USDA Natural Resources
Conservation Service

Ecological site DX032X01A141
Saline Upland Loamy (SUL) Big Horn Basin Core

Last updated: 2/22/2019
Accessed: 05/07/2024

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

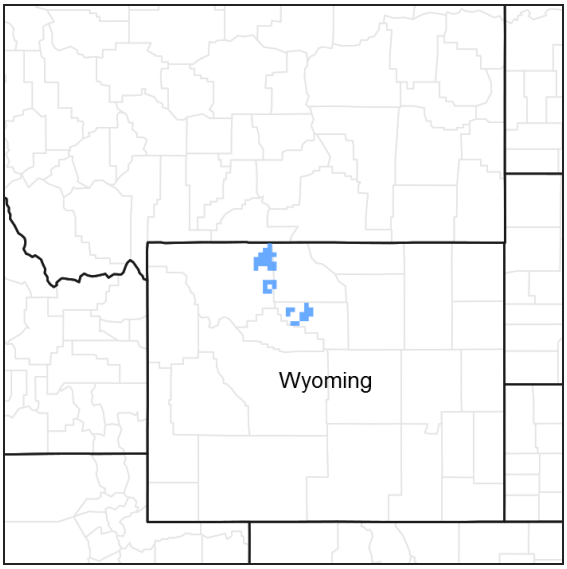


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 032X–Northern Intermountain Desertic Basins

032 – Northern Intermountain Desertic Basins – This MLRA is comprised of two major Basins, the Big Horn and Wind River. These two basins are distinctly different and are split by LRU's to allow individual ESD descriptions. These warm basins are surrounded by uplifts and rimmed by mountains, creating a unique set of plant responses and communities. Unique characteristics of the geology and geomorphology single these two basins out.

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):

32X01A (WY): This LRU is the Big Horn Basin within MLRA 32. This LRU is lower in elevation, slightly warmer and receives slightly less overall precipitaiton than the Wind River Basin (LRU 02). This LRU was originally divided into

two LRU's - LRU A which was the core and LRU B which was the rim. With the most current standards, this LRU is divided into two Subsets. This subset is Subset A, referred to as the Core, which is warm, dry eroded basin floor. As the LRU shifts outer edges, aspect and relation to the major bodies of water and taller landforms create minor shifts in soil chemistry influencing the variety of ecological sites and plant interactions. 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. Older ESD's will refer to LRU A. LRU A and LRU 01 in MLRA 32X are synonymous.

Moisture Regime: Typic Aridic, prior to 2012, there are map units that cross over to ustic aridic or ustic aridic was correlated into this core area. As progressive mapping continues and when the ability to do update projects, these overlapping map units will be corrected.

Temperature Regime: Mesic
Dominant Cover: Rangeland, with Saltbush flats the dominant vegetative cover for this LRU/ESD.
Representative Value (RV) Effective Precipitation: 5-9 inches (127 – 229 mm)
RV Frost-Free Days: 110-150 days

Classification relationships

Relationship to Other Established Classification Systems:

National Vegetation Classification System (NVC):
3 Xeromorphic Woodland, Scrub & Herb Vegetation Class
3.B Cool Semi-Desert Scrub & Grassland Subclass
3.B.1 Cool Semi-Desert Scrub & Grassland formation
3.B.1.NE Western North American Cool Semi-Desert Scrub & Grassland Division
M169 Great Basin Saltbush Scrub Macrogroup
G301 Atriplex corrugate – Artemisia pedatifida – Picrothamnus desertorum Dwarf-Scrub Group
CEGL001439 Atriplex gardneri – Bud Sagebrush Dwarf-shrubland
CEGL001445 Atriplex gardneri / Pascopyrum smithii Dwarf-shrubland

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.g Big Horn Salt Desert Shrub Basin

Ecological site concept

• Site does not receive any additional water.
• Slope is < 30%
• Soils are:
- saline, sodic, or saline-sodic
- Shallow, moderately deep, deep, or very deep
- With < 3% stone and boulder cover and < 20% cobble and gravel cover
- Not skeletal (<35% rock fragments) within 20" (51 cm) of mineral soil surface
- Textures usually range from very fine sandy loam to clay loam
- Clay content is < 32% in mineral soil surface 4".
- With an average particle size class or equal to 18% but < 35% clay

The site concept is based on soils that are well drained, alluvium or residuum of a composite of alkaline or sodic sedimentary sources. Originally, Saline Upland spanned the full spectrum of textural classes (sandy through clayey), grouping them based on the chemical similarities. After closer review, it appears that a shift in plant communities occurs with the transition across the soil textural gradient. This community shift is assisted with a change in response to management and climate within the textural gradient. The original Saline Upland ecological site will be divided into: Saline Upland, Loamy; Saline Upland, Sandy; and Saline Upland, Clayey. There may also be a need to separate saline/sodic soils that are influenced strongly by gypsum or calcium carbonate

accumulations, lab sampling will be processed to document if it is warranted. Until such time, these communities will be documented within the respective textural breaks of the Saline Upland site.

Associated sites

DX032X01A122	**Loamy (Ly) Big Horn Basin Core** Loamy sites are found adjacent to Saline upland sites. Generally are in depressional or concave areas that allow salts to be flushed lower in the profile.
R032XY118WY	**Impervious Clay (IC) 5-9” Big Horn Basin Precipitation Zone** Impervious Clay sites typically are found at the base of shale outcrops and as they transition down slope gain silt and sands, increasing in vegetation and productivity.

Similar sites

DX032X01A143	**Saline Upland Clayey (SUC) Big Horn Basin Core** This site is the clayey counter part to the current site. This site has greater than 35% clays within the particle control section and classifies typically as a fine textural class.
R032XY344WY	**Saline Upland (SU) 10-14" East Precipitation Zone** This site is the foothills higher precipitation version of the original description. Production is higher.
R032XY144WY	**Saline Upland (SU) 5-9” Big Horn Basin Precipitation Zone** This site was the original description that ranged or included all textural classes of this site. This description also use a wider area of interest, stretching precipitation further up into the foothills region of the Big Horn Basin.
R032XY244WY	**Saline Upland (SU) 5-9” Wind River Basin Precipitation Zone** This site is located in the Wind River Basin, has similar characteristics but due to varied climatic conditions, historically has been written as its own ecological site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Atriplex gardneri* (2) *Picrothamnus desertorum*
Herbaceous	(1) *Achnatherum hymenoides* (2) *Elymus elymoides*

Legacy ID

R032XA141WY

Physiographic features

These sites generally occur on slopes ranging from nearly level to 30%. It has been documented that most of these soils are found on the bottom of drainages in enclosed basins or where marine shales outcrop. They may also occupy residual and fan soils of the foothills and lower mountain ranges with lower precipitations. The inter-bedded and dissected geomorphic features within the Big Horn Basin has a mixture of these soils creating a wide range of saline-driven communities.

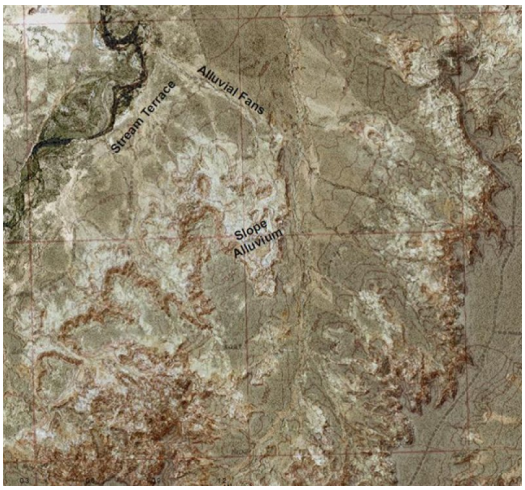


Figure 2. Aerial imagery of feature landscape positions

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Stream terrace (3) Basin-floor remnant
Elevation	1,100–1,981 m
Slope	0–30%
Ponding depth	0 cm
Water table depth	122 cm
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation and modeled relative effective annual precipitation ranges from 5 to 9 inches (127 – 229 mm). The normal precipitation pattern shows peaks in May and June and a secondary peak in September. The noted peaks account for approximately 50% of the mean annual precipitation. Much of the moisture that falls in the latter part of the summer is lost by evaporation and much of the moisture that falls during the winter is lost by sublimation.

Average snowfall is about 20 inches annually. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation. 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. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring. High winds are generally blocked from the basin by high mountains, but can occur in conjunction with an occasional thunderstorm.

Growth of native cool-season plants begins approximately on April 1st and continues through to July 1st. Cool weather and moisture in September may produce some green up of cool season plants that will continue to late October. For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/. “Basin”, "Emblem", "Greybull", “Lovell”, "Worland FAA AP" and “Worland” are the representative weather stations for LRU A. 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 (average)	125 days
Freeze-free period (average)	149 days

Precipitation total (average)	203 mm

Climate stations used

- (1) EMBLEM [USC00483031], Burlington, WY
- (2) WORLAND [USC00489770], Worland, WY
- (3) LOVELL [USC00485770], Lovell, WY
- (4) BASIN [USC00480540], Basin, WY
- (5) GREYBULL [USC00484080], Greybull, WY
- (6) WORLAND [USW00024062], Worland, WY

Influencing water features

None Present. The lack of water table above 48 in (122 cm) during any part of the growing season is a key factor for the Saline Upland sites. As the landscape transitions into the bottomlands (lowlands) or drainages, gaining overland flow and ground water influence changes the site to a saline lowland or saline subirrigated ecological site.

Soil features

The soils of this site are shallow to very deep (greater than 10” (25 cm) to bedrock), well drained soils with moderate to slow permeability. The soils are also moderately to strongly saline and/or alkaline. The surface soil will vary from 2 to 6 inches (5-15 cm) in thickness. The soil characteristics that have the most influence on the plant community are the high quantity of soluble salts. Some soils may contain more soluble salts in the subsurface than in the surface.

Major Soil Series correlated to this site include: Muff, Uffens, Greybull, Persayo, Binton, Youngston, Youngston-like, Lostwells, Lostwells-like, Sharland, Mudray-like. This list of soil series is subject to change upon completion and correlation of the initial soil surveys.
Typical Pedon: Muff Soil Series

Taxonomic Classification: Fine-loamy, mixed, superactive, mesic Typic Natrargids. The Muff series consists of well drained, moderately deep soils formed in residuum and slope alluvium weathered from sandstone or shale. Muff soils are on hillslopes, strath terraces and summits. Muff fine sandy loam-rangeland. (Colors are for dry soil unless otherwise stated.)

GEOGRAPHIC SETTING: Muff soils are on rolling hills, plains, strath terraces and benches. These soils formed in residuum, and slope alluvium weathered from sodic shale and sandstone. Slopes are 0 to 30 percent. Elevations range from 4,000 to 6,400 feet. The mean annual precipitation is about 8 inches. The mean annual precipitation ranges from 5 to about 10 inches of which about half falls as rain or snow in April, May, and early June. The mean annual temperature is about 44 degrees F., but ranges from 43 to 50 degrees F. The frost-free season is estimated to range from 110 to about 140 days depending upon aspect, air drainage, and elevation.

A1--0 to 3 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak thick and very thick vesicular platy structure parting to weak fine granular; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; moderately alkaline (pH 8.0); abrupt smooth boundary. (2 to 5 inches thick)
Range in Characteristics: The A horizon has hue of 5Y through 7.5YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. ESP ranges from 5 to 30. EC ranges from 2 to 4 mmhos. Reaction is mildly through very strongly alkaline.

A2--3 to 5 inches; grayish brown (10YR 5/2) fine sandy loam, light yellowish brown (10YR 5/4) moist; weak thin platy structure parting to weak very fine subangular blocky; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; moderately alkaline (pH 8.2); abrupt smooth boundary. (0 to 4 inches thick)
Range in Characteristics: The A horizon has hue of 5Y through 7.5YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. ESP ranges from 5 to 30. EC ranges from 2 to 4 mmhos. Reaction is mildly through very strongly alkaline.

Btn--5 to 10 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; moderate

medium columnar structure parting to moderate medium angular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many prominent clay films on faces of peds; strongly alkaline (pH 9.0); clear wavy boundary. (4 to 15 inches thick)
Range in Characteristics: The Btn and Btnk horizons have hue of 2.5Y through 7.5YR, value of 4 through 7 dry, 4 or 5 moist, and chroma of 2 through 4. This horizon meets the diagnostic properties of a natric horizon. Texture is typically clay loam or sandy clay loam but may be a loam. Clay ranges from 18 to 35 percent, sand from 20 to 60 percent, and silt from 10 to 50 percent. ESP ranges from 15 to 45 percent when averaged for this horizon. Reaction is strongly or very strongly alkaline. EC ranges from 4 to 8 mmhos.

Btnk--10 to 19 inches; light brownish gray (10YR 6/2) sandy clay loam, yellowish brown (10YR 5/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and plastic, common fine roots; many distinct clay films on faces of peds; strongly effervescent, calcium carbonate as common filaments and threads on vertical faces of peds; very strongly alkaline (pH 9.2); gradual wavy boundary. (6 to 12 inches thick)
Range in Characteristics: The Btn and Btnk horizons have hue of 2.5Y through 7.5YR, value of 4 through 7 dry, 4 or 5 moist, and chroma of 2 through 4. This horizon meets the diagnostic properties of a natric horizon. Texture is typically clay loam or sandy clay loam but may be a loam. Clay ranges from 18 to 35 percent, sand from 20 to 60 percent, and silt from 10 to 50 percent. ESP ranges from 15 to 45 percent when averaged for this horizon. Reaction is strongly or very strongly alkaline. EC ranges from 4 to 8 mmhos.

Bk--19 to 27 inches; light brownish gray (10YR 6/2) sandy clay loam, yellowish brown (10YR 5/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; violently effervescent, calcium carbonate as common soft masses, threads, and seams; strongly alkaline (pH 9.0); clear wavy boundary. (4 to 10 inches thick)
Range in Characteristics: The Bk horizon has hue of 5Y through 10YR, value of 5 through 7 dry, 4 through 7 moist, and chroma of 2 through 4. Texture is sandy loam, loam, sandy clay loam, or clay loam with clay content from 10 to 30 percent. Calcium carbonate and gypsum are segregated and occur as few or common soft masses, threads, and filaments. Carbonates range from 4 to 15 percent throughout but morphologically do not meet the qualifications of a diagnostic calcic horizon. ESP ranges from 8 to 35 percent. EC is 4 to 8 mmhos. Reaction is strongly or very strongly alkaline.

C--27 to 30 inches; pale yellow (2.5Y 7/4) sandy loam, light yellowish brown (2.5Y 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; strongly effervescent, calcium carbonate disseminated; strongly alkaline (pH 8.8); clear wavy boundary. (2 to 8 inches thick)
Range in Characteristics: The C horizon has hue of 5Y through 10YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 4. Texture is sandy loam or loam. Calcium carbonate and gypsum are mostly disseminated with few segregated soft masses, threads, or filaments. Carbonates range from 4 to 12 percent. ESP ranges from 8 to 15 percent and EC from 4 to 15 mmhos.

Cr--30 to 60 inches; soft, calcareous sodic shale interbedded with thin seams of soft sandstone.
Range in Characteristics: The Cr horizon consists of soft sodic shale interbedded with thin lenses of sandstone. The shale ranges from yellowish brown to olive and contains large amounts of quartz. Thin lenses of visible salts of sodium, gypsum, and carbonates are common between the shale plates. This material extends to over 80 inches and is estimated to extend to over 15 feet in most areas.

RANGE IN CHARACTERISTICS: The depth to soft bedrock and paralithic contact ranges from 20 to 40 inches. The mean annual soil temperature ranges from 47 to 53 degrees F. Depth to continuous horizons of carbonate accumulation ranges from 6 to 25 inches. These soils may be effervescent at the surface but are typically leached free of carbonates in the A and upper B horizons.

TYPE LOCATION: Washakie County, Wyoming; 2,000 feet north and 2,000 feet west of the SE corner of sec. 19, T. 46 N., R. 91 W. Banjo Flats Quadrangle 43 degrees 56 minutes 10 seconds north latitude and 107 degrees 48 minutes 33 seconds west longitude.

Figure 7. Soils Profile Image.—Natric soil profile of Saline

Table 4. Representative soil features

Parent material	(1) Residuum–shale (2) Alluvium–sandstone
Surface texture	(1) Gravelly loam (2) Fine sandy loam (3) Sandy clay loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Slow to moderate
Soil depth	20–152 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	5.33–21.08 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	4–16 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	3–40
Soil reaction (1:1 water) (0-101.6cm)	7.4–11
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

The vegetation on this site is dominated by salt tolerant plants; specifically low, woody shrub species. Droughts resistant, mid-stature cool-season perennial grasses also hold a niche on this site. The expected potential composition is 35% grasses, 10% forbs, and 55% shrubs (woody species). The composition and production will vary naturally due to fluctuating precipitation quantity as well as timing and intensity of storm events. Historical use has shifted the vigor and plant community as well; however unlike the sagebrush counter-parts, fire frequency is not seen as a factor in these communities due to the lack of fine fuels.

As this site deteriorates, species such as Birdfoot sagebrush and Greasewood will increase. Weedy annuals will invade, including Halogeton and Cheatgrass. Cool season grasses such as Indian ricegrass, Bottlebrush squirreltail, and rhizomatous wheatgrasses will decrease in frequency and production.

The reference community (description follows the state and transition diagram) has been determined by study of rangeland relic areas, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

The following is a State and Transition Model (STM) Diagram for this ecological site. An STM has five fundamental components: states, transitions, restoration pathways, community phases and community pathways. The state, designated by the bold box, is 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 the natural disturbance regime of 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 -> State1 or better illustrated by State 1<- State 2) and are denoted in the Legend as an “R” (R2-1). They describe the management actions required to recover the state. Remediation is included.

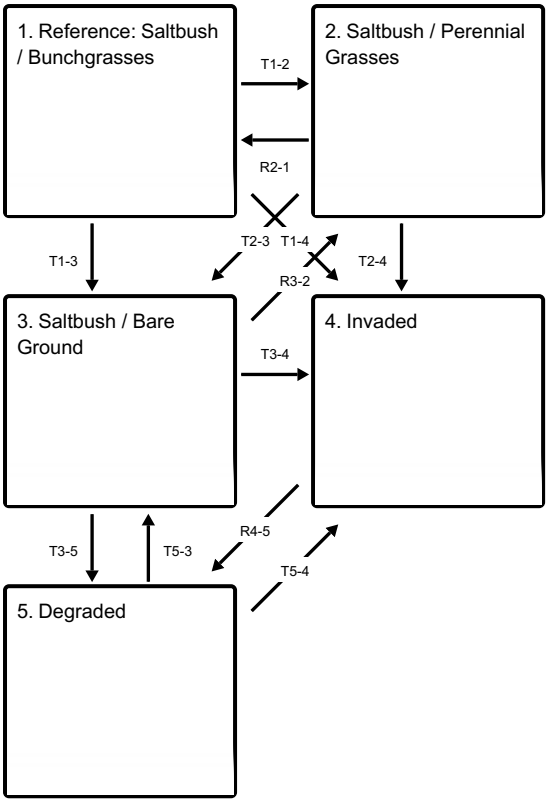
Community phases, small boxes within the bold state boxes, generally have important management or ecological significance. Collectively, the community phases represent the range of variation within a state, including conditions that place the state at risk for transition. Community pathways are represented by the lighter arrows moving between community phases and are labeled with “CP” (CP1.1-1.2). They describe the causes of shifts between community phases. The community phases captured in this STM may not represent every possibility, but are the most prevalent and repeatable plant communities.

The specific ecological processes and community variability will be discussed in more detail in the plant community narratives following the diagram. The plant composition tables, shown within each community phase narrative, have been developed from the best available knowledge at the time of this revision. As more data is collected, some of these plant communities may be revised or removed, and new ones may be added.

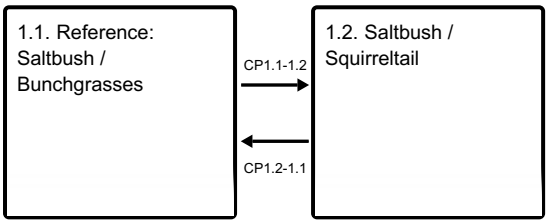
No plant communities should necessarily be thought of as “Desired Plant Communities”. According to the USDA NRCS National Range and Pasture Handbook, Desired Plant Communities (DPC’s) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including any description of a plant community here is to capture the current knowledge and experience at the time of this revision.

State and transition model

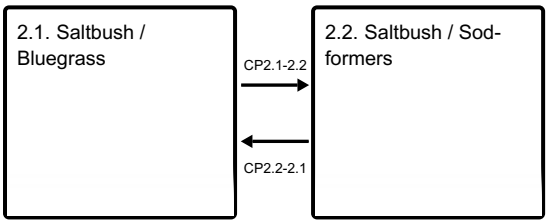
Ecosystem states



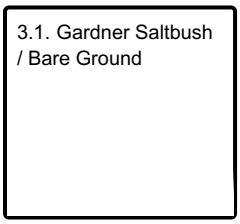
State 1 submodel, plant communities



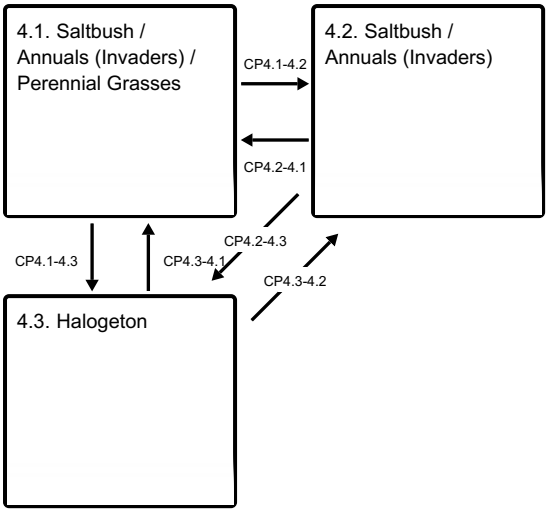
State 2 submodel, plant communities



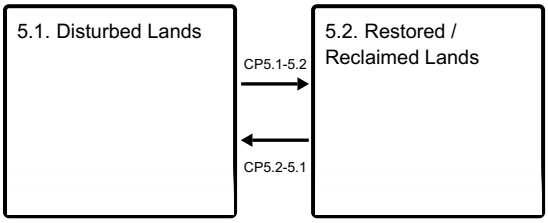
State 3 submodel, plant communities



State 4 submodel, plant communities



State 5 submodel, plant communities



State 1
Reference: Saltbush / Bunchgrasses

Saline Upland is a dynamic and complex concept that crossed soil textural breaks and includes a wide range of soil chemistry, that work together to create a salt-tolerant community. Field sampling can not capture the full dynamic of the chemistry and the current lack of soil laboratory data prevents clear separation of specific characteristics. Composition and production for this State have been ranged to incorporate the full range of possibilities. Soils within the 5-9" precipitation zone, fine-loamy particle size class, and with a wide range of alkali, saline, sodic and gypsum influences, are characterized by Gardner's Saltbush dominated plant communities. These communities may also have Bud Sagebrush, Birdfoot Sagebrush, Cottonthorn Horsebrush, and in some locations Greasewood that will comprise approximately 40% of the production (as a group) on the site. The grasses, composing 50% of the plant communities, are predominately Bottlebrush Squirreltail and Indian Ricegrass. As the sites transition, Sandberg Bluegrass and Blue Grama will begin to increase. Needleandthread is incidental in this State. The original Range Site description has rhizomatous wheatgrasses as a component, but data is minimal to support its presence within this LRU. The forb component is minor with only 10% of the production composed of by a select few forbs. A variety of biscuitroots/Desert Parsleys (Lomatiums), wild onion, milkvetches, and asters are found within this state. The general ground cover for this state is open with bare ground consisting of 30 to 50%, but it is stable. The drought tolerance of this state allows for a wide flexibility in production and composition shifts from year to year, but maintains the base diversity for each community phase.

Community 1.1
Reference: Saltbush / Bunchgrasses

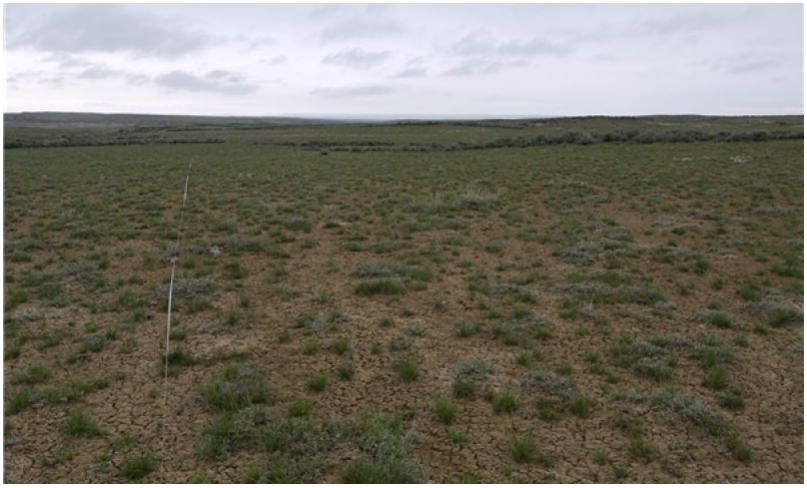


Figure 8. Early Spring view of Reference for Saline Upland, Loamy

The reference plant community for Saline Upland Loamy is characterized by an equal mixture of Saltbush and perennial grasses with a minor component of perennial forbs. This community evolved with grazing by large herbivores and droughty, alkaline and saline/sodic soils. The dominant plant community can be found on areas that are properly managed with grazing and on areas receiving short periods of rest. Potential vegetation is about 50% grasses or grass-like plants, 10% forbs, and 40% woody plants. Gardner Saltbush, Indian Ricegrass, and Bottlebrush Squirreltail are dominant with Bud Sagebrush, Winterfat, and Sandberg Bluegrass being sub-dominant within the Reference community (1.1). Other potential salt tolerant shrubs include Birdfoot Sagebrush, and Greasewood. Rhizomatous wheatgrasses were stated to be common on these sites in the historic rangeland description; however, in review of historical and current data, rhizomatous wheatgrasses rarely were identified. The total annual production (air-dry weight) of this community is about 370 pounds per acre, but it can range from about 190 lbs./acre in unfavorable years to about 635 lbs./acre in above average years. This state is fragile, but well adapted to the Northern Intermountain Desertic Basins climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community but is difficult to re-establish when damaged, in reference to site/soil stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	123	224	448
Grass/Grasslike	84	168	213
Forb	6	22	50
Total	**213**	**414**	**711**

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	0-2%
Litter	20-35%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	40-45%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	9-10%	–	0-2%
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 10. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			15	50	20	5		10			

Community 1.2
Saltbush / Squirreltail

Figure 11. Community 1.2, Gardners Saltbush with Squirreltail

Historically, this plant community evolved under grazing by large ungulates. The Saltbush/Squirreltail Community (1.2) is found under moderate season-long grazing by livestock. Prolonged drought plays an important role in the shift/transition to and from this community phase. Gardner’s saltbush and Bottlebrush squirreltail are the major components of this plant community. Cool-season grasses make up the majority of the understory with the balance made up of short warm-season grasses, and miscellaneous forbs. Dominant grasses include Bottlebrush Squirreltail, Sandberg Bluegrass, and Blue Grama. Forbs commonly found include Smooth woodyaster, Biscuitroot/desertparsley, and Wild Onion. Plains prickly pear, Winterfat, Cottonthorn horsebrush and Birdfoot sagebrush may also occur. When compared to the Reference Community (1.1), Birdfoot sagebrush has increased while Indian ricegrass and Bud sagebrush have decreased and may only exist in trace amounts. In addition, Winterfat may or may not have changed depending on the season of use. The total annual production (air-dry weight) of this community phase is about 235 pounds per acre but it can range from 100 lbs. /acre in unfavorable years to about 385 lbs/acre in above average years. Rangeland Health Indicators: This plant community is relatively resistant to change. The herbaceous species are well adapted to grazing; however, species composition can be altered through long-term grazing. The herbaceous component is mostly intact and plant vigor and replacement

capabilities are sufficient. Water flow patterns and litter movement may occur, but is not extensive. Incidence of pedestalling is minimal. Soils are mostly stable and the surface shows minimal soil loss. The watershed is functioning and the biotic community is intact.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	78	140	235
Grass/Grasslike	28	90	129
Forb	6	34	67
Total	**112**	**264**	**431**

Table 9. 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	0-2%
Litter	10-20%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	40-55%

Table 10. Canopy structure (% cover)

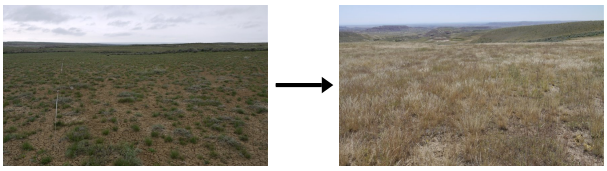
Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	10-20%	–	1-2%
>0.15 <= 0.3	–	0-1%	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 13. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			15	50	20	5		10			

Pathway CP1.1-1.2

Community 1.1 to 1.2

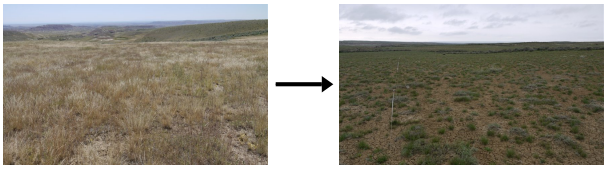


Reference: Saltbush / Bunchgrasses

Saltbush / Squirreltail

Moderate Continuous Season-long Grazing, Drought - Gardner's Saltbush has shown a tolerance or resilience under slight and moderate grazing pressures over a period of time, however the herbaceous component is susceptible, and is weakened under constant use. Indian Ricegrass is the main species that will decrease initially. As the pressure persists, vigor and density of Indian Ricegrass will decrease while Sandberg Bluegrass increases, and Bottlebrush Squirreltail will remain fairly stable. Production may not be altered depending on the precipitation for the year, but with continued stress the production will decrease as overall diversity and herbaceous cover is reduced.

Pathway CP1.2-1.1
Community 1.2 to 1.1



Saltbush / Squirreltail

Reference: Saltbush / Bunchgrasses

Prescribed Grazing or Long-term Prescribed Grazing - Given there is a viable seed source within distance, and appropriate rest and recovery time between grazing periods occurs, Indian Ricegrass and Bottlebrush Squirreltail can re-establish. The recovery process will take time and with the low precipitation rates and the tendency towards less than desirable seed establishment conditions, it may take several years (10-30 years). At this stage, seeding or other mechanical treatments are not suggested. Increased ground disturbance increases the potential risk of introducing invasive species. Considering the reduced vigor and diversity at this stage, the lower the risks taken the more apt the site is to recover.

Conservation practices

Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Prescribed Grazing
Grazing Management Plan - Applied

State 2
Saltbush / Perennial Grasses

The Saltbush/Perennial Grasses State (State 2) has been pressured into mid-stature bluegrasses and low-stature warm season grasses, reducing the flexibility of the community. Diversity has been reduced and although the state is stable with approximately 50% ground cover by Saltbush or salt tolerant shrubs, the production is slightly reduced. Much of the Big Horn Basin has transitioned to this state, and persist with higher level of annual forbs than compared to the reference state communities (1.1 and 1.2). Current and historic data has documented a cyclic 8-10 year trend with extreme fluctuation in production of Sandberg Bluegrass and other species that has skewed production data. (Based on a 50 year data set).

Community 2.1
Saltbush / Bluegrass

Figure 14. Community 2.1, Bluegrass dominant site (drought)

Currently, this community persists under moderate, season-long grazing by livestock and can be the result of prolonged drought conditions. This site appears to respond with an exaggerated shift in production from wet, normal and dry seasons and thus the fire threat will vary drastically from one production cycle to the next. This plant community is still dominated by cool-season grasses, while short warm-season grasses and miscellaneous forbs account for the balance of the understory. Continued drought or intense grazing places this community at-risk of shifting to a sod-forming, warm-season dominated grass community. The dominant plants for this community are Gardner's saltbush and Sandberg bluegrass. Grass species incidental include: Prairie junegrass, Blue grama, Bottlebrush squirreltail, and Needleandthread. Forbs commonly found in this plant community include annual mustards, stickseeds, desert parsley/biscuitroot, milk vetches and asters. This site can still provide a diverse plant community, but lacks the structure for cover and wildlife habitat. When compared to the Reference Community, Sandburg bluegrass and Blue grama have increased; and Plains prickly pear cactus will also have invaded. Indian ricegrass and Bottlebrush squirreltail have decreased and may occur only in trace amounts within the patches of Plains prickly pear. Season of use and treatment type may have limited or removed Winterfat from this community. The total annual production (air-dry weight) of this community phase is about 220 pounds per acre, but it can range from about 90 lbs./acre in unfavorable years to about 775 lbs./acre in above average years. Rangeland Health Implications/Indicators: This plant community is resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. The herbaceous component is mostly intact and plant vigor and replacement capabilities are sufficient. Water flow patterns and litter movement may be occurring but only on steeper slopes. 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.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	78	112	560
Grass/Grasslike	17	101	196
Forb	6	34	112
Total	**101**	**247**	**868**

Table 12. 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	0-1%
Litter	10-30%

Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-60%

Table 13. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	8-20%	–	0-2%
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 16. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			15	50	20	5		10			

Community 2.2
Saltbush / Sod-formers

Figure 17. Community 2.2, Blue grama dominated community

This plant community is the result of frequent and severe year-long grazing, which has adversely affected the perennial grasses. Unlike other sites, the shrub component is less affected, but still sees a change with continued pressure. The nature of the sod-forming plants is a decrease of infiltration of water with a thick shallow mat of roots, and tends to channelize runoff between established clumps of vegetation. The density of the “patches” is smaller than seen in similar Sagebrush communities. This, with the lack of structure to hold moisture, compounded by drought can reduce the stability of the site, making erosion a more significant problem. Prickly pear cactus as well as the open canopy of Gardner’s saltbush can provide a niche for other perennial native species to persist. When compared to the Reference Plant Community (1.1), Blue grama has increased. Prickly pear cactus has invaded. All

cool-season mid-stature grasses, forbs, and most shrubs have been greatly reduced. Production has been significantly decreased. The total annual production (air-dry weight) of this community phase is about 220 lbs./acre, but it can range from about 65 lbs./acre in unfavorable years to about 400 lbs./acre in above average years. Rangeland Health Implications/Indicators: This community is resistant to change and the removal of grazing does not seem to affect the plant composition or structure of the sod-formers. The biotic integrity of this state is not functional and plant diversity is extremely low. The plant vigor is significantly weakened and replacement capabilities are limited due to the reduced number of cool-season grasses. The sod-bound nature of this plant community is resistant to water infiltration, however the open dissected nature of the "patches" has a minimal impact on infiltration. While this sod protects the site itself, off-site areas are affected by excessive runoff that can cause rills and gully erosion. Water flow patterns are obvious in areas of bare ground and pedestalling is apparent along the sod edges. Rill channels are noticeable in the interspaces and down slope. The watershed may or may no be functioning, as runoff may affect adjoining sites.

Table 14. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	45	123	224
Forb	6	39	112
Grass/Grasslike	22	84	112
Total	**73**	**246**	**448**

Table 15. 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%
Litter	10-30%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	45-60%

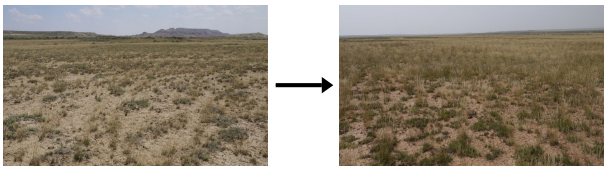
Table 16. Canopy structure (% cover)

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

Figure 19. Plant community growth curve (percent production by month). WY0504, 5-9 BH Upland Sites Warm Season Dominate. Monthly percentages of total annual growth based on a predominately C4 warm season plant community with shrubs and some C3 plants. Generally sod-forming community..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	15	25	45	10	0	5	0	0	0

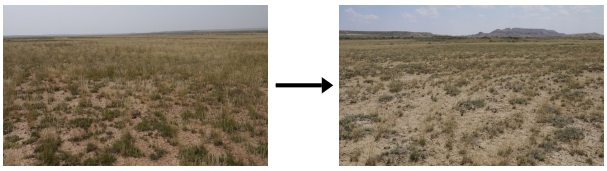
Pathway CP2.1-2.2
Community 2.1 to 2.2



Saltbush / Bluegrass **Saltbush / Sod-formers**

Frequent and Severe Utilization of cool season mid-grasses during the growing season, Drought - The low growing warm season grass, Blue grama, is encouraged with the high utilization of the cool season mid-stature grasses. As grazing removes Sandberg bluegrass and opens the canopy, Blue grama, if present in the system, increases in density building a sod mat between Gardner's saltbush plants. Drought will also open the canopy, encouraging Blue grama to gain dominance in this community.

Pathway CP2.2-2.1
Community 2.2 to 2.1



Saltbush / Sod-formers **Saltbush / Bluegrass**

Prescribed Grazing with environmental or human disturbances to break the sod-forming root structure - In extended periods of drought or with severe hoof action the sod "patchwork" of Blue grama has been interrupted or opened enough to encourage Sandberg bluegrass and Bottlebrush squirreltail to begin to find stature in the community again. Areas that have been furrowed or other means of mechanical disturbance, as well as livestock hoof action, are tools that can be implemented to encourage the mid-stature cool season grasses; however, there is the inherent risk of introduction of invasive species to the system. If mechanical means are use, the site will respond differently to management, over time, due to alteration of the soil structure and hydrologic function.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Native Plant Community Restoration and Management
Prescribed Grazing
Grazing Management Plan - Applied

State 3
Saltbush / Bare Ground

A saltbush dominant site with bare ground is the second State captured within the original range site description for Saline Upland. As more soils data and vegetation data was analyzed, a trend shows many of the study locations with this community contained a higher percent clay. A few site classifications were on the border of the concept characteristics for Saline Upland, Clayey ecological site. These borderline sites currently classify/key to Saline Upland, Loamy. Management or Climatic conditions that caused this State may not be clear cut, and require continued investigation. It is recognized that with continued pressure and drought conditions, the productivity and sustainability of most perennial grasses will decrease leaving a shrub dominated state. In the absence of invasive species, this state can persist on the landscape. Very long-term prescribed grazing and grazing land mechanical treatment (with seeding possibly) may be practices that can be used to bring this state near or similar to reference. Remnant populations of native perennial grasses will persist in pockets within the Gardner's Saltbush, but in some instances, seeding may be required to help re-establish herbaceous species to these sites. No research was located for large areas of re-vegetation, but minor success has occurred with seeding trials completed by local bentonite mining reclamation processes within the Big Horn Basin. These seeding trials were small isolated areas requiring extended periods of rest and will require long-term management to bring them back to a state that will resemble Reference (communities 1.1 and 1.2).

Community 3.1
Gardner Saltbush / Bare Ground

Figure 20. Community 3.1 - Gardner saltbush and Bare ground

This plant community can occur where sites are subjected to continuous year-long grazing. Gardner’s Saltbush dominates and in some cases comprises almost 100% of the plant community. The interspaces between plants have expanded significantly leaving the amount of bare ground prevalent and the soil surface exposed to erosive elements. Cool season grasses have been eliminated or greatly reduced. The community is highly susceptible to invasion by noxious weeds such as Russian Knapweed and Halogeton. When compared to the reference state (communities 1.1 and 1.2), plant production is diminished due to the excessive amount of bare ground. The total annual production (air-dry weight) of this community phase is about 145 pounds per acre, but it can range from about 80 lbs. /acre in unfavorable years to about 515 lbs./acre in above average years. Rangeland Health Indicators: This plant community is resistant to change as the stand becomes more decadent. These areas are resistant to fire due to the lack of fine fuels and the increase of bare ground between the salt-tolerant shrubs. Continued frequent and severe grazing or the removal of grazing does not seem to affect the plant composition or structure of the pant community. Plant diversity is extremely low. The plant vigor is diminished and replacement capabilities are severely reduced due to the decrease in the number of cool-season grasses. Plant litter is noticeably less when compared to the reference state. Soil erosion is 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 down slope.

Table 17. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	78	112	448
Forb	6	39	112
Grass/Grasslike	6	11	17
Total	**90**	**162**	**577**

Table 18. 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%
Litter	10-20%
Surface fragments >0.25" and <=3"	0-7%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	50-70%

Table 19. Canopy structure (% cover)

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

Figure 22. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			15	50	20	5		10			

State 4
Invaded

The Saline Upland site has proven to be more tolerable or resistant to invasion by many of the invasive species threatening the rangelands today. However, there are a few species that still present issues as these lands are disturbed by development, continued drought, and shifts in use patterns. Many of these sites are under pressure by local threats such as False Wheatgrass and False Buffalograss, as well as the national threats of Halogeton,

Cheatgrass (Downy Brome), and a variety of Knapweed and thistles. The persistence, resistance and resilience of specific communities within this state will be discussed further below.

Community 4.1
Saltbush / Annuals (Invaders) / Perennial Grasses

Figure 23. Cheatgrass Enroachment on Saline Upland, Loamy site

The Saltbush/Annuals (Invaders)/Perennial Grasses phase has maintained a representative sample of the native perennial grasses and forbs with the accompanying Gardner's Saltbush composition. The invasive species are present and hold a significant (10% or greater) composition of the landscape, and are prominent on the site (referring to a more wide scale composition, not isolated patches on of the landscape). Production of the desired perennial species of this site is generally reduced but the total production is maintained or elevated due to the production potential of many of the annual or invasive species. Production of this community phase will vary depending on the invasive species. Site-specific evaluation will need to be completed to determine productivity and the growth curve that is best suited. The curve selected below is for a Cheatgrass influenced community. Rangeland Health Implications/Indicators: This plant community is resistant to change. Plant diversity is moderate to poor. The plant vigor is diminished and replacement capabilities are limited due to the reduced number of cool-season grasses. Plant litter is noticeably more when compared to reference communities due to the potential biomass produced by the invasive 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.

Figure 24. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	25	45	5	0	0	10	5	5	0

Community 4.2
Saltbush / Annuals (Invaders)

Figure 25. Halogeton and Gardner Saltbush dominated community

This community phase is the at-risk community. As the native populations of perennial grasses and forbs become weakened, the site becomes invader driven, and is extremely difficult to improve. Gardner's Saltbush is able to compete and maintain a strong community under a heavy infestation level. The canopy, although dwarfed, can serve as a protected niche in the system that can hold native grass species and help them to persist. But the system is low in resistance. Rangeland Health Implications/Indicators: This plant community is resistant to change as the stand becomes more decadent. Plant diversity is poor. The plant vigor is diminished and replacement capabilities are limited due to the reduced number of cool-season grasses. Plant litter is noticeably more when compared to reference communities due to the potential biomass produced by the invasive species (species dependent). Soil erosion is variable depending on the species of invasion and the associated litter accumulation. Variability of water flow, pedestalling, infiltration and runoff is determined by the invasive species inhabiting the community.

Figure 26. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	25	45	5	0	0	10	5	5	0

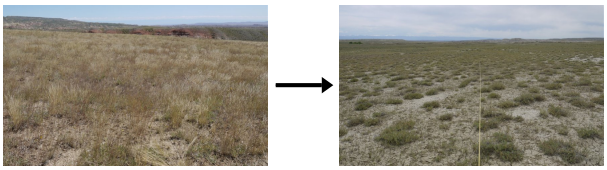
Community 4.3
Halogeton

Halogeton is a common weed found on a variety of soils and in a wide range of climates. It is aggressive and able to take advantage of disturbed and degraded soils, out-competing other species for limited resources. It is a common species found on the alkaline soils, especially saline or sodic soils. It was thought to fill a niche until perennial natives could establish and begin to out compete for the resource. Studies completed by the University of Wyoming and partnering agencies have found that over time, Halogeton has been able to encroach in and push Gardner's saltbush out of locations. Photo point and transect data has shown that Gardner's Saltbush can fluctuate significantly with precipitation and extended periods of drought, and will recover with the return of adequate moisture events; but given time and continued pressure of Halogeton, the shrub component will eventually be reduced or eliminated. This was seen with grazed as well as ungrazed locations (study completed with established exclosures and photo points over time). Management solutions are still being evaluated, but it appears that grazing is not a factor affecting the movement of this species. As perennial grasses decrease and annual forbs begin to dominate a site, the niche for Halogeton to take over increases. Although chemical control is an option, success and longevity of this type of treatment is still being reviewed in this site specific situation. It is not seen as a stable state that cannot be transitioned out of without significant inputs; however it is a community that is of significant management impacts and is a concern for livestock on the landscape, especially sheep operations. Currently only small isolated areas of this site have been identified on the landscape and no production data has been collected at this time. Halogeton is known to have a wide swing of productivity based on the time and timing of precipitation for the year. This plant community is resistant to change. Plant diversity is poor, and vigor is diminished. Replacement capabilities are significantly reduced due to the loss of cool-season grasses. Soil erosion is generally reduced in response to the litter accumulation; however, the annual nature of this plant accentuates the water flow patterns. Infiltration is reduced and runoff is increased with the loss of perennial vegetation and root depth and density.

Figure 27. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	25	45	5	0	0	10	5	5	0

Pathway CP4.1-4.2
Community 4.1 to 4.2



Saltbush / Annuals (Invaders) / Perennial Grasses

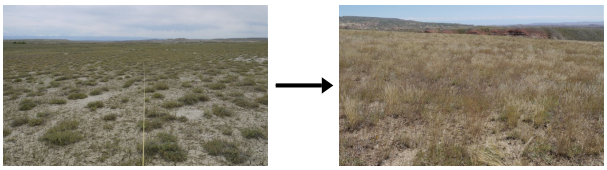
Saltbush / Annuals (Invaders)

No Use, Severe or Frequent Grazing, Drought, Disturbance – After crossing the threshold into an invaded state, the community will continue to degrade if disturbances (or over-use) are repetitive or persist. Drought and non-use can leave soils dispersed, disturbed, and susceptible to further loss of perennial grasses. Once an invasive species has gained a niche within a community and is able to begin to propagate, the transition from the initial phase in this state to a more degraded phase may happen quickly, especially if there are multiple factors working to remove or weaken the perennial grasses.

Pathway CP4.1-4.3
Community 4.1 to 4.3

No Use, Severe and Frequent Grazing with Drought or major disturbance – As mentioned above, once a community has transitioned into an invaded state it is at-risk of deteriorating quickly. The severity of the disturbance will exacerbate the situation even more. In cases where the disturbance or use removes the native vegetation, including the saltbush, the site will become a monoculture of Halogeton or at least dominated by the invasive species that was introduced to the site.

Pathway CP4.2-4.1
Community 4.2 to 4.1



Saltbush / Annuals (Invaders)

Saltbush / Annuals (Invaders) / Perennial Grasses

Integrated Pest Management with Prescribed Grazing – The native grasses displaced by invasive species will persist in remnant populations within the crowns of the Saltbush or scattered in small pockets on the landscape. If a site is addressed in the preliminary stages of the phase transition, there is a higher likelihood that integrated pest management (weed control) and grazing management will encourage the perennial grasses to increase or persist on the landscape. But as the site continues to degrade or transition to an invasive dominated community, the ability to recover becomes more and more minimal. Halogeton maintains a more desirable community for grasses to persist. Where Cheatgrass and knapweeds tend to overpower and remove or inhibit the perennial grasses from the system, making recovery more difficult without major inputs.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting

Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Grazing Management Plan - Applied

Pathway CP4.2-4.3
Community 4.2 to 4.3

No Use, Severe or Frequent Grazing, Drought with Disturbance – Photo point studies of Halogeton infested communities over a period of years have shown that continued season or year-long grazing pressure, or in areas with extended drought and development disturbance, transitions to a Halogeton dominated community with only a few random annual weedy species in the interspaces. The photo point studies also showed that non-use (exclosures) allowed the transition to continue, and was expedited by drought.

Pathway CP4.3-4.1
Community 4.3 to 4.1

Long-term Prescribed Grazing with Integrated Pest Management – Considering the above research, given significant rest, perennial species are expected to return to a community if there is a remnant population or seed bank. The time required and the degree of degradation may render this an infeasible pathway. Exclosure studies have shown that a small population of natives will persist and will increase given time. But the success on achieving a sustainable population to support grazing is not known at this time.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Tree/Shrub Establishment
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Livestock Use Area Protection
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Grazing Management Plan - Applied

Pathway CP4.3-4.2
Community 4.3 to 4.2

Integrated Pest Management with Prescribed Grazing - Research completed on communities in Southern Wyoming has shown that when inventories are taken saltbush generally does not register as being present on the site; however, as the Halogeton is suppressed with chemical control, the saltbush will begin to appear on the landscape.

It generally is not thought to be possible to completely remove Halogeton, or other invasive species, from an area. But they can be managed at a level to allow saltbush to persist.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Tree/Shrub Establishment
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Livestock Use Area Protection
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Grazing Management Plan - Applied

State 5
Degraded

Mining/energy development, borrow/gravel pits, farming/irrigation, and roads are only a few of the land uses that have had an impact on this site. Much of the land correlated as Saline Upland is deemed unfit or non-productive, and either no attempt was made to reclaim areas or reseeding attempts have failed. As this land recovers, is restored or reclaimed, or further disturbances occur, the site potential and stability is greatly affected. Historic attempts to improve productivity of these areas has altered the resilience and response to management/natural disturbance regimes. Specific references will be discussed below.

Community 5.1
Disturbed Lands

Figure 28. Contour Furrows completed in the late 1960s by BLM

Degraded or disturbed lands are locations that have been impacted by human settlement and land use advancement. Many areas within the Big Horn Basin were farmed during settlement periods, but as water and times became difficult many farmed areas were abandoned. In more currant times, there were attempts made to expand irrigated fields to incorporate sprinkler irrigation or other irrigation techniques but soon realized the difficulties and low productivity of salt-affected areas. The expanded zone was then abandoned and left to natural processes or seeded them to an inexpensive, generic, seed mix. Rangeland improvement projects were completed in the late

1950’s and early 1960’s by the Bureau of Land Management in conjunction with University of Wyoming. Through this, sections of these barren landscapes were contour furrowed and seeded with pre-dominantly Crested Wheatgrass (Agropyron Cristatum) and Russian Wildrye (*Psathyrostachys juncea*). The furrows were created to increase water holding capacity, improving vigor and production of Nuttall’s (Garner’s) Saltbush, and assisted in seeding establishment. It was hypothesized that increased productivity would last for at least 20 years past 1972. In 2014 and 2015 a few of these locations were visited across the Big Horn Basin to find only very remnant populations of Crested Wheatgrass existing, however, the furrows were still visible to the eye. An exclosure comparison of this treatment exhibited significant persistence of seeded species and the presence of native species as well. Productivity of Gardner’s saltbush and Sandberg bluegrass was markedly higher than expected, but this was true of untreated locations as well. Because these areas were mechanically altered with lasting affects to hydrology, in conjunction with a seeding of an introduced species, even though introduced species did not persist in all locations, these locations are marked as disturbed lands to capture the altered functionality when compared to the reference functionality group. Given more time the furrows may completely disappear from the visual view and the benefits of such furrows will be decreased, but the argument is made that these communities will not respond the same as an unaltered, native community. Similarly, with lands that were farmed/irrigated and then left to return to a natural state of vegetation will never respond the same as a reference community. Persistence of an introduced, non-native species is a very indicative trait that will assist in identifying this community. These non-native species are not invasive, although they may be persistent and aggressive. Crested Wheatgrass, Russian Wildrye, and Big Bluegrass are a few cultivar species that have been planted that have persisted on the landscape, altering the community. The act of seedbed preparation alone, without consideration of the original disturbance, can be seen as an alteration to the soil function. The restored/reclaimed lands community phase is very similar to this concept; however, in the term restored/reclaimed the inference is “to a native or natural state pre-disturbance”. With the use of introduced or improved cultivars, the site is not similar to pre-disturbance. Productivity of these sites varies greatly dependent on the disturbance, age and successional stage of recovery, and if or what species were seeded. Due to the lack of current and comparative production data, no production estimate is provided. The growth curve will depend on the species seeded, or the succession completed. So no growth curve will be given.

Community 5.2
Restored / Reclaimed Lands

When restoring a site (returning disturbed lands to a former, original, normal or unimpaired condition) or reclaiming a site (restoring to a pre-determined level of productivity or usefulness similar to pre-disturbance) within the Big Horn Basin, climatic limitations are the most limiting factor of success. However, the sodicity/salinity/alkalinity of the Saline Upland sites also causes further complication and limitation of available species. Research has been completed by Plant Material Centers and Universities, improving the seedling establishment of Gardner’s Saltbush and developing newer cultivars of key species. Review of disturbed areas, showed very low or non-existent success in reclamation. Every site that was found had a high rate of annuals and only trace amounts of desired grasses and forbs. Saltbush establishment was found to be very low, but the rate of desired and planted was unknown. Production and the growth curve factors are dependent on the seeding mixtures selected and the level of establishment achieved. As with the disturbed lands, these sites are highly vulnerable to erosion and invasion by annuals or other undesirable species.

Pathway CP5.1-5.2
Community 5.1 to 5.2

Grazing Land Mechanical Treatment and/or Rangeland Seeding with Prescribed Grazing – Degraded communities may be at various levels of succession or ground condition. To have the desired seedbed, most areas will require site preparation (disking, plowing, harrowing, etc.) to seed a large area. In some instances, contour furrow plantings similar to those completed in the 1960s by the BLM, may be a preferred practice. No matter whether the area has a grazing land mechanical treatment or is seeded to natives (or selected seed mix), once the seed has a chance to establish, prescribed grazing is necessary to maintain the established plant community.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting

Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Livestock Use Area Protection
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Grazing Management Plan - Applied

Pathway CP5.2-5.1
Community 5.2 to 5.1

No Use, Drought, Disturbances, Severe and Frequent Grazing – After initiation of the reclamation process, establishment of seed mixture or recovery of vegetation is affected by land use and environmental factors. Further/continued disturbances or use before fully established will quickly degrade the community. Non-use for extended periods of time after establishment has led to some species becoming decadent, causing reduced vigor and potentially leading to die off.

Transition T1-2
State 1 to 2

Drought, Frequent or Severe Grazing – Extended periods of drought have the ability to weaken the resilience or push plant species to their maximum resilience level, forcing the community over the threshold into the next state. Drought with added stresses of frequent or severe grazing can expedite the process, or frequent and severe grazing can remove the key species leaving the site dominated by the less desirable herbaceous species. Any combination of these factors will reduce or remove the key bunchgrasses (Indian Ricegrass and Bottlebrush Squirreltail), and leave a Sandberg bluegrass or Blue grama dominated site.

Transition T1-3
State 1 to 3

Frequent and Severe Grazing, Severe Ground Disturbance, Drought - The combination of frequent and severe grazing and drought reduces the key bunchgrasses of this community. With no protection or defense, the forbs and grasses may become very sparse or may be removed from the community leaving a saltbush dominated location. Extended long periods of drought alone, or severe ground disturbance, will remove or inhibit the sustainability of this community, including Gardner's saltbush.

Transition T1-4
State 1 to 4

Frequent and Severe Grazing, No Use, Drought, Ground Disturbance with Seed Source – Halogeton, Cheatgrass (Downy Brome), and many of the invasive weeds that are present in the Big Horn Basin are drought tolerant and able to tolerate the least desirable soils and growing conditions. The barren, open canopy that is typical with Saline Upland is a prime target for these invaders. Given any level of disturbance, whether it is from heavy and frequent grazing use, drought or other ground disturbances, if there is a seed source present, these invaders will find a niche and establish themselves. The nature of these salt affected soils to become dispersed, especially in the absence of hoof action or traffic to compact the soils to some degree, allows for a loose and inviting seedbed. An open seedbed and a seed source for any variety of invasive species quickly transitions the reference community into an invaded state.

Restoration pathway R2-1
State 2 to 1

Long-term Prescribed Grazing – Trials completed successfully on BLM lands in the 1960s have shown the ability to manipulate salt-influenced sod communities. Given time and favorable conditions, Indian ricegrass and Bottlebrush squirreltail were seen to re-establish themselves, when seed sources were within the area. These factors provide the ability for the Saltbush/Perennial Grasses state to transition back to the Saltbush/Bunchgrass state (Reference). This transition may take a substantial amount of time, but it is able to recover with only minor inputs and increased management.

Conservation practices

Integrated Pest Management (IPM)
Prescribed Grazing
Grazing Management Plan - Applied

Transition T2-3
State 2 to 3

Frequent and Severe Grazing, Severe Ground Disturbance, Drought – Further stress opens the transition from the Saltbush/Perennial grasses to a Saltbush/*Bare Ground* dominated community (State 3). Reduced function of the perennial herbaceous species and decreased diversity weakens the resilience to changing conditions within the community. As grazing intensity remains high, drought is extensive, or if a source of ground disturbance occurs, the native perennial grasses cannot maintain a foothold in the community forcing the community across the threshold to a Saltbush/*Bare Ground* state.

Transition T2-4
State 2 to 4

No Use, Ground Disturbance (with presence of seed source), Drought, Frequent or Severe Grazing – The vulnerability of transitioning from the Saltbush/Perennial Grasses state to an invaded state is increased as the canopy is opened with further disturbance, drought or grazing use. No use of a community opens the possibility of the soils becoming loose (fluffy), open to seedling establishment, but highly erosive.

Restoration pathway R3-2
State 3 to 2

Prescribed Grazing (Long-term), Grazing Land Mechanical Treatment (possibly with seeding) – As referenced above, seeding success is minimal within the conditions of the Big Horn Basin as well as the limitations of salt-affected soils. With prescribed grazing and remnant seed sources available, this State has the potential to recover; however, the time required may not be feasible. Native seed mixtures that have been proven to tolerate saline, sodic, or saline/sodic soils are not necessarily the key species for the Reference communities. These locations have the potential to maintain perennial herbaceous vegetation and to function in State 2 – Saltbush and Perennial Grasses. Poa Secunda (Sandberg/Big bluegrass) and Western wheatgrass are a few of the species that may be a viable selection for seeding back to these locations. If a site is seeded (drilled or broadcast seeding), the response to management and climatic conditions may be altered.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Prescribed Grazing
Grazing Management Plan - Applied

Transition T3-4
State 3 to 4

No Use, Ground Disturbance (with seed source present), Drought, Frequent or Severe Grazing – Once a community has transitioned to a saltbush dominated community, productivity and functionality of the site are at risk. If further disturbance (livestock/wildlife, human or environmental disturbance) saltbush will begin to decrease and annuals and other less desirable species will begin to dominate. Hydrologic function will decrease and erosional hazard will increase as a community is transitioned into an invaded state.

Transition T3-5
State 3 to 5

No Use, Drought, Disturbance, or Frequent and Severe Use – Following or with continued disturbance the perennial grasses will be slow to recover or may not be able to recover, leaving a saltbush dominated community. Density or frequency of saltbush will be reduced. Drought or frequent and severe use can also work to remove the herbaceous component from a disturbed/reclaimed community. No use, and the tendency for these soils to become loose will reduce the ability for many plants to persist, removing most herbaceous species. Saltbush will maintain a community in these soils, but may become less productive.

Restoration pathway R3-5
State 3 to 5

Grazing Land Mechanical Treatment or Rangeland Seeding with Prescribed Grazing - The large scale success of contour furrowing on the rangelands with a mixture of crested wheatgrass and other introduced/cultivated species has shown that this landscape can be restored to a functional state using improved varieties and selective grazing land mechanical treatments. Once established the site will need to be managed for the species selected to ensure proper use of the resource. Once the site is disturbed there is a risk of erosion until establishment of the seedlings can occur. Management of undesired species (noxious or invasive weed species) is an integral component of the reclamation process to ensure the community is restored to an acceptable condition.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Native Plant Community Restoration and Management
Prescribed Grazing
Grazing Management Plan - Applied

Restoration pathway R4-5
State 4 to 5

Integrated Pest Management, Grazing Land Mechanical Treatment, or Rangeland Seeding with Prescribed Grazing – Once invasive species such as Cheatgrass, Halogeton, or knapweeds are established, eradication is not a feasible option and restoration to a prior State is not possible. An invaded site, however, can be restored to a functional plant community through intensive or integrated pest management. Grazing land mechanical treatments to reduce existing populations and to introduce forage species that are desirable and able to compete with the invasive species will restore grazing. When a community has been significantly invaded, losing all of the key grazing species, re-seeding the site to a competitive species may be the only option. Establishment will be slow and the variety of available seed sources for salty soil conditions is minimal but, small scale projects have been achieved

with marginal success.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Livestock Use Area Protection
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Agrichemical Handling Facility
Grazing Management Plan - Applied

Transition T5-3
State 5 to 3

No Use, Drought, Disturbance, or Frequent and Severe Use – Following or with continued disturbance the perennial grasses will be slow to recover or may not be able to recover, leaving a saltbush dominated community. Density or frequency of saltbush will be reduced. Drought or frequent and severe use can also work to remove the herbaceous component from a disturbed/reclaimed community. No use, and the tendency for these soils to become loose will reduce the ability for many plants to persist, removing most herbaceous species. Saltbush will maintain a community in these soils, but may become less productive.

Transition T5-4
State 5 to 4

No Use, Disturbance, Severe and Frequent Grazing, Drought with a seed Source Present – Loose soils as a result of non-use or the decrease in key species due to severe and frequent grazing, drought or disturbance opens the canopy and provides opportunity for invasive species to establish. Continued pressure, added disturbances, or introduction of undesirable species will weaken and trigger a shift from the degraded state to an Invaded state.

Additional community tables

Table 20. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				73–151	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	73–151	15–30
2				56–140	
	squirreltail	ELEL5	*Elymus elymoides*	56–140	2–10
3				20–39	
	western wheatgrass	PASM	*Pascopyrum smithii*	20–39	–
4				0–28	
	Sandberg bluegrass	POSE	*Poa secunda*	0–28	0–5
5				0–22	
	Grass, perennial	2GP	*Grass, perennial*	0–22	0–5
Forb					
6				1–50	
	milkvetch	ASTRA	*Astragalus*	0–28	0–5
	salsify	TRPO	*Tragopogon porrifolius*	0–28	0–5
	woodyaster	XYLOR	*Xylorhiza*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–22	0–5
	textile onion	ALTE	*Allium textile*	0–22	0–5
Shrub/Vine					
7				78–168	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	78–168	10–30
8				0–56	
	bud sagebrush	PICRO	*Picrothamnus*	0–56	0–5
9				0–56	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	0–5
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–28	0–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–28	0–5
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–28	0–5

Table 21. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				22–90	
	squirreltail	ELEL5	*Elymus elymoides*	22–90	5–35
2	**Miscellaneous Grasses**			6–34	
	Sandberg bluegrass	POSE	*Poa secunda*	6–34	2–10
	Grass, perennial	2GP	*Grass, perennial*	0–11	0–5
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	1–11	1–5
	blue grama	BOGR2	*Bouteloua gracilis*	1–11	1–5
Forb					
3				3–39	
	plains pricklypear	OPPO	*Opuntia polyacantha*	1–22	1–5
	textile onion	ALTE	*Allium textile*	0–11	0–5
	aster	ASTER	*Aster*	0–6	0–2
	desertparsley	LOMAT	*Lomatium*	0–6	0–2
	tansyaster	MACHA	*Machaeranthera*	0–6	0–2
	tenpetal blazingstar	MEDE2	*Mentzelia decapetala*	0–6	0–2
	Forb, perennial	2FP	*Forb, perennial*	0–6	0–2
4	**Annual Forbs**			0–78	
	flatspine stickseed	LAOC3	*Lappula occidentalis*	1–78	0–5
	threadleaf phacelia	PHLI	*Phacelia linearis*	0–6	0–2
	madwort	ALYSS	*Alyssum*	0–6	0–2
Shrub/Vine					
5				78–135	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	78–135	5–20
6	**Miscellaneous Shrubs**			0–112	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–112	0–10
	bud sagebrush	PIDE4	*Picrothamnus desertorum*	0–56	0–5
	Shrub, other	2S	*Shrub, other*	0–11	0–5
	shortspine horsebrush	TESP2	*Tetradymia spinosa*	0–11	0–1
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–6	0–2

Table 22. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				0–168	
	Sandberg bluegrass	POSE	*Poa secunda*	0–56	0–30
2				0–6	
	blue grama	BOGR2	*Bouteloua gracilis*	0–22	0–5
3	**Miscellaneous Grasses**			0–28	
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–112	0–2
	mustard	BRASS2	*Brassica*	0–56	0–2
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–11	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–11	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–11	0–5
	threadleaf phacelia	PHLI	*Phacelia linearis*	0–11	0–2
	woolly plantain	PLPA2	*Plantago patagonica*	0–6	0–2
	western wheatgrass	PASM	*Pascopyrum smithii*	0–6	0–2
	Grass, perennial	2GP	*Grass, perennial*	0–6	0–2
Forb					
3	**Annual Forbs**			0–112	
	plains pricklypear	OPPO	*Opuntia polyacantha*	1–39	0–5
	desertparsley	LOMAT	*Lomatium*	0–22	0–5
	textile onion	ALTE	*Allium textile*	0–6	0–2
4				1–39	
	aster	ASTER	*Aster*	0–6	0–2
	tansyaster	MACHA	*Machaeranthera*	0–6	0–2
	woodyaster	XYLOR	*Xylorhiza*	0–6	0–2
	tenpetal blazingstar	MEDE2	*Mentzelia decapetala*	0–6	0–1
5	**Miscellaneous Forbs**			0–17	
Shrub/Vine					
7				78–560	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	78–560	5–20
8	**Miscellaneous Shrubs**			0–112	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–112	0–10
	bud sagebrush	PIDE4	*Picrothamnus desertorum*	0–78	0–5
	shortspine horsebrush	TESP2	*Tetradymia spinosa*	0–11	0–2
	Shrub, other	2S	*Shrub, other*	0–11	0–2
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–6	0–2

Table 23. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				34–112	
	blue grama	BOGR2	*Bouteloua gracilis*	34–112	10–40
2				0–22	
	squirreltail	ELEL5	*Elymus elymoides*	0–11	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–11	0–5
3	**Miscellaneous Grasses**			0–6	
	Grass, perennial	2GP	*Grass, perennial*	0–6	0–1
Forb					
4				0–28	
	textile onion	ALTE	*Allium textile*	0–6	0–1
	desertparsley	LOMAT	*Lomatium*	0–6	0–1
	tansyaster	MACHA	*Machaeranthera*	0–6	0–1
5	**Miscellaneous Forbs**			0–6	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–11	0–5
	woodyaster	XYLOR	*Xylorhiza*	0–6	0–2
	Forb, perennial	2FP	*Forb, perennial*	0–6	0–1
6	**Annual Forbs**			0–6	
	Forb, annual	2FA	*Forb, annual*	0–6	0–1
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–6	0–1
	threadleaf phacelia	PHLI	*Phacelia linearis*	0–6	0–1
Shrub/Vine					
7				45–196	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	45–196	5–15
8	**Miscellaneous Shrubs**			0–56	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–56	0–10
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–11	0–5
	bud sagebrush	PIDE4	*Picrothamnus desertorum*	0–11	0–5
	Shrub, other	2S	*Shrub, other*	0–11	0–5
	shortspine horsebrush	TESP2	*Tetradymia spinosa*	0–6	0–1

Table 24. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				0–6	
	squirreltail	ELEL5	*Elymus elymoides*	0–6	0–2
	western wheatgrass	PASM	*Pascopyrum smithii*	0–6	0–1
	alkali sacaton	SPAI	*Sporobolus airoides*	0–6	0–1
2	**Miscellaneous Grasses**			0–6	
	Grass, perennial	2GP	*Grass, perennial*	0–6	0–2
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–6	0–2
	blue grama	BOGR2	*Bouteloua gracilis*	0–6	0–2
	Sandberg bluegrass	POSE	*Poa secunda*	0–6	0–1
Forb					
3	**Perennial Forbs**			0–56	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–39	0–3
	Forb, perennial	2FP	*Forb, perennial*	0–11	0–2
	textile onion	ALTE	*Allium textile*	0–6	0–2
	woodyaster	XYLOR	*Xylorhiza*	0–6	0–2
	tansyaster	MACHA	*Machaeranthera*	0–6	0–2
	desertparsley	LOMAT	*Lomatium*	0–6	0–1
	aster	ASTER	*Aster*	0–2	0–1
4	**Annual Forbs**			0–34	
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–112	0–5
	woolly plantain	PLPA2	*Plantago patagonica*	0–11	0–2
	threadleaf phacelia	PHLI	*Phacelia linearis*	0–6	0–2
	Forb, annual	2FA	*Forb, annual*	0–6	0–2
	mustard	BRASS2	*Brassica*	0–6	0–2
Shrub/Vine					
5				78–448	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	78–448	0–20
6	**Miscellaneous Shrubs**			0–140	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–112	0–10
	bud sagebrush	PIDE4	*Picrothamnus desertorum*	0–56	0–5
	Shrub, other	2S	*Shrub, other*	0–11	0–2
	shortspine horsebrush	TESP2	*Tetradymia spinosa*	0–6	0–2
	seepweed	SUAED	*Suaeda*	0–2	0–1

Animal community

Animal Community – Wildlife Interpretations

1.1 - Saltbush/Bunchgrasses: The predominance of woody plants in this plant community provides winter grazing for mixed feeders, such as elk, and antelope. Suitable thermal and escape cover for these animals are limited due to the low quantities of tall woody plants. When found adjacent to sagebrush-dominated states, this plant community may provide lek sites for sage grouse. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles. Some grassland obligate small mammals would occur here.

1.2 - Saltbush/Squirreltail: The combination of shrubs, grasses, and forbs can provide a forage source for large grazers, such as wild horses, deer and antelope. Suitable thermal and escape cover for these animals is limited due to the low quantities of tall woody plants. When found adjacent to sagebrush communities, this plant community may provide lek sites for sage grouse. Other birds that would frequent this plant community include western meadowlarks, horned larks and golden eagles. Some grassland obligate small mammals would occur here.

2.1 - Saltbush/Bluegrass: Decreased diversity and change in phenology of grasses and forbs reduces the value for the large grazers, but still has a forage source for them. Thermal and escape cover suitable for large animals is still very limited due to the low quantities of tall woody plants. Areas with sagebrush communities adjacent to this plant community may provide lek sites for sage grouse, and in productive years provides better cover for birds and some of the grassland obligate small mammals.

2.2 - Saltbush/Sod-formers: Forage value for large grazers has shifted to provide a late spring early summer source of green forage, although less accessible due to low growth stature. Cover is essentially non-existent, but when adjacent to sagebrush-dominated states, this plant community provides lek sites for sage grouse.

3.1 - Saltbush/*Bare Ground*: This Plant community exhibits a low level of plant species diversity. It may have forage value for antelope and deer, but in most cases is not a desirable plant community due to the lack of cover and selectivity by the wildlife. It is not, for most cases, a desirable plant community to select for in wildlife habitat management. Due to the open and exposed nature of this community, it may be a location for sage grouse leks, if there is edge effect provided by a sagebrush site surrounding the saltbush community.

4.1 - Saltbush/Annuals/Perennial Grasses: The unpalatable nature of many of the invasive species would reduce the value of this plant community for large grazers; however, species dependent, there would still be forage available. Suitable thermal and escape cover is very limited and highly variable. Seeds from invasive species would serve as a forage source for sage grouse and other birds as well as small mammals.

4.2 - Saltbush/Annuals: This plant community exhibits a low level of plant species diversity. It is not a desirable plant community to select as a wildlife habitat management objective. However, seeds produced by many of the invasive species serve as a forage source for sage grouse and other birds as well as grassland obligate small mammals. Knapweeds provide good cover for small mammals and birds as well.

4.3 - Halogeton: This plant community exhibits a low level of plant species diversity. It is not a desirable plant community to select as a wildlife habitat management objective. No known benefit to wildlife is known.

5.1 - Disturbed/Restored/Reclaimed: Depending on the stage of succession, or selected seed mixture, locations may vary widely on value for wildlife habitat management.

Animal Community – Grazing Interpretations

The following table lists suggested stocking rates for cattle under continuous season-long grazing under 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 pant 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
Plant Community Description/Title Lbs./Acre AUM/Acre*
Below Ave. Normal Above Ave.
1.1 Reference: Saltbush / Bunchgrasses 190 370 635 0.10
1.2 Saltbush / Squirreltail 100 235 385 0.06
2.1 Saltbush / Bluegrass 90 220 775 0.06
2.2 Saltbush / Blue Grama 65 220 400 0.03
3.1 Saltbush / *Bare Ground* 75 145 515 0.05
4.1 Saltbush / Annuals / Perennial Grasses ** ** ** **

4.2 Saltbush / Annuals ** ** ** **
4.3 Halogeton ** ** ** **
5.1 Disturbed/Degraded ** ** ** **
5.2 Restored/Reclaimed ** ** ** **

* - Continuous, Season-long grazing by cattle under average growing conditions.
** - Production and Carrying Capacity is dependent on the species mixture that is present and the stage of succession that each community is at. Site specific investigation is necessary due to the highly variable composition.

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

Hydrological functions

Water and salinity are the principal factors limiting forage production on this site. Soils in the hydrologic group B and C dominate this site, with localized areas of hydrologic group D. Infiltration ranges from slow to moderate. 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 an 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 may be present. Cryptogamic crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

This site provides marginal hunting opportunities for upland game species. Because of the raw nature of these sites, cultural artifacts can be found or viewed in the area of these sites especially along the drainages that dissect the area. The extent of this ecological site is found within three different wild horse ranges: Pryor Mountain, McCullough Peaks, and 15 Mile. Wild Horse/Wildlife Excursions are found as recreational venues for BLM lands and State Lands within the Big Horn Basin. This ecological site, however, proves to be limited in association with roadways and trails in relation to erosion potential and functionality. The soils will be sticky or slick when wet and are more erosive than other associated ecological sites. Need to take these soils into consideration when crossing the area with trails or roadways. The site is generally rough as well and provides no soft cover for camping or resting.

Wood products

No appreciable wood products are present on the site.

Other products

Herbs: There are a select few forb species that are found on this site, that have medicinal characteristics and have ben used by the Native Americans in this area, and currently are in use by the naturopathic profession.

Ornamentals Species: The flowering forbs of this site have been found useful in landscaping and xeriscaping. The shrub component has cultivated species that have been used in conservation plantings and in more natural landscaping schemes.

Inventory data references

Information presented here has been derived from NRCS inventory data, Field observations from range trained personnel, and the existing range site descriptions. Those involved in developing the Loamy range site include:

Chris Krassin, Range Management Specialist, NRCS and Everet Bainter, Range Management Specialist. Those involved in the development of the Saline Upland Loamy ecological site include: Ray Gullion, Area Range Management Specialist, NRCS; Jim Wolf, Resource Manager, USDI-BLM; Jack Mononi, Range Management Specialist, USDI-BLM; Daniel Wood, MLRA Soil Survey Leader, NRCS; Jane Karinen, Soil Data Quality Specialist, NRCS; and Marji Patz, Ecological Site Specialist, NRCS.

Data references were taken from the following publication:
H.G. Fisser, D.C. Trueblood, and D.D. Samuelson. 1979. "Soil-Vegetation Relationships on Rangeland Exclosures in the Grass Creek Planning Unit of North Central Wyoming". University of Wyoming Cooperative Research Report to the Bureau of Land Management. 280 pp.

Type locality

Location 1: Big Horn County, WY	
Township/Range/Section	T57N R95W S19
UTM zone	N
UTM northing	4976655
UTM easting	707683
Latitude	44° 54′ 46″
Longitude	108° 22′ 8″
General legal description	46m south, 192m east of NW corner. Travel E from Lovell, WY on 14A 2.8 mi, turn N on hwy 37, travel 1.7 mi, turn W on County Rd. 9.5, travel 1.4 miles, turning N on bentonite haul road travel 3.8 mi, Site is on W side of road 220 meters.

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Approval

Scott Woodall, 2/22/2019

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
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Date	12/19/2014
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be present.

2. **Presence of water flow patterns:** Barely observable.

3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground averages between 35 and 45% in reference conditions.

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:** None

7. **Amount of litter movement (describe size and distance expected to travel):** Little to no plant litter movement should occur. Plant littler remains in place and is not moved by erosional forces.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant cover and littler average 50% or greater of the soil surface and maintains soil surface integrity. The soil

stability class is found to average 3.8 ranging from 1 to 6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The soil surface structure is fine moderate granular (moderate fine subangular or angular blocky parting to granular) with a surface depth of 2 to 7 inches (5- 15 cm). The dry surface Colors are generally in the 10YR to 7.5YR range with a Hue of 6 and a Chroma of 3. Organic matter in the surface ranges from 0.5 to 1.0.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Grass canopy and basal cover should reduce raindrop impact and slow overland flow, providing increased time for infiltration to occur. Healthy deep rooted native grasses enhance infiltration and reduce runoff. Infiltration is slow to moderate.

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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 should be present. Slight crusting may be visible, but friable and does not impede infiltration rates.

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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: Mid stature Grasses > Shrubs

    Sub-dominant: Forbs > Short stature Grasses

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Is very low.

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14. **Average percent litter cover (%) and depth (in):** Litter cover ranges from 6 to 20% with an average of 15% litter cover, reaching up to 44% including litter beneath the plants. Herbaceous litter depth typically ranges from 3-10 mm, and woody litter ranging from 2-6 mm.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The site averages 350 lbs/acre in a normal year and can vary from 95 to 530 lbs in a wet year as seen in 2014.

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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: Cottonthorn (Spiny) Horsebrush, Greasewood, Birdfoot Sagebrush, Flatspine Stickseed, Mustards, and Woolly Plantain, Annual false wheatgrass, false buffalograss are native species that increase with stress; invasive species such as, but not limited to: Halogeton, Cheatgrass (Downy Brome), thistles, knapweed, Kochia, Russian Thistle are also found on this site.

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17. **Perennial plant reproductive capability:** All species are capable of reproducing.
