

Ecological site F093AY011MN

Dry Sandy Upland Forest

Last updated: 9/06/2024
Accessed: 08/31/2026

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): 093A–Superior and Rainy Stony and Rocky Till Plains and Moraines

The Superior Stony and Rocky Loamy Plains and Hills, Western Part is located and completely contained in northeastern Minnesota. This area has both the highest and lowest elevations in the state, as well as some of the state's most rugged topography (Ojakangas and Matsch, 1982). The MLRA was glaciated by numerous advances of the Superior, Rainy, and Des Moines glacial lobes during the Wisconsin glaciation as well as pre-Wisconsin glacial periods. The geomorphic surfaces in this MLRA are geologically very young (i.e., 10,000 to 20,000 years) and dominated by drumlin fields, moraines, small lake plains, outwash plains, and bedrock-controlled uplands (USDA-NRCS, 2022). There are thousands of lakes scattered throughout the region that were created by these glacial events. Most of these lakes are bedrock-controlled in comparison to adjacent glaciated regions where glacial drift deposits are much thicker and the lakes occur in depressions atop the glacial drift (Ojakangas and Matsch, 1982). In contrast to adjacent MLRAs, the depth to the predominantly crystalline or sandstone bedrock in MLRA 93A is relatively shallow because the most recent glacial events were more erosional than depositional (Ojakangas and Matsch, 1982).

Classification relationships

Major Land Resource Area (MLRA): Superior Stony and Rocky Loamy Plains and Hills, Western Part (93A) USFS Subregions: Northern Superior Uplands Section (212L); North Shore Highlands Subsection (212Lb) Relationship to Other Established Classifications: F093AY012MN Northern Dry-Sand Pine Woodland, Fire-Dependent Forest/Woodland System, Northern Floristic Region, Minnesota Department of Natural Resources

Ecological site concept

This site is a dry jack pine-red pine woodland and located on outwash plains and moraines. Soils are course textured, well drained to excessively drained, and have a low available water capacity. Historically, fire was a common disturbance that influenced plant community composition. Jack pine, red pine, and balsam fir have frequent occurrence and moderately high cover on this site.

Associated sites

F093AY012MN	Sandy Upland Forest The Sandy Upland Forest ecological site is located on uplands with soils that are course textured and moderately well drained to somewhat excessively drained. Available water capacity ranges from 2-5 inches.
-------------	---

Similar sites

F093AY012MN	Sandy Upland Forest The Sandy Upland Forest ecological site is located on uplands with soils that are course textured and moderately well drained to somewhat excessively drained. Available water capacity ranges from 2-5 inches.
-------------	---

Table 1. Dominant plant species

Tree	(1) <i>Pinus banksiana</i> (2) <i>Pinus resinosa</i>
Shrub	(1) <i>Vaccinium angustifolium</i> (2) <i>Amelanchier</i>
Herbaceous	(1) <i>Maianthemum canadense</i> (2) <i>Pteridium aquilinum</i>

Physiographic features

This upland site is located on outwash plains and moraines. No flooding or ponding occurs. The available water capacity ranges from 2-4.5 inches (5 - 11 centimeters) and the vegetation consists of tree species tolerant of dry soil conditions.

Table 2. Representative physiographic features

Landforms	(1) Outwash plain (2) Moraine
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	310 – 530 m
Slope	0 – 60 %
Water table depth	200 cm
Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation is 26-32 inches (66 to 81 centimeters). Measurable climatic variation (due to the lake effect) near some of Lake Superior may alter temperature and precipitation (Hillman & Nielsen, 2023). About 65 percent of the precipitation falls as rain during the growing season (May through September) and about 21 percent falls as snow. The freeze-free period averages about 130 days and ranges from 97 to 150 days (USDA-NRCS, 2022).

Table 3 Representative climatic features

Frost-free period (characteristic range)	90-110 days
Freeze-free period (characteristic range)	120-140 days

Precipitation total (characteristic range)	660-810 mm
Frost-free period (actual range)	40-110 days
Freeze-free period (actual range)	100-150 days
Precipitation total (actual range)	660-810 mm
Frost-free period (average)	90 days
Freeze-free period (average)	130 days
Precipitation total (average)	740 mm

- (1) GRAND PORTAGE [USC00213296], Grand Portage, MN
- (2) WOLF RIDGE ELC [USC00219134], Finland, MN
- (3) DULUTH [USW00014913], Duluth, MN
- (4) ELY 25E [USC00212555], Ely, MN
- (5) KETTLE FALLS [USC00214306], Voyageurs Natl Park, MN
- (6) BRIMSON 2S [USC00210989], Brimson, MN
- (7) KABETOGAMA [USC00214191], Orr, MN

Influencing water features

This site is not influenced by riparian and wetland features.

Wetland description

N/A

Soil features

Representative soil series include Beargrease, Biwabik, Graycalm, Grayling, Rollins, and Shagawa. Soil parent materials include outwash plains and moraines. Soils are well drained to excessively drained and very deep. The soil available water capacity is low and results in plant species that are highly tolerant of dry conditions.

Table 4. Representative soil features

Parent material	(1) Drift (2) Outwash
-----------------	--------------------------

Surface texture	(1) Sand (2) Very stony loam (3) Sandy loam (4) Loamy sand (5) Cobbly sandy loam
Drainage class	Well drained to excessively drained
Permeability class	Rapid to very rapid
Depth to restrictive layer	200 cm
Soil depth	200 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	0 – 20 %
Available water capacity (0-152.4cm)	5.08 – 11.43 cm
Sodium adsorption ratio (Depth not specified)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	4.5 – 7.3
Subsurface fragment volume <=3" (Depth not specified)	0 – 60 %
Subsurface fragment volume >3" (Depth not specified)	0 – 50 %

Ecological dynamics

This site is a dry jack pine-birch woodland. Fire was a historical disturbance that influenced plant species composition. Young woodlands post-fire are dominated by jack pine and paper birch. Mature woodlands are pine dominated with an understory variability dependent upon the fire regime (MN DNR, 2005). Jack pine (*Pinus banksiana*) occurs over a broad range of glacially scoured bedrock and outwash

sand plains, with cover ranging from sparse to dense, depending on habitat features. On sand plain habitats, the combination of physiognomy, floristics, and disturbance factors can be used to further distinguish the denser forests with blueberries (*Vaccinium* spp.) and feathermoss (*Pleurozium schreberi*) from more open stands, maintained by a 25 to 50 year fire rotation, where oaks (*Quercus* spp.), little bluestem (*Schizachyrium scoparium*), and other prairie forbs may be common (Faber-Langendoen 2001).

The Dry Sandy Upland Forest ecosite exhibits compositional change during the course of stand maturation. Under the model of succession for this ecological site species achieved dominance by outliving shorter-lived trees as the stand matures. The natural pattern of tree mortality and replacement was the partial loss of trees on a rotation of approximately 50 years. Stand-replacing fire was infrequent with an estimated rotation of 170 years although it is an important driver of many dominant tree species on this site. Stand-replacing windthrow was rare with an estimated rotation of approximately 610 years. Gaps in the canopy also drive the natural succession as species vie for dominance (MN DNR 2022).

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 1.3 plant community composition

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

Table 8. Community 2.1 plant community composition

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

Table 9. Community 2.2 plant community composition

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

Inventory data references

No field plots were established for this project. A review of the scientific literature and professional experience were used to approximate the plant communities for this provisional ecological site. Information for the state-and-transition model was obtained from the same sources. All community phases are considered provisional based on these plots and the sources identified in ecological site description. Future field verification will refine the plant communities described in this project.

References

. (Date accessed). USNVC [United States National Vegetation Classification]. 2019. United States National Vegetation Classification Database, V2.03. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC.. USNVC: <http://usnvc.org/>.

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.

Faber-Langendoen, D., editor. 2001. Plant communities of the Midwest: Classification in an ecological context. Association for Biodiversity Information, Arlington, VA. 61 pp. + appendix (705 pp.).

Flaccus, E. and L.F. Ohmann. 1964. Old-growth Northern Hardwood Forests in Northeastern Minnesota. Ecology 45:3, 448-459.

Hillman, A., & Nielsen, S. E. (2023). Lake Superior's summer cooling of shorelines and adjacent inland forests: Implications for refugia of boreal forests and disjunct Arctic–Alpine plants. Ecology and Evolution, 13(12). doi:10.1002/ece3.10833

Minnesota Department of Natural Resources. 2005. Field Guide to the Native Plant Communities of Minnesota: the Laurentian Mixed

Forest Province. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. St. Paul, Minnesota.

Minnesota Department of Natural Resources. 2022. Northern Dry-Sand Pine Woodland - FDn12. Available online at https://www.dnr.state.mn.us/forestry/ecs_silv/npc/fdn12.html. last accessed December 2023.

Minnesota Department of Agriculture. Minnesota Noxious Weed List. Available online at: <https://www.mda.state.mn.us/plants-insects/minnesota-noxious-weed-list>; accessed June 2022.

Minnesota Department of Transportation. 2020. Available online at: <https://www.dot.state.mn.us/roadsides/vegetation/pdf/noxiousweeds.pdf>; accessed June 2022.

Mitsch, WJ. and J.G. Gosselink. 2007. Wetlands, fourth ed. John Wiley & Sons, Inc. New York, NY.

NatureServe. 2013a. Associations and Alliances of USFS Section 212L in Minnesota. NatureServe, St. Paul, Minnesota.

Smith, W.R. 2008. Trees and Shrubs of Minnesota. University of Minnesota Press. Minneapolis, MN.

United States Department of Agriculture, Forest Service. Non-Native Invasive Species in the Border Lakes Region. Available online at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5209114.pdf; accessed June 2022.

United States Department of Agriculture, Natural Resources Conservation Service. 2022. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Contributors

Anita Arends, Former ESI Specialist, Springfield, IL
Mike Rokus, SSOL, Duluth, MN
Kade Anderson, NRCS Ecologist, Duluth, MN

Approval

Suzanne Mayne-Kinney, 9/06/2024

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	09/06/2024
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:

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:

17. Perennial plant reproductive capability:
