USDA Natural Resources Conservation Service

Ecological site R115XA103IL
Sand Dunes

Last updated: 12/30/2024
Accessed: 01/09/2025

General information

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

MLRA notes

Major Land Resource Area (MLRA): 115X–Central Mississippi Valley Wooded Slopes

This MLRA is characterized by deeply dissected, loess-covered hills bordering well defined valleys of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers and their tributaries. It is used to produce cash crops and livestock. About one-third of the area is forested, mostly on the steeper slopes. This area is in Illinois (50 percent), Missouri (36 percent), Indiana (13 percent), and Iowa (1 percent) in two separate areas. It makes up about 25,084 square miles (64,967 square kilometers).

Most of this area is in the Till Plains section and the Dissected Till Plains section of the Central Lowland province of the Interior Plains. The Springfield-Salem plateaus section of the Ozarks Plateaus province of the Interior Highlands occurs along the Missouri River and the Mississippi River south of the confluence with the Missouri River. The nearly level to very steep uplands are dissected by both large and small tributaries of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers. The Ohio River flows along the southernmost boundary of this area in Indiana. Well defined valleys with broad flood plains and numerous stream terraces are along the major streams and rivers. The flood plains along the smaller streams are narrow. Broad summits are nearly level to undulating. Karst topography is common in some parts along the Missouri and Mississippi Rivers and their tributaries. Well-developed karst areas have hundreds of sinkholes, caves, springs, and losing streams. In the St. Louis area, many of the karst features have been obliterated by urban development.

Elevation ranges from 90 feet (20 meters) on the southernmost flood plains to 1,030 feet (320 meters) on the highest ridges. Local relief is mainly 10 to 50 feet (3 to 15 meters) but can be 50 to 150 feet (15 to 45 meters) in the steep, deeply dissected hills bordering rivers and streams. The bluffs along the major rivers are generally 200 to 350 feet (60 to 105 meters) above the valley floor.

The uplands in this MLRA are covered almost entirely with Peoria Loess. The loess can be more than 7 feet (2 meters) thick on stable summits. On the steeper slopes, it is thin or does not occur. In Illinois, the loess is underlain mostly by Illinoian-age till that commonly contains a paleosol. Pre-Illinoian-age till is in parts of this MLRA in Iowa and Missouri and to a minor extent in the western part of Illinois. Wisconsin-age outwash, alluvial deposits, and sandy eolian material are on some of the stream terraces and on dunes along the major tributaries. The loess and glacial deposits are underlain by several bedrock systems. Pennsylvanian and Mississippian bedrock are the most extensive. To a lesser extent are Silurian, Devonian, Cretaceous, and Ordovician bedrock. Karst areas have formed where limestone is near the surface, mostly in the southern part of the MLRA along the Mississippi River and some of its major tributaries. Bedrock outcrops are common on the bluffs along the Mississippi, Ohio, and Wabash Rivers and their major tributaries and at the base of some steep slopes along minor streams and drainageways.

The soils on uplands in this area support natural hardwoods. Oak, hickory, and sugar maple are the dominant species. Big bluestem, little bluestem, and scattered oak and eastern redcedar grow on some sites. The soils on flood plains support mixed forest vegetation, mainly American elm, eastern cottonwood, river birch, green ash, silver maple, sweetgum, American sycamore, pin oak, pecan, and willow. Sedge and grass meadows and scattered trees are on some low-lying sites. (United States Department of Agriculture, Natural Resources Conservation Service,

2022)

LRU notes

Most of this LRU (Land Resource Unit) is in the glaciated Till Plains Section of the Central Lowland Province of the Interior Plains. The southeast corner is in the Highland Rim Section (locally known as the Shawnee Hills Section) of the Interior Low Plateaus Province of the Interior Plains. The nearly level to very steep uplands in this LRU are dissected by both large and small tributaries of the Wabash and Ohio Rivers. Well defined valleys with broad flood plains and numerous stream terraces are along the major streams and rivers. The flood plains along the smaller streams are narrow. Broad summits are nearly level to gently sloping.

This area is covered almost entirely with Peoria loess. The loess can be more than 7 feet (2 meters) thick on stable summits. On the steeper slopes, it is thin or does not occur. The loess throughout the area is underlain dominantly by glacial till. Wisconsin outwash, alluvial deposits, and sandy eolian material are on some of the stream terraces and on dunes along the major tributaries in the area. The loess and glacial drift are underlain by Pennsylvanian-age bedrock. Bedrock outcrops are common in the walls of the valleys along the Wabash and Ohio Rivers and at the base of some steep slopes along minor streams and drainageways.

The dominant soil orders in this LRU are Alfisols, Entisols, Inceptisols, and Mollisols. The soils in the area have a mesic soil temperature regime, a udic or aquic soil moisture regime, and dominantly mixed or smectitic mineralogy. The soils are very deep, poorly drained to excessively drained, and loamy, silty, or clayey. Nearly level Endoaqualfs (Iva series) and Argiaquolls (Ragsdale series) formed in loess on broad upland summits and flats. Nearly level to steep Hapludalfs (Alford, Iona, Muren, Stoy, and Sylvan series) and Fragiudalfs (Hosmer series) formed in loess on uplands. Hapludalfs (Alvin, Bloomfield, and Princeton series) and Argiudolls (Ade series) formed in sandy eolian material in areas of dunes on uplands and stream terraces. Steep and very steep Hapludalfs (Hickory series) formed in Illinoian till along the major streams and dissected upland drainageways. Hapludalfs (Wellston series) formed in siltstone or sandstone residuum on strongly sloping to steep side slopes underlain by bedrock.

The soils in the major stream valleys include Hapludolls (Carmi series), Argiudolls (Elston series), and Hapludalfs (Skelton series), all of which formed in outwash on nearly level to moderately sloping stream terraces and outwash plains. Endoaquolls (Montgomery series), Endoaquepts (Zipp series), Epiaqualfs (McGary series), and Hapludalfs (Shircliff and Markland series) formed in clayey lacustrine sediments on nearly level to strongly sloping lacustrine terraces or lake plains. Endoaquepts (Evansville series), Endoaquolls (Patton series), and Hapludalfs (Henshaw and Uniontown series) formed in silty sediments on terraces and lake plains.

LRU notes (excerpts from Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. USDA Handbook 296, 2006)

Classification relationships

Major Land Resource Area (MLRA) 115X–Central Mississippi Valley Wooded Slopes

U.S. Forest Service Ecoregions (Cleland et al. 2007):
Domain: Humid Temperate Domain
Division: Hot Continental Division
Province: Eastern Broadleaf Forest (Continental)
Province Code: 222
Section Code: 222G, 222D

Relationship to other established ecological classifications. Field verification is necessary to confirm any association.

Biophysical Setting (LANDFIRE, 2009); the reference community of this ecological site is similar to: North-Central Interior Dry Oak Forest and Woodland (CES202.047)

Ecological site concept

These sites are very deep, well-drained soils that formed in deposits of eolian silt and fine sand. Sites are located

on upland dunes or stream terraces. Available water capacity is from 6-7 inches and sites are not impacted by flooding or ponding. The reference community is an open oak-dominated woodland. Trees on site include black oak (Quercus velutina), white oak (Quercus alba), pignut hickory (Carya glabra), shagbark hickory (Carya ovata), black cherry (Prunus serotina), and red maple (Acer rubrum). Shrubs species include blueberry (Vaccinium spp.), gray dogwood (Cornus racemosa), and American hazelnut (Corylus americana). The ground layer will exhibit a diverse mix of native grasses, sedges and forbs which will vary according to slope, aspect and fire return intervals.

Associated sites

R115XA101IL	**Wet Sand Dunes** Wet Sand Dune. These sites are somewhat poorly drained or poorly drained and located downslope from Sand Dune sites.
R115XA102IL	**Dry Sand Dunes** Dry Sand Dune. These sites have a lower available water capacity and are somewhat excessively to excessively drained.

Similar sites

R115XA102IL	**Dry Sand Dunes** Dry Sand Dune. These sites have a lower available water capacity and are somewhat excessively to excessively drained.
R115XA104IL	**Sandy Terrace** Sandy Terrace. These sites are on sandy soils but located on terraces.

Table 1. Dominant plant species

Tree	(1) *Quercus velutina* (2) *Quercus alba*
Shrub	(1) *Corylus americana* (2) *Cornus racemosa*
Herbaceous	(1) *Carex pensylvanica* (2) *Maianthemum racemosum*

Physiographic features

Sand Dune sites are on very deep, well drained soils on dunes and occasionally, stream terraces. These soils formed in deposits of eolian silt and fine sand. Slopes range from 0-50% percent. The runoff class ranges from low to high, so these sites can generate runoff to adjacent lower sites.

Table 2. Representative physiographic features

Landforms	(1) Valley > Terrace (2) Valley > Stream terrace (3) Upland > Dune
Runoff class	Very low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	104–305 m
Slope	6–18%
Water table depth	183 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0–50%
Water table depth	Not specified

Climatic features

About 60 percent of the precipitation falls during the freeze-free period. Most of the rainfall occurs as high-intensity, convective thunderstorms in summer. Snowfall is common in winter. The following information is based on data taken from five weather stations within MLRA 115X as provided in EDIT (Ecosystem Dynamics Interpretive Tool, 2020).

Table 4. Representative climatic features

Frost-free period (characteristic range)	171-179 days
Freeze-free period (characteristic range)	192-199 days
Precipitation total (characteristic range)	1,118-1,194 mm
Frost-free period (actual range)	166-180 days
Freeze-free period (actual range)	190-204 days
Precipitation total (actual range)	1,016-1,219 mm
Frost-free period (average)	175 days
Freeze-free period (average)	196 days
Precipitation total (average)	1,143 mm

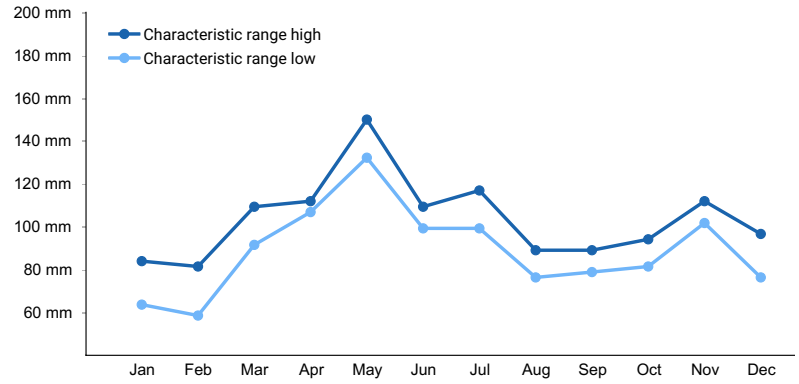


Figure 1. Monthly precipitation range

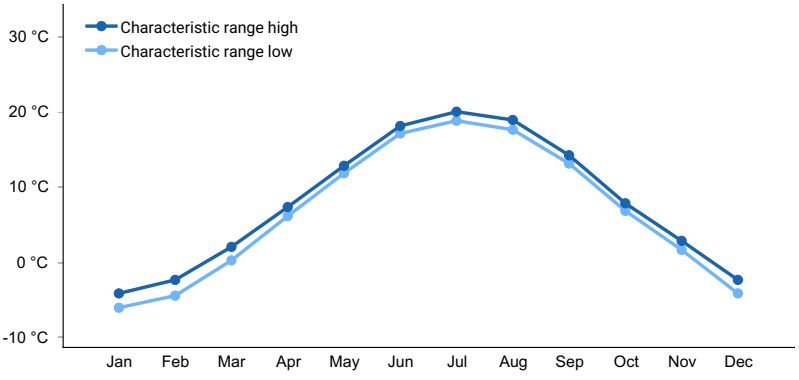


Figure 2. Monthly minimum temperature range

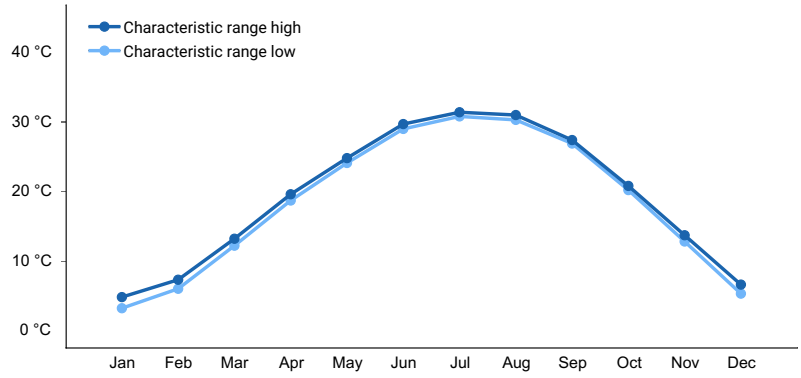


Figure 3. Monthly maximum temperature range

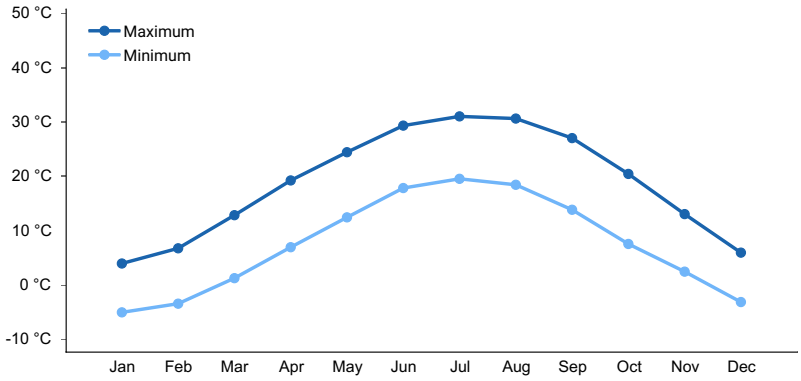


Figure 4. Monthly average minimum and maximum temperature

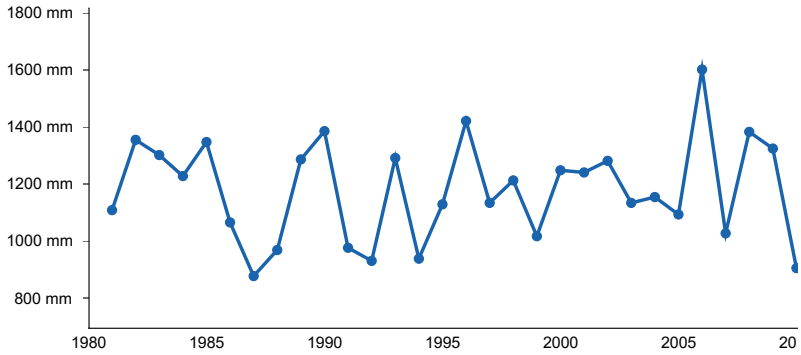


Figure 5. Annual precipitation pattern

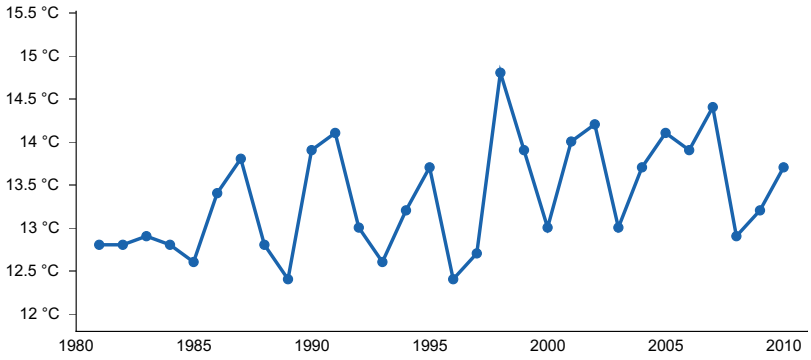


Figure 6. Annual average temperature pattern

Climate stations used

- (1) TERRE HAUTE CAA AP [USW00093823], Terre Haute, IN
- (2) VINCENNES 5 NE [USC00129113], Vincennes, IN
- (3) PRINCETON 1 W [USC00127125], Princeton, IN

- (4) MT VERNON [USC00126001], Uniontown, IN
- (5) EVANSVILLE REGIONAL AP [USW00093817], Evansville, IN

Influencing water features

Sand Dune sites are not influenced by flooding or ponding. Precipitation is the main source of water for this ecological site. The potential for surface runoff is very low to medium on slopes less than 20 percent and high on slopes greater than 20 percent. (OSD, 2020) Precipitation can infiltrate the soil surface and move freely downward through the soil horizons as there is no restrictive layer in the soil profile. Surface runoff does contribute water to ecological sites downslope. The wet layer depth is greater than 6 feet.

Soil features

These sites are on very deep, well-drained soils that were formed in deposits of eolian silt and fine sand. These soils are not affected by seasonal wetness. Soils of this ecological site are in the Alfisol order. Taxonomic class is fine-loamy, mixed, active, mesic Typic Hapludalfs. Soil series associated with this site include Princeton.

Table 5. Representative soil features

Parent material	(1) Eolian deposits (2) Eolian sands
Surface texture	(1) Fine sandy loam (2) Loam (3) Sandy loam
Drainage class	Well drained
Permeability class	Moderate to rapid
Depth to restrictive layer	152–203 cm
Soil depth	152–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	15.24–17.78 cm
Calcium carbonate equivalent (Depth not specified)	0–30%
Electrical conductivity (Depth not specified)	0 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	5.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This ecological site occurs on dunes and less commonly stream terraces. Slopes range from 0-50% so slope and aspect will influence vegetation on these sites. The Sand Dune reference community is an open oak woodland with a diverse understory of native shrub, grass and forb species. According to LANDFIRE, fire was historically a key factor in the maintenance of these ecological sites. Impacts to the site were dependent upon fire intensive and frequency. Most natural fires were likely of low to moderate severity and this disturbance regime reduced fire-intolerant species, reduced shrub density, and enhanced the inclusion of prairie herbaceous and grass species on site. Other disturbances would have included grazing by livestock, grazing by native ungulates, ice storms, and

logging or clearing of sites.

These sandy sites would also be very susceptible during periods of drought. During dry years, plant species adapted to drought conditions would increase on site. Conversely, during multiple years of high precipitation, more mesic species would be found.

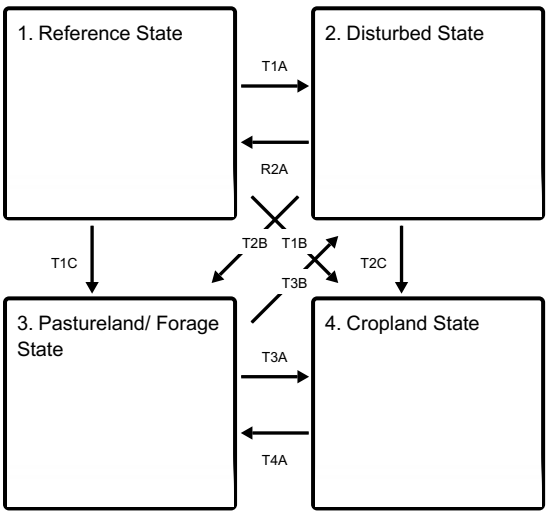
Today, most Sand Dune sites are utilized for row-crop agriculture or pasture. Remaining wooded sites have been altered due to lack of a natural fire regime and repeated human disturbances. Many sites have had unmanaged grazing which has altered not only the shrub and herbaceous layers, but tree regeneration. Landowners should be aware of potential overgrazing impacts such as soil erosion, soil compaction, water quality impacts, and noxious weeds. Invasive non-native vegetation is a serious concern in many remaining wooded areas as bush honeysuckle, euonymus, Japanese honeysuckle, privet, and other non-native plants have been introduced and are increasing without management controls.

Long-term fire suppression has resulted in some sites transitioning to a mixed deciduous forest with a noticeable increase in maple saplings. In Indiana, tulip poplar is recorded on some sites. Without management inputs such as prescribed fire or timber stand improvement work, oak regeneration is limited, and species composition on these sites will transition toward shade-tolerant, fast-growing species.

A provisional state and transition diagram is depicted in Figure 2. This model is based on available information and no field verification has been conducted for this initial PES project. It is expected that this project, including the STM, will be enhanced and modified during ecological site description (ESD) development.

State and transition model

Ecosystem states



T1A - Large scale disturbance

T1C - Clearing of site; agricultural production - forage

T1B - Clearing of site; agricultural production -row crops.

R2A - Restoration inputs such as planting, brush control, prescribed fire, and timber stand improvement.

T2B - Clearing; agricultural production - forage

T2C - Clearing; agricultural production - row crops

T3B - Abandonment of agricultural practices

T3A - Site preparation and tillage, seeding, weed control, cropland management

T4A - Transition site to forage production; seeding; weed/brush control; pasture management

State 1 submodel, plant communities

1.1. Reference community

State 2 submodel, plant communities

2.1. Disturbed community

State 3 submodel, plant communities

3.1. Pastureland/Forage community

State 4 submodel, plant communities

4.1. Cropland community

State 1
Reference State

The vegetative community on this dune woodland community was historically influenced by a natural fire regime, periods of drought, ungulate grazing, and periodic ice and windstorms. Community 1.1. is an open woodland dominated by black oak. A natural fire regime would have maintained the oak dominance in the canopy and a variety of native shrubs, grasses, and herbaceous species. Plant community composition will vary depending on the fire regime, slope, aspect, and other natural disturbances.

Dominant plant species

- black oak (*Quercus velutina*), tree
- white oak (*Quercus alba*), tree
- American hazelnut (*Corylus americana*), shrub
- gray dogwood (*Cornus racemosa*), shrub
- Pennsylvania sedge (*Carex pensylvanica*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- feathery false lily of the valley (*Maianthemum racemosum*), other herbaceous

Community 1.1
Reference community

The Sand Dune reference community is an open oak woodland with a diverse understory of native shrub, grass and forb species. According to LANDFIRE, fire was historically a key factor in the maintenance of these ecological sites. Impacts to the site were dependent upon fire intensive and frequency.

Dominant plant species

- black oak (*Quercus velutina*), tree
- white oak (*Quercus alba*), tree
- American hazelnut (*Corylus americana*), shrub
- gray dogwood (*Cornus racemosa*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- Pennsylvania sedge (*Carex pensylvanica*), grass
- feathery false lily of the valley (*Maianthemum racemosum*), other herbaceous

State 2
Disturbed State

Today, remaining wooded sites have often had repeated and sever disturbances including lack of natural fire regimes, selective oak harvest, clearing, unmanaged grazing, and the introduction of non-native species. Depending on the intensity and duration of the disturbances, multiple tree species may now be on these sites. Lack of natural fire will transition an open oak-dominated woodland to a more closed forest-type with an increase in maples, hickories, sassafras, and tulip poplar. NRCS has recorded many tree species on these sites including southern red oak, shingle oak, scarlet oak, blackgum, white oak, black walnut, yellow poplar, sugar maple, sycamore, and hackberry.

Dominant plant species

- red maple (*Acer rubrum*), tree
- hybrid hickory (*Carya*), tree
- oak (*Quercus*), tree
- sugar maple (*Acer saccharum*), tree
- American hazelnut (*Corylus americana*), shrub
- sumac (*Rhus*), shrub
- blackberry (*Rubus*), shrub
- rose (*Rosa*), shrub
- maple (*Acer*), shrub

Community 2.1
Disturbed community

This is a disturbed, successional community that includes a variety of fast-growing trees such as maples and ashes. Species on these sites will vary depending on the disturbance, management, and seed sources. Shrub and understory species will depend on the type, severity and length of disturbances, available seed sources, slope/aspect, and management inputs, if present.

Dominant plant species

- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree
- hybrid hickory (*Carya*), tree
- oak (*Quercus*), tree
- American hazelnut (*Corylus americana*), shrub
- sumac (*Rhus*), shrub
- blackberry (*Rubus*), shrub
- rose (*Rosa*), shrub
- maple (*Acer*), shrub

State 3
Pastureland/ Forage State

A portion of these sites have been converted to pastureland or forage production. Species selection will depend upon the objectives and goals of the landowner; however, commonly planted grasses include tall fescue (*Schedonorus arundinaceus*), brome (Bromus spp.), white clover (*Trifolium repens*) and red clover (*Trifolium*

pratense). Species health and productivity are determined by the management.

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- brome (*Bromus*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- white clover (*Trifolium repens*), other herbaceous
- red clover (*Trifolium pratense*), other herbaceous

Community 3.1
Pastureland/Forage community

These sites are managed for forage production and often include tall fescue (*Schedonorus arundinaceus*), brome (Bromus spp.), white clover (*Trifolium repens*) and red clover (*Trifolium pratense*). Selection of species will depend on the landowner's objectives.

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- brome (*Bromus*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- red clover (*Trifolium pratense*), other herbaceous
- white clover (*Trifolium repens*), other herbaceous

State 4
Cropland State

Common crops include corn (*Zea mays*), soybeans (*Glycine max*), and occasionally winter wheat (*Triticum aestivum*). Some landowners choose to convert sites to cool season grasses for a period before resuming cropland production. A return to the historical Reference State from State 4 is unlikely, if not impossible.

Dominant plant species

- corn (*Zea mays*), other herbaceous
- soybean (*Glycine*), other herbaceous

Community 4.1
Cropland community

This community is characterized by the management and production of row crop agriculture. Common species include corn, soybean and wheat. Many other crops are suitable for these sites, and species selection will depend upon the landowners goals and objectives.

Dominant plant species

- soybean (*Glycine max*), other herbaceous
- corn (*Zea mays*), other herbaceous

Transition T1A
State 1 to 2

Severe disturbances, such as clearing or selective harvesting, will transition this site to State 2.

Transition T1C
State 1 to 3

Site is transitioned to an agricultural site focused on forage production. Management inputs would include clearing, site preparation, seeding and weed/brush control.

Transition T1B
State 1 to 4

Site is transitioned to an agricultural site focused on row crop production. Management inputs would include clearing, site preparation, seeding and weed control. Hydrological modifications are often installed to aid in drainage.

Restoration pathway R2A
State 2 to 1

Restoration would require long-term management inputs including planting of desired species, weed control, brush control, timber stand improvement, and prescribed fire.

Transition T2B
State 2 to 3

Site is cleared and forage/pasture production is initiated. Management inputs would include tree/shrub removal, site preparation, seeding, and weed/brush control.

Transition T2C
State 2 to 4

Site is cleared and row crop production is initiated. Management inputs would include tree/shrub removal, site preparation, tillage, seeding, and weed control.

Transition T3B
State 3 to 2

Site is abandoned and slowly would transition to a wooded state dominated by deciduous trees. Species on site would depend on the severity and length of disturbance and available seed sources.

Transition T3A
State 3 to 4

Management inputs that transition a site from pasture or forage production to a site that is utilized for row crop production.

Transition T4A
State 4 to 3

Management inputs to transition a site from cropland production to a state of pasture/forage production.

Additional community tables

Inventory data references

A Provisional Ecological Site Description (PESD) describes ecological potential and ecosystem dynamics of land areas and their potential management. Ecological sites are linked to soil survey map unit components, which allows for mapping of ecological sites. A PESD with a provisional status represents the lowest tier of documentation that is releasable to the public. No field level data have been collected as part of this PESD. It is expected that a PESD will continue to be refined through field verification and field sampling.

Reference and alternative state concepts, including the state-and-transition model and vegetative communities are not yet well-documented and will require field sampling for verification.

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Approval

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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	01/09/2025
Approved by	Suzanne Mayne-Kinney
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:**

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:**
