USDA Natural Resources
Conservation Service

Ecological site EX043B23B142
Saline Subirrigated (SS) Absaroka Upper Foothills

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Accessed: 05/10/2025

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 influence by a water table below soil surface through the entire growing season (within 40 inches), and water may move over the surface from run-in but only for short periods.
• Slope is <6%
• Soils are:
- saline, sodic, or saline-sodic, gypsic
- Moderately deep, deep, or very deep (depth to restrictive layer is greater than 10” (25 cm).
- Poorly to moderately well drained
- Textures usually range from loamy sand to clay loam
- Clay content is < 60% in mineral soil surface 4”.
- With an average particle size class < 40% clay

Associated sites

EX043B23B138	**Saline Lowland (SL) Absaroka Upper Foothills** Saline Lowland ecological site is drier with a water table that is 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.
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. Saline Subirrigated is associated with the current stream channel or water table.
EX043B23B178	**Wetland (WL) Absaroka Upper Foothills** Wetland ecological sites are connected to or a transition from Saline Subirrigated and Subirrigated sites. Wetlands hold water year round and have water over the surface for part of the growing season, where Saline Subirrigated has a receding of the water table during the growing season and rarely has water standing on the surface for long periods of time.

Similar sites

EX043B23A142	**Saline Subirrigated (SS) Absaroka Lower Foothills** The lower foothills Saline Subirrigated 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	Not specified

Herbaceous	(1) *Sporobolus airoides* (2) *Puccinellia nuttalliana*

Legacy ID

R043BX642WY

Physiographic features

This site occurs on relatively level lands adjacent to perennial streams, lakes, ponds and springs.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Alluvial fan (2) Foothills > Drainageway (3) Foothills > Flood plain
Runoff class	Negligible to low
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Rare to occasional
Ponding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Ponding frequency	None to frequent
Elevation	6,000–9,000 ft
Slope	0–6%
Ponding depth	0–3 in
Water table depth	12–40 in
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)	14-16 in
Frost-free period (actual range)	5-65 days
Freeze-free period (actual range)	22-108 days
Precipitation total (actual range)	14-16 in
Frost-free period (average)	36 days
Freeze-free period (average)	70 days
Precipitation total (average)	15 in

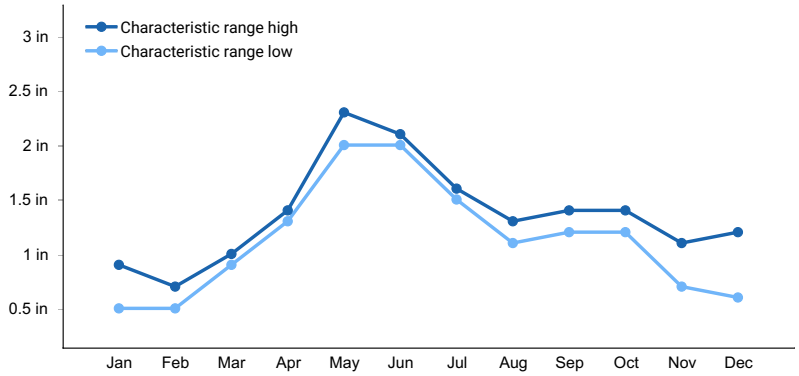


Figure 1. Monthly precipitation range

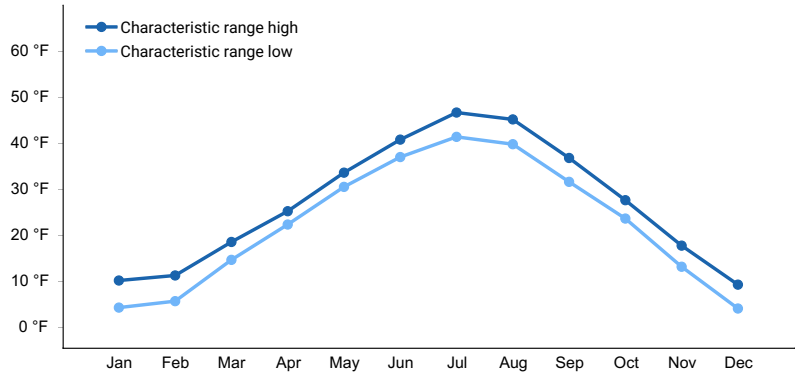


Figure 2. Monthly minimum temperature range

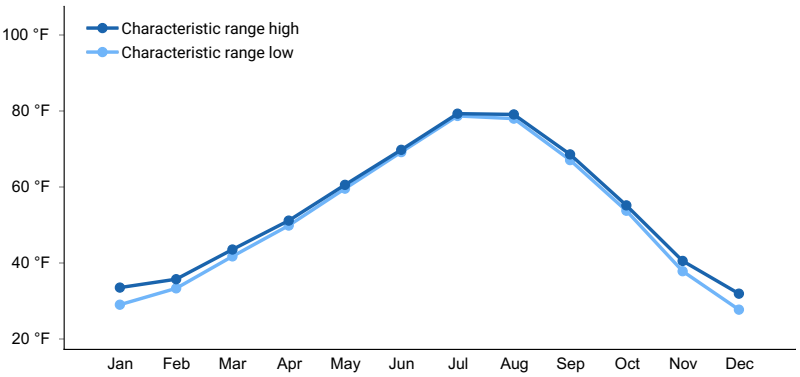


Figure 3. Monthly maximum temperature range

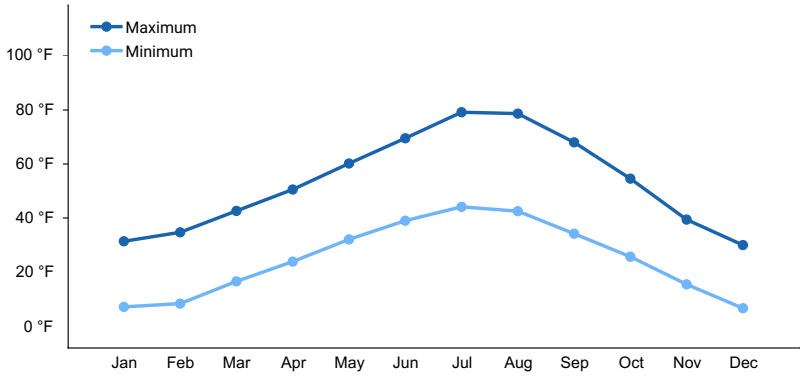


Figure 4. Monthly average minimum and maximum temperature

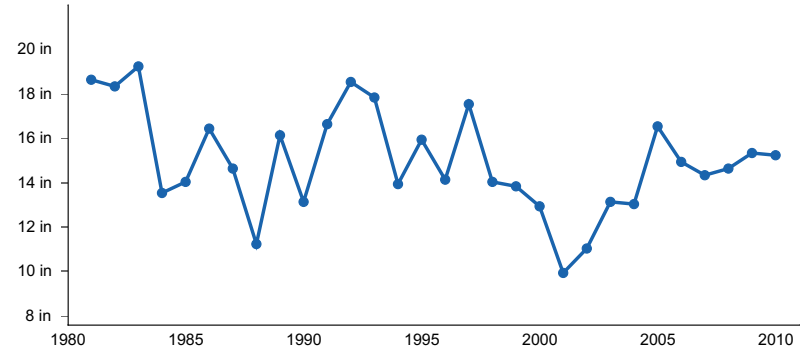


Figure 5. Annual precipitation pattern

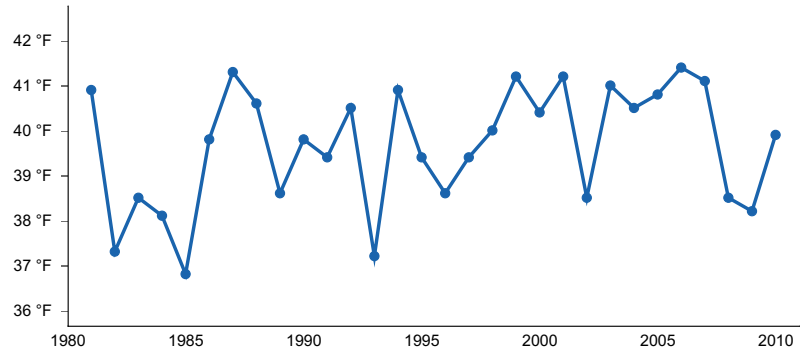


Figure 6. Annual average temperature pattern

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 soils have influence from ground water that is within 40 inches of the soil surface and will be just below the surface for all of the growing season. Water over the surface from run-in may occur but only for short periods of time.

Wetland description

No wetland classification was established for this site.
Stream type: C (Rosgen)

Soil features

The soils of the Saline Subirrigated site are moderately deep to very deep (greater than 20 inches (50 cm) to bedrock) poorly drained to moderately well drained soils formed in alluvium. A water table persists below the soil surface for all of the growing season, and is within 40 inches throughout most of the year. The soil surface may have water flow over (flooding) from run-in but only for short periods of time. The soil characteristics having the most influence on the plant community are depth to a water table during the growing season and the amount of soluble salts.

Figure 7. Soils with a fluctuating water table and soluble salts are the key characteristics for the Saline Subirrigated ecological site.

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Cobbly, extremely cobbly, gravelly loam (2) Clay loam (3) Silt loam (4) Sandy clay loam (5) Sandy loam
Family particle size	(1) Fine-loamy (2) Fine (3) Loamy-skeletal (4) Fine-loamy over sandy or sandy-skeletal
Drainage class	Somewhat poorly drained to poorly drained
Permeability class	Slow to moderate
Soil depth	20–60 in
Available water capacity (Depth not specified)	2.8–6.2 in
Calcium carbonate equivalent (Depth not specified)	0–15%
Electrical conductivity (Depth not specified)	2–8 mmhos/cm
Sodium adsorption ratio (Depth not specified)	8–40
Soil reaction (1:1 water) (Depth not specified)	7.4–9

Ecological dynamics

Potential vegetation on this site is dominated by plants that can tolerate soils that are saline and/or alkaline and have a water table near the surface for most of the growing season. The expected potential composition for this site is about 80 percent grasses, 5 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 from improper grazing management, species such as inland saltgrass, alkali bluegrass, and inland saltgrass increase. Grasses such as alkali sacaton, basin wildrye, and Nuttall's alkaligrass will decrease in frequency and production.

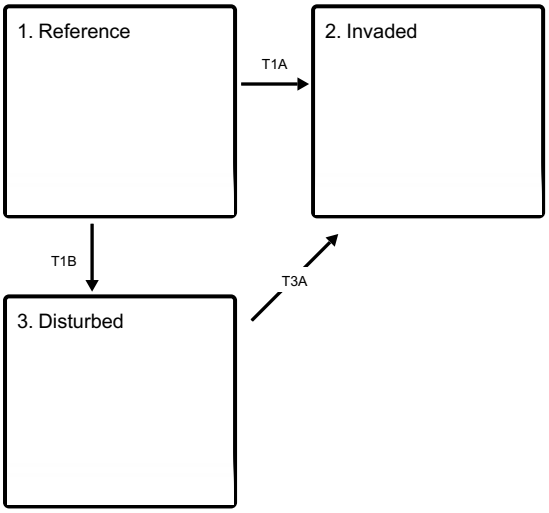
The ecological states and community phases as well as the dynamic processes driving the transitions between these communities have been determined by studying this ecological site under all management scenarios, including those that do not include cattle grazing. Trends in plant communities going from 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

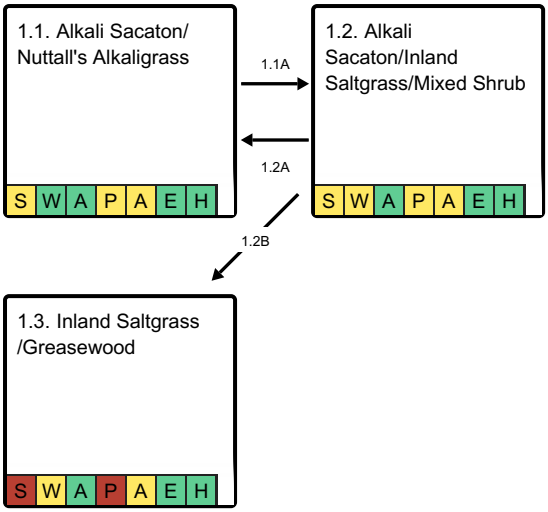


T1A - Frequent and Severe grazing plus encroachment will convert this plant community to a Invaded State.

T1B - Catastrophic events, gullying, or washouts leave a disturbed site.

T3A - The weakened or lack of native community and open soil leaves a community open to invasion.

State 1 submodel, plant communities

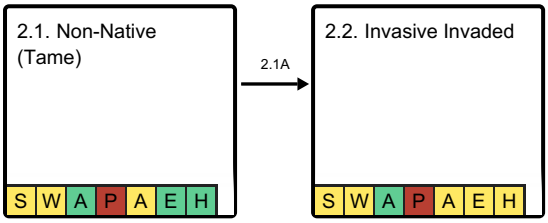


1.1A - Moderate, continuous season-long grazing and drought weaken the herbaceous cover and transition this community.

1.2A - Prescribed grazing over time and possibly brush control will aid in recovery.

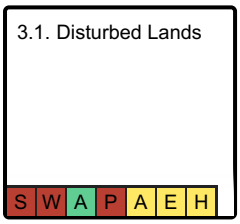
1.2B - Frequent and Severe grazing plus no encroachment will convert this plant community to the Inland Saltgrass /Greasewood Community Phase.

State 2 submodel, plant communities



2.1A - Soil disturbance with seed sources present will aid in adding invasive species to a tame community.

State 3 submodel, plant communities



State 1
Reference

The Saline Subirrigated ecological site is a wet site that hosts a mixture of sedges and grasses, as well as a minor component of shrubs. 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, alkali bluegrass, and inland saltgrass are dominant with Nebraska sedge, beaked sedge, and baltic rush. Common shrubs in this community is greasewood, wild rose, shrubby cinquefoil, and on occasion willows. As a community is in drier stages or degrades, foxtail barley, little barley and ryegrass are common.

Resilience management. The wet nature of this community creates a fragile community that is easily altered with management pressures. The community is also resilient because of the wet nature and the significant freeze and thaw cycles common to this higher elevation soil. The salt-laden characteristic of these soils limits resiliency

slightly, but the community does have the potential to recover after disturbance.

Community 1.1
Alkali Sacaton/ Nuttall's Alkaligrass

Figure 8. A diverse community is present, but with the loss of ground water, sedges and other key species are starting to recede.

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 80 percent grasses or grass-likes, 5 percent forbs and 15 percent woody plants. The major grasses include alkali sacaton, Nuttall's alkaligrass, alkali cordgrass, and Canada wildrye. Grasses of secondary importance are Baltic rush, Chairmaker's bulrush, alkali bluegrass, and inland saltgrass. Woody plants are primarily greasewood and shrubby cinquefoil. 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 3800 pounds per acre, but it can range from about 3200 lbs./acre in unfavorable years to about 4400 lbs./acre in above average years.

Resilience management. The state is stable and well adapted to the climate. The diversity in plant species and the reliable water table allow 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
- shrubby cinquefoil (*Dasiphora fruticosa*), shrub
- Woods' rose (*Rosa woodsii*), shrub
- alkali sacaton (*Sporobolus airoides*), grass
- Nuttall's alkaligrass (*Puccinellia nuttalliana*), grass
- Nebraska sedge (*Carex nebrascensis*), grass
- aster (*Eucephalus*), other herbaceous
- American licorice (*Glycyrrhiza lepidota*), other herbaceous
- silverweed cinquefoil (*Argentina anserina*), 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
- Inadequate livestock water quantity, quality, and distribution

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	3000	3350	3650
Shrub/Vine	150	350	500
Forb	50	100	250
Total	**3200**	**3800**	**4400**

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%
Water	0%
Bare ground	0-10%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	0-2%	0-10%	0-2%
>0.5 <= 1	–	0-5%	10-25%	0-5%
>1 <= 2	–	0-5%	20-50%	0-10%
>2 <= 4.5	–	0-5%	0-20%	0-5%
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

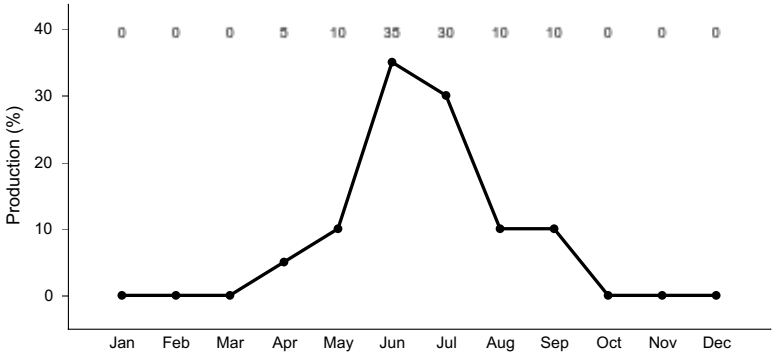


Figure 10. Plant community growth curve (percent production by month). WY0603, 15-19E Free water sites - WL, Sb. SS.

Community 1.2
Alkali Sacaton/Inland Saltgrass/Mixed Shrub

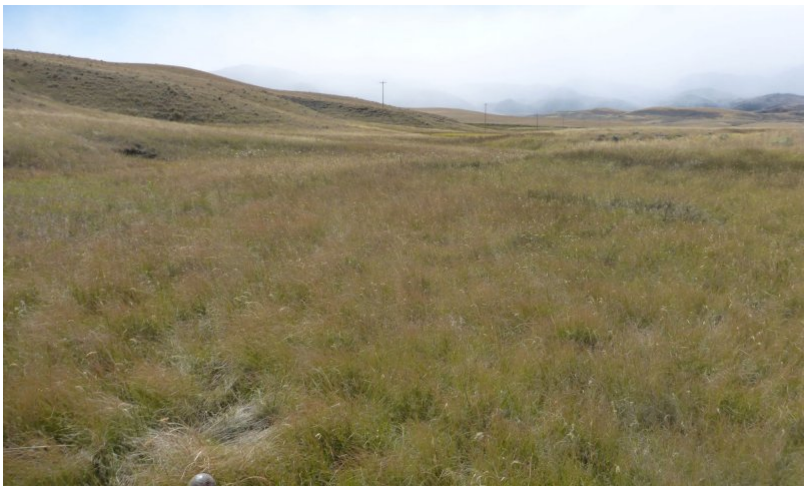


Figure 11. Alkali sacaton, with a alkali bluegrass and inland saltgrass understory. Shrubs have been removed from this site.

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, alkali bluegrass, and Baltic rush. Forbs commonly found in this plant community include alkali seepweed, silverweed, American licorice, seaside arrowgrass, and smooth horsetail. Greasewood and rose comprise the majority of the woody species and make up less than 25 percent of the annual production. When compared to the Reference Community Phase, Canada wildrye, Nuttall's alkaligrass, alkali cordgrass, and Nebraska sedge have decreased. Inland saltgrass, forbs, and greasewood, have increased. The total annual production (air-dry weight) of this state is about 3200 pounds per acre, but it can range from about 2800 lbs./acre in unfavorable years to about 3600 lbs./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
- Woods' rose (*Rosa woodsii*), shrub
- alkali sacaton (*Sporobolus airoides*), grass
- saltgrass (*Distichlis spicata*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- seaside arrowgrass (*Triglochin maritima*), other herbaceous
- American licorice (*Glycyrrhiza lepidota*), other herbaceous
- silverweed cinquefoil (*Argentina anserina*), 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
- Inadequate livestock water quantity, quality, and distribution

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	2500	2600	2700
Shrub/Vine	200	400	600
Forb	100	200	300
Total	**2800**	**3200**	**3600**

Community 1.3
Inland Saltgrass /Greasewood

This plant community is the result of frequent and severe grazing with periodic overflows. This plant community is dominated by a dense short grass sod and includes a mosaic shrub overstory. Greasewood, the primary shrub, comprises less than 25 percent of the annual production, and shrub numbers are kept in check by the herbaceous understory. The dominant grasses are inland saltgrass, alkali bluegrass, Baltic rush and Chairmaker's bulrush. Forbs such as seaside arrowgrass, American licorice, curly dock, and smooth horsetail are common. Greasewood is the primary overstory species in this plant community. Plant diversity is moderate to poor. When compared to the Reference Community Phase, the tall and mid-stature grasses are significantly reduced or absent. Short-stature warm-season grasses are dominant and less desirable native grasses are common (foxtail barley and little barley). Shrubs will have increased as a percentage of the total production, but will not dominate as the sod prevents a homogeneous shrub cover. Areas of bare ground may have increased in patches, and total production has decreased as the short grasses have replaced the tall and mid-stature grasses. The total annual production (air-dry weight) of this state is about 1800 pounds per acre, but it can range from about 1400 lbs./acre in unfavorable years to about 2200 lbs./acre in above average years.

Resilience management. The sod component of this plant community is extremely resistant to change and continued frequent and severe grazing or the removal of grazing does not seem to affect the plant composition or structure of the plant community. The biotic integrity of this state is generally not functional as plant diversity is poor, especially the amount of herbaceous species. The vegetative structure has shifted as the shrubs and short-stature grasses now occupy the majority of the site. This sod bound plant community is very resistant to water infiltration. While this sod protects the site itself, excessive runoff increases erosion on bare ground and can cause rill channels and gully erosion. 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 not be functioning, as runoff is excessive and erosional processes are accelerated.

Dominant plant species

- greasewood (*Sarcobatus vermiculatus*), shrub
- saltgrass (*Distichlis spicata*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- foxtail barley (*Hordeum jubatum*), grass
- horsetail (*Equisetum*), other herbaceous
- seaside arrowgrass (*Triglochin maritima*), other herbaceous
- American licorice (*Glycyrrhiza lepidota*), other herbaceous

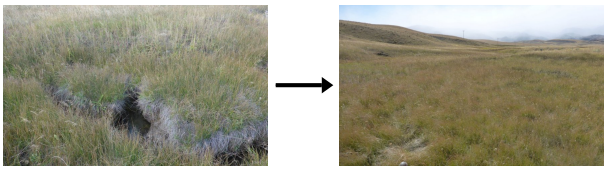
Dominant resource concerns

- Ephemeral gully erosion
- Classic gully erosion
- Bank erosion from streams, shorelines, or water conveyance channels
- Inefficient irrigation water use
- Sediment transported to surface 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 (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1200	1500	1600
Shrub/Vine	150	200	400
Forb	50	100	200
Total	**1400**	**1800**	**2200**

Pathway 1.1A
Community 1.1 to 1.2

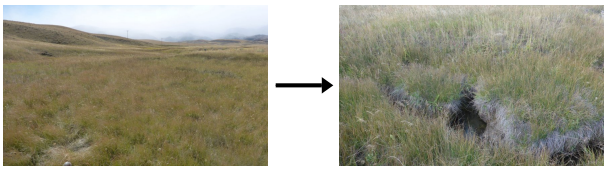


Alkali Sacaton/ Nuttall's Alkaligrass

Alkali Sacaton/Inland Saltgrass/Mixed Shrub

Moderate, continuous season-long grazing will convert this plant community to the Alkali Sacaton/Inland Saltgrass/Mixed Shrub 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.

Pathway 1.2A
Community 1.2 to 1.1



Alkali Sacaton/Inland Saltgrass/Mixed Shrub

Alkali Sacaton/ Nuttall's Alkaligrass

Prescribed grazing or possibly long-term prescribed grazing will result in a plant community very similar to the Reference Community Phase, except that greasewood will persist without some form of brush control.

Conservation practices

Brush Management
Critical Area Planting
Prescribed Grazing
Grazing Land Mechanical Treatment

Pathway 1.2B
Community 1.2 to 1.3

Frequent and Severe grazing will convert this plant community to the Inland Saltgrass Sod/Greasewood Plant Community. Fire or mowing of the area may increase the greasewood cover, and will encourage inland saltgrass and other tillering and low-stature species.

State 2
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 prevelant invader on saline sites is foxtail barley, redtop bentgrass, and occasionaly Kentucky bluegrass on these subirrigated sites. There are instances where these communities cross on the landscape, and they are 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 Subirrigated 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 and invasive species are resistant to change and resilient following disturbances. This makes a stable community that is difficult to change without significant inputs. The salt-laden soils limit the type of treatment, access, and species adapted to help recovery of the Invaded Community. Kentucky bluegrass, smooth brome, and other non-native species have a high resiliency once they have established in a community. The management of the native species is difficult, and is dependent on what specific species composition exists in the individual community. The removal or treatment of encroaching woody species is best tackled when they occur at a low intensity, before they may be seen as a concern.

Community 2.1
Non-Native (Tame)

Figure 14. Smooth brome and Kentucky bluegrass encroachment in a community. Greasewood was removed for haying.

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
- willow (*Salix*), shrub
- shrubby cinquefoil (*Dasiphora fruticosa*), shrub
- creeping meadow foxtail (*Alopecurus arundinaceus*), grass
- little barley (*Hordeum pusillum*), grass
- redtop (*Agrostis gigantea*), grass
- common dandelion (*Taraxacum officinale*), other herbaceous
- American licorice (*Glycyrrhiza lepidota*), other herbaceous
- povertyweed (*Iva axillaris*), 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
- Inefficient irrigation water use
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Aquatic habitat for fish and other organisms
- Feed and forage imbalance

Community 2.2
Invasive Invaded

Figure 15. Dense Canada thistle within a smooth brome and Kentucky bluegrass dominated community.

The Invasive Invaded Community Phase has maintained a fractured sample of the perennial grasses and forbs that are typical of the Saline Subirrigated 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). Tamarisk or Russian olive as

well as greasewood may be more abundant than other shrubs, as they are strong resprouters and may quickly re-establish the site after a disturbance. With the decrease or loss of most desirable grasses, foxtail barley, little barley, inland saltgrass, and baltic rush will persist on the site. Creeping meadow foxtail, Kentucky bluegrass, redtop bentgrass, 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

- Russian olive (*Elaeagnus angustifolia*), tree
- tamarisk (*Tamarix*), tree
- greasewood (*Sarcobatus vermiculatus*), shrub
- Woods' rose (*Rosa woodsii*), shrub
- shrubby cinquefoil (*Dasiphora fruticosa*), shrub
- creeping meadow foxtail (*Alopecurus arundinaceus*), grass
- foxtail barley (*Hordeum jubatum*), grass
- redtop (*Agrostis gigantea*), grass
- Canada thistle (*Cirsium arvense*), other herbaceous
- cocklebur (*Xanthium*), other herbaceous
- alkali swainsonpea (*Sphaerophysa salsula*), other herbaceous

Dominant resource concerns

- Classic gully erosion
- Bank erosion from streams, shorelines, or water conveyance channels
- Concentration of salts or other chemicals
- Inefficient irrigation water use
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Aquatic habitat for fish and other organisms
- Feed and forage imbalance
- Energy efficiency of farming/ranching practices and field operations

Pathway 2.1A
Community 2.1 to 2.2

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 3
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 3.1
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 Subirrigated 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

- Classic gully erosion
- Bank erosion from streams, shorelines, or water conveyance channels

- Concentration of salts or other chemicals
- Ground water depletion
- Inefficient irrigation water use
- Petroleum, heavy metals, and other pollutants transported to surface water
- Petroleum, heavy metals, and other pollutants 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
- Aquatic habitat for fish and other organisms
- Feed and forage imbalance

Transition T1A
State 1 to 2

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 T1B
State 1 to 3

An abrupt or catastrophic disturbance will remove or significantly impact the native community and the soil structure, leaving a disturbed and barren site. 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.

Transition T3A
State 3 to 2

Once a site has transitioned to this state, the increased bare ground and weakened plant structure leaves the community for 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.

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm Season Grasses**			750–1750	
	alkali sacaton	SPAI	*Sporobolus airoides*	1000–1350	–
	alkali cordgrass	SPGR	*Spartina gracilis*	50–350	–
	saltgrass	DISP	*Distichlis spicata*	100–300	–
2	**Cool Season Grasses**			750–1750	
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	500–1000	10–20
	Canada wildrye	ELCA4	*Elymus canadensis*	0–500	0–10
	Sandberg bluegrass	POSE	*Poa secunda*	0–500	0–10
3	**Grasses/Grass-likes**			250–1000	
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–200	0–10
	chairmaker's bulrush	SCAM6	*Schoenoplectus americanus*	0–200	0–10
	common spikerush	ELPA3	*Eleocharis palustris*	0–200	0–10
	Nebraska sedge	CANE2	*Carex nebrascensis*	0–200	0–10
	rush	JUNCU	*Juncus*	0–200	0–10
	arctic rush	JUAR2	*Juncus arcticus*	0–200	0–10
	beaked sedge	CARO6	*Carex rostrata*	0–200	0–10
	Grass, perennial	2GP	*Grass, perennial*	0–200	0–10
	Grass-like, perennial	2GLP	*Grass-like, perennial*	0–200	0–10
	little barley	HOPU	*Hordeum pusillum*	0–200	0–10
Forb					
4	**Perennial Forbs**			0–250	
	common plantain	PLMA2	*Plantago major*	0–100	0–5
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–100	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–100	0–5
	silverweed cinquefoil	ARAN7	*Argentina anserina*	0–100	0–5
	aster	EUCEP2	*Eucephalus*	0–100	0–5
	arrowgrass	TRIGL	*Triglochin*	0–100	0–5
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–100	0–5
	milkvetch	ASTRA	*Astragalus*	0–100	0–5
Shrub/Vine					
5	**Shrubs**			150–500	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–300	0–15
	Woods' rose	ROWOW	*Rosa woodsii var. woodsii*	0–100	0–5
	shrubby cinquefoil	DAFR6	*Dasiphora fruticosa*	0–100	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–100	0–5

Animal community

Reference Community Phase (1.1): The predominance of grasses in this plant community favors grazers and mixed-feeders, such as bison, elk, and antelope. Suitable thermal and escape cover for deer may be limited due to

the low quantities of woody plants. However, topographical variations could provide some escape cover. This plant community may provide brood rearing/foraging areas for sage grouse. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles. Many grassland obligate small mammals would occur here.

1.2 - Alkali Sacaton/Inland Saltgrass/Mixed Shrub: This plant community may be useful for the same large grazers that would use the Historic Climax Plant Community. However, the plant community composition is less diverse, and thus, less apt to meet the seasonal needs of these animals. It may provide some foraging opportunities for sage grouse when it occurs proximal to woody cover. Good grasshopper habitat equals good foraging for birds.

1.3 - Inland Saltgrass Sod/Mixed Shrub: This plant community may be useful for the same large grazers that would use the Historic Climax Plant Community. However, the plant community composition is less diverse, and thus, less apt to meet the seasonal needs of these animals. It may provide some foraging opportunities for sage grouse when it occurs proximal to woody cover. Good grasshopper habitat equals good foraging for birds.

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.
Historic Climax Plant Community 3200-4400 2.1 0.48
Alkali Sacaton/Inland Saltgrass/Mixed Shrub 2800-3600 1.8 0.56
Inland Saltgrass Sod/Greasewood 1400-2200 1.3 0.77

* - 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

Climate 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 moderately slow to moderately

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 and dominate 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 are rare to non-existent. Cryptogamic crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

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

Wood products

Limited wood products are present on the site. Poplars and willows provide some firewood, and do provide materials for crafters. But no commercial harvest is known.

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 Subirrigated 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.

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Approval

Kirt Walstad, 3/06/2025

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	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)

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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.

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3. **Number and height of erosional pedestals or terracettes:** Rare to nonexistent. 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.

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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 0-5%. Any bare ground openings present should be <1 foot in size and should not be connected.

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

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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.

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7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous and woody litter is not expected to move.

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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):** Soil Stability Index ratings range from 3 (interspaces) to 6 (under plant canopy), but average values should be 4.0 or greater.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Typically an A-horizon of greater than 2 inches (5 cm) with massive structure and color hues of 10YR or 2.5Y, values of 5-6, and chromas of 2-3. Organic matter typically is 1-2%.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 75-90% grasses, 10% forbs, and 0-15% shrubs. Dense plant canopy (80-100%) and litter plus moderate infiltration rates result in minimal to nonexistent runoff. Basal cover is typically greater than 5% for this site and effectively reduces runoff on this site. With the physiographic location of this site being in low lying areas, it often acts as a terminal accumulation site for runoff. The amount of sodium in the soil can affect infiltration and facilitate puddling on the surface.

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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):** No compaction layer exists. This site will normally have textural changes within its' profile and should not be mistaken for compaction layers.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: warm-season bunchgrasses (3 species)

    Sub-dominant: cool-season bunchgrasses (3 species)

    Other: Community 1.1 = warm-season bunchgrasses > cool-season bunchgrasses > Perennial Forbs = Shrubs
    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: 6 species

    Additional: Biological soil crust is variable in its' expression where present on this site and is measured as a component of ground cover. Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions. 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.

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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 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.

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14. **Average percent litter cover (%) and depth (in):** Litter ranges from 0-20% of total canopy measurement with total litter (including beneath the plant canopy) from 80-100% expected. Herbaceous litter depth typically ranges from 10-25 mm.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total annual production ranges from 3200-4400 lb/ac (3586-4931 kg/ha); with an average annual production of 3800 lb/ac (4259 kg/ha).

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Bare ground greater than 20% is the most common indicator of a threshold being crossed. Greasewood and inland saltgrass are common increasers. Redtop bentgrass and foxtail barley may degrade the site.

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