pathway A
State 3 to 5

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			229–498	
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	180–270	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	12–90	–
	Webber needlegrass	ACWE3	*Achnatherum webberi*	12–48	–
	Sandberg bluegrass	POSE	*Poa secunda*	12–30	–
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	1–30	–
	squirreltail	ELEL5	*Elymus elymoides*	12–30	–
2	**Secondary Perennial Grasses**			12–48	
	desert needlegrass	ACSP12	*Achnatherum speciosum*	3–18	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	3–18	–
	needle and thread	HECO26	*Hesperostipa comata*	3–18	–
	basin wildrye	LECI4	*Leymus cinereus*	3–18	–
3	**Secondary Annual Grasses**			1–18	
Forb					

4	**Perennial**			30–60	
	buckwheat	ERIOG	*Eriogonum*	3–12	–
	desertparsley	LOMAT	*Lomatium*	3–12	–
	lupine	LUPIN	*Lupinus*	3–12	–
	phlox	PHLOX	*Phlox*	3–12	–
5	**Annual**			6–18	
Shrub/Vine					
6	**Primary Shrubs**			132–210	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	120–180	–
	spiny hopsage	GRSP	*Grayia spinosa*	12–30	–
7	**Secondary Shrubs**			30–75	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	6–18	–
	Nevada jointfir	EPNE	*Ephedra nevadensis*	6–18	–
	horsebrush	TETRA3	*Tetradymia*	6–18	–
Tree					
8	**Evergreen**			3–12	
	Utah juniper	JUOS	*Juniperus osteosperma*	3–12	–

Animal community

Livestock Interpretations:
This site is suitable for livestock grazing. Grazing management should be keyed to perennial grass production. Thurber’s needlegrass species begin growth early in the year and remain green throughout a relatively long growing season. This pattern of development enables animals to use Thurber’s needlegrass when many other grasses are unavailable. Cattle prefer Thurber’s needlegrass in early spring before fruits have developed as it becomes less palatable when mature. Thurber’s needlegrass is grazed in the fall only if the fruits are softened by rain. Indian ricegrass is highly palatable to all classes of livestock in both green and cured condition. It supplies a source of green feed before most other native grasses have produced much new growth. Webber’s needlegrass is desired forage in the spring and undesired the rest of the year for livestock. Bluebunch wheatgrass is considered one of the most important forage grass species on western rangelands for livestock. Although bluebunch wheatgrass can be a crucial source of forage, it is not necessarily the most highly preferred species. Bottlebrush squirreltail is very palatable winter forage for domestic sheep of Intermountain ranges. Domestic sheep relish the green foliage. Overall, bottlebrush squirreltail is considered moderately palatable to livestock. Sandberg bluegrass is a widespread forage grass. It is one of the earliest grasses in the spring and is sought by domestic livestock and several wildlife species.

Sandberg bluegrass is a palatable species, but its production is closely tied to weather conditions. It produces little forage in drought years, making it a less dependable food source than other perennial bunchgrasses. Livestock browse Wyoming big sagebrush, but may use it only lightly when palatable herbaceous species are available. Spiny hopsage provides a palatable and nutritious food source for livestock, particularly during late winter through spring. Domestic sheep browse the succulent new growth of spiny hopsage in late winter and early spring.

Stocking rates vary over time depending upon season of use, climate variations, site, and previous and current management goals. A safe starting stocking rate is an estimated stocking rate that is fine tuned by the client by adaptive management through the year and from year to year.

Wildlife Interpretations:
Wyoming big sagebrush is preferred browse for wild ungulates. Pronghorn usually browse Wyoming big sagebrush heavily. Sagebrush-grassland communities provide critical sage-grouse breeding and nesting habitats. Meadows surrounded by sagebrush may be used as feeding and strutting grounds. Sagebrush is a crucial component of their diet year-round, and sage-grouse select sagebrush almost exclusively for cover. Sage-grouse prefer mountain big sagebrush and Wyoming big sagebrush communities to basin big sagebrush communities. Spiny hopsage provides a palatable and nutritious food source for big game animals. Spiny hopsage is used as forage to at least some extent by domestic goats, deer, pronghorn, and rabbits. Thurber needlegrass is valuable forage for wildlife. Indian ricegrass is eaten by pronghorn in moderate amounts whenever available. In Nevada it is consumed by desert bighorns. A number of heteromyid rodents inhabiting desert rangelands show preference for seed of Indian ricegrass. Indian ricegrass is an important component of jackrabbit diets in spring and summer. In Nevada, Indian ricegrass may even dominate jackrabbit diets during the spring through early summer months. Indian ricegrass seed provides food for many species of birds. Doves, for example, eat large amounts of shattered Indian ricegrass seed lying on the ground. Webber’s needlegrass is desired forage in the spring and undesired the rest of the year for wildlife. Bluebunch wheatgrass is considered one of the most important forage grass species on western rangelands for wildlife. Bluebunch wheatgrass does not generally provide sufficient cover for ungulates, however, mule deer are frequently found in bluebunch-dominated grasslands. Bottlebrush squirreltail is a dietary component of several wildlife species. Bottlebrush squirreltail may provide forage for mule deer and pronghorn. Sandberg bluegrass is desirable for pronghorn antelope and mule deer in the spring and preferable in the spring, summer, and fall for elk and desirable as part of their winter range.

Hydrological functions

Rills and pedestals are none to rare. A few rills can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt. Occurrence of pedestals is usually limited to areas of water flow patterns. Water flow patterns are none to

rare but can be expected in areas subjected to summer convection storms or rapid snowmelt. Frost heaving of shallow rooted plants should not be considered a normal condition. Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., Thurber's needlegrass & Indian ricegrass] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.

Recreational uses

Aesthetic value is derived from the diverse floral and faunal composition and the colorful flowering of wild flowers and shrubs during the spring and early summer. This site offers rewarding opportunities to photographers and for nature study. This site is used for camping and hiking and has potential for upland and big game hunting.

Other products

Native Americans made tea from big sagebrush leaves. They used the tea as a tonic, an antiseptic, for treating colds, diarrhea, and sore eyes and as a rinse to ward off ticks. Big sagebrush seeds were eaten raw or made into meal. Some Native American peoples traditionally ground parched seeds of spiny hopsage to make pinole flour. Indian ricegrass was traditionally eaten by some Native Americans. The Paiutes used seed as a reserve food source.

Other information

Wyoming big sagebrush is used for stabilizing slopes and gullies and for restoring degraded wildlife habitat, rangelands, mine spoils and other disturbed sites. It is particularly recommended on dry upland sites where other shrubs are difficult to establish. Spiny hopsage has moderate potential for erosion control and low to high potential for long-term revegetation projects. It can improve forage, control wind erosion, and increase soil stability on gentle to moderate slopes. Bottlebrush squirreltail is tolerant of disturbance and is a suitable species for revegetation.

Type locality

Location 1: Humboldt County, NV	
Township/Range/Section	T42N R25E S13
Latitude	41° 33′ 22″
Longitude	119° 4′ 24″
General legal description	N 1/2, Summit Lake Indian Reservation, Humboldt County, Nevada.

Other references

Fire Effects Information System (Online; http://www.fs.fed.us/database/feis/plants/).

USDA-NRCS Plants Database (Online; http://www.plants.usda.gov).

Contributors

BH/SW

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)	GK BRACKLEY
Contact for lead author	State Rangeland Management Specialist
Date	06/20/2006
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are none to rare. A few rills can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt.

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2. **Presence of water flow patterns:** Water flow patterns are none to rare but can be expected in areas subjected to summer convection storms or rapid snowmelt. Typically short (<3m) and disconnected.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare. Occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants should not be considered a normal condition.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground ± 50% depending on amount of surface rock fragments.

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

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

7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) is expected to move the distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 3 to 6 on most soil textures found on this site. (To be field tested.)

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically thin to thick platy. Soil surface colors are grays or pale browns and soils are typified by an ochric epipedon. Organic matter of the surface 2 to 3 inches is typically 1 to 1.5 percent, dropping off quickly below. Organic matter content can be more or less depending on micro-topography.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., Thurber needlegrass & Indian ricegrass] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.

11. **Presence and thickness of compaction layer (usually none; describe soil profile**

features which may be mistaken for compaction on this site): Compacted layers are none. Platy or massive sub-surface horizons, or subsoil argillic horizons are not to be interpreted as compacted layers.

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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: Reference Plant Community: Deep-rooted, cool season, perennial bunchgrasses >> tall shrubs (Wyoming big sagebrush) >> associated shrubs. (By above ground production)

    Sub-dominant: Shallow-rooted, cool season, perennial grasses > deep-rooted, cool season, perennial forbs = fibrous, shallow-rooted, cool season, annual and perennial forbs. (By above ground production)

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs are common and standing dead shrub canopy material may be as much as 35% of total woody canopy; some of the mature bunchgrasses (<20%) have dead centers.

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14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (20-30%) and litter depth is ± 0.25 inch.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (through May) ± 600 lbs/ac; Spring moisture significantly affects total production. Favorable years ±800 lbs/ac and unfavorable years ± 400 lbs/ac.

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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: Potential invaders include cheatgrass, halogeton, Russian thistle, annual mustards, and bassia are invaders on this site. Douglas rabbitbrush and Utah or western juniper are increasers on this site.

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17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years. Little growth or reproduction occurs in drought years.
