USDA Natural Resources
Conservation Service

Ecological site EX043B23B138
Saline Lowland (SL) Absaroka Upper Foothills

Last updated: 3/04/2024
Accessed: 04/30/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 043B–Central Rocky Mountains

43B – Central Rocky Mountains – The Central Rocky Mountains extends from northern Montana to southern extent of Wyoming and from Idaho to central Wyoming. The southern extent of 43B is comprised of a combination of metamorphic, igneous, and sedimentary mountains and foothills. Climatic changes across this extent are broad and create several unique breaks in the landscape.

Further information regarding MLRAs, refer to: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.
Available electronically at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624#handbook.

LRU notes

Land Resource Unit (LRU) 43B23B: Absaroka Upper Foothills

Based on the shifts in geology, precipitation patterns and other climatic factors, as well as elevations and vegetation, the Absaroka Range was divided into LRU 23. Further division of this LRU is necessary due to the gradient moving from the foothills to the summit, as well as aspect shifts (north/east face versus south/west face). Subset B is set for the higher elevations within the foothills, with 15 to 19 inches of precipitation. To verify or identify Subset B (the referenced subset for this ecological site), refer to the Wyoming LRU matrix key contained within the Ecological Site Key.

This particular LRU/Subset occurs along the eastern foothills of the Absaroka Range. This LRU starts north of Clark, WY and runs to the Thermopolis, WY area. Once the foothills cross into the Northern Beartooth Range, the climatic patterns and elevational changes shifts the plant community and allows for a break in LRU's near the Montana state line. As the LRU follows to the south and then tracks east to the intersection of the Absaroka Range and the Owl Creek Range, the face changes aspect and geology creating a shift in plant dynamics and a break in the LRU.

The extent of soils currently correlated to this ecological site does not fit within the digitized boundary. Many of the noted soils are provisional and will be reviewed and corrected in mapping update projects. Other map units are correlated as small inclusions within other MLRA’s/LRU’s based on elevation, landform, and biological references.

Moisture Regime: Typic Ustic
Temperature Regime: Frigid
Dominant Cover: Rangeland – Sagebrush Steppe (major species is Mountain Big Sagebrush)
Representative Value (RV) Effective Precipitation: 15-19 inches (381 – 483 mm)
RV Frost-Free Days: 37 - 80 days

Classification relationships

Relationship to Other Established Classification Systems:

National Vegetation Classification System (NVC):
2 Shrub & Herb Vegetation Class
2.B Temperate & Boreal Grassland & Shrubland Subclass
2.B.2 Temperate Grassland & Shrubland Formation
2.B.2.Na Western North American Grassland & Shrubland Division Division
M048 Central Rocky Mountain Montane-Foothill Grassland & Shrubland Macrogroup
G273 Central Rocky Mountain Lower Montane, Foothill & Valley Grassland Group

Ecoregions (EPA):
Level I: 10 North American Deserts Level II: 10.1 Cold Deserts
Level III: 10.1.18 Wyoming Basin
Level IV: 10.1.18.d Foothills and Low Mountains

Ecological site concept

• Site receives additional water from a fluctuating water table and overflow from stream flow.
• Depth of water can vary from one to five feet, but is below 40 inches for a majority of the growing season.
• Slope is <6%
• Soils are:
o Poorly drained
o Saline, sodic, or saline-sodic
o Moderately deep to very deep (20-80+ in. (50-200+ cm)
o None to Slightly effervescent throughout top 20” (50 cm) of mineral soil surface
o Textures range from loamy sand to clay loams, often soils are stratified in nature with gravels.
o <10% stone and boulder cover and <10% cobble and gravel cover

Associated sites

EX043B23B140	**Saline Lowland Drained (SLDr) Absaroka Upper Foothills** Saline Lowland Drained ecological sites occur on terraces or relict floodplains that have lost their connection to the water table due to down cutting of the original stream channel.
EX043B23B178	**Wetland (WL) Absaroka Upper Foothills** Wetland ecological sites are often connected to Saline Lowland sites. Wetlands hold water year round and have water over the surface for part of the growing season. Saline Lowland sites will receive additional water as overflow from stream channels and be influenced from fluctuating water table. However, the water table of a saline lowland site is generally 40 inches or deeper from the soil surface and are generally on the driest edge of the drainage system or wetland.
EX043B23B142	**Saline Subirrigated (SS) Absaroka Upper Foothills** Saline Subirrigated is associated with Saline Lowland in perennial stream systems or in irrigated landscapes (historic flood irrigation seepage or runoff). Saline Subirrigated has a receding water table during the growing season and rarely has water standing on the surface for long periods of time. Whereas Saline Lowland ecological site is drier with a water table that is even lower (100 cm) in the profile for most of the growing season. The productivity is less and the plant community is a mixture of upland (dry) and moist or water loving plants.

Similar sites

EX043B23A138	**Saline Lowland (SL) Absaroka Lower Foothills** The lower foothills Saline Lowland ecological site is lower in production, with a few minor plant shifts, but are very similar in overall composition.

Table 1. Dominant plant species

Tree	Not specified

Shrub	(1) *Sarcobatus vermiculatus*
Herbaceous	(1) *Sporobolus airoides* (2) *Leymus cinereus*

Legacy ID

R043BX638WY

Physiographic features

This site is located on nearly level land adjacent to streams that run water at least during the major part of the growing season. Saline Lowland ecological sites are also found on upland or dryland areas associated with irrigation water seepage from conveyance ditches or excess flood irrigation.. Slopes are nearly flat to 10 percent, with an average slope of 5 percent.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Flood plain (2) Foothills > Drainageway (3) Foothills > Stream terrace
Runoff class	Negligible to low
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	Occasional to frequent
Elevation	1,829–2,743 m
Slope	0–10%
Water table depth	102–152 cm
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation and modeled relative effective annual precipitation ranges from 15 to 19 inches (381 – 483 mm). The normal precipitation pattern shows peaks in June tapering into September. This amounts to about 50 percent of the mean annual precipitation. Average snowfall is about 150 inches annually. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation.

Because of the varied topography, the wind will vary considerably for different parts of the area. The wind is usually much lighter at the lower elevations and in the valleys as compared with the higher terrain. The average winter wind velocity is 8.5 mph while the summer wind velocity averages 7.5 mph. Winds during storms and on ridges may exceed 45 mph.

Temperatures show a wide range between summer and winter and between daily maximums and minimums, due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. High winds are generally blocked by high mountains but occur in conjunction with thunderstorms, which are common in late summer. Growth of native cool-season plants begins about May 1 to May 15 and continues until about October 15.

For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/. Historically, Crandall Creek was the representative weather stations within this subset. However, Sunshine 3NE, Tower Falls, and Yellowstone Pk Mammoth are the available weather stations within a close proximity in location and characteristics for this subset. The following graphs and charts are a collective sample representing the averaged normals and 30-year annual rainfall data for the selected weather stations from 1981 to 2010.

Table 3. Representative climatic features

Frost-free period (characteristic range)	17-57 days
Freeze-free period (characteristic range)	43-100 days
Precipitation total (characteristic range)	356-406 mm
Frost-free period (actual range)	5-65 days
Freeze-free period (actual range)	22-108 days
Precipitation total (actual range)	356-406 mm
Frost-free period (average)	36 days
Freeze-free period (average)	70 days
Precipitation total (average)	381 mm

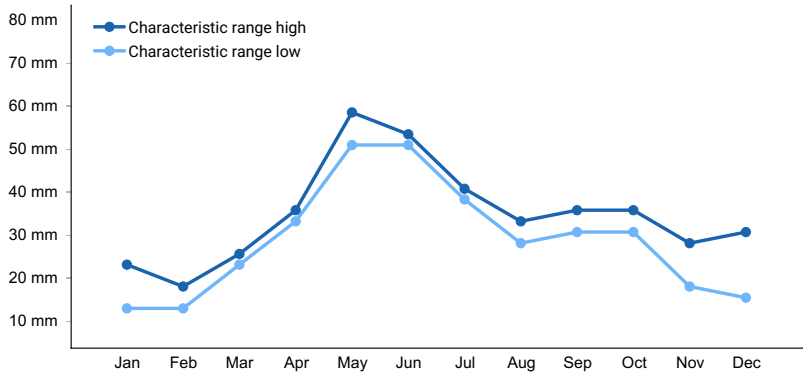


Figure 1. Monthly precipitation range

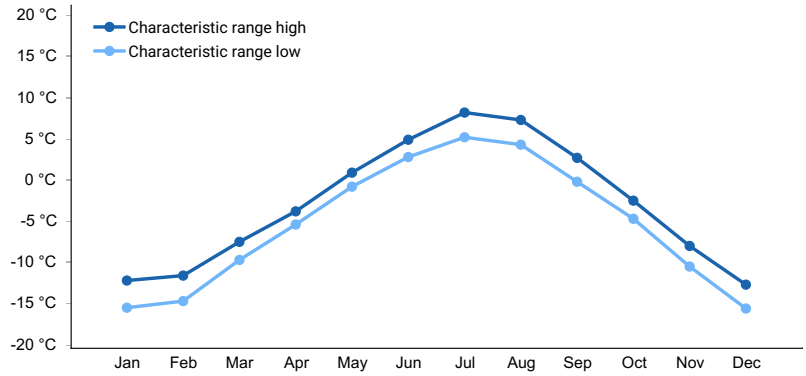


Figure 2. Monthly minimum temperature range

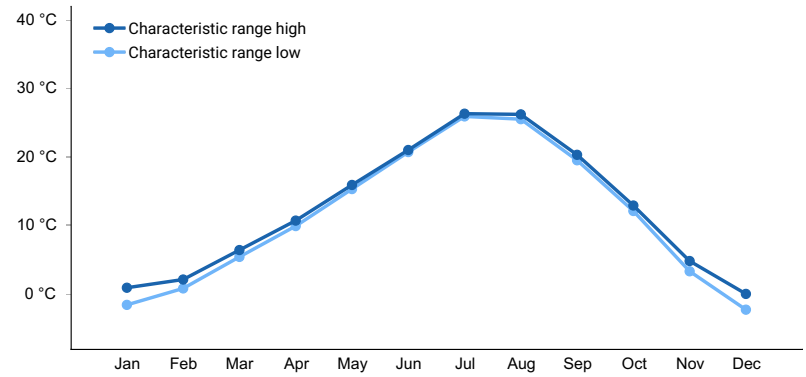


Figure 3. Monthly maximum temperature range

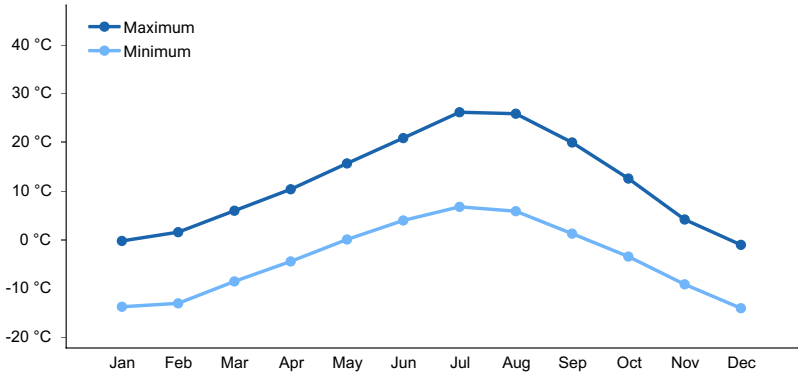


Figure 4. Monthly average minimum and maximum temperature

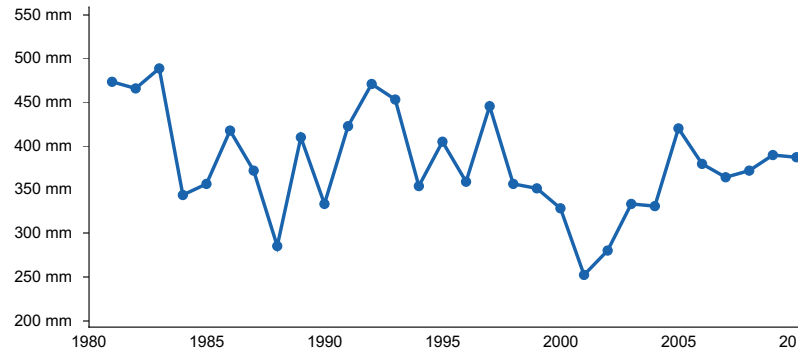


Figure 5. Annual precipitation pattern

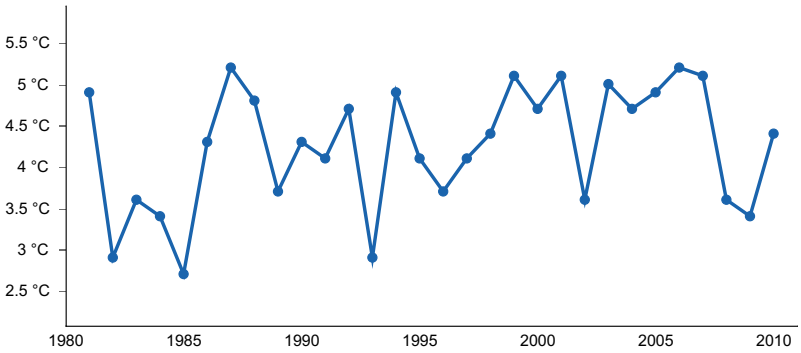


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SUNSHINE 3NE [USC00488758], Meeteetse, WY
- (2) TOWER FALLS [USC00489025], Yellowstone National Park, WY
- (3) YELLOWSTONE PK MAMMOTH [USC00489905], Yellowstone National Park, WY

Influencing water features

The characteristics of these bottomland soils have a minor influence from ground water (water table below 40 inches (100 cm)) and have an influence from surface water/overland flow. Irrigation induced seeps and overflow create these features on stream terraces and other isolated upland landforms.

Wetland description

The Saline Lowland ecological site may be associated with a wetland area, but does not currently have a wetland designation assigned.

Soil features

The soils of this site are moderately deep and very deep well-drained soils formed in alluvium. These soils have moderate to rapid permeability and are moderately to strongly saline and/or alkaline. Higher soluble salt concentrations may be found in the subsoils. The surface soil will be highly variable and range from 2 to 8 inches in thickness. A fluctuating water table occurs in these areas that is usually deeper than 40 inches, but will be higher during spring melt and irrigation season.. These areas are subject to occasional overflow. The soil characteristics having the most influence on the plant community are depth to a water table during the growing season, occasional overflow or flooding during the growing season, and the elevated quantities of soluble salts.

Major soil series correlated to this site include: Ravalli-like series.

Figure 7. Image taken of a cut bank showing the soil profile for Saline Lowland ecological site.

Figure 8. Image of hand dug pit showing the soil profile for Saline Lowland ecological site.

Table 4. Representative soil features

Parent material	(1) Alluvium–interbedded sedimentary rock (2) Slope alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Clay loam (3) Silt loam (4) Clay (5) Sandy clay loam
Family particle size	(1) Fine-loamy (2) Fine (3) Fine-loamy over sandy or sandy-skeletal
Drainage class	Somewhat poorly drained to poorly drained
Permeability class	Moderate to rapid

Soil depth	51–152 cm
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–5%
Available water capacity (Depth not specified)	2.54–15.75 cm
Calcium carbonate equivalent (Depth not specified)	0–15%
Electrical conductivity (Depth not specified)	2–16 mmhos/cm
Sodium adsorption ratio (Depth not specified)	13–40
Soil reaction (1:1 water) (Depth not specified)	7.8–9.2
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

Potential vegetation on this site is dominated by tall and mid perennial grasses, which can tolerate soils with moderate amounts of salinity and alkalinity. These grasses are also adapted to periodic overflows and a water table near the surface for a portion of the growing season. Other significant vegetation includes greasewood, rubber rabbitbrush and a variety of forbs. The expected potential composition for this site is about 75 percent grasses, 10 percent forbs, and 15 percent woody plants. The composition and production will vary naturally due to historical use, fluctuating precipitation and fire frequency.

As this site deteriorates, species such as inland saltgrass and greasewood increase. Weedy annuals will invade. Grasses such as alkali sacaton, basin wildrye, and rhizomatous wheatgrasses will decrease in frequency and production.

Any significant hydrologic disturbance that results in channelization and down cutting of teh stream channel will result in the conversion to a plant community dominated more by upland plant species. The transition from lowland plants to upland plants is usually not recoverable and with time will develop into a Saline Lowland Drained ecological site.

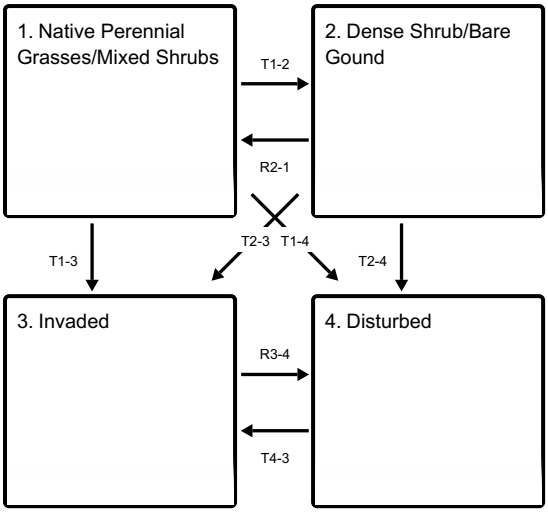
The ecological states and community phases as well as the dynamic processes driving the transitions between these communities have been determined by studying this ecological site under all management scenarios, including those that do not include cattle grazing. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical accounts have been used.

The following State and Transition Model (STM) Diagram has five fundamental components: states, transitions, restoration pathways, community phases and community pathways. The state, designated by the bold box, is considered to be a set of parameters with thresholds defined by ecological processes. A State can be a single community phase or suite of community phases. The reference state is recognized as State 1. It describes the ecological potential and natural range of variability resulting from dynamic ecological processes occurring on the site. The designation of alternative states (State 2, etc.) in STMs denotes changes in ecosystem properties that cross a certain threshold.

Transitions are represented by the arrows between states moving from a higher state to a lower state (State 1 - State 2) and are denoted in the legend as a “T” (T1-2). They describe the variables or events that contribute directly to loss of state resilience and result in shifts between states. Restoration pathways are represented by the arrows between states returning back from a lower state to a higher state (State 2 - State) or better illustrated by State 1.

State and transition model

Ecosystem states



T1-2 - Soil disturbance, drought or loss of hydrology can cause a loss of herbaceous species.

T1-3 - Wildfire, extreme drought and the accompanying disease and insect damage, as well as frequent and intense use by large herbivores are the impacts most commonly seen to insight a weed infestation.

T1-4 - Catastrophic disturbances or increasing disturbance over time, removes the key native community and alters soil structure, leaving a Disturbed State.

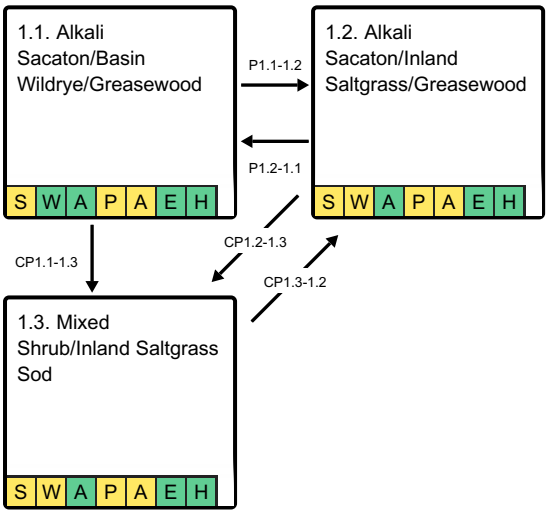
R2-1 - Long-term prescribed grazing with brush management and possibly seeding will help recovery.

T2-3 - Frequent and Severe grazing plus encroachment will convert this plant community to an Invaded State.

R3-4 - Intensive weed control, seed bed preparation to remove, tame invaders followed with seeding and grazing management will restore this community.

T4-3 - Drought, grazing pressure or increased activity in already weakened community provides opportunity and seed source for encroachment.

State 1 submodel, plant communities



P1.1-1.2 - Moderate, continuous season-long grazing will convert this plant community to the Alkali Sacaton/Inland Saltgrass/Greasewood Plant Community.

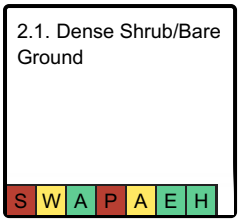
CP1.1-1.3 - Significant impacts to the herbaceous cover must occur for this transition to take place.

P1.2-1.1 - Prescribed grazing over a period of time, with brush management, aids in the recovery to the Reference Community Phase.

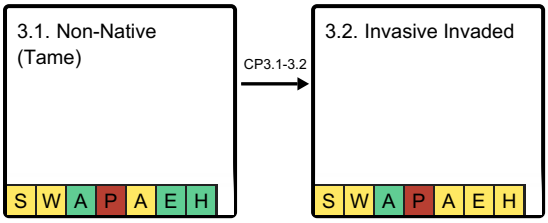
CP1.2-1.3 - Frequent and Severe grazing or high traffic areas will convert this plant community to the Inland Saltgrass Sod/Greasewood Community Phase.

CP1.3-1.2 - Prescribed grazing or possibly long-term prescribed grazing will result in a plant community very similar to the Reference Community Phase.

State 2 submodel, plant communities

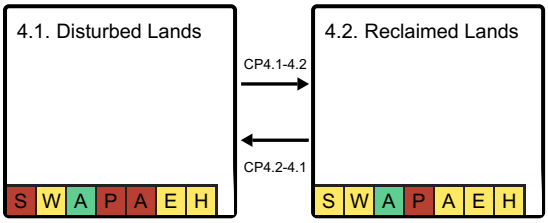


State 3 submodel, plant communities



CP3.1-3.2 - Drought, ground/soil disturbance including impacts by grazing large herbivores or recreation create a niche for undesirable weeds to establish

State 4 submodel, plant communities



CP4.1-4.2 - Seeding and integrated weed management are necessary to shift a disturbed community back to a representative or functional plant community.

CP4.2-4.1 - If a reclaimed or restored site is not maintained or managed for the species implemented, the community will degrade over time.

State 1
Native Perennial Grasses/Mixed Shrubs

The Saline Lowland ecological site is composed of a mixture of salt tolerant grasses, as well as a minor component of shrubs. Potential vegetation is about 75 percent grasses or grass-like plants, 10 percent forbs and 15 percent woody plants. The communities that represent the reference communities are native driven. Disturbances and the natural hydrologic processes involved in these generally riparian communities will affect which community is occurring along a landscape gradient. In communities not tied to a riparian system, the same shift in species will occur with the shift in the water table over time.

Characteristics and indicators. Alkali sacaton, Nuttall's alkaligrass, basin wildrye and inland saltgrass are dominant within the site. Common shrubs in this community are greasewood, wild rose, shrubby cinquefoil, and occasionally willows. As a community is in drier stages or degrades, foxtail barley, little barley and western wheatgrass are common.

Resilience management. This state is stable and well adapted to the Central Rocky Mountains climatic conditions. The diversity in plant species allows for high drought resistance. This is a sustainable plant community (site/soil stability, watershed function, and biologic integrity).

Community 1.1
Alkali Sacaton/Basin Wildrye/Greasewood

The interpretive plant community for this site is the Reference Community Phase. This state evolved with grazing by large herbivores, periodic fires, supplemental moisture, and saline and/or alkali soils. Potential vegetation is 75 percent grasses or grass-like plants, 10 percent forbs and 15 percent woody plants. Saline tolerant grasses

dominate the state. The major grasses include alkali sacaton, basin and Canada wildrye, and rhizomatous wheatgrasses. Dominant woody plants are typically greasewood and rubber rabbitbrush. A variety of forbs also occurs in this state and plant diversity is high (see Plant Composition Table). The total annual production (air-dry weight) of this state is about 2200 pounds per acre, but it can range from about 1600 pounds per acre in unfavorable years to about 2600 pounds per acre in above average years.

Resilience management. This state is stable and well adapted to the Central Rocky Mountains climatic conditions. The diversity in plant species allows for high drought resistance. This is a sustainable plant community (site/soil stability, watershed function, and biologic integrity).

Dominant plant species

- greasewood (*Sarcobatus vermiculatus*), shrub
- Woods' rose (*Rosa woodsii var. woodsii*), shrub
- shrubby cinquefoil (*Dasiphora fruticosa*), shrub
- alkali sacaton (*Sporobolus airoides*), grass
- basin wildrye (*Leymus cinereus*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- Canada wildrye (*Elymus canadensis*), grass
- saltgrass (*Distichlis spicata*), grass
- goldenrod (*Solidago*), other herbaceous
- tansyaster (*Machaeranthera*), other herbaceous
- common plantain (*Plantago major*), other herbaceous

Dominant resource concerns

- Bank erosion from streams, shorelines, or water conveyance channels
- Concentration of salts or other chemicals
- Terrestrial habitat for wildlife and invertebrates

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1457	1849	2186
Shrub/Vine	224	364	448
Forb	112	252	280
Total	**1793**	**2465**	**2914**

Table 6. Soil surface cover

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

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-2%	0-2%	0-5%
>0.15 <= 0.3	–	0-2%	10-20%	5-10%
>0.3 <= 0.6	–	0-10%	25-50%	0-5%
>0.6 <= 1.4	–	0-5%	0-5%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

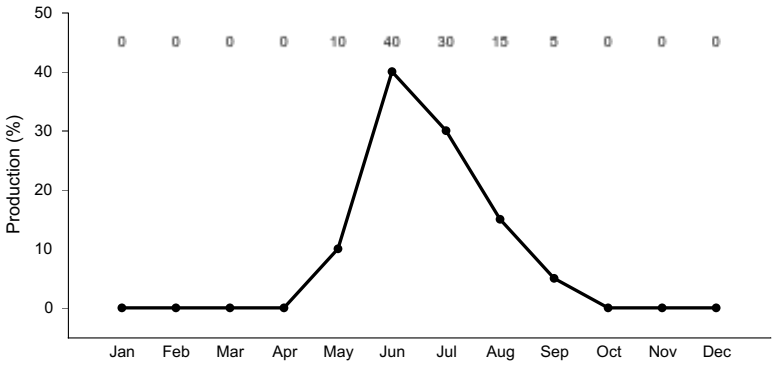


Figure 10. Plant community growth curve (percent production by month). WY0202, 15-19W Extra water sites - LL, Ov, CyO, SL.

Community 1.2
Alkali Sacaton/Inland Saltgrass/Greasewood

Historically, this plant community evolved under moderate grazing by domestic livestock and low fire frequency. Currently, this site is normally found under a moderate, season-long grazing regime and in the absence of fire or brush control. Prolonged drought can also play an important role and will exacerbate these conditions. Saline and flood tolerant perennial plants make up the dominant species in this plant community. The dominant grasses include alkali sacaton, inland saltgrass, rhizomatous wheatgrasses, bottlebrush squirreltail, and Sandberg bluegrass. Forbs commonly found in this plant community include wild onion, pursh seepweed, smooth goldaster, and povertyweed. Greasewood and rubber rabbitbrush comprises the majority of the woody species and make up less than 25 percent of the annual production. When compared to Community 1.1, basin and Canada wildrye have decreased. Annual weedy plants have invaded, but occur in small patches. Inland saltgrass, greasewood, and rubber rabbitbrush have increased. The total annual production (air-dry weight) of this state is about 1700 pounds per acre, but it can range from about 1300 pounds per acre in unfavorable years to about 2100 pounds per acre in above average years.

Resilience management. This state is stable and protected from excessive erosion. The herbaceous component is mostly intact and plant vigor and replacement capabilities are sufficient. Only minimal occurrences of water flow patterns and litter movement is evident. Incidence of pedestalling is minimal. Soils are mostly stable and the surface shows minimum soil loss. The watershed is functioning and the biotic community is intact.

Dominant plant species

- greasewood (*Sarcobatus vermiculatus*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- Woods' rose (*Rosa woodsii var. woodsii*), shrub
- alkali sacaton (*Sporobolus airoides*), grass
- saltgrass (*Distichlis spicata*), grass
- western wheatgrass (*Pascopyrum smithii*), grass

- silverweed cinquefoil (*Argentina anserina*), other herbaceous
- American licorice (*Glycyrrhiza lepidota*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous

Dominant resource concerns

- Bank erosion from streams, shorelines, or water conveyance channels
- Concentration of salts or other chemicals
- Plant productivity and health
- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1009	1233	1513
Shrub/Vine	336	504	616
Forb	112	168	224
Total	**1457**	**1905**	**2353**

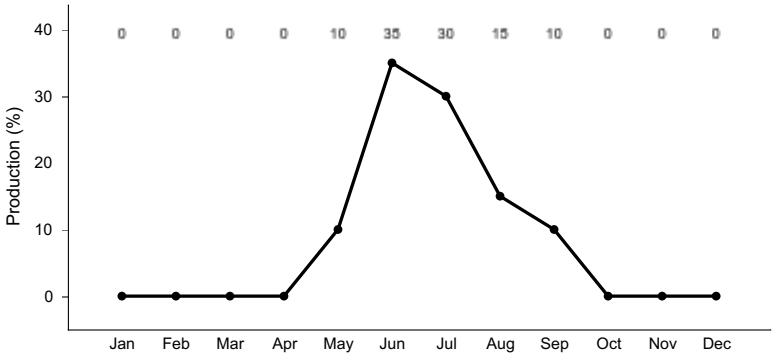


Figure 12. Plant community growth curve (percent production by month). WY0602, 15-19E Extra water sites - LL, Ov, CyO, SL.

Community 1.3
Mixed Shrub/Inland Saltgrass Sod

Greasewood and rubber rabbitbrush are the primary overstory species in this plant community. Shrubs comprise less than 35 percent of the annual production. Wild rose and shrubby cinquefoil are still common shrubs that will establish as well as fringed sagewort and white sagebrush. The dominant grass is inland saltgrass. The stoloniferous habit of inland saltgrass creates a sod or mat cover. Within open spaces in this community, species such as Sandberg bluegrass and western wheatgrass hold a place in this community. Plant diversity is moderate to poor. The total annual production (air-dry weight) of this state is about 1000 pounds per acre, but it can range from about 700 pounds per acre in unfavorable years to about 1300 pounds per acre in above average years.

Resilience management. This sod bound plant community is restricts water infiltration. While this sod protects and stabilizes the site itself, increased offsite runoff elevating the risk of erosion on bare ground and can cause rills and gullying. Water flow patterns are obvious in the bare ground areas and shrubs and sod patches are pedestalled. Rill channels are noticeable in the interspaces and gullies may be establishing where rills have concentrated. The watershed may or may not be functioning, as runoff is excessive and erosional processes are accelerated.

Dominant plant species

- greasewood (*Sarcobatus vermiculatus*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- Woods' rose (*Rosa woodsii*), shrub
- saltgrass (*Distichlis spicata*), grass

- alkali sacaton (*Sporobolus airoides*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- silverweed cinquefoil (*Argentina anserina*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- seaside arrowgrass (*Triglochin maritima*), other herbaceous

Dominant resource concerns

- Classic gully erosion
- Bank erosion from streams, shorelines, or water conveyance channels
- Concentration of salts or other chemicals
- Salts transported to surface water
- Salts transported to ground water
- Plant productivity and health
- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance
- Inadequate livestock water quantity, quality, and distribution

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	729	841	1009
Shrub/Vine	336	504	616
Forb	56	112	168
Total	**1121**	**1457**	**1793**

Pathway P1.1-1.2
Community 1.1 to 1.2

Moderate, continuous season-long grazing will convert this plant community to the Alkali Sacaton/Inland Saltgrass/Greasewood Plant Community. Prolonged drought will exacerbate this transition. Continuous grazing pressure weakens the key species targeted by grazing animals, which include Canda wildrye and Nuttall's alkaligrass, while encouraging inland saltgrass. Timing and intensity of grazing will have an effect on the basin wildrye on this community. Late season grazing allows wildrye to become coarse and undesirable by most grazers. Spring and early summer will quickly remove this plant while it is young and susceptible to grazing.

Pathway CP1.1-1.3
Community 1.1 to 1.3

Significant impacts to the herbaceous cover must occur for this transition to take place. A parking area with high volume of traffic, a construction site, or similar period of events are the most common drivers. However, a series of flood events or a catastropic flood event that leaves a significant volume of sediment deposition or scouring. In these instances, inland saltgrass is able to respond quickly and spread to hold the soil while other species struggle to emerge from the depositional layer.

Pathway P1.2-1.1
Community 1.2 to 1.1

Prescribed grazing or possibly long-term prescribed grazing will result in a plant community very similar to the Reference Community phase. Greasewood will persist without some form of brush control. Fire, depending on the intensity, will cause greasewood to resprout quickly, so is not a desired means of controlling greasewood. Significant root impact is needed to kill back greasewood from a community or selective chemical control.

Conservation practices

Brush Management
Prescribed Burning
Critical Area Planting
Prescribed Grazing
Grazing Land Mechanical Treatment
Upland Wildlife Habitat Management

Pathway CP1.2-1.3
Community 1.2 to 1.3

Frequent and Severe grazing or high traffic areas will convert this plant community to the Inland Saltgrass Sod/Greasewood Community Phase. Fire or mowing of the area may increase the greasewood cover, and will encourage inland saltgrass and other tillering species. Rubber rabbitbrush will respond to fire as well and will increase with greaewood following fire. The compaction and impact of recreational vehicles, trailing of animals or human activity aid in this transition.

Pathway CP1.3-1.2
Community 1.3 to 1.2

Prescribed grazing or possibly long-term prescribed grazing will result in a plant community very similar to the Reference Community Phase. Hoof action will help to break up the root structure of Inland saltgrass, while rest after grazing will allow native key species to establish. Timing of grazing is important and will be based on the other species that are in or near a specific community, soil conditions and access.

Conservation practices

Critical Area Planting
Prescribed Grazing
Grazing Land Mechanical Treatment
Recreation Area Improvement
Upland Wildlife Habitat Management

State 2
Dense Shrub/Bare Gound

With continued disturbance and stress on the native key herbaceous cover, the understory begins to decrease or fade into the bases of the woody vegetation leaving an increase in bare ground. Greasewood and rubber rabbitbrush are prone to increase, especially in the case of fire or soil impacts (damage to the plant base will encourage sprouting). Fringed sagewort, wild rose, and shrubby cinquefoil will maintain cover, or may increase as well, depending on the type of disturbance driving the change.

Characteristics and indicators. The dominance of shrubs or woody cover and minimal key herbaceous cover is the main characteristic of this community. There is an increase in annual forbs like mustards, pepperweed, and woolly plantain. Six-weeks fescue and annual bluegrass are common in the understory.

Resilience management. The salt-laden soils limit the recovery capabilities of this community creating a resistant community to improving. The community is at-risk of transitioning to a more degraded state and to erosion.

Community 2.1
Dense Shrub/Bare Ground

This plant community evolved under frequent and severe grazing with the absence of fire and an interruption in overflow or an extended period of drought. Greasewood and rubber rabbitbrush are the dominant species of this

plant community. Tall and mid-stature grasses have been eliminated or are minimized to the basal protection of the woody cover. The interspaces between shrubs have expanded leaving the amount of bare ground more prevalent and more soil surface exposed to erosive elements. The annual grasses and forbs, such as six-weeks fescue, annual bluegrass, foxtail barley, woolly plantain, mustards and pepperweeds make up the dominant understory. Total annual production is mostly from shrubs and annuals. Shrubs make up greater than 35 percent of the total annual production. When compared with the Mixed Shrub/Inland Saltgrass Sod Community phase, the annual production is similar as the shrub production compensates for the decline in the herbaceous production. Further degradation of this community will lead to headcutting and loss of hydrologic connectivity. The loss of hydrology will lead to the transition to the Saline Lowland Drained ecological Site. During this transition, upland species will begin to become common within the community. The total annual production (air-dry weight) of this state is not provided due to the lack of sufficient data.

Resilience management. This plant community is resistant to change as the stand becomes more decadent. These areas may actually be more resistant to fire as less fine fuels are available and the bare ground between the shrubs is increased. Continued frequent and severe grazing or the removal of grazing does not seem to affect the plant composition or structure of the plant community. Annual grasses, weedy species and bare ground compromise the biotic integrity. Plant diversity is poor and the potential for native grasses to reproduce is absent. The shift in the vegetative structure and function is extreme and the biotic integrity is lost. The soil of this state is not well protected as erosion has accelerated because of increased bare ground. Water flow patterns and pedestalling are obvious. Infiltration is reduced and runoff is increased. Rill channels may be noticeable in the interspaces and gullies may be establishing where rills have concentrated.

Dominant plant species

- greasewood (*Sarcobatus vermiculatus*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- sixweeks fescue (*Vulpia octoflora*), grass
- bluegrass (*Poa*), grass
- foxtail barley (*Hordeum jubatum*), grass
- tansymustard (*Descurainia*), other herbaceous
- woolly plantain (*Plantago patagonica*), other herbaceous
- pepperweed (*Lepidium*), other herbaceous

Dominant resource concerns

- Classic gully erosion
- Bank erosion from streams, shorelines, or water conveyance channels
- Organic matter depletion
- Concentration of salts or other chemicals
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

State 3
Invaded

Increased activity on the landscapes provides more opportunity for disturbances as well as an increase of non-native species seed source. Disturbances to the soil surface and exiting canopy cover provides opportunity for non-native species to establish. The most prevalent invader on saline sites is smooth brome, redtop bentgrass, and occasionally Kentucky bluegrass on Saline Lowland ecological sites. There are instances where the non-native or tame species and invasive communities cross on the landscape, leaving the site at-risk of further transformation. The occurrence of these communities can be a process of time or of disturbance. Historic studies have documented the presence of non-native species such as Kentucky bluegrass and dandelions prior to the early 1950's. Another concern is the threat of large scale weed invasions. Currently, most of the mountain has retained only small or isolated patches of invasive weeds. Areas of leafy spurge, toadflax (yellow or dalmation) and thistles have been identified. Although early detection/rapid response techniques are applied for land management, limited resources make it difficult to track all current and new infestation sites. Overall, the weed infestation level is not seen as a

critical concern, but the threat is growing and being monitored closely.

Characteristics and indicators. Non-native or tame species and invasive species are less of a concern on the salt-laden soils. There are, however, species that are salt-tolerant that will establish on the Saline Lowland ecological site, reducing or pushing native species out. The threshold that is crossed to indicate an invaded site is 5 percent composition by cover or by weight. The dominant non-native/invader species are Kentucky bluegrass, redtop bentgrass, thistles, toadflax (Dalmatian, yellow), and swanson's pea. As new species are found, this list will be adapted to include these species.

Resilience management. Non-native tame invaders as well as invasive species are able to adapt and tolerate a wide range of conditions, creating a resilient community once established.Their aggressive nature and ability to out compete native species for resources make the community resistant to positive change.

Community 3.1
Non-Native (Tame)

Non-Native (Tame) Community Phase has maintained a representative sample of the perennial grasses and forbs that are typical of the site with a mixed shrub community. Non-native or tame species have established in the community and are a significant component (five percent or greater by foliar cover or weight), and are prominent (referring to a more wide scale composition, not one isolated patch in an isolated portion of the landscape). Production of the desired perennial species is generally reduced but the total production is maintained or elevated due to the production potential of the non-native species. The species most common are Kentucky bluegrass, creeping meadow foxtail, redtop bent and common dandelion. However, smooth brome, meadow brome and timothy are possible components in areas with lower alkalinity. Native species that are less desirable that are common to this community are foxtail barley, little barley, American licorice, and povertyweeds.

Resilience management. This plant community is resistant to change. These areas may be more prone to fire as fine fuels are more available. Plant diversity is moderate to poor. The plant vigor is diminished and replacement capabilities are limited due to the reduced number of native hydrophitic grasses. Plant litter is noticeably more when compared to reference communities due to the potential biomass produced by the non-native species (species dependent). Soil erosion is variable depending on the species of invasion and the litter accumulation thus associated, this variability also applies to water flow patterns and pedestalling. Infiltration is reduced and runoff is increased due to loss of perennial vegetation and root density.

Dominant plant species

- greasewood (*Sarcobatus vermiculatus*), shrub
- Woods' rose (*Rosa woodsii var. woodsii*), shrub
- creeping meadow foxtail (*Alopecurus arundinaceus*), grass
- little barley (*Hordeum pusillum*), grass
- redtop (*Agrostis gigantea*), grass
- smooth brome (*Bromus inermis*), grass
- common dandelion (*Taraxacum officinale*), other herbaceous
- American licorice (*Glycyrrhiza lepidota*), other herbaceous

Dominant resource concerns

- Classic gully erosion
- Bank erosion from streams, shorelines, or water conveyance channels
- Concentration of salts or other chemicals
- Surface water depletion
- Ground water depletion
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

Community 3.2
Invasive Invaded

The Invasive Invaded Community Phase has maintained a fractured sample of the perennial grasses and forbs that are typical of the Saline Lowland ecological site, however there is a significant establishment of invasive species. This plant community evolved under frequent and severe grazing. The shrub component has been impacted and possibly removed by heavy browsing or human means. Weedy annuals and non-native species are the most dominant plants. Invasive species, most commonly canada thistle, cockle bur, swainson's pea, and perennial pepperweed, hold a significant (5 percent or greater) composition on the landscape, and are prominent (referring to a more wide scale composition, not isolated patches on the landscape). Greasewood may be more abundant than other shrubs, as it is a strong resprouter and may quickly re-establish the site after a disturbance. Russian olive may be present, but is not as common as on lower elevations. With the decrease or loss of most desirable grasses, foxtail barley, inland saltgrass, and smooth brome will persist on the site. Creeping meadow foxtail, Kentucky bluegrass, dandelion and other introduced species will increase if present on the site. Other noxious weeds such as sow thistle may invade the site if a seed source is available. Production of the desired perennial species is generally reduced but the total production is maintained or elevated due to the production potential of the invasive species.

Resilience management. This plant community is resistant to continued herbivory. Annuals and invader species are effectively competing against the establishment of perennial cool-season grasses. Plant diversity is greatly altered and the herbaceous component is not intact. Recruitment of the major perennial grasses is not occurring and the replacement potential is low. The biotic integrity is missing. The state is unstable and is not protected from excessive erosion. Rill channels and gullies may be present on site and adjacent areas are impacted by excessive runoff. Water flow patterns and pedestalling are obvious. The watershed is not functioning.

Dominant plant species

- greasewood (*Sarcobatus vermiculatus*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- foxtail barley (*Hordeum jubatum*), grass
- ryegrass (*Lolium*), grass
- little barley (*Hordeum pusillum*), grass
- Canada thistle (*Cirsium arvense*), other herbaceous

- cocklebur (*Xanthium*), other herbaceous
- broadleaved pepperweed (*Lepidium latifolium*), other herbaceous

Dominant resource concerns

- Classic gully erosion
- Bank erosion from streams, shorelines, or water conveyance channels
- Concentration of salts or other chemicals
- Surface water depletion
- Ground water depletion
- Sediment transported to surface water
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance
- Energy efficiency of farming/ranching practices and field operations

Pathway CP3.1-3.2
Community 3.1 to 3.2

Non-Native (Tame) **Invasive Invaded**

Seed sources are abundant for both non-native and for invasive invader species. Drought stress, ground/soil disturbance including impacts by grazing large herbivores or recreation create a niche for undesirable weeds to establish, even in the aggressive cover of tame invaders. Overland flow or irrigation practices can also serve as a seed source and means of establishing many invasive species in the community.

State 4
Disturbed

Although to a much smaller extent than in lower elevations, there are areas that have been accessed for irrigation convenience ditches or were part of a homestead. These areas have remnants of introduced species from haylands or have been left to recover and may be in varying stages of succession. There are areas that are heavily impacted by recreational vehicles, parking, trails, roadways, or other land disturbances that have reduced or removed most native perennial vegetation and left a highly disturbed land. The Disturbed State could be drafted as a stand-alone box within the state and transition model diagram. No matter what state a site originally is ranked in, once the site is mechanically disturbed, or suffers a catastrophic or significant natural disaster that alters the soil properties (erosional, depositional, or chemical), the site potential is altered. The most prominent shift for this site tends to be a shift in the natural hydrology that is key to this site. This can include both the loss of or enhancement to the additional moisture to the site (seepage from irrigation ditches). Mechanical disturbances and reclamation practices using non-native species could qualify some stages of this state to be considered as a land use shift. The result is the shift in potential and response in management so that it is no longer similar to the reference community. The potential shifts are highly variable, so a dynamic state was captured to highlight the altered communities that exist on the landscape.

Characteristics and indicators. The soil disturbance and mechanical or physical removal of the vegetative canopy is the key characteristic of the Disturbed State. The initial indicators are the primary successional species that establish following a disturbance including Russian thistle, kochia, and sunflowers. These initial colonizers will then be followed by any seeded species, or other species from within the locations seed bank.

Resilience management. The Disturbed State is highly variable and in a state of flux as the successional processes occur. Continued disturbance of these communities is a potential threat; and the communities are at high

risk of transitioning to the Invaded State.

Community 4.1
Disturbed Lands

The title Disturbed Lands is encompassing two broad classifications of these land types. Go-back fields or tilled areas form Type one. The soils were once cultivated or were impacted by cultivation pracites and have since been left to natural processes. Homestead and abandoned farming sites can be identified on the landscape (through photo-tone shifts in aerial photographs) and are generally a mix of natives and introduced herbaceous species as well as trees. Cottonwood breaks, Russian Olive, and other species of trees on these sites are key markers of old homestead locations. These sites are generally isolated or small in nature and are difficult to reclaim due to the introduced species that persist on the landscape and the shift in hydrology. If reclaimed, they do not respond to the natural disturbance regimes in the same manner that a native, mechanically undisturbed site would respond. The Saline Lowland ecological site was incidental to disturbance by homesteading or irrigation processes. The extent of this type is limited on the landscape. A subset of Type one are those areas that were or currently are being impacted by recreation - camp sites, trails, parking areas, roadways. The varying stages of healing once abandoned, or the level and age of disturbance at each location leave a variable community. In a similar process, lands affected by energy development including transmission and transportation corridors provide a host of successional processes. Many times, these locations are re-exposed to disturbance frequently by mechanical means leaving annual weeds and primary successional species as the dominate canopy. Older, established sites or abandoned locations, have established communities similar to those expected on go-back fields and may be stable in nature. The growth curve of this plant community will vary depending on the species that are selected for seeding. For a more accurate portrait of the growth curve for the seeded community, the species used and the climatic tendencies of the region must be considered.

Resilience management. The plant community is variable and depending on the age of the stand and the stage of successional tendencies that the location is in will determine how stable (resilient/resistant) the community is. Plant diversity is generally strong, but is usually lacking in the structural and functional groups that are desired on the site. Soil erosion is variable depending on the disturbance regime that is occurring on the site and will vary with the specific community that has established on a specific location. Site-specific evaluation is needed to determine the water flow and pedestalling as well as infiltration and runoff potential and associated risks for each community.

Dominant resource concerns

- Sheet and rill erosion
- Classic gully erosion
- Bank erosion from streams, shorelines, or water conveyance channels
- Compaction
- Concentration of salts or other chemicals
- Salts transported to surface water
- Salts transported to ground water
- Sediment transported to surface water
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance
- Inadequate livestock shelter
- Inadequate livestock water quantity, quality, and distribution

Community 4.2
Reclaimed Lands

Shifts in reclamation practices over the last several decades have altered the success and stability of reclaiming a site. Crested wheatgrass and smooth brome were species used frequently for reclamation throughout Wyoming; and across the state, many of these communities persist today. These stands are stable and generally persist as a monoculture until a disturbance creates a niche for native species to establish. Russian wildrye and varieties of

rhizomatous and bunch-wheatgrasses are used in mixes to help increase establishment on many locations. Policies on federal lands, especially on forest lands, limits the use of non-native species and further limits where seed sources must be collected for use on these lands. Current interpretations of reclamation specifies the source of viable seed and the mix acceptable to achieve a composition as close to a natural (pre-disturbance) plant community as possible. This excludes the use of non-native species and allows for a more similar ecological response than what is expected with non- native species. These plantings will not replicate the reference community in response to management due to the change in soil dynamics with mechanical disturbance (seedbed preparation and seeding), but they may be similar. The growth curve of this plant community is generally species dependent, but the climatic limitations are the major driver of this system. The short growing season with persistant snow cover through early fall to late spring and delayed warm up are the limitations to seedling establishment. For non-typical seed mixes and for project specific scenarios, the species used and the climatic tendencies of the site must be considered, and appropriate adjustments made to the growth curve provided below.

Resilience management. Seeding mixtures will determine the plant community's resistance to change and resilience against the threat of invasive species and to erosion. Many of the stands established during seeding are diversity poor, but are better than monocultures that were seeded historically. Soil erosion is variable depending on the establishment of the seeding, how it is seeded, and mechanical procedures put in place. The variability of the water flow and pedestaling as well as infiltration and runoff is determined again by the species that comprise the community and the method of seeding (site preparation and seeding practice).

Dominant resource concerns

- Classic gully erosion
- Bank erosion from streams, shorelines, or water conveyance channels
- Compaction
- Salts transported to surface water
- Salts transported to ground water
- Sediment transported to surface water
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock water quantity, quality, and distribution

Pathway CP4.1-4.2
Community 4.1 to 4.2

Reclamation processes are necessary to shift a disturbed community back to a representative or functional plant community. Reclamation may include soil/dirt work to rebuild the soil profile (replace topsoil, land shaping, spoil placement), as well as re-seeding, integrated pest management, and long-term prescribed grazing or other managed use of the landscape. However, climatic variability and topography limits the success of seeding projects (accessibility by equipment, lack of suitable seed sources, limited growing season, and timing of precipitation). Proper preparation of a location to be seeded or once a site is seeded, integrated pest management becomes crucial to allow seedling establishment and to prevent undesirable species from invading the area. Brush management may be required to accommodate some areas to readily be seeded.

Context dependence. The existing plant community and the disturbance that led to the need for reclamation are factors influencing what preparations are necessary to begin the reclamation process and also determine the feasibility of restoring the desired community.

Conservation practices

Brush Management
Critical Area Planting
Prescribed Grazing
Grazing Land Mechanical Treatment
Range Planting

Integrated Pest Management (IPM)
Restoration and Management of Rare and Declining Habitats
Upland Wildlife Habitat Management
Stream Corridor Improvement

Pathway CP4.2-4.1
Community 4.2 to 4.1

If a reclaimed or restored site is not maintained or managed for the species implemented, the community will degrade over time. Non-use or lack of a disturbance regime to maintain function of the system can lead to a softening of the soils, loss of herbaceous cover, and increases erosion potential. In the same, over-use of the system by livestock or wildlife can also shift the composition or revert the site back to a degraded phase. The initial establishment phase of a reclaimed site is crucial to determine success, but at any stage of a seeding, degradation or further disturbance can occur forcing the site to phase back to the disturbed community.

Context dependence. Since the soils are altered from reference state due to seed-bed preparation, or mechanical disturbances associated with road/site development, mining, or other human activities, the plant community will not follow the same expected shifts as the native community. Monitoring and trend over time need to be recorded to determine if a location is degrading or adjusting with the climatic variables of the site.

Transition T1-2
State 1 to 2

Significant soil disturbance, extended periods of drought or loss of hydrology will impact the herbaceous species creating a shrub and bare ground dominated community.

Constraints to recovery. The saline soils are limiting to seedling establishment. Outside of the harsh nature of the soils, if alteration or loss of hydrology is the cause of this shift, there may be constraints to returning this natural hydrologic cycle.

Transition T1-3
State 1 to 3

Fire, Drought, Ground Disturbance, Over Use - Once a community has been compromised by stress or ground disturbance of any means, can cause the invasive species to take over and dominate the site. Wildfire, extreme drought and the accompanying disease and insect damage, as well as frequent and intense use by large herbivores are the impacts most commonly seen to insight a weed infestation. Any action that reduces or damages the existing brush canopy exposing the sensitive native grass population will start the transition. Drought, further disturbance or ill-planned grazing (grazing when the natives are trying to break boot and grow), will remove the competition and finish the transition.

Constraints to recovery. The ability to control or eradicate most invasive species is difficult, costly, and time consuming. Complete eradication may not be possible, especially with the non-native tame species. Control of these species is currently in trial stages in other regions of the United States with varying successes.

Transition T1-4
State 1 to 4

An abrupt or catastrophic disturbance will remove or significantly impact the native community and the soil structure, leaving a disturbed and barren site. Repeated disturbances over time will weaken a community leading to this transition as well.With time, natural succession will begin the recovery process. However, the soil as well as hydrologic function has been altered in many cases, leaving a Disturbed State.

Constraints to recovery. The inability to restore hydrology or to replace soil stability in function (in the scope of significant head cuts or gullying) limits the recovery potential after significant disturbance.

Context dependence. Reclamation or restoration of the reference community is a challenge due to limitations of seed sources. Many of the species that are common in this community are established by sprig plantings only. Seedbed or site preparation is limited by the wetness of the soil, depth to water table and the soil textures. Access to these sites with equipment is difficult if not impossible for a large portion of the year.

Restoration pathway R2-1
State 2 to 1

Over an extended period of time, prescribed grazing with rest as well as brush management and possibly seeding in areas where seed sources or replacement materials are lacking, will help to restore this community back towards reference.

Context dependence. Removal or improvement of the disturbances that caused this transition are necessary. Loss of hydrology or natural flooding cycles will create a major disturbance or stress on a community and may restrict the recovery potential.

Conservation practices

Brush Management
Critical Area Planting
Prescribed Grazing
Grazing Land Mechanical Treatment
Heavy Use Area Protection
Recreation Area Improvement
Upland Wildlife Habitat Management

Transition T2-3
State 2 to 3

Frequent and Severe grazing plus encroachment will convert this plant community to an Invaded State. Grazing reduces the vigor and cover of native cover, allowing aggressive non-native species to creep into a community. Soil disturbance and increased activity (by livestock, wildlife, or human) provide a seed source for invaders to establish.

Constraints to recovery. The aggressive nature of invader species limits the ability for a community to overcome their establishment. In many cases, control or removal has not been completed successfully without complete manipulation.

Context dependence. The presence of greasewood in the community will hinder the practices that are suited for vegetation treatments. Fire and mechanical disturbances to the surface vegetation will encourage the sprouting capabilities of greasewood and could compound the situation in some instances. The moisture content of the soil, water table depth, and extent of salt load may restrict access to treat the soils or to manipulate the vegetation on some locations.

Transition T2-4
State 2 to 4

Fire, Drought, Ground Disturbance, Over Use - Once a community has been compromised by a notable composition of an invasive species, stress or ground disturbance of any means can cause the invasive species to take over and dominate the site. Wildfire, extreme drought and the accompanying disease and insect damage, as well as frequent and intense use by large herbivores are the impacts most commonly seen to insight a weed infestation. Any action that reduces or damages the existing brush canopy exposing the sensitive native grass population will start the transition. Drought, further disturbance or ill-planned grazing (grazing when the natives are trying to break boot and grow), will remove the competition and finish the transition.

Restoration pathway R3-4
State 3 to 4

Once a site has transitioned to the Invaded State, the composition of tame and invasive species limits the ability to restore the community without major inputs into the system. Site preparation and seeding with intensive weed and integrated pest management is required. Seeding of both herbaceous as well as woody species may be required depending on the extent of alteration the site has seen. The soil preparation for seeding will affect the response to management and natural disturbances due to the mixing and alteration of the soil profile. Once the community is established, grazing management to maintain this community as well as control of other disturbances is required.

Context dependence. The inability to effectively eradicate the undesirable species is the known limitation or constraint to this site recovering. Seed availability and establishment rates are also considerations needed when looking at the scope of this process.

Conservation practices

Brush Management
Prescribed Burning
Critical Area Planting
Prescribed Grazing
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Recreation Area Improvement
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Controlled Stream access for Livestock Watering
Cut Bank Stabilization
Stream Corridor Improvement

Transition T4-3
State 4 to 3

The increased bare ground and weakened plant structure of the Disturbed State leaves the community susceptible to encroachment or species creep by non-native species such as Kentucky bluegrass, creeping meadow foxtail, and redtop. Thistles, toadflax, and houndstounge are quickly becoming significant problems on areas within these weakened plant communities. Increasing bare ground and weakening plant community structure leaves the community vulnerable to invader species such as toadflax and houndstongue.

Constraints to recovery. The inability to effectively eradicate the undesirable species is the known financially limiting constraint to this site recovering. Most invader species are prolific and aggressive, complicating the ability to effectively remove them from the community.

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall-stature Cool-season Grasses**			560–1401	
	basin wildrye	LECI4	*Leymus cinereus*	280–841	10–30
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	280–560	10–20
	alkali cordgrass	SPGR	*Spartina gracilis*	0–280	0–10
	Canada wildrye	ELCA4	*Elymus canadensis*	0–280	0–10
2	**Mid-stature Cool-season Grasses**			112–560	
	alkali sacaton	SPAI	*Sporobolus airoides*	112–336	5–15
	Sandberg bluegrass	POSE	*Poa secunda*	0–112	0–5
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	0–112	0–5
3	**Rhizomatous Cool-Season Grasses**			112–448	
	western wheatgrass	PASM	*Pascopyrum smithii*	112–336	5–15
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–112	0–5
4	**Short-stature Cool-season Grasses**			0–112	
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–84	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–84	0–5
5	**Miscellaneous Grasses/Grass-Likes**			0–112	
	Grass, perennial	2GP	*Grass, perennial*	0–112	0–5
	saltgrass	DISP	*Distichlis spicata*	0–112	0–5
	sedge	CAREX	*Carex*	–	–
	Grass-like, perennial	2GLP	*Grass-like, perennial*	–	–
Forb					
6	**Forbs**			112–280	
	Forb, perennial	2FP	*Forb, perennial*	0–112	0–5
	textile onion	ALTE	*Allium textile*	0–112	0–5
	silverweed cinquefoil	ARAN7	*Argentina anserina*	0–112	0–5
	povertyweed	IVAX	*Iva axillaris*	0–112	0–5
	phlox	PHLOX	*Phlox*	0–112	0–5
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–112	0–5
	woodyaster	XYLOR	*Xylorhiza*	0–112	0–5
Shrub/Vine					
7	**Dominant Shrubs**			112–336	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	224–448	10–20
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–112	0–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–112	0–5
	Woods' rose	ROWOW	*Rosa woodsii var. woodsii*	0–112	0–5
8	**Miscellaneous Shrubs**			0–112	

Animal community

1.1 - Reference Community Phase: The predominance of grasses in this plant community favors grazers and mixed-feeders, such as bison, deer, and antelope. Suitable thermal and escape cover for wildlife is available as quantities of woody plants are adequate. In addition, topographical variations provide some escape cover as well. When found adjacent to sagebrush dominated states, this plant community may provide brood rearing/foraging

areas for sage grouse, as well as lek sites. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles as well as upland game birds. Many grassland obligate small mammals would occur here.

1.2 - Alkali Sacaton/Inland Saltgrass/Greasewood Plant Community: This plant community exhibits a moderate level of plant species diversity due to the accumulation of salts in the soil. It provides both thermal and escape cover for deer and antelope especially if other woody communities are nearby. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles as well as upland game birds. Many grassland obligate small mammals would occur here.

1.3 - Mixed Shrub/Inland Saltgrass Sod Plant Community: These communities provide some foraging and cover for deer, antelope, and other large ungulates. This plant community may be used by sage grouse and other game birds for foraging and cover.

2.1 - Dense Shrub/*Bare Ground* Plant Community: This plant community can provide important winter foraging and cover for mule deer and antelope during that time. The plant community composition comprises little diverse, and thus, less apt to meet the seasonal needs of large grazers. It may provide some foraging opportunities and cover for sage grouse, pheasant, and partridge.

Animal Community – Grazing Interpretations

The following table lists suggested stocking rates for cattle under continuous season-long grazing with normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor.

Plant Community Production Carrying Capacity*
The Carrying capacity is calculated as the production (normal year) X .25 efficiency factor / 912.5 # /AUM to calculate the AUM's/Acre.

Plant Community Description Title Lbs./Acre AUM/Acre* Acres/AUM*
Below Ave. Normal Above Ave.

Plant Community Production Carrying Capacity*
(lb./ac) (AUM/ac) (Ac/AUM)
1.1 - Reference Community Phase 1600-2200-2600 .60 1.7
1.2 - Alkali sacaton/Inland saltgrass/Greasewood 1300-1700-2100 .47 2.1
1.3 - Mixed Shrub/Inland Saltgrass Sod 1000-1300-1600 .36 2.8
2.1 - Dense Shrub/*Bare Ground* ** **
3._ - Invaded State ** **
4._ - Disturbed State ** **

* - Carrying Capacity is figured for continuous, season-long grazing by cattle under average growing conditions.
** - Sufficient data for invaded and reclaimed communities has not be collected or evaluated, at this time, so no projection of a stocking rate recommendation or production range will be established at this time.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the forage for livestock use needs to be supplemented with protein because the quality does not meet minimum livestock requirements.

Distance to water, shrub density, and slope can affect carrying capacity (grazing capacity) within a management unit. Adjustments should be made for the area that is considered necessary for reduction of animal numbers. For example, 30 percent of a management unit may have 25 percent slopes and distances of greater than one mile from water; therefore, the adjustment is only calculated for 30 percent of the unit (i.e. 50 percent reduction on 30

percent of the management unit).

Fencing, slope length, management, access, terrain, kind and class of livestock, and breeds are all factors that can increase or decrease the percent of graze-able acres within a management unit. Adjustments should be made that incorporate these factors when calculating stocking rates.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B and C, with localized areas in hydrologic group D. Infiltration ranges from moderate to rapid. Runoff potential for this site varies from moderate to high depending on soil hydrologic group and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where short-grasses form a strong sod that dominates the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information).

Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Pedestals are only slightly present in association with bunchgrasses. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts may be present. Cryptogamic crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

This site provides hunting opportunities for upland game species and big game such as deer and antelope. The wide varieties of plants which bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

none noted

Inventory data references

Information presented in this description was derived from NRCS inventory data. Field observations from range trained personnel were also used. Those involved in the development of the new concept for the Saline Lowland ecological site include: Blaise Allen, Area Range Management Specialist, NRCS; Jim Wolf, Resource Manager, USDI-BLM; Daniel Wood, MLRA Soil Survey Leader, NRCS; Jane Karinen, Soil Data Quality Specialist, NRCS; and Marji Patz, Ecological Site Specialist, NRCS. Other sources used as references include USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, USDI and USDA Interpreting Indicators of Rangeland Health Version IV, and USDA NRCS Soil Surveys from various counties.

Inventory Data References:
Ocular field estimations observed by trained personnel were completed at each site. Then sites were selected where a 100 foot tape was stretched and the following sample procedures were completed by inventory staff. For full sampling protocol and guidelines with forms please refer to the Wyoming ESI Operating Procedures, compiled in 2012 for the Powell and Rock Springs Soil Survey Office, USDA-NRCS.
• Double Sampling Production Data (9.6 hoop used to estimate ten points, clipped a minimum of three of the estimated points, with two 21-foot X 21-foot square extended shrub plots).
• Line Point Intercept (over story and understory captured with soil cover). Height of herbaceous and woody cover is collected every three feet along established transect.)
• Continuous Line Intercept (Woody Canopy Cover, with minimum gap of 0.2 of a foot for all woody species and succulents. Intercept height collected at each measurement.),
• Gap Intercept (Basal Gap measured with a minimum gap requirement of 0.7 foot.),
• Sample Point (ten – 1 meter square point photographs taken at set distances on transect. Red using the sample point computer program established by the High Plains Agricultural Research Center, WY).

• Soil Stability (Slake Test – surface and subsurface samples collected and processed according to the soil stability guidelines provided by the Jornada Research Center, NM.)

Other references

Baker, William L. 2006. Fire and Restoration of Sagebrush Ecosystems. Wildlife Society Bulletin 34(1): 177-185.

Bestelmeyer, B., and J. R. Brown. 2005. State-and-transition models 101: a fresh look at vegetation change. The Quivira Coalition Newsletter, Vol. 7, No. 3.

Bestelmeyer, B., J. R. Brown, K. M. Havstad, B. Alexander, G. Chavez, J. E. Herrick. 2003. Development and use of state and transition models for rangelands. Journal of Range Management 56(2):114-126.

Bestelmeyer, B., J. E. Herrick, J. R. Brown, D. A. Trujillo, and K. M. Havstad. 2004. Land management in the American Southwest: a state-and-transition approach to ecosystem complexity. Environmental Management 34(1):38-51.

Herrick, J. E., J. W. Van Zee, K. M. Havstad, L. M. Burkett, and W. G. Whitford. 2005. Monitoring manual for grassland, shrubland and savanna Ecosystems. Volume I Quick Start. USDA - ARS Jornada Experimental Range, Las Cruces, New Mexico.

Herrick, J. E., J. W. Van Zee, K. M. Havstad, L. M. Burkett, and W. G. Whitford. 2005. Monitoring manual for grassland, shrubland and savanna Ecosystems. Volume II: Design, supplementary methods and interpretation. USDA - ARS Jornada Experimental Range, Las Cruces, New Mexico.

NRCS. 2014. (electronic) National Water and Climate Center. Available online at http://www.wcc.nrcs.usda.gov/

NRCS. 2014. (electronic) Field Office Technical Guide. Available online at http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=WY NRCS. 2009. Plant Guide: Cheatgrass. Prepared by Skinner et al., National Plant Data Center.

Pellant, M., P. Shaver, D. A. Pyke, and J. E. Herrick. 2005. Interpreting indicators of rangeland health. Version 4. Technical Reference 1734-6. USDI-BLM.

Ricketts, M. J., R. S. Noggles, and B. Landgraf-Gibbons. 2004. Pryor Mountain Wild Horse Range Survey and Assessment. USDA-Natural Resources Conservation Service.

Schoeneberger, P. J., D. A. Wysocki, E. C. Benham, and Soil Survey Staff. 2012. Field book for describing and sampling soils, Version 3.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE. (http://soils.usda.gov/technical/fieldbook/)

Stringham, T. K. and W. C. Krueger. 2001. States, transitions, and thresholds: Further refinement for rangeland applications. Agricultural Experiment Station, Oregon State University. Special Report 1024.

Stringham, T. K., W. C. Kreuger, and P. L Shaver. 2003. State and transition modeling: an ecological process approach. Journal of Range Management 56(2):106-113.

United States Department of Agriculture. Soil Survey Division Staff. 1993. Soil Survey Manual, United States Department of Agriculture Handbook No. 18, Chapter 3: Examination and Description of Soils. Pg.192-196.

USDA, NRCS. 1997. National Range and Pasture Handbook. (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html)

Trlica, M. J. 1999. Grass growth and response to grazing. Colorado State University. Cooperative Extension. Range. Natural Resource Series. No. 6.108.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS). 2007. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS), Soil Survey Staff. 2010. Keys to Soil Taxonomy, Eleventh Edition, 2010.

USDA/NRCS Soil survey manuals for appropriate counties within MLRA 32X.

Western Regional Climate Center. (2014) (electronic) Station Metadata. Available online at: http://www.wrcc.dri.edu/summary/climsmwy.html.

Contributors

Dan Mattke, Resource Soil Scientist, NRCS Riverton Office

Approval

Kirt Walstad, 3/04/2024

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)	Marji Patz, Ray Gullion, Blaise Allen
Contact for lead author	blaise.allen@wy.usda.gov
Date	03/31/2020
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rare to nonexistent. A very slight amount of rill development may be observed following large storm events or spring runoff periods, but they should heal within the following growing season. Slight rill development may also be observed where the site is adjacent to ecological sites that produce large amounts of runoff (i.e. steeper sites)

---

2. **Presence of water flow patterns:** Barely observable. Any flow patterns present should be sinuous and wind around perennial plant bases. They should be short (5 to 10 feet), one foot wide, and spaced from 20 to 30 feet apart. They should be stable with only minor evidence of deposition. This site is periodically inundated with runoff water from adjacent sites. It also acts as a filter and trap sediment.

---

3. **Number and height of erosional pedestals or terracettes:** None to rare. A few plants may show very minor pedestalling where they are adjacent to any water flow patterns present, but there will be no exposed roots. Terracettes are not present.

---

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground can range from 0-20%. Any bare ground openings present should be < 2 feet in size and should not be connected.

---

5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present.

---

6. **Extent of wind scoured, blowouts and/or depositional areas:** No evidence of wind generated soil movement. Wind scoured (blowouts) and depositional areas are not present.

---

7. **Amount of litter movement (describe size and distance expected to travel):** The majority of litter accumulates in place at the base of plant canopies. Slight movement of the finest material (< 1/8 inch) may move 1 to 2 feet downslope when transported by water. Little accumulation is observed behind obstructions. Wood litter not expected to move.

---

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil Stability Index ratings range from 2 (interspaces) to 6 (under plant canopy), but average values should be 3.5 or greater.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil data is limited for this site. Organic matter typically ranges from 0.5 to 2%.

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 60-80% grasses, 5% forbs, and 15-35% shrubs. Dense plant canopy (75-100%) and litter, despite slow to moderate infiltration rates, result in minimal runoff. Basal cover is typically greater than 5% for this site and does effectively reduce runoff on this site.

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. This site will normally have textural changes within the soil profile. These should not be mistaken for compaction layers.

---

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: Perennial Bunchgrasses (2 species), perennial shrubs (1 species)

    Sub-dominant: cool season rhizomatous grasses (1 species)

    Other: Community 1.1 = Perennial bunchgrasses > cool season rhizomatous grasses > Shrubs > Perennial Forbs

    12b. F/S Groups not expected for the site: Annual Grasses
    12c. Number of F/S Groups: 3 groups
    12d. Species number in Dominate and Sub-dominate F/S Groups: 4 species

Additional: Disturbance regimes include insects, infrequent fire, and flooding. Temporal variability can be caused by fires, droughts, insects, etc. Spatial variability can be caused by runoff, soil pH, and topography.

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal decadence, typically associated with shrub component. During years with average to above average precipitation, there should be no mortality or decadence in either perennial grasses or grasslikes. During severe (multi-year) droughts that affect groundwater levels, up to 10% of the perennial plants may die. There may be partial mortality of individual grasses and grasslikes during less severe droughts.

---

14. **Average percent litter cover (%) and depth (in):** Litter ranges from 10-30% of total canopy measurement with total litter (including beneath the plant canopy) from 75-90% expected. Herbaceous litter depth typically ranges from 10-25 mm. Woody litter can be up to a couple inches (4-6 cm)

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total annual production ranges from 1600-2600 lb/ac (1793-2914 kg/ha); with an average annual production of 2200 lb/ac (2466 kg/ha).

---

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:** Bare ground greater than 30% is the most common indicator of a threshold being crossed. Greasewood and inland saltgrass are common increasers. Perennial pepperweed, annual mustards, kochia, and Russian thistle are common invasive species in disturbed sites.

---

17. **Perennial plant reproductive capability:** All species are capable of reproducing, except in drought years.
