Ecological site DX032X01B112
Gravelly (Gr)
Big Horn Basin Rim

Last updated: 10/04/2019
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General information

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

MLRA notes

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

Major land resource area (MLRA): 032X – 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): 32X01B (WY): This LRU is the Big Horn Basin within MLRA 32. This LRU is lower in elevation, slightly warmer and receives slightly less overall precipitation 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 B, referred to as the Rim, is a transitional band between the basin floor and the lower foothills. The subset encircles Subset A which was originally LRU A. As the LRU shifts towards the south and tracks east, changes in geology and relation to the mountain position, creates a minor shift 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. Moisture Regime: Ustic Aridic – Prior to 2012, many of the soils within this group were correlated as Frigid Ustic Aridic or as Mesic Typic Aridic, with few mapped within this cross over zone. As progressive soil survey mapping continues, these "crossover" or transitional areas are being identified and corrected. Temperature Regime: Mesic Dominant Cover: Rangeland, with Saltbush flats the dominant vegetative cover for this LRU/ESD. Representative Value (RV) Effective Precipitation: 10-14 inches (254 – 355 mm) RV Frost-Free Days: 105-125 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 & Intermountain Tall Sagebrush Shrubland & Steppe Macrogroup G302 Artemisia Tridentata - Artemisia tripartita - Purshia tridentata Big Sagebrush Steppe Group CEGL001535 - Artemisia tridentata ssp. wyomingensis/Pseudoroegneria spicata Herbaceous Vegetation or CEGL001009 - Artemisia tridentata ssp. wyomingensis/Pseudoroegneria spicata 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 receives no additional water. • Slope is 50% • Soils are: o Textures range from loamy sand to very fine sandy loam in top 4" (10 cm) of mineral soil surface o Clay content is or = 18% in top 4" (10 cm) of mineral soil surface o All subsurface horizons in the particle size control section have a weighted average of 18% clay. (The particle size control section is the segment of the profile from either the start of an argillic horizon for 50 cm's or from 25-100 cm's). o Moderately deep to very deep (20-80+ in. (50-200+ cm) o 3% stone and boulder cover and >35% cobble and gravel cover (generally around 60%) o Skeletal (?35% rock fragments) within 20" (50 cm) of mineral soil surface o Non-saline, sodic, or saline-sodic

Associated sites

R032XY366WY	**Shallow Sandy (SwSy) 10-14" East Precipitation Zone** Shallow Sandy sites are present associated with Gravelly sites where the conglomerate (gravelly sandstone) has not degraded and serves as a restrictive layer with a sandy cap, and surrounding areas that are more exposed are weathered into the gravelly site.
R032XY362WY	**Shallow Loamy (SwLy) 10-14" East Precipitation Zone** Shallow Loamy sites are associated with Gravelly sites where the conglomerate (gravelly sandstone) has not degraded and serves as a restrictive layer with a loamy cap, and surrounding areas that are more exposed and weathered.
R032XY322WY	**Loamy (Ly) 10-14" East Precipitation Zone** Loamy sites are present interior to the wind swept edges that have left the gravels exposed. Depositional areas of relict stream channels lay the finer sediments on the surface.
R032XY350WY	**Sandy (Sy) 10-14" East Precipitation Zone** Sandy sites are found lower in the landscape or in depositional areas where the gravel beds have not been exposed.

Similar sites

R032XY112WY	**Gravelly (Gr) 5-9” Big Horn Basin Precipitation Zone** Gravelly Big Horn Basin Core site will be lower in production.
R032XY212WY	**Gravelly (Gr) 5-9” Wind River Basin Precipitation Zone** Gravelly Wind River Basin Core site will be lower in production.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. wyomingensis*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Achnatherum hymenoides*

Legacy ID

R032XB112WY

Physiographic features

This site occurs on nearly level to 50% slopes.

Table 2. Representative physiographic features

Landforms	(1) Intermontane basin > Alluvial fan (2) Intermontane basin > Hill (3) Intermontane basin > Plateau
Runoff class	Negligible to high
Elevation	1,650 – 2,290 m
Slope	0 – 50 %
Aspect	Aspect is not a significant factor

Climatic features

Annual Precipitation and modeled relative effective annual precipitation ranges from 10 to 14 inches (254 – 355 mm). The normal precipitation pattern shows peaks in May and June and a secondary peak in September. This amounts to about 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 form the basin by high mountains but can occur in conjunction with an occasional thunderstorm. Growth of native cool-season plants begins about April 1st and continues to about 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/. "Clark 3NE", "Cody", "Cody 12SE", "Heart Mtn", “Powell Fld Stn", "Shell 1NE", and "Thermopolis 9NE" are the representative weather stations. The following graphs and charts are a collective sample representing the averaged normals and 30-year annual rainfall data for the selected weather stations from 1981 to 2010.

Table 3 Representative climatic features

Frost-free period (characteristic range)	90-90 days
Freeze-free period (characteristic range)	110-120 days
Precipitation total (characteristic range)	180-280 mm
Frost-free period (actual range)	80-110 days
Freeze-free period (actual range)	110-130 days
Precipitation total (actual range)	180-310 mm

Frost-free period (average)	90 days
Freeze-free period (average)	120 days
Precipitation total (average)	230 mm

- (1) THERMOPOLIS 9NE [USC00488884], Thermopolis, WY
- (2) SHELL 1NE [USC00488124], Shell, WY
- (3) CODY 12SE [USC00481850], Meeteetse, WY
- (4) CODY [USC00481840], Cody, WY
- (5) CLARK 3NE [USC00481775], Powell, WY
- (6) HEART MTN [USC00484411], Powell, WY
- (7) POWELL FLD STN [USC00487388], Powell, WY

Influencing water features

The characteristics of these upland soils have no influence from ground water (water table below 60 inches (150 cm)) and have minimal influence from surface water/overland flow. There may be isolated features that are affected by snow pack that persists longer than surrounding areas due to position on the landform (shaded/protected pockets); but overflow is not a suitable fit. No streams are classified within this ecological site.

Soil features

The soils of this site are moderately deep (greater than 20” to bedrock) to very deep, well to excessively well-drained soils that formed in alluvium or alluvium over residuum. These soils have moderately rapid or rapid permeability. The surface soil will vary from 3 to 6 inches deep. The coarser topsoil’s may be included if underlain by finer textured subsoil. The soil characteristic most influential to the plant community is the high volume of coarse fragments on the surface and in the profile, which reduces plant density and available moisture.

Major Soil Series correlated to this site include: Mcfadden, Pesmore

Table 4. Representative soil features

Parent material	(1) Alluvium – igneous, metamorphic and sedimentary rock (2) Residuum – sandstone
Surface texture	(1) Very gravelly fine sandy loam (2) Sandy loam (3) Loam (4) Very fine sandy loam
Family particle size	(1) Sandy
Drainage class	Well drained to excessively drained
Permeability class	Moderately rapid to rapid

Soil depth	50 – 150 cm
Surface fragment cover <=3"	20 – 50 %
Surface fragment cover >3"	0 – 10 %
Available water capacity (0-101.6cm)	3.56 – 12.19 cm
Calcium carbonate equivalent (0-101.6cm)	0 – 30 %
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	0 – 10
Soil reaction (1:1 water) (0-101.6cm)	7.4 – 8.4
Subsurface fragment volume <=3" (Depth not specified)	10 – 40 %
Subsurface fragment volume >3" (Depth not specified)	0 – 10 %

Ecological dynamics

Disclaimer This PROVISIONAL ecological site was developed for an extended MLRA concept where the foothills (10-14" precipitation Frigid climatic zone) was included in this site. This has created an exaggerated or elevated production value for this site description.

Potential vegetation on this site is dominated by mid cool-season perennial grasses. Other significant vegetation includes winterfat, black and big sagebrush, rubber rabbitbrush, juniper, and a variety of forbs. The expected potential composition for this site is about 75% grasses, 10% forbs and 15% woody plants. The composition and production will vary naturally due to historical use, fluctuating precipitation and fire frequency.

As this site deteriorates, species such as threadleaf sedge, blue grama, big and/or black sagebrush, and juniper will increase. Plains pricklypear and weedy annuals will invade. Mid cool season grasses such as Griffiths and bluebunch wheatgrass, Indian ricegrass, needleandthread, and rhizomatous wheatgrasses will decrease in frequency and production.

A mixture of shrubs may become dominant on some areas with an absence of fire. Wildfires are actively controlled in recent times so chemical control using herbicides has replaced the historic role of fire on this site. Recently, prescribed burning has regained some

popularity.

Due to the amount and pattern of the precipitation, the shrub component typically is not resilient once it has been removed if a healthy and vigorous stand of grass exists and is maintained. The exception to this is where the herbaceous component is severely degraded at the time of treatment, growing conditions are unfavorable after treatment, and/or recovery periods are inadequate.

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

The following is a State and Transition Model Diagram that illustrates the common plant communities (states) that can occur on the site and the transitions between these communities. The ecological processes will be discussed in more detail in the plant community narratives following the diagram.

Plant Community Narratives

Following are the narratives for each of the described plant communities. These plant communities may not represent every possibility, but they probably are the most prevalent and repeatable plant communities. The plant composition tables shown above 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. None of these 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

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1				112-179	
	Montana wheatgrass	ELAL7	*Elymus albicans*	112-179	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	112-179	–
2				22-67	
	needle and thread	HECO26	*Hesperostipa comata*	22-67	–
3				45-90	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	45-90	–
4				0-45	
	western wheatgrass	PASM	*Pascopyrum smithii*	0-45	–
5				0-45	
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0-37	–
	blue grama	BOGR2	*Bouteloua gracilis*	0-22	–
	sedge	CAREX	*Carex*	0-22	–
	squirreltail	ELEL5	*Elymus elymoides*	0-22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0-22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0-22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0-22	–
	Grass, perennial	2GP	*Grass, perennial*	0-22	–
Forb					
6				0-45	
	Forb, perennial	2FP	*Forb, perennial*	0-22	–
	Franklin's sandwort	ARFR	*Arenaria franklinii*	0-22	–

	prairie sagewort	ARFR4	*Artemisia frigida*	0-22	–
	woollypod milkvetch	ASPU9	*Astragalus purshii*	0-22	–
	wavyleaf Indian paintbrush	CAAPM	*Castilleja applegatei ssp. martinii*	0-22	–
	miner's candle	CRVI4	*Cryptantha virgata*	0-22	–
	larkspur	DELPH	*Delphinium*	0-22	–
	cutleaf daisy	ERCO4	*Erigeron compositus*	0-22	–
	fleabane	ERIGE2	*Erigeron*	0-22	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0-22	–
	nailwort	PARON	*Paronychia*	0-22	–
	fuzzytongue penstemon	PEER	*Penstemon eriantherus*	0-22	–
	waxleaf penstemon	PENI3	*Penstemon nitidus*	0-22	–
	phlox	PHLOX	*Phlox*	0-22	–
	lemon scurfpea	PSLA3	*Psoralidium lanceolatum*	0-22	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0-22	–
	thrift mock goldenweed	STARA	*Stenotus armerioides var. armerioides*	0-22	–
Shrub/Vine					
7				22-45	
	black sagebrush	ARNO4	*Artemisia nova*	22-45	–
8				0-45	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0-22	–
	big sagebrush	ARTR2	*Artemisia tridentata*	0-22	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0-22	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0-22	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0-22	–
	winterfat	KRASC	*Krascheninnikovia*	0-22	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0-22	–

Table 6. Community 2.1 plant community composition

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

Table 7. Community 3.1 plant community composition

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

Table 8. Community 4.1 plant community composition

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

Animal community

Animal Community – Wildlife Interpretations Historic Climax Plant Community: The predominance of grasses in this plant community favors grazers and mixed-feeders, such as bison, elk, and antelope. Suitable thermal and escape cover for deer may be limited due to the low quantities of woody plants. However, topographical variations could provide some escape cover. When found adjacent to sagebrush dominated states, this plant community may provide brood rearing/foraging areas for sage grouse, as well as lek sites. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles. Many grassland obligate small mammals would occur here. Perennial Grass/Mixed Shrub: These communities provide foraging for antelope and other grazers. They may be used as a foraging site by sage grouse if proximal to woody cover. Mixed Shrub/Bare Ground Plant Community: This plant community can provide important winter foraging for elk, mule deer and antelope, as sagebrush can approach 15% protein and 40-60% digestibility during that time. This community provides excellent escape and thermal cover for large ungulates, as well as nesting and brood rearing habitat for sage grouse. Threadleaf sedge and/or Blue Grama Sod/ Bare Ground: These communities provide limited grazing for antelope and other herbivores due to low production. They may be used as a foraging site by sage grouse if proximal to woody cover. 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 plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor. Plant Community Production Carrying Capacity* (lb./ac) (AUM/ac) Historic Climax Plant Community 250-600 .15 Perennial Grass/Mixed Shrub 200-450 .12 Mixed Shrub/Bare Ground 100-350 .05 Threadleaf Sedge &/or B. Grama Sod/ B.G. 35-120 .03 * - Continuous, season-long grazing by cattle under average growing conditions. Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the forage for livestock use needs to be supplemented with protein because the quality does not meet minimum livestock requirements.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B, with localized areas in hydrologic group C. Infiltration potential for this site varies from moderately rapid to rapid depending on soil hydrologic group and ground cover. Runoff varies from low to moderate. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where short-grasses form a strong sod and dominate the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information). Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Pedestals are only slightly present in association with bunchgrasses. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

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

Wood products

No appreciable wood products are present on the site.

Other products

None noted.

Inventory data references

Information presented here has been derived from NRCS inventory data. Field observations from range trained personnel were also used. Those involved in developing this site include: Chris Krassin, Range Management Specialist, NRCS and Everet Bainter, Range Management Specialist. Other sources used as references include USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, USDI and USDA Interpreting Indicators of Rangeland Health Version 3, and USDA NRCS Soil Surveys from various counties.

Approval

Scott Woodall, 10/04/2019

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)	Ray Gullion, E. Bainter
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Date	05/01/2008
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** **Rare to nonexistent. Where present, short and widely spaced.**

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

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** **Bare ground can range from 25-50%.**

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:** **Minimal to nonexistent.**

7. **Amount of litter movement (describe size and distance expected to travel):** **Herbaceous litter expected to move in moderate amounts. Large woody debris will show only slight movement down slope.**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** **Soil Stability Index ratings range from 2 (interspaces) to 5 (under plant canopy), but average values should be 2.5 or greater.**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** **Soil data is limited for this site. Described A-horizons vary from 2-11 inches (5-28 cm) with OM of .5 to 1%.**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 70-85% grasses, 15% forbs, and 0-15% shrubs. Minimal plant canopy (15-50%) and litter plus slow to moderately rapid infiltration rates result in slight to moderate runoff. Basal cover is typically less than 5% and does very little to effect runoff on this site. Surface rock fragments of 20-50% provide site stability from erosion, but decrease infiltration.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer exists, but large amounts of subsurface coarse fragments may be mistaken for a compaction layer.

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

    Dominant: mid-size, cool season bunchgrasses

    Sub-dominant: perennial forbs = shrubs

    Other: cool season rhizomatous grasses short, cool season bunchgrasses

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal decadence, typically associated with shrub component.

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14. **Average percent litter cover (%) and depth (in):** Litter ranges from 5-25% of total canopy measurement with total litter (including beneath the plant canopy) from 15-50% expected. Herbaceous litter depth is typically shallow, ranging from 2-8mm. Woody litter can be up to a couple inches (4-6 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** English: 250-600 lb/ac (425 lb/ac average); Metric: 280-672 kg/ha (476 kg/ha average).

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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:** Threadleaf sedge, blue grama, big and/or black sagebrush and juniper are common increasers. Annual weeds such as cheatgrass, mustards, kochia, and Russian thistle are common invasive species in disturbed sites.

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