USDA Natural Resources
Conservation Service

Ecological site R036XB132NM
Gravelly Hills

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General information

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

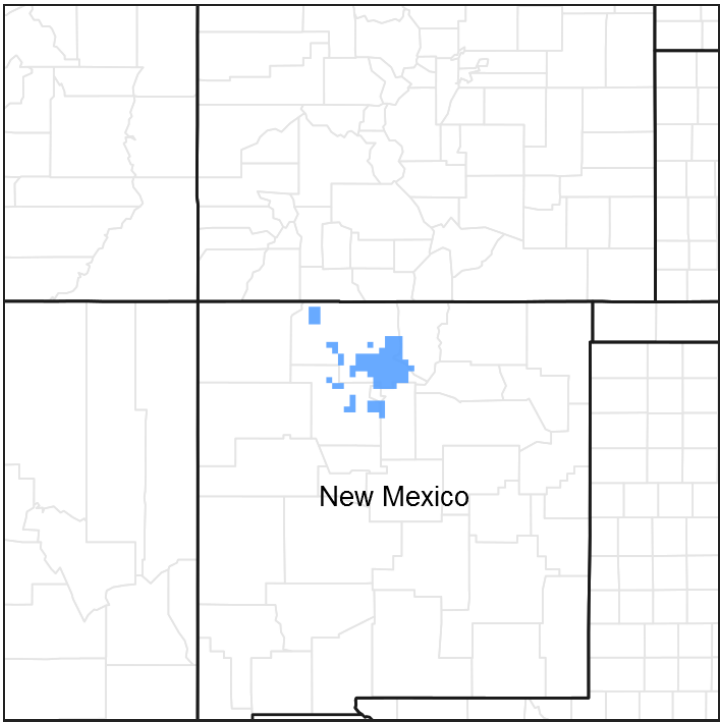

Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 036X–Southwestern Plateaus, Mesas, and Foothills

Gravelly Hills is an ecological site that is found on hills, ridges and knolls in MLRA 36 (Southwestern Plateaus Mesas and Foothills). The southern portion MLRA 36 is illustrated

yellow color on the map where this site occurs. The site concept was established in of the Gravelly Hills site is grass-dominated the Southwestern Plateaus. Mesas, and Foothills – Warm Semiarid Mesas and Plateaus LRU (Land Resource Area). This LRU has 10 to 16 inches of precipitation and has a mesic temperature regime. Lower part of MLRA 36 is dominated by summer precipitation for monsoons, unlike the upper part of MLRA 36 which is almost an equal split. The reference plant community and supports a mixture of warm- and cool-season grasses, widely spaced shrubs and trees, and a minor component of forbs.

Classification relationships

NRCS & BLM:
Major Land Resource Area 36, Southwestern Plateaus Mesas and Foothills (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS:
313Bd Chaco Basin High Desert Shrubland and 313Be San Juan Basin North subsections < 313B Navaho Canyonlands Section < 313 Colorado Plateau Semi-Desert (Cleland, et al., 2007).

315Ha Central Rio Grande Intermontane, and 315Hb North Central Rio Grande Intermontane subsections <315H Central Rio Grande Intermontane Section < 315 Southwest Plateau and Plains Dry Steppe and Shrub (Cleland, et al., 2007).

315Ad Chupadera High Plains Grassland subsections <315A Pecos Valley Section < 315 Southwest Plateau and Plains Dry Steppe and Shrub (Cleland, et al., 2007).

331Jb San Luis Hills and 331Jd Southern San Luis Grasslands subsections <331J Northern Rio Grande Basin Section < 331 Great Plains-Palouse Dry Steppe (Cleland, et al., 2007).

M313Bd Manzano Mountains Woodland subsection < Sacramento-Monzano Mountains Section < M313 Arizona-New Mexico Mountains Semi-Desert - Open Woodland - Coniferous Forest - Alpine Meadow

M331Fg Sangre de Cristo Mountains Woodland and M331Fh Sangre de Cristo Mountains Coniferous Forest subsection < M331F Southern Parks and Rocky Mountain Range Section< M331 Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

M331Gk Brazos Uplift and M331Gm Jemez and San Pedro Mountains Coniferous Forest subsections < M331G South Central Highlands Section < M331 Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

EPA:

21d Foothill Shrublands and 21f Sedimentary Mid-Elevation Forests < 21 Southern Rockies < 6.2 Western Cordillera < 6 Northwestern Forested Mountains (Griffith, 2006).

20c Semiarid Benchlands and Canyonlands < 20 Colorado Plateaus < 10.1 Cold Deserts < 10 North American Deserts (Griffith, 2006).

22m Albuquerque Basin, 22i San Juan/Chaco Tablelands and Mesas, 22h North Central New Mexico Valleys and Mesas, 22f Taos Plateau, and 22g Rio Grande Floodplain, < 22 Arizona/New Mexico Plateau < 10.1 Cold Deserts < 10 North American Deserts (Griffith, 2006).

USGS:
Colorado Plateau Province (Navajo and Datil Section)
Southern Rocky Mountains
Basin and Range (Mexican Highland and Sacramento Section)

Ecological site concept

The 36XB Gravelly Hills ecological site was drafted from the existing Gravelly Hills range site MLRA 36XB (NRCS, 2003). This site occurs on escarpments, fan piedmonts, mesas, hills, ridges and knolls. The soil surface is sandy in textures. Common soil surface textures are very gravelly sandy loam, gravelly fine sandy loam, very gravelly fine sandy loam, very cobbly loam, or gravelly loam. Soil's parent materials are slope alluvium over colluvium derived from igneous and sedimentary rock; eolian deposits over slope alluvium derived from sandstone; or alluvium, eolian material and colluvium derived from igneous and sedimentary rock. It is a grass community with Pinyon and Utah Juniper community. It has an aridic ustic/ustic arid moisture regime and mesic temperature regime. The effective precipitation ranges from 10 to 16 inches.

Associated sites

F036XA005NM	**Riverine Riparian** Riverine Riparian - Site has a water table at 12-36" Landforms are V-shaped valleys, U-shaped valleys and Overflow Stream (channel).
F036XA001NM	**Pinyon Upland** south of Gallup 13-16 - Slope 1-35%; Soils are very shallow to shallow and non-skeletal; soil surface is loam, channery loam or clay loam. Landforms are broad mesas, cuestas, and hills interspersed with numerous deep canyons and dry washes.

F036XB133NM	**Pinyon-Utah juniper/skunkbush sumac** Pinyon-Juniper/Skunkbush Sumac - Slopes are 1-65%; Soils are moderately deep to deep and skeletal and non-skeletal. Surface texture of gravelly to very gravelly sandy loam, very gravelly loam, loam, para-gravelly-ashy loamy coarse sand, and extremely cobbly coarse sandy loam with a sandy subsoil. Landform is mesas, hills, fan piedmonts, valley sides, plateaus, mountain slopes, structural benches, breaks and ridges.
R036XB002NM	**Clayey** Clayey - Slopes are 0-15%; Soils are moderately deep to deep; soil surface loam, clay loam, silty clay loam, and silty clay over clayey subsoil with textures of clay loam, clay to silty clay loam or silty clay. Landforms are stream terraces, valley floors, fan remnants, alluvial fans, dipslopes on cuestas, mesas, hills, and valley floors.
R036XB003NM	**Gravelly Fan** Gravelly Fan - Slopes 3-20%; soils are moderately deep and fine-loamy. Surface soil textures are loam. The subsoil is loamy. Landforms are hills.
R036XB005NM	**Limy** Limy - Slopes are 3-8%; soils are deep; surface is generally a silt loam and subsoil textures range from loam to silt loam. Landforms are gently alluvial fans and valley sides
R036XB006NM	**Loamy** Loamy - Slopes are 1-15%; Soils are moderately deep to deep; soil surface range from loam, gravelly loam, loamy fine sand, fine sandy loam, sandy loam, silt loam and clay loam. Subsoil is loamy and range from loam to clay loam. Landforms are mesas, plateaus, fan remnant, terraces, dipslopes on cuestas, and broad upland valley sides.
R036XB007NM	**Malpais** Malpais - Slopes 1-15%; soils are very shallow to shallow and skeletal and not skeletal; soil surface are loam, stony to very stony loam, very cobbly loam, fine sandy loam, very cobbly fine sandy loam, stony silt loam, stony silty clay loam, and cobbly silty clay loam; Parent materials are basalt influences but can have sometimes influence from sandstone and/or shale. Landforms nearly level to gently sloping mesas, lava plateaus, lava flows, lava flows on valley floors, and ridges.
R036XB008NM	**Meadow** Meadow - Water table 28-72” in depth; slopes 1-5%; soils are deep, Surface textures are silty clay loam, and clay loam with a subsoil of stratified loams, silt loams, silty clay loams, clay loams, very gravelly sand and gravelly sand. Landform is nearly level to gently sloping floodplains.
R036XB012NM	**Sandy Savanna** Sand Plains - Slopes are 1-25%; soils are deep; Surface textures are loamy sand, loamy fine sand, and sandy loam with sandy subsoil. Landforms are plateaus, mesas, upland plains.

R036XB011NM	**Sandy** Sandy - Slopes are 1-15%; soils are deep to very deep; Surface textures are loamy sand, gravelly loamy sand, loamy fine sand, fine sandy loam and sandy loam with sandy subsoil. Landforms are nearly level to gently sloping landscapes on dunes, fan remnant and alluvial fans.
R036XB014NM	**Shallow Loam** Shallow Loam - Slopes 1-25%; soils are very shallow to shallow and non-skeletal; soil surface is sandy loam to loam with a loamy subsoil from basalt and eolian materials. Landform is ridges, hills, interfluves on undulating plateaus, escarpments on cuestas, and escarpments on mesas.
R036XB015NM	**Shallow Savanna** Shallow Savanna - Slopes 1-55%; very shallow to shallow soils and non-skeletal; very cobbly loam, very cobbly sandy loam, loam, cobbly clay loam, and channery clay loam over a clayey subsoil. Bedrock can be sandstone, shale or basalt. Landforms narrow ridges, hills, breaks and mesas of bedrock controlled landscapes.
R036XB017NM	**Swale** Swale - This site is enhanced by runoff during periods of high runoff (intermittent). The water table depth is greater than 6 ft. Soils are deep to very deep soils that have surface textures of loams, silt loams to clays with loamy subsoil. Landforms are broad valley bottoms, floodplains, and in depressions.
R036XB018NM	**Stony Loam** Stony Loam - Slopes 0-15%; soils are deep to very deep and skeletal and non-skeletal; Surface soil textures are cobbly loam, or loam. Subsoils are loamy. Landforms are nearly level alluvial fans, stream terraces, plateaus, mesas and volcanic cones.
R036XB111NM	**Sandy Slopes** Sandy Slopes - Slopes are 15-40% Soils are moderately deep to deep; Surface textures are loamy fine sand, loamy very fine sand, sandy loam and loamy sand with sandy subsoil. Landforms are hills, ridges, escarpments on cuestas, and escarpments on plateaus.
R036XB138NM	**Marshy** Marshy - Water table 0-12” in depth; soils are deep; with soil textures from sandy loam to loamy sand with loamy subsoil. Landform stream and marsh on abandon channels on floodplains of valley floors with intermittent streams.
R036XY038CO	**Wet Meadow** Wet Meadow -Precipitation is 12-16”; High water table with deep gleyed soils; soil textures from loam or clay loam and subsoils are loamy textured, poorly drained. Landforms are gently sloping to flat in lowland position (draws, drainageways, swales, flood plains, flood-plain steps, and terraces).
R036XY114CO	**Mountain Pinyon** Mountain Pinyon -Precipitation is 12-16”; slopes 3 to 25%; soils are very shallow to shallow; Surface textures are fine sandy loam to loam, some gravels may be present on the surface. Subsoils are sandy clay loam, clay loam or loam that can have gravels up to 45%. Landforms are dipslopes, mountain slopes and structural benches.

R036XY289CO	**Clayey Foothills** Clayey Foothills - Precipitation is 12-16”; slopes are 1-30%; soils are moderately deep to very deep; Soils surface textures are silty clay loam or clay loam. Subsoils are clay loam, silty clay loam, silty clay and clay from marine shale. Landforms hills, alluvial fans, pediments, complex landslides, terraces, fan remnants, fans, and valleys.
R036XB009NM	**Salt Meadow** Salt Meadow - Water table 36-72” in depth; slopes are 1-5%; soils are deep, Surface textures are loam, fine sandy loam, clay loam, silty clay loam with a subsoil of clay or clay loam. Landform is nearly level to gently sloping floodplains. This site is dependent on sub-irrigation and overflow for its moist condition. This site is affected by sodium.
R036XB010NM	**Salty Bottomland** Salty Bottomland - Water table 42-72” in depth; soils are deep, high in sodium, soils are gravelly to skeletal (15-35% rock fragments). Surface textures are loam, fine sandy loam, clay loam and silty clay loam with a subsoil of clay or clay loam. Landform is floodplain.

Similar sites

R036XB003NM	**Gravelly Fan** Gravelly Fan - Slopes 3-20%; soils are moderately deep and fine-loamy. Surface soil textures are loam. The subsoil is loamy. Landforms are hills.
R036XB015NM	**Shallow Savanna** Shallow Savanna - Slopes 1-55%; very shallow to shallow soils and non-skeletal; very cobbly loam, very cobbly sandy loam, loam, cobbly clay loam, and channery clay loam over a clayey subsoil. Bedrock can be sandstone, shale or basalt. Landforms narrow ridges, hills, breaks and mesas of bedrock controlled landscapes.
R036XB016NM	**Loamy Savanna** Loamy Savanna - Slopes are 1-15%; Soils are moderately deep to deep; soil surface range from very fine sandy loam to clay loam. Subsoil is fine-textured. Landforms are nearly level to undulating plains, hills, ridges, and mesa tops, although it may occur on more rolling landscapes.

Table 1. Dominant plant species

Tree	(1) *Pinus edulis* (2) *Juniperus scopulorum*

Shrub	(1) *Artemisia bigelovii* (2) *Cercocarpus montanus*
Herbaceous	(1) *Bouteloua curtipendula* (2) *Bouteloua eriopoda*

Physiographic features

This site occurs on escarpments, fan piedmonts, mesas, hills, ridges and knolls. Slopes typically range from 10-65%, and elevations are generally 5300-7200 ft. This site occurs as moderately steep to steep gravelly hills, and ridges often dissected by natural drainages. This site may be associated with Gravelly and Loamy sites.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Escarpment (3) Fan piedmont
Flooding frequency	None to rare
Ponding frequency	None
Elevation	1,615–2,195 m
Slope	10–65%
Aspect	Aspect is not a significant factor

Climatic features

This site has a semi-arid continental climate. There are distinct seasonal temperature variations. Mean annual precipitation varies from 10 to 16 inches. The overall climate is characterized by cold dry winters in which winter moisture is less than summer. Wide yearly and seasonal fluctuations are common for this climatic zone which can range from 5 to 25 inches. Of this, approximately 25-35% falls as snow, and 65-75% falls as rain between April 1 and November 1. The growing season is April through September. As much as half or more of the annual precipitation can be expected to come during the period of July through September. August is typically the wettest month of the year. The driest period is usually from November to April; and February is normally the driest month. During July, August, and September, 4 to 6 inches of precipitation influence the presence and production of warm-season plants. Fall and spring moisture is conducive to the growth of cool-season herbaceous plants and maximum shrub growth. Growth usually begins in March and ends with plant maturity and seed dissemination when the moisture deficiency and warmer temperatures occur in early June. There is also a period of growth in the fall. Summer precipitation is characterized by brief thunderstorms, normally occurring in the afternoon and evening. Winter moisture usually occurs as snow, which seldom lies on the ground for more than a few days. The average annual total snowfall is 29.1 inches. The snow depth usually ranges from 0 to 1 inches during the winter months. The highest

snowfall record is 57.1 inches during the 1993-1994 winter. The frost- free period typically ranges from 110 to 145 days and the freeze free period is from 140 to 170 days. The last spring freeze is the middle of April to the first week of May. The first fall freeze is the middle of October to the first week of November. Mean daily annual air temperature is about 29ºF to 69ºF, averaging about 37ºF for the winter and 67ºF in the summer. The coldest winter temperature recorded was -20ºF on January 6, 1971 and the warmest winter temperature recorded was 70ºF on February 28, 1965. The coldest summer temperature recorded was 26ºF on June 1, 1980. The hottest day on record is 100ºF on July 9, 2003 and June 21, 1968. Data taken from Western Regional Climate Center (2017) for El Rito, New Mexico Climate Station.

Table 3. Representative climatic features

Frost-free period (average)	126 days
Freeze-free period (average)	145 days
Precipitation total (average)	330 mm

Climate stations used

- (1) ABIQUIU DAM [USC00290041], Gallina, NM
- (2) COCHITI DAM [USC00291982], Pena Blanca, NM
- (3) CUBA [USC00292241], Cuba, NM
- (4) SANTA FE 2 [USC00298085], Santa Fe, NM
- (5) EL RITO [USC00292820], El Rito, NM
- (6) LYBROOK [USC00295290], Dulce, NM
- (7) NAVAJO DAM [USC00296061], Navajo Dam, NM

Influencing water features

This site is not influenced by water from a wetland or stream.

Soil features

Soils are very deep in depth (60+ inches). The surface soils textures range from very gravelly sandy loam, gravelly fine sandy loam, very gravelly fine sandy loam, very cobbly loam, or gravelly loam. The surface layer texture usually has clay ranging from 12 to 22%. Depth of the top horizon ranges from 2 to 5 inches. The subsoils are loamy textured. The subsurface can be sandy clay loam, fine sandy loam, sandy loam, loam, and/or clay loam with approximately 12-30% clay. The most common parent materials are slope alluvium over colluvium derived from igneous and sedimentary rock; eolian deposits over slope alluvium derived from sandstone; or alluvium, eolian material and colluvium derived from igneous and sedimentary rock. The soil moisture and temperature regimes are ustic aridic/aridic ustic and mesic respectively. The soils are well-drained and moderately to rapidly permeable. The available water capacity ranges from low to moderate because of

the soil textures that occur on this site. Erosion is normally none to slight unless native plant cover is seriously reduced.

This ecological site has been used in the following Soil Surveys: NM650, NM672, and NM678

Typical soils assigned to this ecological site are:

Loamy-Skeletal – Espiritu

Fine-Loamy – Palacid

Course-Loamy – Florita, Parida

Table 4. Representative soil features

Surface texture	(1) Very gravelly sandy loam (2) Gravelly fine sandy loam (3) Very cobbly loam
Family particle size	(1) Sandy
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Soil depth	152 cm
Surface fragment cover <=3"	20–40%
Surface fragment cover >3"	0–25%
Available water capacity (0-101.6cm)	7.37–18.54 cm
Calcium carbonate equivalent (0-101.6cm)	0–5%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–5
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–20%
Subsurface fragment volume >3" (Depth not specified)	0–25%

Ecological dynamics

MLRA 36 occurs on the higher elevation portion of the Colorado Plateau. The Colorado Plateau is a physiographic province which exists throughout eastern Utah, western Colorado, western New Mexico and northern Arizona. It is characterized by uplifted plateaus, canyons and eroded features. The Colorado Plateau lies south of the Uintah Mountains, north of the Mogollon transition area, west of the Rocky Mountains, and east of the central Utah highlands. The higher elevation portion of the Colorado Plateau which is represented by MLRA 36 is characterize by broken topography, and lack of perennial water sources. This area has a long history of past prehistoric human use for years. MLRA 36 shows archaeological evidence indicating that pinyon-juniper woodlands where modified by prehistoric humans and not pristine and thus where altered at the time of European settlement (Cartledge & Propper, 1993). This area also included natural influences of herbivory, fire, and climate. This area rarely served as habitat for large herds of native herbivores or large frequent historic fires due to the broken topography. This site is extremely variable and plant community composition will vary with the water fluctuations on this site.

The lower part MLRA 36 developed under climatic conditions that include hot, dry summers with summer rains showers and little to no snow with the mild winter temperatures. This area has climatic fluctuations and prolonged droughts are common occurrences. Between an above average year and a drought year. Forbs are the most dynamic component of this community and can vary up to 4 fold (Passey et.al. 1982). The precipitation and climate of MLRA 36 are conducive to producing Pinyon/juniper, and sagebrush complexes with high productive sites in the bottoms of the canyons. Predominant species on the Colorado Plateau are Wyoming big sagebrush (*Artemisia tridentata* var. wyomingensis), mountain big sagebrush (*A. tridentata* var. vaseyana), and black sagebrush (*A. nova*), basin big sagebrush (*A. tridentata* var. tridentata), Utah juniper (Juniperus utahensis), one-seed juniper (*Juniperus monosperma*), and two-needle pinyon (*Pinus edulis*). One-seed juniper has the capability to discontinue active growth when moisture is limited but can resume growth when moisture availability improves. This growth pattern may represent an important adaptation allowing them to survive on very arid sites. It is possible that small trees may be killed by drought; mature one-seed junipers are resilient to drought, especially in comparison to two-needle pinyon (Johnsen, 1962).

The ability for an ecological site to carry fire depends primarily on the present fuel load and plant moisture content—sites with small fuel loads will burn more slowly and less intensely than sites with large fuel loads. Fire is an important aspect of grassland dominated ecological sites. According to the Fire Effects System literature review of one seed juniper fire intervals are historically 5-100 years on desert grassland sites and 10 to 50 years on woodland sites with juniper and pinyon (Johnson, 2002). Modeling done with LANDFIRE successional modeling for southwestern pinyon-juniper communities which includes pinyon-juniper shrubland and pinyon-juniper woodland on the Colorado Plateau. The fire return interval is 10 to 203 years (USFS, 2012). Pinyon-Juniper woodland fires were both

surface and crown fires. Periodic fire is believed to have played an important role in maintaining juniper savannas (Johnsen, 1962, Paysen, et. al., 2000) Mueggler (1976) stated that a fire-free period of 85 to 90 years was necessary for development of a mature juniper woodland. Recent decades of fire suppression have probably contributed to encroachment of juniper into grasslands (Lanner and Van Devender, 1998). Fires varied in intensity and frequency depending on the site's productivity. Fires were typically patchy, and formed mosaics on productive sites (Johnson, 2002, Gottgried, 1999, and Paysen, et.al, 2000). The time necessary for post-fire recovery of one-seed juniper has not been well documented. Data suggests that factors such as soil type and pre-burn community plant composition may influence the length of time required for recovery. Once established, one-seed juniper can bear seed as early as 10 years of age on some sites (Schott and Pieper, 1987). Shrub vegetation is able to reestablish from seed dispersal from the adjacent non burned sagebrush stands; however the process is relatively slow. Fire also decreases the extent of juniper/pinyon pine invasions, which allows the historic plant community to maintain integrity. When the plant community is burned shrubs decrease, while perennial and annual grasses increase. The perennial shrubs associated with this site are able to recover at a faster rate than the invading trees. When the site is degraded by the presence of invasive annuals, the fire return interval is shortened due to increased fuels. The shortened fire return interval is often sufficient to suppress the native plant community. Cheatgrass invaded one seed juniper stand has a fire return interval of < 10 years (Johnson, 2002).

Variability in climate, soils, aspect and complex biological processes will cause the plant communities to differ. These factors contributing to annual production variability include wildlife use, drought, and insects. Factors contributing to special variability include soil texture, depth, rock fragments, slope, aspect, and micro-topography. The species lists are representative and not a complete list of all occurring or potentially occurring species on this site. The species lists are not intended to cover the full range of conditions, species and responses of the site. The State & Transition model depicted for this site is based on available research, field observations and interpretations by experts and could change as knowledge increases. As more data is collected, some of these plant communities may be revised or removed, and new ones may be added. The following diagram does not necessarily depict all the transitions and states that this site may exhibit, but it does show some of the most common plant communities.

State and transition model

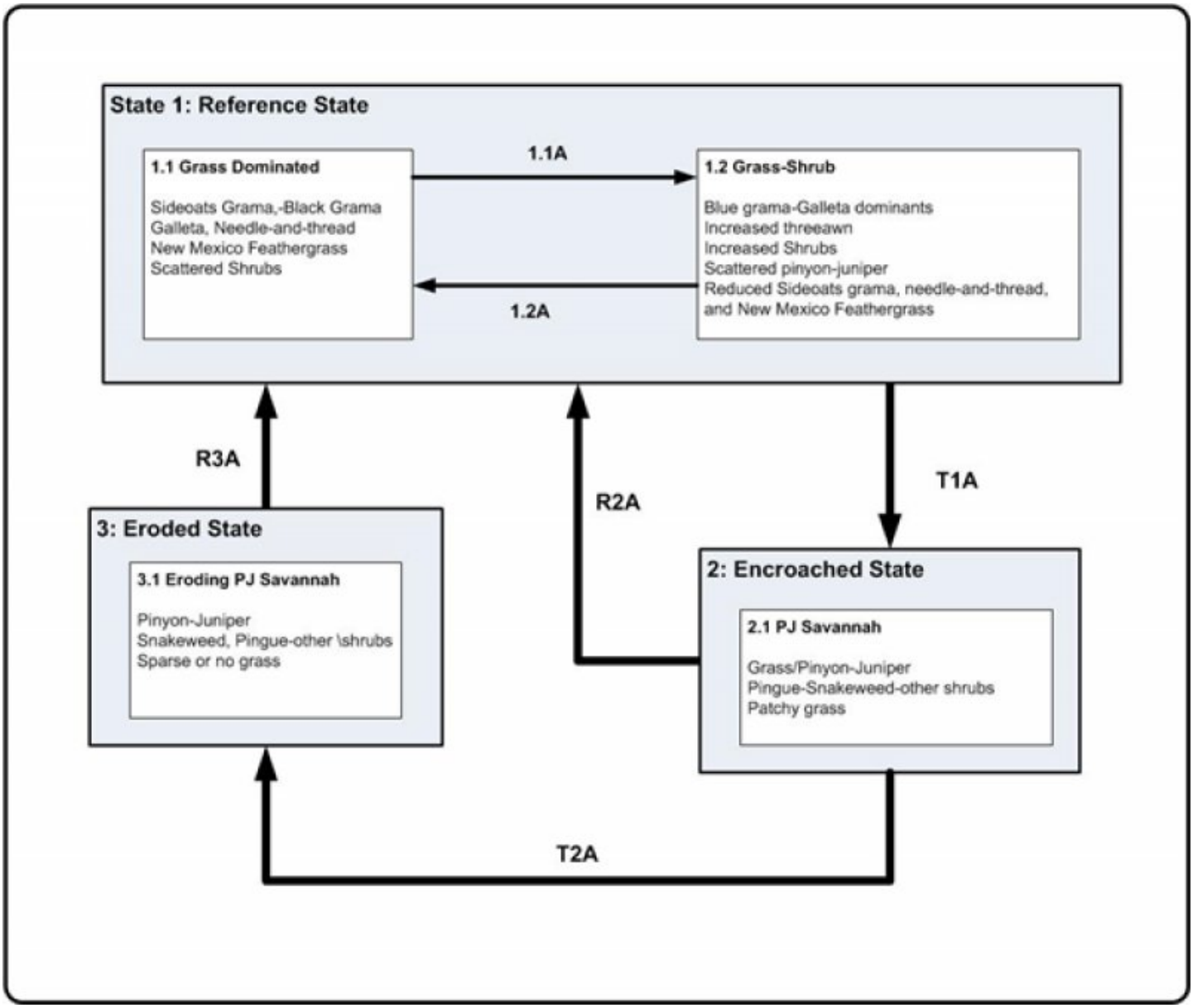

Figure 6. STM

Legend

T1A – repeated warm-season drought; low winter and spring precipitation; repeated improper grazing; fire suppression; erosion; loss of grass cover, resource competition

T2A – repeated warm-season drought; repeated improper grazing; low winter and spring precipitation; fire suppression; continued loss of grasses, erosion and loss of soil fertility

R2A – tree/brush control; fire, prescribed grazing

R3A – tree/brush control; erosion control, seeding; prescribed grazing. State 3 maybe irreverisible.

1.1A – repeated improper grazing; dry winter and/or spring; lack of fire

1.2A – dry winter and/or spring; wet climate cycle during the late spring/summer; fire

Figure 7. Legend

State 1
Reference

The reference state represents the plant communities and ecological dynamics of the Gravelly Hills ecological site. This state includes the biotic communities that become established on the ecological site under the natural disturbance regime prior to pre-European settlement. The main pathways on this site are fire and climate (drought/wet cycles). Drought is frequent on this site. The reference plant community of the Gravelly Hills site is grass-dominated and supports a mixture of warm- and cool-season grasses, widely spaced shrubs and trees, and a minor component of forbs. Sideoats grama and black grama are the dominant grass species. Common shrubs include Bigelow sagebrush, broom snakeweed, longleaf ephedra, feather dalea, and yucca. Sparse stands of pinyon-juniper (P-J) may be widely scattered across the site with 3-5% canopy cover of pinyon and juniper (P-J). The reference state is self-sustaining and resistant to change due to high resistance to natural disturbances and high resilience following natural disturbances. When natural disturbances occur, the rate of recovery is variable due to disturbance intensity. Once invasive plants establish, return to the reference state may not be possible.

Community 1.1
Grass Dominated

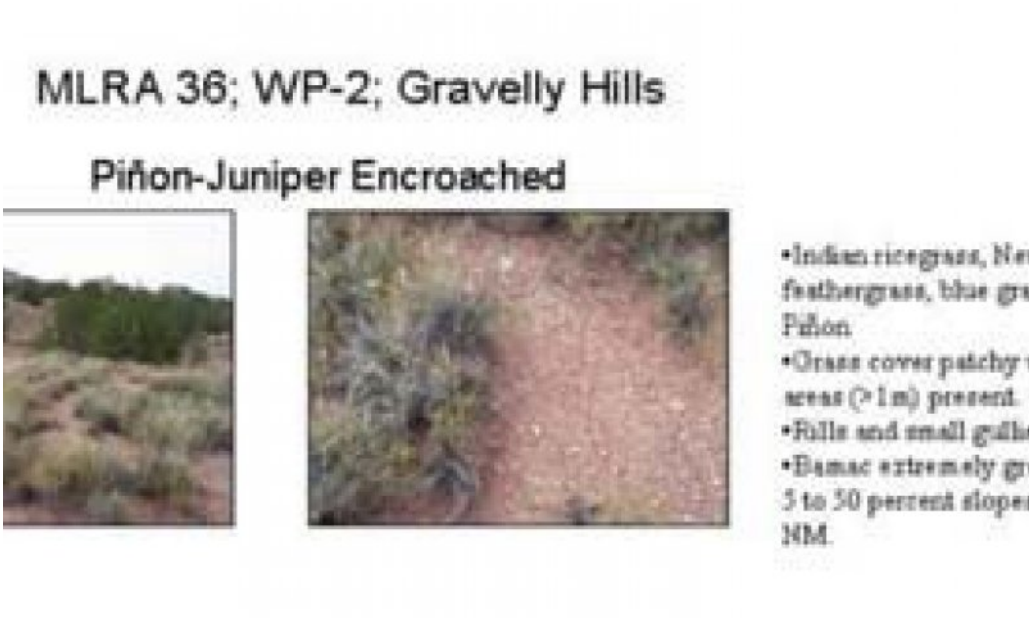

Figure 8. MLRA 36: WP-2: Gravelly Hills

Grass cover is fairly uniform with few large bare areas present. Rock fragments account for a considerable amount of ground cover. Shrubs and trees constitute a minor component of this site. This community phase is dominated by sideoats grama and black grama. Species composition varies with aspect and elevation. Sideoats grama, cool-season grasses, mountain mahogany, and pinyon-juniper are favored on cooler/wetter sites, while black grama, other warm-season grasses, and some shrubs are favored on warmer/dryer sites. Communities dominated by blue grama with galleta or black grama may result. Threeawns, hairy grama, and dropseeds may increase in these communities.

Evidence of erosion such as rills, gullies, and pedestalled grasses is infrequent.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	123	252	420
Forb	22	45	84
Shrub/Vine	22	39	56
Total	**167**	**336**	**560**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	10-20%
Forb foliar cover	1-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-15%
Surface fragments >0.25" and <=3"	25-60%
Surface fragments >3"	10-20%
Bedrock	0%
Water	0%
Bare ground	10-20%

Figure 10. Plant community growth curve (percent production by month). NM0020, R036XB132NM Gravelly Hills HCPC. R036XB132NM Gravelly Hills HCPC.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	7	10	15	20	25	13	5	0	0

Community 1.2
Grass and Shrub

This community consists of shrubs with sparse understory. Scattered juniper and two-needle pinyon might be present. Biological crusts are typically well developed in the interspaces. Improper grazing use can aid the establishment of pinyon and juniper seedlings through reduced competition from grass loss, exposure of mineral soil which will result in accelerated erosion, and reduction of fuel to carry fires. Two-needle pinyon and

juniper are natural invaders if stands are found adjacent to this site.

Pathway 1.1A
Community 1.1 to 1.2

Community phase 1.1 transitions to community phase 1.2 to a state that is dominated by unpalatable and/or drought resistant shrubs and grasses. This pathway happens when fire does not occur within the historical fire regime interval for the site. Continuous heavy grazing, drought and/or insects can reduce grasses, and palatable shrubs. This will lead to an old decadent stand of shrubs with little to no understory. This allows the possibility of juniper and/or two-needle pinyon to become established on the site.

Pathway 1.2A
Community 1.2 to 1.1

This transition is caused by naturally occurring fires, dry winter and/or spring will help in decreasing shrub establishment; and/or wetter climate during late spring and summer will aid in grass and forb establishment. With a mature shrub community, this pathway can be caused by high intensity fire that burns hot enough to remove shrubs. Low-intensity fire after shrubs has had a chance to set seed, proper grazing and or browsing by native ungulates.

State 2
Encroached

This state (Encroached State) is characterized by a noticeable increase in P-J and decreased grass cover and production compared to the Reference State. Grass cover consists mainly of patchy blue grama, ring muhly, galleta, threeawn, and dropseed. Other species that may increase include pingue and broom snakeweed. Grass cover is patchy, large bare areas may be present under P-J canopies. Evidence of erosion such as small rills and pedestalled plants may be present. 10 to 15% tree species canopy cover is usually characterized of this state.

Community 2.1
Pinyon-Juniper Savanna

Proportion of pinyon pine in the Encroached State varies with cycles of drought (reduces the ability of pinyon pine to manufacture pitch which is used to expel boring beetles), insect damage, and subsequent mortality and possible fire. Following fire, there may be a brief (4 to 5 years) flush of forbs and grasses. This increase in fine fuels sets the stage for fire to return the site to the reference state. Without fire, juniper increases in subsequent dry years, pinyon increases in subsequent wet years. Succulents replace grasses in the Encroached State under repeated, continuous grazing.

State 3
Eroded

This state is characterized by reduced cover and production of grasses and accelerated erosion. P-J and shrubs dominate. About 25% tree canopy cover is thought to be the threshold for the transition from the P-J Encroached State to the Eroded State. Arnold (1964) analysis of possible explanations of these threshold include allelopathy, shade, precipitation interception by the canopy, and litter cover forming a physical barrier to germinating plants. Other explanations offered to explain the reduced under-canopy vegetation include root competition for soil moisture, and possible chemical properties of one-seed juniper litter (Arnold, 1964). Broom snakeweed and pingue are often found at increased densities. This state is characterized by soil loss from large, interconnected bare areas and hydrologic events carrying sediment off-site. Evidence of erosion such as rills, gullies, and pedestalled plants is common. The Eroded State is characterized by competition for nutrients, water, and light in the interstitial spaces; multiple age classes of P-J; and sparse understory. Fire return interval in Eroded State may exceed 100 years.

Community 3.1
Eroding Pinyon-Juniper Savanna

Grass cover may decline due to heavy grazing, drought, and increased competition by P-J for available soil moisture. As grass cover is reduced, infiltration, organic matter, and soil aggregate stability decrease, increasing susceptibility to erosion. Bareground increases in size and frequency. Erosion rates are site-specific and are influenced by such factors as watershed size, degree and length of slope, soil profile textures, soil structure, and amount of rock fragments. Loss of herbaceous cover may cause the site to cross a threshold resulting in increased erosion rates, but the amount of cover loss required to cross the threshold varies both within and among areas. Erosion may vary substantially from site to site, or even within areas of a single site. Plants may show pedestalling which indicates an increase in length of water flow patterns and an increase in amount and size of rills.

Transition T1A
State 1 to 2

This transition is from the native shrub and perennial grass state (reference state), to a state that is dominated by pinyon and juniper (Encroached State). The resulting decreased competition by perennial grasses and forbs facilitates the encroachment of pinyon and juniper. Events include time without disturbance, drought, insect herbivory, continuous season long grazing of perennial grasses, and tree invasion. As tree canopy density increase, perennial grass and forb cover is reduced and composition has changed, bare ground will increase in size and frequency, accelerating erosion, increasing run-off and further affecting the watershed functionality. This transition also favors the establishment of invasive annual species such as cheatgrass. In wet years, high grass cover may suppress P-J seedlings by competing directly for available soil moisture; lower grass cover

may facilitate P-J establishment.

Restoration pathway R2A
State 2 to 1

Restoration Pathway from Encroached State to Reference State (R2A). Removal of P-J will be necessary to reduce competition for resources. PJ removal could be from fire; treatments; drought; and/or insect/pathogen outbreaks. Prescribed grazing will help ensure adequate rest following PJ control and will assist in the establishment and maintenance of grass cover, seeding may be necessary depend on herbaceous cover present on the specific site. This pathway requires lots of energy input into the system.

Transition T2A
State 2 to 3

When this transition to state 3 (Eroded State) occurs the site has lost much of its expected resistance and resilience. At this point natural and/or management actions have decreased the understory to a point where erosion increases. Lack of from fire, insects, and drought could cause the tree canopy to close, effectively reducing the herbaceous understory and facilitating the transition. Improper grazing and or increase surface disturbance combined with periods of drought can facilitate this transition since soil stability is lost and susceptibility to soil loss increases.

Restoration pathway R3A
State 3 to 1

Restoration Pathway from Eroded State to Reference State (R3A). Removal of P-J will be necessary to reduce competition for resources. Erosion control structures in conjunction with seeding will be necessary to reestablish hydrology and grass dominance. Prescribed grazing will help ensure adequate rest following seeding and P-J removal and will assist in the establishment and maintenance of grass cover. The degree to which this site is capable of recovery is dependent on the extent of soil degradation.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grass**			17–224	
	sideoats grama	BOCU	*Bouteloua curtipendula*	17–224	–
	black grama	BOER4	*Bouteloua eriopoda*	17–224	–
2	**Grass**			6–84	

2	**Grass**			6–84	
	James' galleta	PLJA	*Pleuraphis jamesii*	6–84	–
3	**Grass**			17–168	
	hairy grama	BOHI2	*Bouteloua hirsuta*	6–56	–
	needle and thread	HECO26	*Hesperostipa comata*	6–56	–
	New Mexico feathergrass	HENE5	*Hesperostipa neomexicana*	6–56	–
4	**Grass/grasslikes**			22–112	
	Grass, perennial	2GP	*Grass, perennial*	6–28	–
	purple threeawn	ARPU9	*Aristida purpurea*	6–28	–
	bottlebrush threeawn	ARSP3	*Aristida spiciformis*	6–28	–
	blue grama	BOGR2	*Bouteloua gracilis*	11–28	–
	sedge	CAREX	*Carex*	6–28	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	11–28	–
Forb					
5	**Forb**			6–84	
	Forb, annual	2FA	*Forb, annual*	6–84	–
	Forb, perennial	2FP	*Forb, perennial*	6–84	–
Shrub/Vine					
6	**Half-shrub**			6–28	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	6–28	–
7	**Shrubs/half shrubs**			6–50	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	6–17	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	6–17	–
	littleleaf mountain mahogany	CEIN7	*Cercocarpus intricatus*	6–17	–
	longleaf jointfir	EPTR	*Ephedra trifurca*	6–17	–
	broom dalea	PSSC6	*Psorothamnus scoparius*	6–17	–
	oak	QUERC	*Quercus*	6–17	–
	soapweed yucca	YUGL	*Yucca glauca*	6–17	–
8	**Succulent**			6–17	

Animal community

Habitat for Wildlife: This range site provides habitats for which support a resident animal community that is characterized by Mule Deer, Bobcat, Black Tailed Jackrabit, White Throated Woodrat, Merriam's kangaroo Rat, Botta's Pocket Gopher, Brush Mouse, Sparrow hawk, Cassin's Kingbird, Meadowlark, Common Raven, Chipping Sparrow, Leopard Lizard, Plateau Whiptail, Short-horned lizard, and Black-tailed Rattlesnake.

Where cliffs and ledges are found in association with the site, Golden eagle, great Horned owl, Prarie falcon, Say's Phoebe, White Throated Swift and Cliff Swallows can be found hunting or loafing on the site. Mourning Dove and Black-chinned sparrow nest of the site. large rocks or boulders, where found associated with the site, provide nesting habitat for Rock Squirrel. Where this site occurs adjacent to Ponderosa pine forest the Elk will range out to feed.

Hydrological functions

Soil Series----------Hydrologic Group

Espiritu----------b
Parida----------b
Palacid----------c
Florita----------b

Recreational uses

This site offers fair to good potential for hiking, horseback riding, nature observation, photography, camping, and picknicking. Scattered forbs and flowering shrubs, in addition to the rolling hills and open grassland to savanna characteristics provide natural beauty.

Wood products

This site has little value for production of wood products.

Other products

This site is suited for grazing by all kinds and classes of livestock. On the north slopes the bulk of the forage is produced by Sideoats Grama. Black Grama produces the bulk of the forage on the south slopes making this aspect best suited for winter grazing. These species together with the cool season growth species respond well to planned deferment periods. A planned system of grazing which rotates the season of use will allow these species to increase in vigor and production. When these sites are lower in condition, severe water erosion, both sheet and rill will take place. If allowed to continue soil erosion can force this site into behaving like another ecological site.

Other information

Guide to suggested Initial Stocking Rate in Acres per Animal Unit Month.

Range Condition Score--
----------Acres/AUM
100-76%----------10-15
75-51%----------15-18
50-26%----------18 plus
25% or less----------rest

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--Site Development and Testing Plan--:

Future work to validate and further refine the information in this Provisional Ecological Site Description is necessary. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data.

Additional information and data is required to refine the Plant Production and Annual Production tables for this ecological site. The extent of MLRA 36 must be further investigated.

Field testing of the information contained in this Provisional ESD is required. As this ESD is moved to the Approved ESD level, reviews from the technical team, quality control, quality assurance, and peers will be conducted.

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)	
Contact for lead author	
Date	05/21/2025
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

   _____

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

   _____

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

   _____

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

   _____

5. **Number of gullies and erosion associated with gullies:**

   _____

6. **Extent of wind scoured, blowouts and/or depositional areas:**

   _____

7. **Amount of litter movement (describe size and distance expected to travel):**

   _____

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

   _____

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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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):**

---

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:

    Sub-dominant:

    Other:

    Additional:

---

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

---

14. **Average percent litter cover (%) and depth (in):**

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

---

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:

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17. **Perennial plant reproductive capability:**
