Ecological site F092XY010WI
Moist Sandy Lowlands

Last updated: 4/09/2020
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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): 092X–Superior Lake Plain

The Wisconsin portion of the Superior Lake Plain (MLRA 92) corresponds very closely to the Superior Coastal Plain Ecological Landscape published by Wisconsin Department of Natural Resources (WDNR 2015). The following brief overview of this MLRA is borrowed from that publication.

The Superior Coastal Plain is bordered on the north by Lake Superior and on the south by the Northwest Sands, Northwest Lowlands, and North Central Forest Ecological Landscapes. The total land area is approximately 1.2 million acres, which mostly consists of privately-owned forestland. The climate is strongly influenced by Lake Superior, resulting in cooler summers, warmer winters, and greater precipitation compared to more inland locations. The most extensive landform in this ecological landscape is a nearly level plain of lacustrine clays that slopes gently northward toward Lake Superior. The coastal plain is cut by deeply incised stream drainages and interrupted by the comparatively rugged Bayfield Peninsula.

During the Late Wisconsin glacial period, this area was covered with the advancing and retreating lobes of Superior and Chippewa. The landscape was rippled with moraines, but they were subdued by deposition of lacustrine materials. As the glaciers receded, glacial lakes riddled the landscape—most notably, Glacial Lake Duluth. The glacier receded eastward, exposing the western Lake Superior Basin. The ice covered the eastern basin, blocking the outlet of the lake, and continued to recede and contribute meltwaters that filled the glacial lake. The deep, red clays were deposited during this period of glacial lakes. The meltwaters from the glacier also contained sands which were deposited along the edge of the glacial lakes as beach deposits. Deep, narrow valleys have since been carved by rivers and streams flowing north into Lake Superior.

Historically, the Superior Coastal Plain was almost entirely forested. Various mixtures of eastern white pine (*Pinus strobus*), white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), white birch (*Betula papyrifera*), balsam poplar (Populus balsamifera), quaking aspen (*Populus tremuloides*), and northern white-cedar (*Thuja occidentalis*) occurred on the fine-textured glacio-lacustrine deposits bordering much of the Lake Superior coast. Sandy soils, sometimes interlayered with clays, occur in some places. Such areas supported forests dominated by eastern white pine and red pine (Pinus resinosa). Eastern white pine was strongly dominant in some areas, according to mid-19th century notes left by surveyors of the federal General Land Office (Finley, R. 1976). Dry-mesic to wet-mesic northern hardwoods or hemlock-hardwood forests were prevalent on the glacial tills of the Bayfield Peninsula. Large peatlands occurred along the Lake Superior shoreline, associated with drowned river mouths.

Classification relationships

Habitat Types of N. Wisconsin (Kotar, 2002): Two sites in this ES key out to *Acer rubrum – Abies balsamea /* Vaccinium spp. – Cornus canadensis [ArAbVCo], and one site keys out to Acer saccharum / Sanicula spp. - Mitchella repens [ASnMi]

Biophysical Setting (Landfire, 2014): This is ES is mapped as Larentian – Acadian Northern Hardwoods Forest –

Hemlock, Laurentian – Acadian Sub-boreal Mesic Balsam Fir-Spruce Forest, Laurentian – Acadian – Northern Pine – (Oak) Forest, and Laurentian – Acadian Sub-Boreal Aspen – Birch Forest. The ES is not well represented by any of these, but most similar to Sub-Boreal Mesic Balsam Fir - Spruce Forest.

WDNR Natural Communities (WDNR, 2015): This ES is not well represented by any of the described natural communities, but bears some resemblance to Northern Wet-Mesic Forest and Boreal Forest.

USFS Subregions: Superior-Ashland Clay Plain Subsection (212Ya); May contain small areas of Ewen Dissected Lake Plain Subsection (212Jo), Winegar Moraines Subsection (212Jc), Gogebic-Penokee Iron Range Subsection (212Jb), and NorthShore Highlands Subsection (212Lb)*

Major Land Resource Area (MLRA): Superior Lake Plain (92)

Ecological site concept

Moist Sandy Lowlands appear throughout MLRA 92, but are most common in the southern portion of Douglas county. This site occurs on plains, drainageways, terraces, and footslopes located on lake plains and outwash plains. Landform shape is predominantly linear, but can be slightly concave. These sites are characterized by very deep, somewhat poorly drained soils formed in a sandy outwash mantle overlying silty, loamy, and sandy glaciofluvial deposits. The stratified deposits typically occur below 100 cm. The underlain finer materials cause episaturation in the profile, perching a seasonally high water table in the spring, and sometimes in the fall. Water is primarily received through precipitation, but runoff and groundwater discharge are common. The soil ranges from slightly to very strongly acid.

Based on historic records, ecological and soils literature, and scattered examples of old forest stands (Curtis, 1959; Finley,1976; Wilde, 1976; Schulte and Mladenoff 2001; Kotar et al. 2002) we can conclude that this Ecological Site historically was dominated primarily by coniferous forests. Balsam fir and white spruce were major dominants, but there were considerable admixtures of white and red pine. Mesic hardwoods, especially sugar maple and basswood, find soil conditions on this Ecological Site to be sub-optimal and they occur only sporadically. The 19th and early 20th century logging and associated fires have drastically altered the forest composition and structure. Today's stands are most often dominated by varying mixtures of aspen, white birch, red maple and balsam fir. Ground flora includes bunchberry, Canada mayflower, American starflower, and hazelnuts.

This ES is somewhat poorly drained, making it wetter than Sandy Sandstone Uplands and Sandy Uplands, but not as wet as Wet Sandy Depressions. This ES has coarser texture and is more acidic than Moist Loamy Lowlands and Moist Clayey Lowlands. Moist Sandy Lowlands often do not remain as saturated as long as the Moist Loamy or Clayey Lowlands.

Associated sites

F092XY006WI	**Wet Sandy Lowlands** Wet Sandy Depressions are poorly or very poorly drained sandy soils that have formed in outwash and lake plains. The sites are seasonally ponded depressions that remain saturated for sustained periods, allowing for hydric conditions to occur. Primarily associated with Kinross soil series. HGM criteria: recharge; Depressional. These sites are often adjacent to Moist Sandy Lowlands, but located on a lower landscape position in the drainage sequence.
F092XY013WI	**Sandy Uplands** These sites are formed primarily in sandy outwash or beach deposits, and some are underlain by finer glaciofluvial material. Sites are moderately well to well drained, but sites with underlying finer materials may have extended saturation in spring and fall. Sites range from strongly acid to neutral and may contain carbonates. These sites are often adjacent to Moist Sandy Lowlands, but located on a higher landscape position in the drainage sequence.
F092XY008WI	**Sandy Sandstone Uplands** These sites are shallow sandy soils that overly sandstone bluffs along the shore of Lake Superior. They are excessively drained, do not remain saturated any time of the year, and are strongly acidic. These sites may be adjacent to Moist Sandy Lowlands, but located on a higher landscape position in certain landforms.

Similar sites

F092XY011WI	**Moist Loamy Lowlands** These sites are somewhat poorly drained soils formed in various parent materials, but primarily are primarily loamy. The loamy texture causes the soil to remain moist for much of the growing season, but does not remain saturated long enough to form hydric conditions. Both sites are characterized by the ArAbVCo Habitat Type. These sites are found in a similar landscape to Moist Sandy Lowlands, but are finer textured and in a different drainage sequence.
F092XY012WI	**Moist Clayey Lowlands** These sites are somewhat poorly drained soils with fine textures that formed in clayey deposits. Some sites have a sandy or loamy mantle. The fine materials cause episaturation in spring and fall and remain saturated for extended period, but the water table can reach depths of 152cm during dry periods. Soils range from strongly acid to strongly alkaline. Carbonates present in some soils beginning at 30cm. Both sites are characterized by the ArAbVCo Habitat Type. These sites are found in a similar landscape to Moist Sandy Lowlands, but are finer textured and in a different drainage sequence.

Table 1. Dominant plant species

Tree	(1) *Acer rubrum* (2) *Abies balsamea*
Shrub	(1) *Corylus cornuta* (2) *Amelanchier*
Herbaceous	(1) *Eurybia macrophylla* (2) *Cornus canadensis*

Physiographic features

This site occurs on plains, drainageways, terraces, and footslopes located on lake plains and outwash plains. Landform shape is predominantly linear, but can be slightly concave. Elevation of the landforms range from 185 to 330 meters above sea level. Slopes are 0 to 3 percent. This site occurs on all slope aspects.

Table 2. Representative physiographic features

Landforms	(1) Plains > Drainageway (2) Plains > Terrace
Runoff class	Medium to high
Elevation	607–1,083 ft
Slope	0–3%
Water table depth	12–30 in
Aspect	Aspect is not a significant factor

Climatic features

The Moist Sandy Lowlands PESD is located throughout the MLRA, but most concentrated along the southern extent with some sites extending up into the Bayfield Peninsula. The annual average precipitation ranges from 29-33 inches, with a range of 56-132 inches of annual average snowfall (PRISM, 1981-2010). The annual average minimum temperature ranges from 29-32oF, and the maximum temperature ranges from 50-52oF (PRISM, 1981-2010). The length of the freeze-free period ranges from 156 to 194 days, with an average of 168 days (Table 2). The length of the frost-free period ranges from 130 to 166 days, with an average of 141 days (Table 2).

Table 3. Representative climatic features

Frost-free period (characteristic range)	75-103 days
Freeze-free period (characteristic range)	111-130 days
Precipitation total (characteristic range)	31-32 in
Frost-free period (actual range)	67-111 days
Freeze-free period (actual range)	106-135 days

Precipitation total (actual range)	31-32 in
Frost-free period (average)	89 days
Freeze-free period (average)	121 days
Precipitation total (average)	32 in

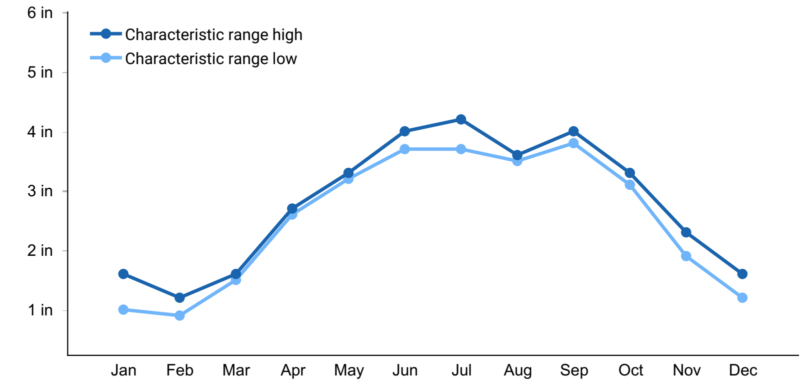


Figure 1. Monthly precipitation range

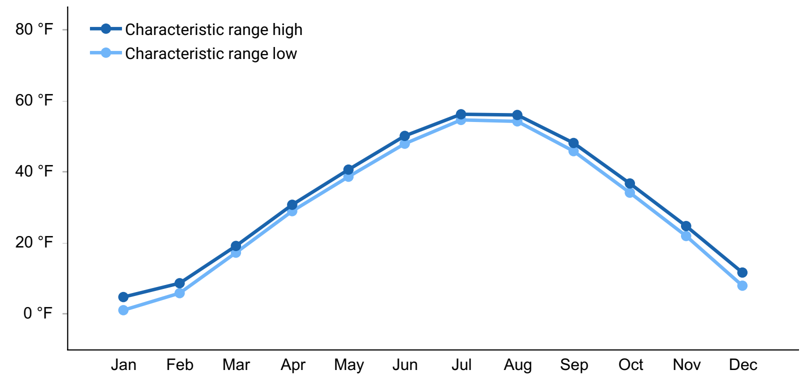


Figure 2. Monthly minimum temperature range

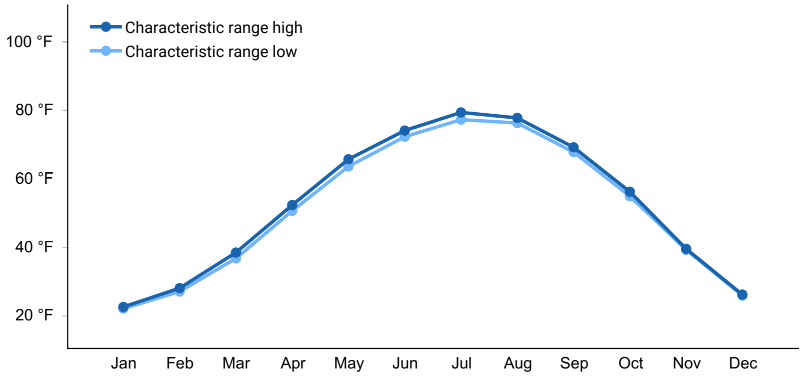


Figure 3. Monthly maximum temperature range

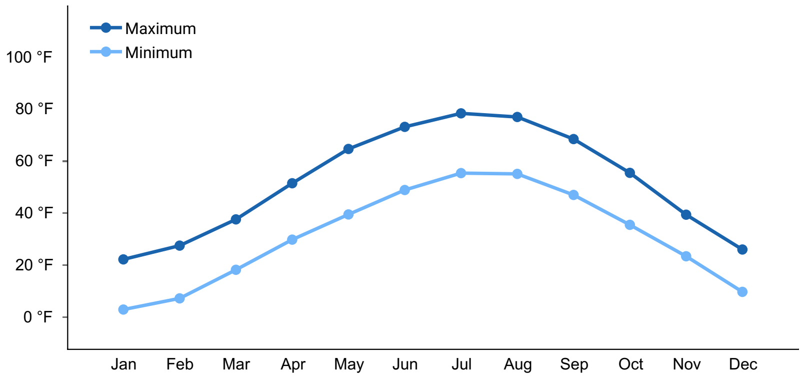


Figure 4. Monthly average minimum and maximum temperature

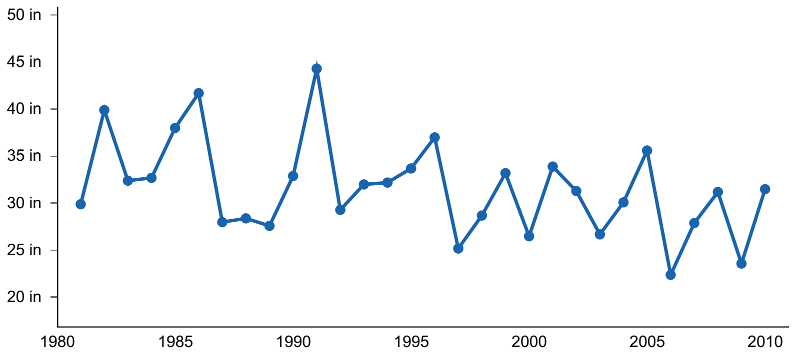


Figure 5. Annual precipitation pattern

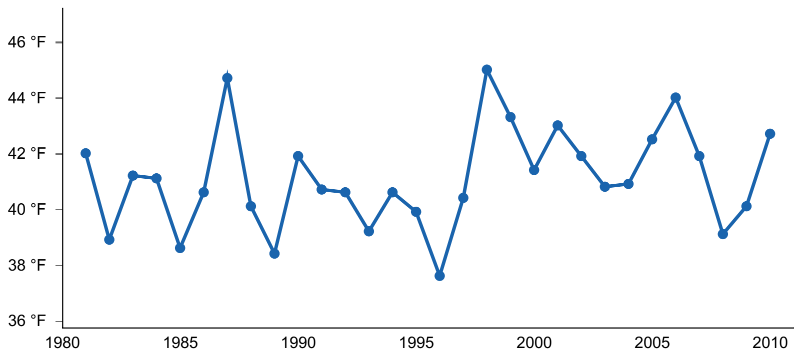


Figure 6. Annual average temperature pattern

Climate stations used

- (1) ASHLAND 3S [USC00470347], Ashland, WI
- (2) BAYFIELD 6 N [USC00470603], Bayfield, WI
- (3) FOXBORO [USC00472889], Foxboro, WI

Influencing water features

Water is received primarily through precipitation, from runoff from adjacent uplands, and from ground water. Water is lost from the site primarily through runoff, evapotranspiration, and ground water recharge.

Permeability of the soil is slow. Runoff potential is negligible to medium. The hydrologic group of this site is C.

Enough water will percolate into the soil resulting in a perched seasonally high water table (episaturation) at a depth of 30 to 76 cm during spring, but will range to greater than 122 cm under dry conditions. Water that percolates into the soil is generally lost through plant uptake and evapotranspiration. There is a high potential for significant ground water recharge.

Soil features

The soils of this site are represented by the Flink, Au Gres, Nemadji, and Winola soil series. The soil series in this ES are classified as either Epiaquods or Endoaquods.

This ecological site is characterized by very deep, somewhat poorly drained soils formed in sandy outwash over stratified silty, loamy and sandy glaciofluvial deposits. The stratified deposits typically occur at a depth below 100 cm.

The average gravel content within the soil can be as much as 5 percent, while the content of cobbles and stones is 0 percent. Soil reaction (pH) in the upper 100 cm ranges from very strongly acid to slightly acid. Carbonates are absent within 200 cm.

Table 4. Representative soil features

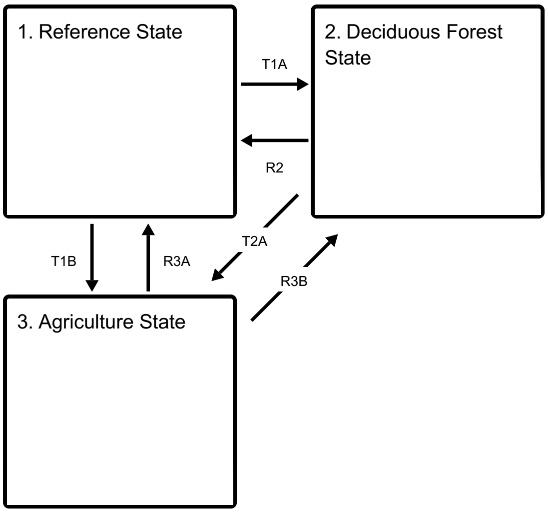
Parent material	(1) Outwash (2) Glaciofluvial deposits
Surface texture	(1) Sand
Drainage class	Somewhat poorly drained
Permeability class	Slow
Soil depth	80 in
Available water capacity (0-60in)	4.7 in
Soil reaction (1:1 water) (0-40in)	4.8–6.2
Subsurface fragment volume <=3" (0-40in)	0–5%

Ecological dynamics

Because of relatively poorly drained soils historic fire disturbance has likely been less frequent and less severe than on the better drained sites. This is evident by the presence (historic and current) of shade-tolerant and fire sensitive species such as red maple, balsam fir and white spruce. Aspen stands are common in current communities, but they are largely the result of fires associated with past logging. Red maple and balsam fir are the most obvious succeeding species, but white pine and white spruce may also become more important in the future as seed source availability increases. Although the shade-tolerant sugar maple occurs sporadically in some stands its competitive ability is reduced by excessive soil moisture and relatively low nutrient availability. For these reasons it is likely to remain only as a sporadic associate rather than the dominant component of mature forest communities as is typically the case on all mesic sites throughout northern Wisconsin.

State and transition model

Ecosystem states



T1A - Stand replacing disturbance that includes fire.

T1B - Removal of forest cover and tilling for agricultural crop production.

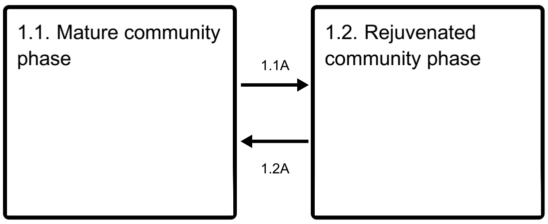
R2 - Deciduous forest community is slowly invaded by conifers.

T2A - Removal of forest cover and tilling for agricultural crop production.

R3A - Cessation of agricultural practices leads to natural reforestation, or site is replanted.

R3B - Cessation of agricultural practices leads to natural reforestation, or site is replanted.

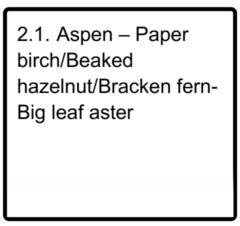
State 1 submodel, plant communities



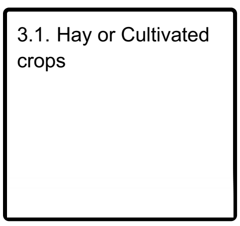
1.1A - Blow-down, severe ice storm, or large-scale mortality in overstory.

1.2A - Advanced regeneration response to canopy disturbance.

State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

Reference state is a forest community dominated by mixed conifers, principally balsam fir (*Abies balsamea*) and white spruce (*Picea glauca*) and scattered individuals of northern white cedar (*Thuja occidentalis*), or white pine

(*Pinus strobus*), often with admixture of several deciduous species, typically trembling aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*), or red maple (*Acer rubrum*). Depending on history of disturbance, two community phases can be distinguished largely by differences in dominance of tree species and community age structure.

Community 1.1
Mature community phase

In absence of stand replacing disturbance (period of 60-80 years) this community is dominated entirely by conifers, or it contains an admixture of old and decaying stems of aspen and/or paper birch. This mixture would be a result of typical succession process of conifer invasion of pioneer aspen-birch stands. In some areas, white pine, northern red cedar, or red maple are common associates. Pre-European settlement forests often contained scattered very large, old white pines that had survived one or more stand-replacing fires in the past. The tree reproduction layer is dominated by balsam fir, with lesser abundance of white spruce and/or red maple. The density of the reproduction is strongly dependent on degree of canopy openings resulting from natural mortality, or small scale disturbance by wind and ice storms. The shrub and herb layers also depend on the degree of canopy opening. The dominant shrub typically is beaked hazel (*Corylus cornuta*). Common associates are mountain maple (*Acer spicatum*), juneberry (Amelanchier spp.), bush- honeysuckle (*Diervilla lonicera*), fly-honeysuckle (Lonicera Canadensis) and blueberries (Vaccinium spp.). The herb layer often is well developed and species rich. Bracken fern (Pteridiun equilinum) and large-leaved aster (*Eurybia macrophylla*) typically dominate the layer. Other well-represented species include, wild sarsaparilla (*Aralia nudicaulis*), bunchberry (Cornus Canadensis), twisted stalk (Streptopus roseus), yellow Bead-lily (*Clintonia borealis*) and sweet-scented bedstraw (*Galium triflorum*).

Community 1.2
Rejuvenated community phase

Disturbance described in 1.1A typically removes over-mature trees, especially old aspen and birch, from the overstory and releases advanced regeneration of balsam fir and white spruce, leading to community dominated by these species. Some presence of red maple and white pine may also result under favorable conditions, but trembling aspen and paper birch regeneration typically is not successful if disturbances do not include fire.

Pathway 1.1A
Community 1.1 to 1.2

Blow-down, severe ice storm, or large scale mortality in overstory

Pathway 1.2A
Community 1.2 to 1.1

Rejuvenated community matures into Community Phase 1.1 in a self-replacement process.

State 2
Deciduous Forest State

Pure, or mixed, aspen – paper birch community replaces the reference state community 1. If seed source is present, red maple readily becomes member of this community.

Community 2.1
Aspen – Paper birch/Beaked hazelnut/Bracken fern-Big leaf aster

This deciduous forest phase is commonly composed of pioneering or disturbance related species such as aspen and/or paper birch. If the seed source is present red maple will like be present in these stands as well. Beaked hazelnut can be a common shrub in this phase as it progresses in age.

State 3

Agriculture State

When farmed these ecological sites are likely in hay or other cultivated crops.

Community 3.1
Hay or Cultivated crops

Agricultural phase including hay or other cultivated crops.

Transition T1A
State 1 to 2

Stand replacing disturbance that may include blow-down or ice storm, but must include fire to eliminate slash and competing vegetation and expose mineral soil to allow aspen and/or paper birch to colonize the site by seed. Alternatively, if the disrupted reference state community included aspen trees, the species may become re-established by vegetative means, which typically is more successful than colonization by seed.

Transition T1B
State 1 to 3

Removal of forest cover and tilling for agricultural crop production

Restoration pathway R2
State 2 to 1

Deciduous forest community is slowly invaded by conifers

Transition T2A
State 2 to 3

Removal of forest cover and tilling for agricultural crop production

Restoration pathway R3A
State 3 to 1

Cessation of agricultural practices leads to natural reforestation, or site is replanted.

Restoration pathway R3B
State 3 to 2

Cessation of agricultural practices leads to natural reforestation, or site is replanted.

Additional community tables

Other references

Cleland, D.T.; Avers, P.E.; McNab, W.H.; Jensen, M.E.; Bailey, R.G., King, T.; Russell, W.E. 1997. National Hierarchical Framework of Ecological Units. Published in, Boyce, M. S.; Haney, A., ed. 1997. Ecosystem Management Applications for Sustainable Forest and Wildlife Resources. Yale University Press, New Haven, CT. pp. 181-200.

County Soil Surveys from Douglas, Bayfield, and Ashland Counties.

Curtis, J.T. 1959. Vegetation of Wisconsin: an ordination of plant communities. University of Wisconsin Press, Madison. 657 pp.
Davis, R.B. 2016. Bogs and Fens, A Guide to the Peatland Plants of Northeastern United States and Adjacent Canada. University Press of New England, Hanover and London. 296 pp.

Finley, R. 1976. Original vegetation of Wisconsin. Map compiled from U.S. General Land Office notes. U.S. Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Hvizdak, David. Personal knowledge and field experience.

Jahnke, J. and Gienccke, A. 2002. MLRA 92 Clay Till Field Investigations. Summary of field day investigations by Region 10 Soil Data Quality Specialists.

NatureServe. 2018. International Ecological Classification Satandard: Terrestrial Ecological Classifications. NautreServe Centreal Databases. Arlington, VA. U.S.A. Data current as of 28 August 2018.

Kotar, J. 1986. Soil – Habitat Type relationships in Michigan and Wisconsin. J. For. and Water Cons. 41(5): 348-350.

Kotar, J., J.A. Kovach and G. Brand. 1999. Analysis of the 1996 Wisconsin Forest Statistics by Habitat Type. U.S.D.A. For. Serv. N.C. Res. Stn. Gen. Tech. Rept. NC-207.

Kotar, J., J. A. Kovach, and T. L. Burger. 2002. A Guide to Forest Communities and Habitat Types of Northern Wisconsin. Second edition. University of Wisconsin-Madison, Department of Forest Ecology and Management, Madison.

Kotar, J., and T. L. Burger. 2017. Wetland Forest Habitat Type Classification System for Northern Wisconsin: A Guide for Land Managers and landowners. Wisconsin Department of Natural Resources, PUB-FR-627 2017, Madison.

Martin, L. 1965. The physical geography of Wisconsin. Third edition. The University of Wisconsin Press, Madison.

McNab, W.H. and P.W. Avers. 1994. Ecological Subregions of the United States: Section Descriptions. USDA For. Serv. Pun. WO-WSA-5, Washington, D.C.

Radeloff, V.C., D.J. Mladenoff, H.S. He and M.S. Boyce. 1999. Forest landscape change in Northwestern Wisconsin Pine Barrens from pre-European settlement to the present. Can. J. For. Res. 29: 1649-1659.

Schulte, L.A., and D.J. Mladenoff. 2001. The original U.S. public land sur¬vey records: their use and limitations in reconstructing pre-European settlement vegetation. Journal of Forestry 99:5–10.

Schulte, L.A., and D.J. Mladenoff. 2005. Severe wind and fire regimes in northern forests: historical variability at the regional scale. Ecology 86(2):431–445.

Soil Survey Staff. Input based on personal experience. Tim Miland, Scott Eversoll, Ryan Bevernitz, and Jason Nemecek.

Stearns, F. W. 1949. Ninety years change in a northern hardwood forest in Wisconsin. Ecology, 30: 350-58.

United States Department of Agriculture, Forest Service. 1989. Proceedings – Land Classification Based on Vegetation: Applications for Management. Gen. Tech. Report INT-527.

United States Department of Agriculture, Forest Service. 1990. Silvics of North America, Vol. 1, Hardwoods. Agricultural Handbook 654, Washington, D.C.

United States Department of Agriculture, Forest Service. 1990. Silvics of North America, Vol. 2, Conifers. Agricultural Handbook 654, Washington, D.C.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource and Major Land Resource Areas of the United Sates, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

United States Department of Agriculture, Natural Resources Conservation Service. 2008. Hydrogeomorphic

Wetland Classification System: An Overview and Modification to Better Meet the Needs of the Natural Resources Conservation Service. Technical Note No. 190-8-76. Washington D.C.

Wilde, S.A. 1933. The relation of soil and forest vegetation of the Lake States Region. Ecology 14: 94-105.

Wilde, S.A. 1976. Woodlands of Wisconsin. University of Wisconsin Cooperative Extension, Pub. G2780, 150 pp.

Wisconsin Department of Natural Resources. 2015. The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management. Wisconsin Department of Natural Resources, PUB-SS-1131 2015, Madison.

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Approval

Chris Tecklenburg, 4/09/2020

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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	11/13/2024
Approved by	Chris Tecklenburg
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):

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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:**
