# Ecological site F089XY013WI
# Moist Loamy-Clayey Bedrock Upland Forest

Last updated: 9/27/2023
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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): 089X–Wisconsin Central Sands

The Wisconsin Central Sands (MLRA 89) corresponds closely to Central Sand Plains Ecological Landscape published by the Wisconsin Department of Natural Resources (WDNR, 2015). Much of the following brief overview of this MLRA is borrowed from that publication. The Wisconsin Central Sands MLRA is entirely in Wisconsin. The total land area is 2,187,100 acres (3,420 square miles, 8858 square kilometers). It is bordered to the east by Johnstown-Hancock end moraines, which were pushed to their extent by the west side of the Green Bay Lobe (Clayton & Attig, 1999). It is bordered to the southwest by highly eroded, unglaciated valleys and ridges. The dominant feature of this MLRA is the remarkably flat, sandy plain, composed of lacustrine deposits and outwash sand, that was once the main basin of Glacial Lake Wisconsin. It also features extensive pine and oak barrens and wetland complexes. Glacial Lake Wisconsin was fed primarily by glacial meltwater from the north and east. The lake deposited silt overlain by tens of meters of sand (Clayton & Attig, 1989). The silty layers are closer to the surface in some areas, where they impede drainage and contribute to the formation of extensive wetland complexes. It is believed that Glacial Lake Wisconsin drained within several days after a breach in the ice dam that supported it. The catastrophic flood that followed flowed to the south and carved the scattered buttes and mesas protruding from the sandy plain in the southern portion of this MLRA. Before vegetation established after glacial recession, strong winds formed aeolian sand dunes that now support xeric pine and oak stands within the Wisconsin Central Sands. The surface of the northwestern portion is mostly undulating. The sandy surface sediment was mostly deposited by meltwater during the Wisconsin glaciation. Gentle hills are a result of underlying bedrock topography. Valleys and floodplains are formed by stream action. The underlying bedrock controls the water table elevation and contributes to the formation of numerous wetlands. Historically, the Wisconsin Central Sands were dominated by large wetland complexes, sand prairies, and oak forests, savannas, and barrens. Some pine and hemlock forests were found in the northwest portion. The Wisconsin Central Sands was subject to frequent fires, leading to today’s need for prescribed burns to maintain the area.

## Classification relationships

Major Land Resource Area (MLRA): Wisconsin Central Sands (89) USFS Subregions: Neillsville Sandstone Plateau (222Rb) Small sections occur in the Lincoln Formation Till Plain - Mixed Hardwoods (212Qb) and Central Wisconsin Sand Plain (222Ra) Subregions Relationship to Established Framework and Classification Systems: Habitat Types of N. & S. Wisconsin (Kotar, 2002 & 1996): The sites of this ES keyed out to five habitat types: Acer-Quercus/Viburnum, Geranium variant (AQVb-Gr); Acer-Tilia-Fraxinus/Circaea(ATiFrCi); Pinus/Vaccinium-Hamamelis (PVHa); Pinus/Vaccinium-Rubus hispidus(PVRh); Tsuga/Maianthemum-Coptis (TMC). Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Northern Hardwoods Forest, North-Central Interior Maple-Basswood Forest, and Eastern Cool Temperate Row Crop. WDNR Natural Communities (WDNR, 2015): This ES is most similar to the Mesic Hardwood Forest, Central Sands, Pine-Oak Forest, an Northern Dry-Mesic Forest communities.

## Ecological site concept

The Moist Loamy Bedrock Uplands ecological site is widespread on hills and pediments in the northern portion of MLRA 89 where loamy till was deposited during the Wisconsin glaciation and where the depth to bedrock is relatively shallow. These sites are characterized by very deep, somewhat poorly drained soils that formed in loamy materials over loamy residuum weathered from the underlying interbedded sandstone and shale. Precipitation, runoff from adjacent uplands, and groundwater discharge are the primary sources of water. Soils range from very strongly acid to strongly acid. The exact nature of pre-European settlement vegetation is difficult to assess at the scale of this Ecological Site. Natural disturbances and activities of native peoples no doubt produced a mosaic of plant community types. However, based on our understanding of ecological characteristics of species currently occupying these sites we can make estimates of the nature of ecological states and transitions that we might expect under current conditions. In our sampling of five representative sites, three species occurred on all of them: Trembling aspen (Populus tremuloidesred), red maple (A. rubrum) and white pine (P. strobus). Common associates were white oak (Q. alba) and paper birch (Betula papyrifera). One site included several species that are more typical of nutrient-richer sites: White ash (Fraxinus americana), ironwood (Ostrya virginiana) and yellow birch (B.

alleghaniensis). This site also included a number of understory species clearly identifying it as a richer Forest Habitat Type, ATiFrCi (Acer-Tilia-Fraxinus/Circaea). Some of these are: Alternate leaved dogwood (Cornus alternifolia), Enchanter's nightshade (Circaea lutetiana) and Jack-in-the-Pulpit (Arisaema triphyllum). Moist Loamy Bedrock Uplands differs from other sites by its drainage, loamy textures, and relatively shallow bedrock. Other somewhat poorly drained loams lack bedrock contact within 80 inches (200 cm) of the surface. In addition to perching the water table, the relatively shallow bedrock restricts root growth which may cause trees to tip. Other somewhat poorly drained sites have sandy or clayey textures. Loamy textures tend to have higher pH and available water capacity than sand, but less than clay. The somewhat poor drainage sets this site apart from other loamy sites.

## Associated sites

| | |
|---|---|
| F089XY004WI | **Loamy-Clayey Floodplain Forest**<br><br>Loamy Floodplains are found exclusively on floodplains in loamy alluvium underlain by sandy alluvium. Soils are somewhat poorly to poorly drained and are subject to flooding. These sites occur primarily along tributaries to the Yellow River in central Wood County and along the Lemonweir River. They may be adjacent to Moist Loamy Bedrock Uplands. |
| F089XY008WI | **Wet Loamy-Clayey Lowland Forest**<br><br>Wet Loamy Lowlands form in a loamy or silty mantle 10 to 40 inches (25 to 100 cm) thick overlying sandy residuum weathered from sandstone and shale. Bedrock contact may occur as high at 26 inches (66 cm). These soils are poorly drained, remain saturated for much the growing season, and are sometimes subject to ponding. They are exclusive to the northern third of the Wisconsin Central Sands MLRA, which was covered in loamy glacial deposits prior to the most recent glacial advance. They occur lower on the drainage sequence and are wetter than Moist Loamy Bedrock Uplands. |
| F089XY019WI | **Loamy-Clayey Bedrock Upland Forest**<br><br>Loamy Bedrock Uplands form in loamy alluvium or loess overlain by interbedded sandstone and shale. Bedrock contact occurs within 39 inches (99 cm) of the surface. Soils are moderately well or well drained. These sites are primarily found in the northern portion of the Wisconsin Central Sands MLRA which was covered in loamy glacial deposits prior to the most recent glacial advance and where depth of bedrock is shallow. They occur higher on the drainage sequence and have a deeper water table than Moist Loamy Bedrock Uplands. |

## Similar sites

| | |
|---|---|
| F089XY014WI | **Moist Loamy Lowland Forest**<br><br>Moist Loamy Uplands consist of deep loamy alluvium over sandy alluvium or clayey lacustrine deposits. They are somewhat poorly drained and are subject to neither flooding nor ponding. These sites are primarily found in the northwestern portion of the Wisconsin Central Sands MLRA. Their vegetative communities are similar to those of Moist Loamy Bedrock Uplands. |
| F089XY004WI | **Loamy-Clayey Floodplain Forest**<br><br>Loamy Floodplains are found exclusively on floodplains in loamy alluvium underlain by sandy alluvium. Soils are somewhat poorly to poorly drained and are subject to flooding. These sites occur primarily along tributaries to the Yellow River in central Wood County and along the Lemonweir River. Occasional perching of the water table can create conditions on Moist Loamy Bedrock Uplands sites suitable for supporting the same vegetative communities found on Loamy Floodplains. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Pinus strobus*<br>(2) *Quercus alba* |

| | |
|---|---|
| Shrub | (1) *Amelanchier* |
| Herbaceous | (1) *Pteridium aquilinum* |

## Physiographic features

These sites formed in loamy alluvium or loess over loamy and clayey residuum on pediments and upland hill positions. Slope is primarily 0 to 6 percent, but some sites may reach up to 12 percent. Elevation ranges from 705 to 1,394 feet (215 to 425 meters) above sea level. These sites are not subject to ponding or flooding. Sites have a seasonally high water table at depths of 6 to 24 inches (15 to 61 cm). Water table may drop to 40 inches (100 cm) during drier conditions on these sites. Surface runoff is medium to high.

**Figure 1. Distribution of Moist Loamy Bedrock Uplands in the Wisconsin Central Sands MLRA (89).**

**Table 2. Representative physiographic features**

| | |
|---|---|
| Hillslope profile | (1) Footslope |
| Slope shape across | (1) Linear |
| Slope shape up-down | (1) Concave |
| Landforms | (1) Pediment<br>(2) Hill<br>(3) Flat |
| Runoff class | Medium to high |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 220 – 430 m |
| Slope | 0 – 10 % |
| Water table depth | 20 – 60 cm |
| Aspect | W, NW, N, NE, E, SE, S, SW |

## Climatic features

The continental climate of the Wisconsin Central Sands is typical of the southern half of the state – cold winters and warm summers. Precipitation is well-distributed throughout the year with a slight peak in the summer months. Snowfall covers the ground from late fall to early spring. The soil moisture regime of MLRA 89 is udic (humid climate). The soil temperature regime is mostly frigid, with a small portion of mesic in the southern tip. Neither precipitation nor temperature vary greatly across this MLRA. More so than latitude, local topography seems to be an important predictor of growing season length, with fewer growing degree days in lower-lying areas.

The average annual precipitation for this ecological site is 33 inches. The average annual snowfall is 43 inches. The annual average maximum and minimum temperatures are 56°F and 33°F, respectively.

**Table 3 Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 80-110 days |
| Freeze-free period (characteristic range) | 100-130 days |
| Precipitation total (characteristic range) | 810-840 mm |
| Frost-free period (actual range) | 80-120 days |
| Freeze-free period (actual range) | 100-140 days |
| Precipitation total (actual range) | 810-840 mm |
| Frost-free period (average) | 100 days |
| Freeze-free period (average) | 120 days |
| Precipitation total (average) | 840 mm |

- (1) HATFIELD [USC00473471], Merrillan, WI
- (2) WISCONSIN RAPIDS [USC00479335], Wisconsin Rapids, WI
- (3) PRENTICE #2 [USC00476859], Marshfield, WI

## Influencing water features

Water is received through precipitation, runoff from adjacent uplands, groundwater discharge, and, rarely, stream inflow. Water levels are greatly influenced by precipitation rates and runoff from upland sites. Water leaves the site primarily through runoff, evapotranspiration, and groundwater recharge. Subsurface flow may occur where the sandstone bedrock perches the water table.

Permeability of these sites is impermeable. Hydrologic group is B/D or C/D.

## Soil features

These sites are represented by the Kert, Merrillan, and Rietbrock soil series. Kert and Rietbrock series are classified as Aquic Glossudalfs, and Merrillan is an Ultic Epiaquod. 52% of the acreage of this site is classified as Ultic Epiaquods.

These sites formed in loamy alluvium or loess over loamy or clayey residuum that weathered from the underlying interbedded sandstone and shale. Soil depth to bedrock ranges from 11 to 48 inches (74 to 122 cm). Soils are somewhat poorly drained but do not meet hydric soil requirements.

The surface of these sites is primarily fine sandy loam or silt loam. Subsurface horizons consist of sandy loam, loam, and clay loam textures. Soil pH ranges from very strongly acid to slightly acid with values from 4.5 to 6.5. Surface fragments are absent. Subsurface fragments less than 3 inches range from 3 to 21 percent volume. Subsurface fragments greater than 3 inches range from 0 to 18 percent volume. Carbonates are absent on most sites, but can be present up to 5 percent beginning at 38 inches (97 cm).

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Loess<br>(2) Residuum |
| Surface texture | (1) Loam<br>(2) Sandy loam<br>(3) Silt loam |
| Drainage class | Somewhat poorly drained |
| Permeability class | Very slow |
| Soil depth | 30 – 120 cm |
| Surface fragment cover <=3" | Not specified |
| Surface fragment cover >3" | Not specified |
| Available water capacity (0-121.9cm) | 8.03 – 18.85 cm |
| Calcium carbonate equivalent (0-101.6cm) | 0 – 10 % |
| Soil reaction (1:1 water) (0-101.6cm) | 4.5 – 6.5 |
| Subsurface fragment volume <=3" (Depth not specified) | 0 – 20 % |
| Subsurface fragment volume >3" (Depth not specified) | 0 – 20 % |

## Ecological dynamics

Perhaps the most important ecological characteristic of this Ecological Site, in terms of its influence on forest community dynamics, is its lack of capacity to support high nutrient requiring species such as sugar maple, basswood and white ash, the shade-tolerant species, that typically dominate the more productive sites throughout Wisconsin.

In pre-European settlement time wild fire was the main controlling factor of forest community dynamics. Following a severe, stand-replacing fire, any of the species present on the landscape could become established, depending on seed source availability and specific conditions of post-fire seedbed. The newly established young stands of any species were easily eliminated by recurring fires, but differences in fire-resisting properties among the species began to play a role in any species' survival success. White pine is best adapted for long-term success on this Ecological Site. Although vulnerable to damage or elimination by fire in early life it eventually develops thick fire-resistant bark which helps to extend its longevity, in some cases for up to four centuries or more. These survival properties assure the species' relatively continuous seed source in the region as a whole. White pine is also moderately shade-tolerant in early life which means that it can become established in some pioneer communities, such as aspen – white birch stands, or in poorly stocked oak and red maple dominated communities. Red pine had in the past been a common associate of white pine stands. It shares some of the fire-resisting properties of white pine, but it lacks shade-tolerance and does not become established in the understory. For this reason, it has not maintained its presence in current stands and its seed source has been greatly reduced throughout its natural range following the unset of fire suppression. Several species of oak are common members of forest communities on this ecological site. Northern pin oak (Q. ellipsoidalis) and, to a lesser degree, black oak (Q. velutina), are intolerant of shade and do not reproduce from seed under existing canopies. However, following fire or clear cutting they respond by sprouting from stumps. In the absence of disturbance they are replaced, through succession, by more shade-tolerant white pine, red maple (Acer rubrum), or white oak (Q. alba). Red oak (Q. rubra) is less shade-tolerant than the preceding species, but often reproduces in larger canopy gaps.

Red maple has not been identified by Finley (1976) as an important component of pre-settlement pine or oak forests, but it is a prominent member in current stands. Absence of fire since the original logging era is probably the main reason. Red maple is extremely sensitive to fire damage, but is a prolific and early seed producer. Stems of 2-4 inches in diameter can produce large amounts of seed (USDA For. Serv. 1990). It is sufficiently shade-tolerant to become established in the understories of most communities on sandy soils. On this Ecological Site it behaves similarly to white pine, but because of its much smaller size at maturity, it does not compete with white pine in the upper canopy.

## 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 (%) |
|---|---|---|---|---|---|

**Table 6. Community 1.2 plant community composition**

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

**Table 7. Community 2.1 plant community composition**

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

**Table 8. Community 2.2 plant community composition**

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

**Table 9. Community 2.3 plant community composition**

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

**Table 10. Community 2.4 plant community composition**

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

**Table 11. Community 3.1 plant community composition**

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

**Table 12. Community 4.1 plant community composition**

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

## Inventory data references

Plot and other supporting inventory data for site identification and community phases is located on a NRCS North Central Region shared and one drive folder. University Wisconsin-Stevens Point described soils, took photographs, and inventoried vegetation data at community phases within the reference state. The data sources include WI ESD Plot Data Collection Form - Tier 2, Releve Method, NASIS pedon description, NRCS SOI 036, photographs, and Kotar Habitat Types.

## Other references


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## Approval

Suzanne Mayne-Kinney, 9/27/2023

## 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 | 09/27/2023 |
| Approved by | |
| 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):**

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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:**

    **Sub-dominant:**

    **Other:**

    **Additional:**

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

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

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

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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:**

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17. **Perennial plant reproductive capability:**

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