Ecological site F089XY011WI
Moist Sandy Lowland Forest

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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: Central Wisconsin Sand Plain (222Ra) Small sections occur in the Neillsville Sandstone Plateau (222Rb), Central Wisconsin Moraines and Outwash (222Kb), and Lincoln Formation Till Plain - Mixed Hardwoods (212Qb) 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 four habitat types: Pinus/Vaccinium-Gaultheria (PVG); Acer rubrum/Desmodium (ArDe); Acer rubrum/Desmodium, Vaccinium variant (ArDe-V); Pinus strobus-Acer rubrum/Vaccinium-Rubus hispidus (PArVRh) Biophysical Settings (Landfire, 2014): This ES is largely mapped as North-Central Interior Maple-Basswood Forest, North-Central Interior Dry Oak Forest and Woodland, North-Central Oak Barrens Woodland, Laurentian Oak Barrens. WDNR Natural Communities (WDNR, 2015): This ES is most similar to the Central Sands Pine-Oak Forest and Northern Dry-mesic Forest communities.

Ecological site concept

The Moist Sandy Outwash Uplands ecological site is widespread on the eastern portion of MLRA 89, which is dominated by an expansive sand plain created from the deposition of sandy outwash and sandy lacustrine materials by glacial meltwaters and Glacial Lake Wisconsin, respectively. These sites are characterized by very deep, somewhat poorly drained soils that formed in sandy outwash and sandy lacustrine. Some sites have sandy or loamy drift and/or alluvium. Precipitation, runoff from adjacent uplands, groundwater discharge are the primary sources of water. Soils range from very strongly acid to slightly acid. These conditions are clearly reflected by floristic composition of plant communities. Historically, this Ecological Site was dominated by a variety of plant communities, apparently reflecting differences in fire regime. Prairie, Pine Barrens, Oak Barrens, Oak Savanna and mixed Pine - Oak forests were all represented (Finley,1976). Following European settlement most of the area was cleared of forest vegetation and converted to farming, although scattered woodlots remained. Current woodlots typically consist of mixed oak, primarily white oak (Q. alba) and Red oak (Q. rubra), white pine (Pinus strobus) and red maple (Acer rubrum).. There are also considerable areas of planted red pine (P. resinosa). Even though this Ecological Site is classified as Somewhat Poorly Drained, these conditions are not uniform across the landscape. Species reflecting

relatively high soil moisture, such as winterberry (Ilex verticillata), swamp dewberry (Rubus hispidus) and sensitive fern (Onoclea sensibilis), occur only sporadically. Moist Sandy Outwash Uplands differs from other sites based on its deep sandy deposits and somewhat poorly drained soils. These sites formed in outwash and lacustrine sands that are not siliceous, differentiating them from Moist Siliceous Sand Uplands. Sites with outwash sand tend to be more productive than the siliceous sands, and the vegetative communities supported by outwash sands may be slightly different from those supported by siliceous sands. Depth to bedrock sets apart Moist Sandy Bedrock Uplands. The somewhat poor drainage of this site differs it from other sandy sites.

Associated sites

F089XY017WI	**Sandy Upland Forest** Sandy Outwash Uplands primarily consist of deep sandy outwash deposits. Soils are somewhat excessively to excessively drained and are primarily found east of the Yellow River. They occur higher on the drainage sequence and are drier than Moist Sandy Outwash Uplands.
F089XY002WI	**Organic Swamps** Mucky Swamps sites consist of herbaceous organic materials sometimes underlain by sandy to loamy mineral soil. They are very poorly drained and remain saturated throughout much of the year. These sites are wetlands and they occur lower on the drainage sequence and are much wetter than Moist Sandy Outwash Uplands.
F089XY006WI	**Wet Sandy Lowland Forest** Wet Sandy Outwash Lowlands consist of deep sandy deposits derived from a mixture of outwash, alluvium, and lacustrine sources. They are very poorly to poorly drained, remain saturated for much of the growing season, and are subject to frequent ponding. These sites are primarily found in the eastern half of the Wisconsin Central Sands MLRA. They occur lower on the drainage sequence and are wetter than Moist Sandy Outwash Uplands.

Similar sites

F089XY015WI	**Moist Clayey Lowland Forest** Moist Clayey Uplands consist of deep clayey lacustrine deposits overlain by sandy or loamy alluvium. 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, especially in Juneau County adjacent to the Lemonweir River. Despite the differences in texture, these sites have vegetative communities similar to those of Moist Sandy Outwash Uplands.
F089XY010WI	**Moist Sandy Bedrock Upland Forest** Moist Sandy Bedrock Uplands sites consist of sandy deposits derived from a mixture of outwash, alluvium, and lacustrine sources. They have contact with sandstone bedrock within 40 inches (102 cm) of the surface. These soils are somewhat poorly drained. These sites are found to the west of the Wisconsin River, mostly in Clark and Jackson counties where the depth of bedrock is shallow. Their vegetative communities are similar to those of Moist Sandy Outwash Uplands.
F089XY012WI	**Moist Sandy Nutrient Limited Lowland Forest** Moist Siliceous Sand Uplands consist of deep sandy deposits sourced primarily from the weathering of sandstone high in silica. The weathered sand was deposited by rivers or glacial lakes. They are somewhat poorly drained and are subject to neither flooding nor ponding. These sites are found west of the Wisconsin River. Their vegetative communities are similar to those of Moist Sandy Outwash Uplands.

Table 1. Dominant plant species

Tree	(1) *Pinus strobus* (2) *Quercus alba*
Shrub	(1) *Acer rubrum*
Herbaceous	(1) *Vaccinium* (2) *Pteridium aquilinum*

Physiographic features

This site occurs on depressions, drainageways, and flats in outwash plains and stream terraces. Slops range from 0 to 3 percent. Elevation ranges from 590 to 1,804 feet (180 to 550 meters) above sea level. These sites are not subject to ponding or flooding. Soils have an apparent seasonally high water table (endosaturation) at depths of 6 to 30 inches (15 to 76 cm) but can drop to 60 inches (150 cm) during dry conditions. Runoff is negligible to very low.

Figure 1. Distribution of Moist Sandy Outwash Uplands in the Wisconsin Central Sands MLRA (89).

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope
Slope shape up-down	(1) Linear
Slope shape across	(1) Linear
Landforms	(1) Depression (2) Drainageway (3) Flat
Runoff class	Negligible to very low
Flooding frequency	None
Ponding frequency	None
Elevation	180 – 550 m
Slope	0 %
Water table depth	20 – 80 cm

Aspect	Aspect is not a significant factor

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 PESD is 33 inches. The average annual snowfall is 43 inches. The annual average maximum and minimum temperatures are 56°F and 34°F, respectively.

Table 3 Representative climatic features

Frost-free period (characteristic range)	110-120 days
Freeze-free period (characteristic range)	140-140 days
Precipitation total (characteristic range)	810-840 mm
Frost-free period (actual range)	100-120 days
Freeze-free period (actual range)	130-140 days
Precipitation total (actual range)	810-860 mm
Frost-free period (average)	110 days
Freeze-free period (average)	140 days
Precipitation total (average)	840 mm

- (1) FRIENDSHIP [USC00472973], Adams, WI
- (2) NECEDAH [USC00475786], Necedah, WI
- (3) STEVENS POINT [USC00478171], Stevens Point, WI
- (4) HANCOCK EXP FARM [USC00473405], Hancock, WI
- (5) WISCONSIN RAPIDS [USC00479335], Wisconsin Rapids, 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. Permeability of these sites range from slow to moderately rapid. Hydrologic group is A/D.

Soil features

These sites are represented by the Au Gres, Meehan, Leola, and Brems soil series. Au Gres is classified as a Typic Endoaquod, Meehan and Brems are Aquic Udipsamments, and Leola is an Aquic Arenic Hapludalf. 87% of the acreage of this site is classified as Aquic Udipsamments.

These soils primarily formed in outwash sands, but some formed in sandy lacustrine deposits or sandy drift. Soils are very deep and somewhat poorly drained. They do not meet hydric requirements.

The surface of these sites is primarily loamy sand, though some sites are comprised of moderately decomposed herbaceous organic material (hemic materials), sand, or fine sandy loam. Subsurface textures are sand, loamy sand, and sandy loam. Soil pH ranges from very strongly acid to slightly acid with values of 4.7 to 6.2. Surface fragments are absent. Subsurface fragments less than 3 inches are present from 2 to 36 percent volume. Subsurface fragments greater than 3 inches can be present up to 3 percent volume. Carbonates are absent.

Table 4. Representative soil features

Parent material	(1) Outwash (2) Lacustrine deposits (3) Drift
Surface texture	(1) Sand (2) Loamy sand (3) Sandy loam
Drainage class	Somewhat poorly drained
Permeability class	Slow to moderately rapid
Soil depth	200 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-152.4cm)	6.25 – 15.75 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	4.7 – 6.2

Subsurface fragment volume <=3" (0-203.2cm)	0 – 40 %
Subsurface fragment volume >3" (0-203.2cm)	Not specified

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 the high to moderate soil moisture and 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 somewhat less shade-tolerant than the preceding species, and reproduces sporadically in larger canopy gaps and following a major stand disturbance.

Although red maple has not been identified by Finley (1976) as an important component of pre-settlement pine or oak forests, 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.

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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	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):**

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

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

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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:**
