USDA Natural Resources
Conservation Service

Ecological site R036XY306UT
Upland Loam (big sagebrush)

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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.

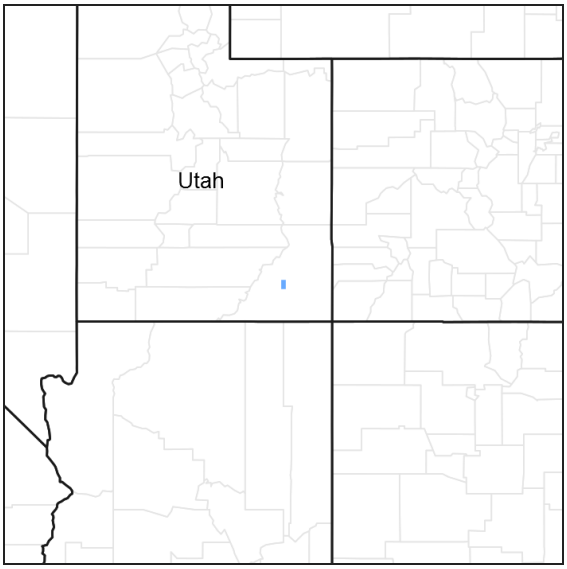


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

Associated sites

R036XY307UT	**Upland Loam (pinyon-Utah juniper)**
R036XY315UT	**Upland Shallow Loam (pinyon-Utah juniper)**

Similar sites

R035XY306UT	**Upland Loam (Basin Big Sagebrush)** This site is simlar to the D36 site; however it is located in MLRA 35. Other than location there are no differences in these two sites.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. tridentata*
Herbaceous	(1) *Achnatherum hymenoides*

Physiographic features

This site occurs on level to very gently sloping structural benches, plateaus, hills, and mesas. Run off is variable,

and is greatly influenced by micro-topography. Typically slopes range from 0-10%; however sites may occur on sites up to 40% slope.

Table 2. Representative physiographic features

Landforms	(1) Structural bench (2) Mesa
Flooding frequency	None
Ponding frequency	None
Elevation	1,829–2,134 m
Slope	0–10%
Aspect	Aspect is not a significant factor

Climatic features

The climate is characterized by warm summers, cool winters. The climate is modified by local topographic conditions, such as aspect. Mean annual high temperatures range from 62-65 degrees Fahrenheit and mean annual low temperatures range from 35-40 degrees Fahrenheit. Much of the rainfall occurs as convective storms in late summer and early fall; about 20-30% percent of the total precipitation fall in July and August. Snow packs are generally light and not persistent, about 15 to 20 percent of the total precipitation falls as snow. May and June are typically the driest months, with average annual precipitation ranging from 12-14 inches.

Table 3. Representative climatic features

Frost-free period (average)	175 days
Freeze-free period (average)	178 days
Precipitation total (average)	356 mm

Influencing water features

There are no water features influencing this site.

Soil features

The soils are moderately deep to very deep and are typically well drained and well developed. Typically the dry surface is a dark yellowing brown to brown. Runoff typically low due to flatter slopes and high permeability; soils occurring on greater than 20% slopes have a moderate run-off potential; however occurrences are rare. The soils temperature and moisture regimes are mesic and aridic ustic respectively. Surface textures and subsurface textures are generally fine sandy loams, sandy loams, and sandy clay loams. Soils are none saline and neutral to slightly alkaline. Biological soils crust cover varies by plant community phase, soil, aspect, elevation, etc. This site has been used in the following soil surveys and has been correlated to the following components:

UT638—Natural Bridges National Monument, UT – Plumasano and Nomrah

Typical Soil Profile:
A—0 to 3 inches; fine sandy loam; brown; neutral (pH 6.8)
Bt1—3 to 23 inches; sandy clay loam, brown; neutral (pH 6.8)
Bt2—23 to 32 inches; sandy clay loam; yellowish red; neutral (pH 7.0)
Btk—32 to 58 inches; sandy clay loam; light reddish brown; moderately alkaline (pH 8.4)
BC—58 to 62 inches; fine sandy loam; strong brown; slightly alkaline (pH 7.8)

Table 4. Representative soil features

Surface texture	(1) Fine sandy loam (2) Sandy loam (3) Sandy clay loam
Family particle size	(1) Loamy
Drainage class	Well drained to excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	51–152 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	15.24–18.03 cm
Calcium carbonate equivalent (0-101.6cm)	1–15%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	6–8
Soil reaction (1:1 water) (0-101.6cm)	3.8–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–5%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This site developed under Colorado Plateau climatic conditions and included natural influences of herbivory, fire, and climate. This ecological site occurs on deep productive soils typically found on mesa tops in Major Land Resource Area (MLRA) 36—Southwestern Plateaus, Mesas, and Foothills. The precipitation and climate of MLRA 36 are conducive to producing Pinyon/juniper, sagebrush, and grassland complexes. The primary shrub species on this site is Basin big sagebrush, but may contain a significant component of Wyoming big sagebrush. Typically, when this site occurs on Cedar Mesa sandstone, the sagebrush is a tetraploid variety of basin big sagebrush. In the northern range of this site, Wyoming big sagebrush becomes a significant component of the ecological site.

The natural disturbance regime consisted of fires caused by natural and Native American ignition sources. The sagebrush and grassland communities were expected to be persistent with relatively frequent fire return intervals in locations where large unbroken expanses of vegetation were present. Fire return intervals were expected to be between 25-60 years. However, some natural topographic relief (extensive and frequent rock outcrops), infrequent lightning as an ignition source, and warm season grasses remaining green and inflammable during the lightning storm season may hinder the persistence of the sagebrush dominated plant communities through lengthened fire return intervals (>100 years), allowing for the encroachment of Pinyon and Utah juniper. Due to landscape dissection by large canyons, there are large firebreaks that reduce the influence of short fire return intervals creating occurrences of this ecological site that have longer periods of succession (i.e. periods of Pinyon and Utah juniper communities).

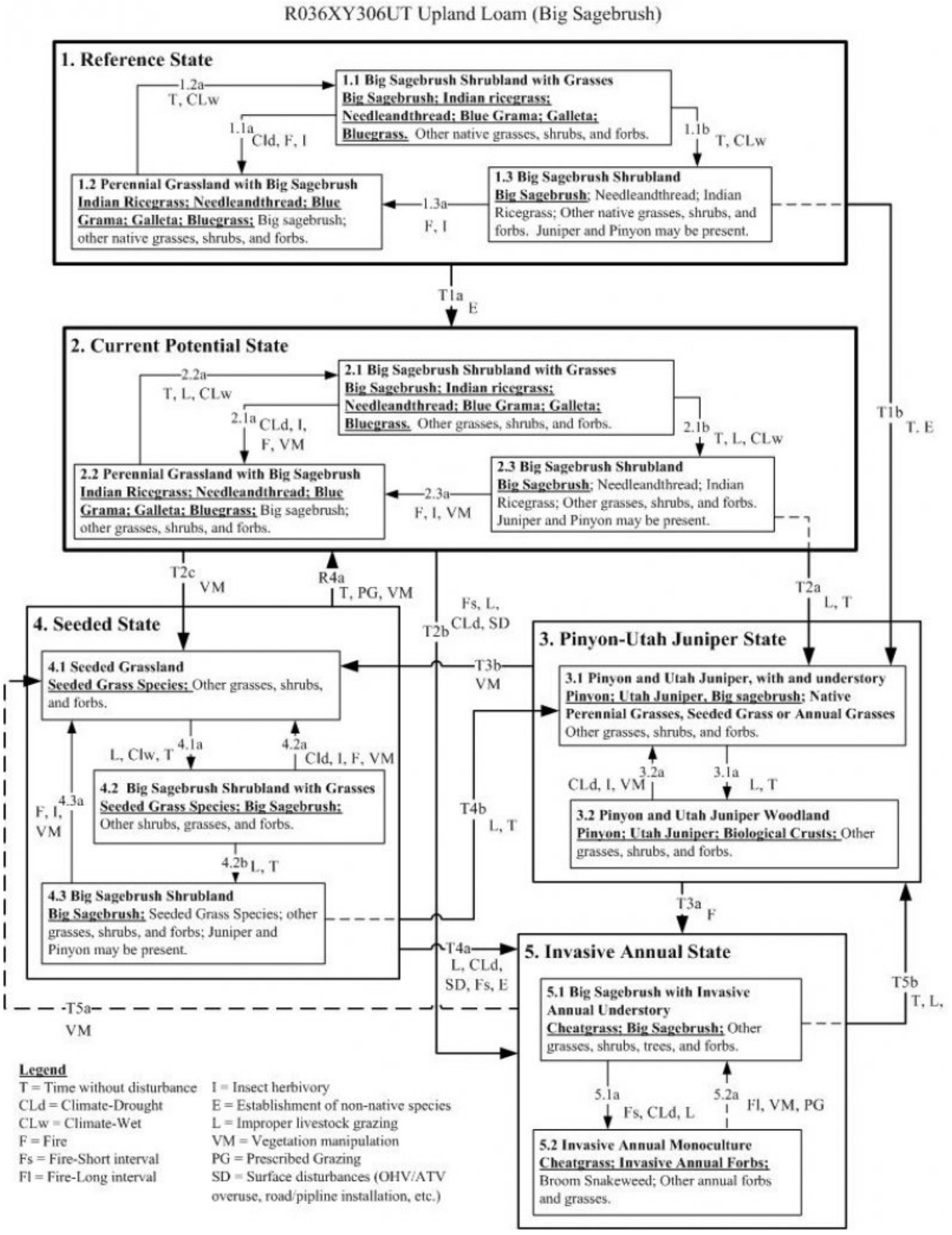
This ecological site has been grazed by domestic livestock since they were first introduced into the area. The introduction of domestic livestock and the use of fencing and reliable water sources have influenced the disturbance regime of this site. Introduction of livestock during the late 1800s/early 1900s coincides with the initial expansion of Pinyon and juniper woodlands (Miller and Tausch 2002). It is likely that domestic grazing influenced the expansion of Pinyon and Utah juniper woodlands through the reduction of fine fuels, thereby lengthening the fire return interval. Typically, fires would be able to carry following favorable growing conditions that created continuous fuels at sufficient intervals, thereby inhibiting Pinyon and Utah juniper establishment. In addition to influencing the fire regime, improper grazing can cause species composition shifts in the understory and may cause this site to depart

from the reference state. Native perennial grasses and shrub will decrease while invasive forbs and annual grasses.

Other than fire and improper livestock grazing, other disturbance mechanisms include extended drought, insect herbivory, surface disturbances, such as off highway vehicle overuse, etc., all of which change the soil/water/vegetation relationships. These disturbances can either facilitate the transition into different plant communities or the transition from one stable state to another, depending on severity and durations.

As vegetation communities respond to changes in management or natural occurrences, thresholds can be crossed, which usually means that return to previous states may not be possible without major energy inputs. The amount of energy input needed to affect vegetative shifts depends on the present biotic and abiotic features and the desired results. The following diagram does not necessarily depict all the transitions and states that this site may exhibit, but it does show some of the most common plant communities. These plant communities may not represent every possibility, but they are the most prevalent and repeatable. As more data is collected, some of these plant communities may be revised or removed, and new ones may be added. This model was developed using range data collected in 2005 and 2006 in Natural Bridges National Monument in Southeastern Utah. Both ocular and measured data was collected and utilized.

State and transition model



State 1
Reference

The Reference state has been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under outside influences such as domestic livestock grazing and recreational uses. Literature review, trends in plant communities under a variety of uses, and historical accounts also have been considered. The reference state represents all plant communities and ecological dynamics of the upland loam Big sagebrush site. This state includes all biotic communities that become on the ecological site if all successional sequences are completed under the natural disturbance regime. This state is dominated by Basin and/or Wyoming big sagebrush with a diverse understory of native perennial grasses and native perennial and annual forbs. The nutrient cycling in native shrub-steppe ecosystems is characteristically ‘‘tight’’ (i.e. net concentrations of plant-available nutrients are low) because the broad spatial and temporal diversity of plants (woody and herbaceous) and soil microbes rapidly exploit nutrients as they are mineralized (Paschke et al., 2000). The primary disturbance mechanisms for this site in reference condition include fire, insect herbivory, and fluctuations in climate, such as drought or wet periods. Prior to European settlement, fire return intervals were thought to be adequate enough to inhibit the encroachment of Pinyon and Utah juniper into the more productive deeper soils that support shrub steppe communities (Tausch 2002, Romme et al. 2007). However, as the number of years between fire events increases due to reduction in fine fuels or fire suppression, Pinyon and Utah juniper readily invade these communities. The time required to complete the transition of shrub steppe to a closed Pinyon and juniper woodland is variable. The transition is dependant on both the rate of tree establishment and site potential. Woodland presence at the landscape level also influences the rate of encroachment and closure on adjacent open areas Reference state: Community phases maintained by fire, drought, insect herbivory, and time without disturbances. Indicators: A diverse and productive understory co-existing with a fluctuating canopy of big sagebrush. Feedbacks: Infrequent, but regular droughts that result in a reduction of sagebrush cover. Higher than average precipitation cycles that maintains the episodic native plant reproductive cycles. Insect infestations and/or a fire regime sufficient enough to inhibit Pinyon and Utah juniper encroachment. Improper grazing that results in a loss of native herbaceous understory, the establishment of non-native invasive plants, and a reduction in the fire return interval. At-risk Community Phase: All communities are at risk when native plants in the understory are stressed, and nutrients become available for non-natives to establish. However, plant community 1.3 is most at risk due Pinyon and Utah juniper encroachment. Trigger: The establishment of non-native invasive plants and/or Increased establishment of Utah juniper and Pinyon to a point where they drive the ecological dynamics of the site.

Community 1.1
Big Sagebrush Shrubland with Grasses

This community phase is dominated by big sagebrush and a diverse understory of native perennial grasses and forbs. This phase supports cool and warm season grasses including Indian ricegrass, needle and thread, and galleta, along with several forbs. Dominance of warm or cool season herbaceous plants and forb production are dependent on the timing of precipitation, and can vary widely between years. Interspaces supporting highly developed lichen crusts are common, while bare ground is rare.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	560	785	897
Shrub/Vine	280	392	504
Forb	45	56	67
Tree	–	–	–
Total	**885**	**1233**	**1468**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	20-35%
Grass/grasslike foliar cover	15-20%
Forb foliar cover	1-10%
Non-vascular plants	0%

Biological crusts	5-10%
Litter	3-8%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-40%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	1-5%	1-10%
>0.15 <= 0.3	–	0-5%	2-10%	1-5%
>0.3 <= 0.6	–	10-20%	5-20%	1-10%
>0.6 <= 1.4	–	10-20%	1-5%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.2
Perennial Grassland with Big Sagebrush

This community phase is dominated by native perennial grasses and forbs, where big sagebrush is minimally present. As a result bare ground patches are small and rarely connected. Vegetative production is highest in this community of the reference state. Diverse and highly developed biological crusts are present throughout the site; moss is common under the few shrub canopies.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	560	897	1121
Shrub/Vine	168	224	280
Forb	45	56	67
Tree	–	–	–
Total	**773**	**1177**	**1468**

Table 9. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	5-15%
Grass/grasslike foliar cover	20-30%
Forb foliar cover	1-10%
Non-vascular plants	0%
Biological crusts	5-10%
Litter	3-8%

Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	40-60%

Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	1-5%	1-10%
>0.15 <= 0.3	–	0-5%	5-10%	1-5%
>0.3 <= 0.6	–	5-10%	10-30%	1-10%
>0.6 <= 1.4	–	5-10%	1-5%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.3
Big Sagebrush Shrubland

This community phase is dominated by big sagebrush, where it typically measure greater than 37 percent cover. Pinyon and Utah juniper may have encroached, however does not yet control the ecological site dynamics. If Pinyon and Utah juniper are present, big sagebrush cover is expected to be less. The understory supports sparse native herbaceous vegetation, including forbs and perennial grasses. Biological crusts are typically well developed in the interspaces; however, bare ground is most common in this community phase.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	224	392	504
Grass/Grasslike	112	168	224
Forb	22	45	56
Tree	–	2	11
Total	**358**	**607**	**795**

Table 12. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	35-50%
Grass/grasslike foliar cover	5-10%
Forb foliar cover	1-5%
Non-vascular plants	0%
Biological crusts	10-20%
Litter	5-10%
Surface fragments >0.25" and <=3"	0-5%

Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	50-60%

Table 13. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	0-5%	0-5%
>0.15 <= 0.3	–	5-10%	0-5%	0-5%
>0.3 <= 0.6	–	25-40%	5-10%	0-5%
>0.6 <= 1.4	0-5%	25-40%	0-5%	–
>1.4 <= 4	0-5%	5-10%	–	–
>4 <= 12	0-5%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Pathway 1.1A
Community 1.1 to 1.2

Pathway 1.1B
Community 1.1 to 1.3

Pathway 1.2A
Community 1.2 to 1.1

Pathway 1.3A
Community 1.3 to 1.2

State 2
Current Potential

The current potential state is very similar to the reference state in energy capture, nutrient cycling, hydrologic function and disturbance regime. The current potential state may include acclimatized, naturalized, or invasive nonnative species. With proper management, plant communities within the current potential state may be managed and used for various purposes by man without significant alteration in plant community composition or production. It includes all of the plant communities that exist in the reference state, but with the inclusion of nonnative species. These plant communities with significant portions of invasive annuals are possible within this state. Continuous surface disturbances (improper grazing, off-highway-vehicle (OHV) use, recreational activities, etc.) can stress the native perennial plants and allow the non-natives species to increase. This shift in species composition could invoke another transition to a different state and affect the nutrient cycling, hydrologic function and soil stability. At this time there is no known way to completely remove the non-native plants from the site once they have become established. Therefore, this state is irreversibly altered from the reference state. Current Potential state: Community phases maintained by fire, insects, drought, and time without disturbances. Indicators: A diverse and productive understory dominated by native plants with non-native herbaceous plants co- existing under a canopy of big sagebrush. Feedbacks: Infrequent, but regular droughts that reduce grass cover combined with sufficient moist cycles to maintain episodic reproductive cycles of native plants. Insect herbivory or fire return interval sufficient enough to inhibit Pinyon and juniper encroachment. Improper livestock grazing, that facilitates the loss of herbaceous understory, increasing non-native invasive plants, and causing a lengthened fire return interval). At-risk community: Community 2.3 is the most at risk when Utah juniper and Pinyon have increase to a point where they

drive the ecological dynamics of the site and have suppressed the understory. Trigger – Increased Utah juniper and Pinyon, lack of understory, and increased erosion.

Community 2.1
Big Sagebrush Shrubland with Grasses

This community phase is dominated by big sagebrush with a diverse understory of native and non-native perennial grasses and forbs, including Indian ricegrass, galleta, and needle and thread. Non-native invasive species, such as cheatgrass and/or crested wheatgrass are present but in minimal amounts. This site supports highly developed lichen crusts and patches of bare ground are rare.

Table 14. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	560	785	897
Shrub/Vine	280	392	504
Forb	45	56	67
Tree	–	–	–
Total	**885**	**1233**	**1468**

Table 15. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	20-35%
Grass/grasslike foliar cover	15-20%
Forb foliar cover	1-10%
Non-vascular plants	0%
Biological crusts	5-10%
Litter	3-8%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-40%

Table 16. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	1-5%	1-10%
>0.15 <= 0.3	–	0-5%	2-10%	1-5%
>0.3 <= 0.6	–	2-20%	5-20%	1-10%
>0.6 <= 1.4	–	10-20%	1-5%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 2.2
Perennial Grassland with Big Sagebrush

This community phase is dominated by grasses (introduced and native) with little production and cover from big sagebrush. Native species dominate the herbaceous production, and include Indian ricegrass, galleta, needle and thread, and various native perennial and annual forbs. Vegetative production is usually high because grasses are able to respond to available nutrients and sunlight. Diverse and highly developed biological crusts are present throughout the site; moss is common under the few shrub canopies.

Table 17. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	560	897	1121
Shrub/Vine	168	224	280
Forb	45	56	67
Tree	–	–	–
Total	**773**	**1177**	**1468**

Table 18. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	5-15%
Grass/grasslike foliar cover	20-30%
Forb foliar cover	1-10%
Non-vascular plants	0%
Biological crusts	5-10%
Litter	3-8%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	40-60%

Table 19. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	1-5%	1-10%
>0.15 <= 0.3	–	0-5%	5-10%	1-5%
>0.3 <= 0.6	–	5-10%	10-30%	1-10%
>0.6 <= 1.4	–	5-10%	1-5%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 2.3
Big Sagebrush Shrubland

This community phase is dominated by big sagebrush, where it typically measure greater than 37 percent cover. Pinyon and Utah juniper may have encroached, however does not yet control the ecological site dynamics. If Pinyon and Utah juniper are present, big sagebrush cover is expected to be less. The understory supports sparse native herbaceous vegetation, including forbs and grasses, both natives and non-natives. Biological crusts are typically well developed in the interspaces; however, bare ground is most common in this community phase.

Table 20. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	224	392	504
Grass/Grasslike	112	168	224
Forb	22	45	56
Tree	–	2	11
Total	**358**	**607**	**795**

Table 21. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	35-50%
Grass/grasslike foliar cover	5-10%
Forb foliar cover	1-5%
Non-vascular plants	0%
Biological crusts	10-20%
Litter	5-10%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	20-60%

Table 22. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	0-5%	0-5%
>0.15 <= 0.3	–	5-10%	0-5%	0-5%
>0.3 <= 0.6	–	25-40%	5-10%	0-5%
>0.6 <= 1.4	0-5%	25-40%	0-5%	–
>1.4 <= 4	0-5%	5-10%	–	–
>4 <= 12	0-5%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Pathway 2.1A
Community 2.1 to 2.2

Pathway 2.1B

Community 2.1 to 2.3

Pathway 2.2A
Community 2.2 to 2.1

Pathway 2.3A
Community 2.3 to 2.2

State 3
Pinyon-Utah Juniper

This state is characterized by a dominance of Utah juniper and Pinyon, with some to very little understory depending on which community phase it is in. It typically occurs if there is a long interval between disturbances, accompanied by a nearby source for Pinyon and Utah juniper seeds. This state can persist for long periods of time until extreme conditions needed for wildfire occur or a management treatment is implemented. Pinyon and Utah Juniper State: Community phases maintained, in a self-sustaining manner, over time without disturbance. Indicators: A declining understory, coupled with a dense canopy of Pinyon and Utah juniper. Feedbacks: Surface disturbance and other negative pressures (grazing, drought, etc.) that reduce the herbaceous understory, combined with a lack of disturbances that remove trees from the community. The removal of trees, which facilitates an increase in herbaceous plant production. At-risk community – Community 3.1 is most at risk when Utah juniper and Pinyon have increased to a point where there is no longer an understory. Trigger – Removal of trees. Restoration Pathway – Active vegetation management that facilitates the removal of trees and allows for the reestablishment of desired native and introduced species.

Community 3.1
Pinyon and Utah Juniper with Understory

This community phase is dominated by a dense to almost closed canopy of trees with a minimal understory of big sagebrush, mixed perennial and invasive annuals grasses and forbs. Highly developed and diverse biological crusts are still present in the interspaces; however, the interspaces in this phase are typically barer than in the current potential state.

Table 23. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	168	280	392
Grass/Grasslike	112	168	224
Tree	11	45	67
Forb	22	45	56
Total	**313**	**538**	**739**

Table 24. Ground cover

Tree foliar cover	10-30%
Shrub/vine/liana foliar cover	25-50%
Grass/grasslike foliar cover	5-10%
Forb foliar cover	1-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-10%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%

Bedrock	0%
Water	0%
Bare ground	20-50%

Table 25. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	0-5%	0-5%
>0.15 <= 0.3	–	5-10%	0-5%	0-5%
>0.3 <= 0.6	–	25-40%	5-10%	0-5%
>0.6 <= 1.4	0-5%	25-40%	0-5%	–
>1.4 <= 4	10-25%	5-10%	–	–
>4 <= 12	10-25%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 3.2
Pinyon and Utah Juniper Woodland

This phase is represented by a closed canopy of trees with trace to no understory. The interspaces are lacking in developed biological crust due to increased erosion and uptake of moisture by the trees.

Table 26. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	56	168	280
Tree	67	168	280
Grass/Grasslike	22	90	168
Forb	6	28	56
Total	**151**	**454**	**784**

Table 27. Ground cover

Tree foliar cover	35-85%
Shrub/vine/liana foliar cover	5-10%
Grass/grasslike foliar cover	1-5%
Forb foliar cover	0%
Non-vascular plants	5-10%
Biological crusts	5-10%
Litter	5-10%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	2-25%

Table 28. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	0-5%	0-5%
>0.15 <= 0.3	–	0-5%	0-5%	0-5%
>0.3 <= 0.6	–	5-10%	0-5%	0-5%
>0.6 <= 1.4	10-15%	5-10%	0-5%	–
>1.4 <= 4	30-80%	0-5%	–	–
>4 <= 12	30-80%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Pathway 3.1A
Community 3.1 to 3.2

Pathway 3.2A
Community 3.2 to 3.1

State 4
Seeded

This state results from a significant vegetation manipulation that may include prescribed burning, chaining, disking, mowing, or other technique, with the introduction of non-native perennial grasses such as Crested wheatgrass or Russian wildrye. The dominant understory plant species are the seeded grasses and forbs. The community dynamics are similar to the Current Potential State. Depending on the species used for the reseeding practice, the site could have more resistance to fire as well as better tolerance to grazing pressure. This state may persist for long periods of time. Typically, big sagebrush will reestablish in the seeding to significant proportions within 30 years. Under careful management, native grasses and forbs may reestablish in this plant community over time. Actively manipulating plant communities in the invasive annuals or juniper invasion states to create a seeded range state is often the first step in assisted succession to restore natural plant communities back to the Current Potential State. Seeded state: Community phases maintained by fire, drought, and time without disturbances. Indicators: A developed perennial herbaceous understory of seeded species, typically non-natives, co-existing with a canopy of basin big sagebrush. Feedbacks: Infrequent, but regular droughts that reduce grass cover. Moist cycles that maintain perennial bunch grasses. A fire regime sufficient to inhibit Pinyon and Utah juniper encroachment. Improper grazing resulting in a loss of the herbaceous understory, an increase in invasive plants, and an increase in the fire return interval. At-risk community: Community 4.3 is the most at risk when Utah juniper and Pinyon have increased to a point where they drive the ecological dynamics of the site. Restoration Pathway: proper domestic livestock grazing practices and the removal of trees that facilitates the reestablishment of native and introduced species.

Community 4.1
Seeded Grassland

This community phase is dominated by seeded grasses, with little to no production from big sagebrush. Typically this site has lower species diversity, but higher production than the current potential or reference state. The seeded grasses are able to respond favorably to the available nutrients, and effectively compete with and limit the invasive species. Commonly seen grasses include crested wheatgrass and Russian wildrye.

Table 29. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	560	897	1121
Shrub/Vine	112	168	224
Forb	45	56	67
Tree	–	–	–
Total	**717**	**1121**	**1412**

Table 30. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	50-70%
Forb foliar cover	0-5%
Non-vascular plants	0%
Biological crusts	0-5%
Litter	3-8%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	20-40%

Table 31. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	5-10%	0-5%
>0.15 <= 0.3	–	0-5%	10-30%	0-5%
>0.3 <= 0.6	–	0-5%	30-50%	0-2%
>0.6 <= 1.4	–	0-5%	5-10%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 4.2
Big Sagebrush Shrubland with Grasses

This community phase is represented by seeded species being co-dominant with big sagebrush. Bare interspaces supporting highly developed lichen crusts are common.

Table 32. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	560	897	1121
Shrub/Vine	112	224	336
Forb	45	56	67
Tree	–	–	–
Total	**717**	**1177**	**1524**

Table 33. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	10-30%
Grass/grasslike foliar cover	50-70%
Forb foliar cover	0-5%
Non-vascular plants	0%
Biological crusts	0-5%
Litter	3-8%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	20-40%

Table 34. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	5-10%	0-5%
>0.15 <= 0.3	–	0-5%	10-30%	0-5%
>0.3 <= 0.6	–	2-10%	30-50%	0-2%
>0.6 <= 1.4	–	5-10%	5-10%	–
>1.4 <= 4	–	5-10%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 4.3
Big Sagebrush Shrubland

This community phase is dominated by big sagebrush, where it typically measure greater than 37 percent cover. Pinyon and Utah juniper may have encroached, however does not yet control the ecological site dynamics. If Pinyon and Utah juniper are present, big sagebrush cover is expected to be less. The understory supports sparse native herbaceous vegetation, including forbs and grasses, both natives and non-natives. Biological crusts are typically well developed in the interspaces; however, bare ground is most common in this community phase.

Table 35. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	224	448	673
Shrub/Vine	168	336	392
Tree	6	34	67
Forb	45	56	67
Total	**443**	**874**	**1199**

Table 36. Ground cover

Tree foliar cover	5-15%
Shrub/vine/liana foliar cover	15-50%
Grass/grasslike foliar cover	50-70%
Forb foliar cover	0-5%
Non-vascular plants	0%
Biological crusts	0-5%
Litter	3-8%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	40-70%

Table 37. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	5-10%	0-5%
>0.15 <= 0.3	–	0-5%	10-30%	0-5%
>0.3 <= 0.6	–	5-10%	30-50%	0-2%
>0.6 <= 1.4	0-5%	5-10%	5-10%	–
>1.4 <= 4	5-10%	5-10%	–	–
>4 <= 12	5-10%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Pathway 4.1A
Community 4.1 to 4.2

Pathway 4.2A
Community 4.2 to 4.1

Pathway 4.2B
Community 4.2 to 4.3

Pathway 4.3A
Community 4.3 to 4.1

State 5
Invasive Annual

This state is recognized by the predominance of invasive annuals. Invasive annuals have increased to a point where they influence or drive the disturbance regime and the nutrient cycle and energy flow, altering it from the regimes and cycles associated with sagebrush ecosystems. Research has shown that plant species differ substantially in their effects on soil water content and temperature and their effects on the frequency and intensity of disturbance. Once exotic plants like cheatgrass or Russian thistle have invaded a site fundamental nutrient cycling processes are known to change (Chapin et al., 1997). Cheatgrass invasion has been shown to alter the timing, distribution, and composition of organic matter inputs, as well as uptake of mineralized nutrients (Evans et al., 2001). Energy flow in this state is severely suppressed, with photosynthesis occurring only during a brief period in the spring. Cheatgrass invasion has also been shown to change the composition root pores, mycorrhizal associations, and assemblages of microbial species potentially affecting soil structure and the rate of soil organic matter decomposition (Belknap and Phillips, 2001). The altered disturbance regime and the loss of soil organic matter could create ecologically impoverished sites that are very difficult, if not impossible to restore to functionally diverse perennial herbaceous and woody communities. Invasive Annuals State: Community phases maintained by fire, drought, livestock grazing; vegetation management, and time without disturbances. Indicators: An annual grass or forb understory, where big sagebrush may or may not be present Feedbacks: Short fire intervals, which maintain the annual grass and forb understory. Longer fire intervals, vegetation management, or livestock grazing that allows for the sagebrush overstory to reestablish. At-risk community: Community 5.2 is the most at risk when cheatgrass or other annuals completely dominate the site, shortening the fire return interval, that maintains the annual grass/forb community.

Community 5.1
Big Sagebrush with Invasive Annual Understory

This community phase is dominated by an annual invasive understory with a big sagebrush canopy. Often, the sagebrush canopy is dense because disturbance factors have reduced the understory and nutrients are available. The interspaces are often bare, but may support slightly developed biological crusts.

Table 38. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	224	560	897
Shrub/Vine	56	112	224
Forb	56	84	112
Tree	–	11	17
Total	**336**	**767**	**1250**

Table 39. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	10-25%
Grass/grasslike foliar cover	5-50%
Forb foliar cover	0-15%
Non-vascular plants	0%
Biological crusts	0-10%
Litter	5-10%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%

Bare ground	40-70%

Table 40. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	0-40%	0-5%
>0.15 <= 0.3	–	0-5%	0-50%	0-5%
>0.3 <= 0.6	–	0-10%	0-5%	0-5%
>0.6 <= 1.4	–	0-15%	0-5%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 5.2
Invasive Annual Monoculture

This community phase is characterized by an almost a complete monoculture of cheatgrass or other invasive annuals. This state is typically self-enhancing and potentially perpetual state if fires continue to be frequent. This community is especially difficult for many of the traditional sagebrush wildlife species because forage and structural diversity is limiting. This community is also difficult to graze with domestic livestock because the forage availability is dependent on a singles species response to the time and amount of moisture.

Table 41. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	224	560	897
Shrub/Vine	28	56	112
Forb	11	22	45
Tree	–	–	–
Total	**263**	**638**	**1054**

Table 42. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-5%
Grass/grasslike foliar cover	50-90%
Forb foliar cover	0-15%
Non-vascular plants	0%
Biological crusts	0-10%
Litter	10-25%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%

Bare ground	5-10%

Table 43. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	0-40%	0-5%
>0.15 <= 0.3	–	–	0-80%	0-5%
>0.3 <= 0.6	–	–	–	0-5%
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Pathway 5.1A
Community 5.1 to 5.2

Pathway 5.2A
Community 5.2 to 5.1

Transition T1A
State 1 to 2

This transition from native perennial bunchgrass understory in the reference state to a state that has been invade by non-native species such as crested wheatgrass (blown in), cheatgrass, Russian thistle, and Annual wheatgrass. This transition occurs as natural and/or management actions favor establishment of non-native grasses and forbs, especially annuals. Some invasive plants can become established in undisturbed and healthy native plant communities. Possible events that can accelerate this transition include improper domestic livestock, severe surface disturbances, and extended droughts.

Transition T1B
State 1 to 3

This transition occurs from the big sagebrush shrubland community (1.3) into community 3.1. This occurs as Pinyon and Utah juniper increase to a point where they drive the ecological dynamics of the site. Shrub canopies can act as safe sites and facilitate the encroachment of Pinyon and Utah juniper into these deeper productive soils. Once established, trees are known to be capable of out-competing the remaining understory for nutrients and energy, thus reducing the shrubs and herbaceous understory even more. This process also facilitates the establishment of invasive annual plants such as Cheatgrass. This occurs through time without disturbances such as a fire or insect herbivory.

Transition T2A
State 2 to 3

This transition from a big sagebrush dominated community to a Pinyon and Utah juniper dominated community occurs when there is sufficient fire suppression and accelerated tree invasion to create a closed canopy. With a reduced fire potential this community enters into a perpetual tree dominated community unless there is significant energy inputs from outside influences.

Transition T2C
State 2 to 4

This pathway occurs after high amounts of energy inputs by man have been put into the system. Sagebrush and/or trees have been removed with vegetation manipulation techniques (chemical, mechanical, or fire) and introduced species that are adapted to the area and adapted to management needs have been established.

Transition T2B
State 2 to 5

This transition occurs when events favor the establishment and dominance of invasive annuals. Events could include increase fire return frequency (<5-20 years), improper grazing which reduces perennial bunch grasses, extended drought, increased surface disturbance through off road vehicle use, etc..

Transition T3B
State 3 to 4

This transition occurs through vegetation manipulation by man. Typically trees are removed through mechanical or chemical methods; the area is then re-seeded with grasses and forbs that are adapted to the area and to management needs.

Transition T3A
State 3 to 5

This transition occurs when events favor the establishment and dominance of invasive annuals. Events would likely include a catastrophic wildfire or other method of tree removal in a community that has a cheatgrass dominated understory.

Restoration pathway R4A
State 4 to 2

This pathway occurs as a result of long periods without disturbance and the community is allowed to develop ecosystem functions. This could be through prescribed grazing with domestic livestock to favor the development of native grasses over the introduced species (with proper time, timing, and amounts of grazing), and removal of the Utah juniper and Pinyon as they encroach.

Restoration pathway T4B
State 4 to 3

This transition from a big sagebrush and non-native seeded grassland dominated community to a Pinyon and Utah juniper dominated community occurs when there is sufficient fire suppression and accelerated Pinyon and Utah juniper invasion to create a closed canopy. With a reduced fire potential the site enters into a perpetual tree dominated community unless there is significant energy inputs from outside influences.

Transition T4A
State 4 to 5

This pathway occurs as a result of long periods without disturbance and the community is allowed to develop ecosystem functions. This could be through prescribed grazing with domestic livestock to favor the development of native grasses over the introduced species (with proper time, timing, and amounts of grazing), and removal of the Utah juniper and Pinyon as they encroach.

Transition T5B
State 5 to 3

This transition from a big sagebrush and invasive annual dominated community to a Pinyon and Utah juniper dominated community occurs when there is sufficient fire suppression and accelerated juniper invasion to create a closed canopy. With a reduced fire potential and a non-viable seed bank this community enters into a perpetual tree dominated community unless there is significant energy inputs from outside influences.

Transition T5A
State 5 to 4

Successful completion of this transition is difficult with current knowledge of adapted plants, soil preparation and seed techniques. Large amounts of input and management are required for the establishment of a perennial introduced/adapted grass. This pathway occurs when the invasive annuals are treated and removed from dominance and the desired species (typically non-native perennials that can successfully compete) are seeded and established. At this time, restoring from the invasive annuals state directly to a native grass community has not been successful possibly due to changes in the soil caused by the cheatgrass.

Additional community tables

Table 44. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
0	**Dominant Grasses**			448–616	
1	**Sub-Dominant Grasses**			11–168	
	Grass, perennial	2GP	*Grass, perennial*	22–146	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–22	–
	squirreltail	ELEL5	*Elymus elymoides*	0–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–22	–
Forb					
2	**Forbs**			34–56	
	Forb, annual	2FA	*Forb, annual*	0–22	–
	Forb, perennial	2FP	*Forb, perennial*	0–22	–
	littleleaf pussytoes	ANMI3	*Antennaria microphylla*	0–22	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–22	–
	sego lily	CANU3	*Calochortus nuttallii*	0–22	–
	Anderson's larkspur	DEAN	*Delphinium andersonii*	0–22	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–22	–
	Utah fleabane	ERUT	*Erigeron utahensis*	0–22	–
	scarlet gilia	IPAGA3	*Ipomopsis aggregata ssp. aggregata*	0–22	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–22	–
	spiny phlox	PHHO	*Phlox hoodii*	0–22	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–22	–
Shrub/Vine					
3	**Shrubs**			224–392	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–280	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	22–56	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	11–34	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	11–34	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–34	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	11–22	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	mormon tea	EPVI	*Ephedra viridis*	6–11	–

Table 45. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grasses**			560–673	

	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	336–448	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	224–280	–
	muttongrass	POFE	*Poa fendleriana*	56–112	–
	blue grama	BOGR2	*Bouteloua gracilis*	34–56	–
	James' galleta	PLJA	*Pleuraphis jamesii*	34–56	–
2	**Sub-Dominant Grasses**			22–168	
	Grass, perennial	2GP	*Grass, perennial*	0–22	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–22	–
	squirreltail	ELEL5	*Elymus elymoides*	0–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–22	–
Forb					
3	**Forbs**			34–56	
	Forb, annual	2FA	*Forb, annual*	0–22	–
	Forb, perennial	2FP	*Forb, perennial*	0–22	–
	littleleaf pussytoes	ANMI3	*Antennaria microphylla*	0–22	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–22	–
	sego lily	CANU3	*Calochortus nuttallii*	0–22	–
	Anderson's larkspur	DEAN	*Delphinium andersonii*	0–22	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–22	–
	Utah fleabane	ERUT	*Erigeron utahensis*	0–22	–
	scarlet gilia	IPAGA3	*Ipomopsis aggregata ssp. aggregata*	0–22	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–22	–
	spiny phlox	PHHO	*Phlox hoodii*	0–22	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–22	–
Shrub/Vine					
4	**Shrubs**			112–224	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–224	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	22–56	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	11–34	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	11–34	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–22	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	11–22	–
	mormon tea	EPVI	*Ephedra viridis*	6–11	–

Table 46. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)

Group	Common Name	Symbol	Scientific Name	(Kg/Hectare)	(%)
Grass/Grasslike					
1	**Dominant Grasses**			–	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	6–168	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	6–168	–
2	**Sub-Dominant Grasses**			–	
	muttongrass	POFE	*Poa fendleriana*	0–56	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–34	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–34	–
	squirreltail	ELEL5	*Elymus elymoides*	0–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
	Grass, perennial	2GP	*Grass, perennial*	0–22	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–22	–
Forb					
3	**Forbs**			–	
	Forb, annual	2FA	*Forb, annual*	0–11	–
	Forb, perennial	2FP	*Forb, perennial*	0–11	–
	littleleaf pussytoes	ANMI3	*Antennaria microphylla*	0–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–11	–
	sego lily	CANU3	*Calochortus nuttallii*	0–11	–
	Anderson's larkspur	DEAN	*Delphinium andersonii*	0–11	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–11	–
	Utah fleabane	ERUT	*Erigeron utahensis*	0–11	–
	scarlet gilia	IPAGA3	*Ipomopsis aggregata ssp. aggregata*	0–11	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–11	–
	spiny phlox	PHHO	*Phlox hoodii*	0–11	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–11	–
Shrub/Vine					
4	**Shrubs**			–	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–448	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	22–56	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	11–34	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	11–34	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–22	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	11–22	–
	mormon tea	EPVI	*Ephedra viridis*	6–11	–
Tree					

5	**Trees**			–	
	Utah juniper	JUOS	*Juniperus osteosperma*	0–6	–
	twoneedle pinyon	PIED	*Pinus edulis*	0–6	–

Table 47. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grasses**			448–616	
2	**Sub-Dominant Grasses**			0–168	
	Grass, annual	2GA	*Grass, annual*	0–22	–
	Grass, perennial	2GP	*Grass, perennial*	0–22	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–22	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–22	–
	squirreltail	ELEL5	*Elymus elymoides*	0–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–
	Russian wildrye	PSJU3	*Psathyrostachys juncea*	0–22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–22	–
Forb					
3	**Forbs**			34–56	
	Forb, annual	2FA	*Forb, annual*	0–22	–
	Forb, perennial	2FP	*Forb, perennial*	0–22	–
	littleleaf pussytoes	ANMI3	*Antennaria microphylla*	0–22	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–22	–
	sego lily	CANU3	*Calochortus nuttallii*	0–22	–
	Anderson's larkspur	DEAN	*Delphinium andersonii*	0–22	–
	tansymustard	DESCU	*Descurainia*	0–22	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–22	–
	Utah fleabane	ERUT	*Erigeron utahensis*	0–22	–
	scarlet gilia	IPAGA3	*Ipomopsis aggregata ssp. aggregata*	0–22	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–22	–
	spiny phlox	PHHO	*Phlox hoodii*	0–22	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–22	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–22	–
Shrub/Vine					
4	**Shrubs**			224–392	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–280	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	22–56	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	11–34	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	11–34	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–34	–

	Bigelow sage	ARBI3	*Artemisia bigelovii*	11–22	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	mormon tea	EPVI	*Ephedra viridis*	6–11	–

Table 48. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grasses**			560–673	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	336–448	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	224–280	–
	muttongrass	POFE	*Poa fendleriana*	56–112	–
	blue grama	BOGR2	*Bouteloua gracilis*	34–56	–
	James' galleta	PLJA	*Pleuraphis jamesii*	34–56	–
	cheatgrass	BRTE	*Bromus tectorum*	6–22	–
2	**Sub-Dominant Grasses**			0–168	
	Grass, annual	2GA	*Grass, annual*	0–22	–
	Grass, perennial	2GP	*Grass, perennial*	0–22	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–22	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–22	–
	squirreltail	ELEL5	*Elymus elymoides*	0–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–
	Russian wildrye	PSJU3	*Psathyrostachys juncea*	0–22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–22	–
Forb					
3	**Forbs**			34–56	
	Forb, annual	2FA	*Forb, annual*	0–22	–
	Forb, perennial	2FP	*Forb, perennial*	0–22	–
	littleleaf pussytoes	ANMI3	*Antennaria microphylla*	0–22	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–22	–
	sego lily	CANU3	*Calochortus nuttallii*	0–22	–
	Anderson's larkspur	DEAN	*Delphinium andersonii*	0–22	–
	tansymustard	DESCU	*Descurainia*	0–22	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–22	–
	Utah fleabane	ERUT	*Erigeron utahensis*	0–22	–
	scarlet gilia	IPAGA3	*Ipomopsis aggregata ssp. aggregata*	0–22	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–22	–
	spiny phlox	PHHO	*Phlox hoodii*	0–22	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–22	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–22	–

	globemallow				
Shrub/Vine					
4	**Shrubs**			112–224	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–224	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	22–56	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	11–34	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	11–34	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–22	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	11–22	–
	mormon tea	EPVI	*Ephedra viridis*	6–11	–

Table 49. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grasses**			112–168	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	6–168	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	6–168	–
	cheatgrass	BRTE	*Bromus tectorum*	6–22	–
2	**Sub-Dominant Grasses**			0–168	
	muttongrass	POFE	*Poa fendleriana*	0–56	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–34	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–34	–
	squirreltail	ELEL5	*Elymus elymoides*	0–22	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–
	Grass, annual	2GA	*Grass, annual*	0–22	–
	Grass, perennial	2GP	*Grass, perennial*	0–22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–22	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–11	–
	Russian wildrye	PSJU3	*Psathyrostachys juncea*	0–11	–
Forb					
3	**Forbs**			28–50	
	Forb, annual	2FA	*Forb, annual*	0–11	–
	Forb, perennial	2FP	*Forb, perennial*	0–11	–
	littleleaf pussytoes	ANMI3	*Antennaria microphylla*	0–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–11	–
	sego lily	CANU3	*Calochortus nuttallii*	0–11	–
	Anderson's larkspur	DEAN	*Delphinium andersonii*	0–11	–
	tansymustard	DESCU	*Descurainia*	0–11	–

	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–11	–
	Utah fleabane	ERUT	*Erigeron utahensis*	0–11	–
	scarlet gilia	IPAGA3	*Ipomopsis aggregata ssp. aggregata*	0–11	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–11	–
	spiny phlox	PHHO	*Phlox hoodii*	0–11	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–11	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–11	–
Shrub/Vine					
4	**Shrubs**			336–448	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–448	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	22–56	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	11–34	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	11–34	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–22	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	11–22	–
	mormon tea	EPVI	*Ephedra viridis*	6–11	–
Tree					
5	**Trees**			0–11	
	Utah juniper	JUOS	*Juniperus osteosperma*	0–6	–
	twoneedle pinyon	PIED	*Pinus edulis*	0–6	–

Table 50. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			112–336	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	6–168	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	6–168	–
	muttongrass	POFE	*Poa fendleriana*	0–56	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–34	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–34	–
	cheatgrass	BRTE	*Bromus tectorum*	0–22	–
	squirreltail	ELEL5	*Elymus elymoides*	0–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–22	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–22	–
	Grass, annual	2GA	*Grass, annual*	0–22	–
	Grass, perennial	2GP	*Grass, perennial*	0–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–

	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–
	Russian wildrye	PSJU3	*Psathyrostachys juncea*	0–22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–22	–
Forb					
2	**Forbs**			28–50	
	Forb, annual	2FA	*Forb, annual*	0–11	–
	Forb, perennial	2FP	*Forb, perennial*	0–11	–
	littleleaf pussytoes	ANMI3	*Antennaria microphylla*	0–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–11	–
	sego lily	CANU3	*Calochortus nuttallii*	0–11	–
	Anderson's larkspur	DEAN	*Delphinium andersonii*	0–11	–
	tansymustard	DESCU	*Descurainia*	0–11	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–11	–
	Utah fleabane	ERUT	*Erigeron utahensis*	0–11	–
	scarlet gilia	IPAGA3	*Ipomopsis aggregata ssp. aggregata*	0–11	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–11	–
	spiny phlox	PHHO	*Phlox hoodii*	0–11	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–11	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–11	–
Shrub/Vine					
3	**Shrubs**			224–280	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–280	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–28	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–28	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–11	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–11	–
	mormon tea	EPVI	*Ephedra viridis*	0–11	–
	spiny hopsage	GRSP	*Grayia spinosa*	0–11	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–11	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–11	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	0–11	–
Tree					
4	**Trees**			22–56	
	Utah juniper	JUOS	*Juniperus osteosperma*	11–34	–
	twoneedle pinyon	PIED	*Pinus edulis*	11–34	–

Table 51. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			56–112	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–112	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–112	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–22	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–22	–
	cheatgrass	BRTE	*Bromus tectorum*	0–11	–
	muttongrass	POFE	*Poa fendleriana*	0–11	–
	Russian wildrye	PSJU3	*Psathyrostachys juncea*	0–11	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–11	–
	Grass, annual	2GA	*Grass, annual*	0–6	–
	Grass, perennial	2GP	*Grass, perennial*	0–6	–
Forb					
2	**Forbs**			6–28	
	Forb, annual	2FA	*Forb, annual*	0–22	–
	Forb, perennial	2FP	*Forb, perennial*	0–22	–
	tansymustard	DESCU	*Descurainia*	0–11	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–11	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–6	–
Shrub/Vine					
3	**Shrubs**			112–224	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–224	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–11	–
	mormon tea	EPVI	*Ephedra viridis*	0–11	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–11	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–11	–
Tree					
4	**Trees**			112–224	
	Utah juniper	JUOS	*Juniperus osteosperma*	56–168	–
	twoneedle pinyon	PIED	*Pinus edulis*	56–168	–

Table 52. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			560–897	
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–897	–
	Russian wildrye	PSJU3	*Psathyrostachys juncea*	0–897	–
	cheatgrass	BRTE	*Bromus tectorum*	6–22	–
	Grass, annual	2GA	*Grass, annual*	0–22	–
	Grass, perennial	2GP	*Grass, perennial*	0–22	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–11	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–11	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–11	–
2	**Forbs**			34–56	
	Forb, annual	2FA	*Forb, annual*	0–56	–
	Forb, perennial	2FP	*Forb, perennial*	0–56	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–22	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–22	–
	tansymustard	DESCU	*Descurainia*	0–11	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–11	–
3	**Shrubs**			0–168	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–168	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–112	–

Table 53. Community 4.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			560–673	
Forb					
2	**Forbs**			34–56	
	Forb, annual	2FA	*Forb, annual*	0–56	–
	Forb, perennial	2FP	*Forb, perennial*	0–56	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–22	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–22	–
	tansymustard	DESCU	*Descurainia*	0–11	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–11	–
Shrub/Vine					
3	**Shrubs**			56–224	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–224	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–112	–

Table 54. Community 4.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			392–448	
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–448	–
	Russian wildrye	PSJU3	*Psathyrostachys juncea*	0–448	–
	Grass, annual	2GA	*Grass, annual*	0–22	–
	Grass, perennial	2GP	*Grass, perennial*	0–22	–
	cheatgrass	BRTE	*Bromus tectorum*	6–22	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–11	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–11	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–11	–
Forb					
2	**Forbs**			34–56	
	Forb, annual	2FA	*Forb, annual*	0–56	–
	Forb, perennial	2FP	*Forb, perennial*	0–56	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–22	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–22	–
	tansymustard	DESCU	*Descurainia*	0–11	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–11	–
Shrub/Vine					
3	**Shrubs**			168–336	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–336	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–112	–
Tree					
4	**Trees**			11–34	
	Utah juniper	JUOS	*Juniperus osteosperma*	6–28	–
	twoneedle pinyon	PIED	*Pinus edulis*	6–28	–

Table 55. Community 5.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grass**			448–560	
	cheatgrass	BRTE	*Bromus tectorum*	448–560	–
2	**Sub-Dominant Grass**			6–112	
	James' galleta	PLJA	*Pleuraphis jamesii*	0–56	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–56	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–45	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–11	–
	Russian wildrye	PSJU3	*Psathyrostachys juncea*	0–11	–
	Grass, annual	2GA	*Grass, annual*	0–6	–
	Grass, perennial	2GP	*Grass, perennial*	0–6	–
Forb					
3	**Forbs**			67–84	
	prickly Russian thistle	SATR12	*Salsola tragus*	0–56	–
	tansymustard	DESCU	*Descurainia*	0–56	–
	stickseed	LAPPU	*Lappula*	0–22	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–22	–
	cryptantha	CRYPT	*Cryptantha*	0–22	–
	white blue-eyed grass	SIAL3	*Sisyrinchium albidum*	0–11	–
	Forb, annual	2FA	*Forb, annual*	0–11	–
	Forb, perennial	2FP	*Forb, perennial*	0–11	–
Shrub/Vine					
4	**Shrubs**			0–112	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–112	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–56	–
Tree					
5	**Trees**			0–11	
	Utah juniper	JUOS	*Juniperus osteosperma*	0–11	–
	twoneedle pinyon	PIED	*Pinus edulis*	0–11	–

Table 56. Community 5.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
0	**Dominant Grasses**			336–560	
Forb					
2	**Forbs**			0–22	
	prickly Russian thistle	SATR12	*Salsola tragus*	0–22	–
	tansymustard	DESCU	*Descurainia*	0–11	–
	Forb, annual	2FA	*Forb, annual*	0–6	–
	white blue-eyed grass	SIAL3	*Sisyrinchium albidum*	0–6	–
Shrub/Vine					
3	**Shrubs**			0–56	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–56	–

Animal community

--Threatened and Endangered Species--
This section will be populated as more information becomes available

--Wildlife Interpretations--
Small herds of mule deer, pronghorn antelope, and elk can be seen grazing/browsing on these sites, especially when near water sources and in the winter. The hot climate and lack of water favors small mammals, which have an easier time finding shelter, food, and water. Many species of rats, mice, squirrels, bats, and chipmunks can be observed, along with coyotes and foxes. On sites where Utah juniper is invading or where Utah juniper sites are adjacent, birds are the most visible wildlife species that can be observed; however sightings may be rare due to the sparseness of tree canopies. Species may include juniper titmice, scrub jays, pinyon jays, and black throated gray warblers, and sparrows. Lizards are the most visible and can be observed during the day. Species may include the northern whiptail, desert spiny, and the colorful western collard lizard. (NPS.gov, 2008)

--Grazing Interpretations--
This site provides good grazing conditions for livestock and wildlife during spring, summer, and fall when in good ecological condition due to accessibility and nutritious forage. However, this site often lacks natural perennial water sources, which can influence the suitability for livestock and wildlife grazing. Care should be taken to maintain native perennial grasses and shrubs because they are difficult to reestablish. Reseeding and/or restoration are possible, but the major limiting factor is the lack of precipitation at critical times.

The plant community is primarily grasses, including needleandthread, Indian ricegrass, mutton bluegrass, blue grama, and galleta, which provide desirable grazing conditions for all classes of livestock. The presence of shrubs, including basin big sagebrush, winterfat, and fourwing saltbush, provide good browse for cattle, sheep, and goats. In general, Basin and/or Wyoming big sagebrush, the dominant shrub, is not preferred or desired by livestock. The palatability of big sagebrush is variable and is the least palatable of all the big sagebrush species, thus livestock typically only utilize this shrub in a situation when other forage is unavailable. Forb composition and annual production depends primarily on precipitation amounts and thus is challenging to use in livestock grazing management decisions. However, forb composition should be monitored for species diversity, as well as poisonous or injurious plant communities which may be detrimental to livestock if grazed. Before making specific grazing management recommendations, an onsite evaluation must be made.

Hydrological functions

The soils associated with this ecological site are generally in Hydrologic Soil Group B. Here runoff potential is low and infiltration rates are moderate, depending on slope and ground cover/health (NRCS National Engineering Handbook). Hydrological groups are used in equations that estimate runoff from rainfall. These estimates are needed for solving hydrologic problems that arise in planning watershed-protection and flood-prevention projects and for designing structures for the use, control and disposal of water. In areas similar to the reference state where ground cover is adequate infiltration is increased and runoff potential is decreased. In areas where ground cover is

less than 50%, infiltration is reduced and runoff potential is increased. Heavy use by domestic livestock affects hydrology in two ways. Trampling increases bulk density and breaks down soil aggregates. This results in decreased infiltration rates and increased runoff. Heavy grazing can alter the hydrology by decreasing plant cover and increasing bare ground. Fire can also affect hydrology, but it is variable. Fire intensity, fuel type, soil, climate, and topography can each have different influences. Fires can increase areas of bare ground and hydrophobic layers that reduce infiltration and increase runoff. Different plant communities affect hydrology in different ways. Weedy communities such as states 3 and 4 alter the hydrology by changing the surface soil texture. Soil surfaces will typically become siltier which reduces infiltration and increases runoff potential. (National Range and Pasture Handbook, 2003)

Recreational uses

Recreation activities include aesthetic value; and fair opportunities for hiking and hunting. Opportunities for birding exist year round. The relatively flat terrain make hiking trails easy, but destinations are often at the over looks to other ecological sites such as canyons. Camping sites are usually limited due to the lack of sheltering trees or rock outcrop. The deeper soils in this site might be suitable for homes, cabin, or ponds.

Wood products

The sagebrush communities do not provide wood. However, in the communities invaded by pinyon and Utah juniper, many of the trees grown on this site are suitable for fence posts. Due to the remote locations, extensive harvest for posts is not common.

Other information

--Poisonous/Toxic Plant Communities--
Toxic plants associated with this site include woolly locoweed and broom snakeweed. Woolly locoweed is toxic to all classes of livestock and wildlife. Locoweed is palatable and has similar nutrient value to alfalfa, which may cause animals to consume it even when other forage is available. Locoweed contains swainsonine (indolizdine alkaloid) and is poisonous at all stages of growth. Poisoning will become evident after 2-3 weeks of continuous grazing and is associated with 4 major symptoms: 1) neurological damage, 2) emaciation, 3) reproductive failure and abortion, and 4) congestive heart failure linked with “high mountain disease”. Broom snakeweed contains steroids, terpenoids, saponins, and flavones that can cause abortions or reproductive failure in sheep and cattle, however cattle are most susceptible. These toxins are most abundant during active growth and leafing stage. Cattle and sheep will typically only graze broom snakeweed when other forage is unavailable and generally in winter when toxicity levels are at their lowest. (Knight and Walter, 2001)

Potentially toxic plants associated with this site include Big sagebrush. Basin big sagebrush contains sesquiterpene lactones and monoterpenes which have been suspected of being toxic to sheep. An experimental dosage of ¾ lbs of Big sagebrush fed to sheep for three days was found to be lethal. (Knight and Walter, 2001)

Russian thistle is an invasive toxic plant, causing nitrate and to a lesser extent oxalate poisoning, which affects all classes of livestock. The buildup of nitrates in these plants is highly dependent upon environmental factors, such as after a rain storm during a drought, cool/cloudy days, and soils high in nitrogen and low in sulfur and phosphorus, all which cause increased nitrate accumulation. Nitrate collects in the stems and can persist throughout the growing season. Clinical signs of nitrate poisoning include drowsiness, weakness, muscular tremors, increased heart and respiratory rates, staggering gait, and death. Conversely, oxalate poisoning causes kidney failure; clinical signs include muscle tremors, tetany, weakness, and depression. Poisoning generally occurs when livestock consume and are not accustomed to grazing oxalate-containing plants. Animals with prior exposure to oxalates have increased numbers of oxalate-degrading rumen microflora and thus are able to degrade the toxin before clinical poisoning can occur. (Knight and Walter, 2001)

--Invasive Plant Communities--
Generally as ecological conditions deteriorate and perennial vegetation decreases due to disturbance (fire, over grazing, drought, off road vehicle overuse, erosion, etc.) annual forbs and grasses will invade the site. Of particular concern in semi-arid environments are the non-native annual invaders including cheatgrass, Russian thistle, kochia, halogeton, and annual mustards. The presence of these species will depend on soil properties and moisture

availability; however, these invaders are highly adaptive and can flourish in many locations. Once established, complete removal is difficult but suppression may be possible. Pinyon pine and Utah juniper are natural invaders if stands are found adjacent to this site. Trees left uncontrolled can form dense stands and eventually dominate the site.

Inventory data references

Data used to develop this site was collected in Natural Bridges National Monument and was associated with a soil survey update. All points where georeferenced and typically correlated to a soil observation. Data was collected in 2005-2007.

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Approval

Kirt Walstad, 1/16/2025

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.

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Date	11/03/2008
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None to very rare. Any rills present should be short in length (less than 6 feet long) and only occur where increased runoff occurs on lower part of steeper slopes and areas below exposed bedrock. Old rills should

be weathered and muted in appearance. An increase in rill formation may be seen after disturbance events such as recent fire or thunderstorms.

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2. **Presence of water flow patterns:** None to rare. Flow patterns typically flow around perennial plant bases and show no evidence of erosion. They are short (less than 8 feet long), stable, and not connected.

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3. **Number and height of erosional pedestals or terracettes:** Plants should show no signs of pedestalling. Teracettes occur very rarely.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** In the reference state bare ground ranges from 20 to 60%. Plant community phases 1.2 and 1.1, which have the highest occurrence of perennial bunch grasses, have the least occurrence of bare ground., while community phase 1.3, which is dominated by perennial shrubs, has the most. Areas with well developed biological soil crust should not be counted as bare ground. Areas with poorly developed biological soils crust that are interpreted as functioning as bare ground (therefore they would be susceptible to raindrop splash erosion) should be recorded as bare ground. This site can have up to 5% surface rock cover. Ground cover is based on first raindrop impact, and bare ground is the opposite of ground cover. Ground cover + bare ground = 100%.

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5. **Number of gullies and erosion associated with gullies:** None to very rare. Any gullies present are sparsely located across the landscape and are usually caused by run-in water from adjacent sites that are dominated by exposed bed rock or dissected slopes. If present gullies have been re-stabilized by perennial vegetation.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Minor evidence of wind generated soil movement, slight deposition at the base of shrubs is acceptable; however blowouts or excessive deposition areas are not.

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7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place with some redistribution caused by water and wind movement. Fine litter (<¼ inch in diameter) may be moved up to 2-3 ft with deposition occurring at obstruction. Sites with well developed crust cover such as plant community 1.3, may exhibit litter being trapped by the crust pinnacles. The majority of litter accumulates at the base of plants or in soil depression adjacent to the plant. Woody stems (those greater than ¼ inch in diameter) are not likely to move under normal conditions.

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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):** 80 to 90% of this site should have an erosion rating of 5 to 6. 10 to 20% may have a rating of 3 to 5. Surface texture varies from sandy clay loam to sandy loam.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface depth varies from 2 to 3 inches and structure is typically coarse platy parting moderate granular. The dry surface color is dark yellowish brown (10YR5/5) to brown (10YR4/3). There is little difference in the soils under the plants when compared to soils in the interspaces. Use the specific information for the soil you are assessing found in the published

soil survey to supplement this description.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Bare spaces are small, rounded in shape, and are unconnected. The presence of perennial grasses, shrubs, and any well developed biological soil crusts (moss, pinnacled lichen, and light cyanobacteria) will break raindrop impact and splash erosion. The spatial distribution of vascular plants, non-vascular communities (when present), and interspaces provide detention storage and surface roughness that slows down runoff, allowing time for infiltration.

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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. Some soils have increase in clay content at 3 to 9 inches that could be mistaken for a compaction layer.

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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: cool season perennial grasses (e.g. Indian ricegrass, bluegrass, and needleandthread) > non-sprouting shrubs (e.g. Big Sagebrush)

    Sub-dominant: warm season perennial grasses (e.g. Galleta and blue grama) > forbs

    Other: Biological soil crusts, other shrubs and grasses.

    Additional: Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions. Biological crusts (lichen, moss, and cyanobacteria) should be present but are variable based on plant community and state. In the reference state biological crust cover is characterized by cyanobacteria, pinnacled lichen, and moss with some continuity. Typically moss and lichen clumps will be concentrated under the plant canopy and cyanobacteria will be found in the interspaces.

    Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species in the reference state.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** During years with average to above average precipitation, there should be very little recent mortality or decadence apparent in either the shrubs or grasses. Some mortality of bunchgrass and other shrubs may occur during very severe (long term) droughts.

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14. **Average percent litter cover (%) and depth (in):** Litter cover (including under plants) ranges from 3-10%, nearly all of which should fine litter. Variability is due to the herbaceous production differences from one year to the next. Depth is generally 1 leaf thickness in the interspaces and up to ¼ inch under plant canopies. Litter can increase up to 20% immediate following leaf drop or after favorable conditions increase native annual forb production.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 800-1200 in communities 1.1 and 1.2, 300-800 lbs/acre in community 1.3.

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:** ": Known invasive species include cheatgrass (Bromus tectorum), broom snakeweed (Gutierrezia sarothrae), tansy mustard (Descurainia pinnata), annual stickseed (Lappula sp.), annual Cryptantha (Cryptantha sp.), Russian thistle (Salsola tragus), Single Needle Pinyon (Pinus edulis), and Utah Juniper (Juniperus osteosperma).

17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce in all years, except in extreme drought years.

18. **Supporting Information:** NRCS (Dana Truman) 2005/2006 ESD data from Natural Bridges National Monument.