Ecological site F092XY014WI
Loamy Uplands

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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): Three sites key out to *Acer saccharum* / Athyrium felix-femina – Rubus pubescens [AAtRp] and the remaining sites each key out one of the following: *Acer saccharum* / *Clintonia borealis* [ACl], Acer rubrum – Abies balsamea / Sanicula spp. [ArAbSn], and Pinus strobus – Acer rubrumm / Vaccinium angustifolium – *Aralia nudicaulis* – Polygonatum pubescens variant [PArVAa-Po].

Biophysical Setting (Landfire, 2014): This is ES is mapped as, Laurentian – Acadian Northern Hardwoods Forest – Hemlock, Laurentian – Acadian Sub-boreal Mesic Balsam Fir-Spruce Forest, Laurentian – Acadian – Northern Pine – (Oak) Forest, North Central Interior Dry-Mesic Oak Forest & Woodland, and North Central Interior Maple – Basswood Forest. The ES is best represented by Northern hardwoods Forest and North Central Interior Maple – Basswood Forest.

WDNR Natural Communities (WDNR, 2015): This ES is most similar to Northern Mesic and Northern Wet-mesic Forests.

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)*
*Located in Upper Peninsula of Michigan (212J) and Minnesota (212Lb)

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

Ecological site concept

Loamy Uplands occurs throughout MLRA 92, but has a strong presence in the easternmost section. Sites occur on knolls, ridges, hillslopes, interfluves, terraces, and ravines located on till plains, lake plains, and outwash plains. Landform shape ranges from linear to convex. This ecological site is characterized by very deep, moderately well to well drained soils formed in loamy and silty till, in stratified silty glaciolacustrine deposits, or in stratified loamy glaciolacustrine or glaciofluvial deposits. Some areas include soil formed in a sandy glaciofluvial mantle over the loamy to silty deposits. Some small areas include soil formed in either loamy till having a developed fragipan or in loamy colluvium.

Some sites will have a seasonally high water table with a depth of 0 to 76 cm, but water table depth may exceed 152 cm during dry periods. The soils do not remain moist all year, differing this ES from Moist Loamy Flats and Wet Loamy Depressions. Water is primarily received through precipitation. Soils range from strongly acid to strongly alkaline. Some sites have carbonates present at 58 cm, but are absent in others. This range exists based on the soil parent materials; the sites with a sandy mantle are more acidic and lack carbonates. Sites without the sandy mantle are often more alkaline may have carbonates present.

In general terms, the Site’s capacity to support plant communities can be characterized as mesic to dry-mesic, in respect to available soil moisture and medium in terms of nutrient availability. As such, the Site is capable of supporting, at least temporarily, forest communities that may include any of the native upland tree species of northern Wisconsin. Mature, or late successional communities have historically been dominated by sugar maple (*Acer saccharum*) and eastern hemlock (Tsuga canadensis). Common associates included red maple (Acer rubrum), yellow birch (*Betula alleghaniensis*), basswood (Tilia Americana) and white ash (Fraxinus Americana). In some stands red oak (Quercus rubra) and white pine (Pinus strobus) also occurred. The latter two were most likely present as remnants of stands that originated following post-logging fires.

Current forest communities on this Ecological Site are dominated by sugar maple and red maple, if they originated in cut-over stands that were not also burned, or by aspen and white birch, if logging was followed by fire. Basswood, white ash and yellow birch are often minor associates. In most stands there is conspicuous absence of hemlock, which had been a dominant or co-dominant species, with sugar maple, in pre European-settlement forests. The reason appears to be a combination of lack of seed source and unfavorable conditions for seedling establishment in current early to mid-successional communities. Common ground flora species are raspberries, partridge berry, grasses, sedges, large-leaved aster, wild strawberry, dogwoods, and beaked hazelnut.

Associated sites

F092XY007WI	**Wet Loamy or Clayey Lowlands** These sites are poorly drained soils formed in mainly clayey though sometimes glaciofluvial and silty glaciolacustrine sediments. They have a seasonally high water table and remain saturated for much of the growing season, creating hydric conditions. HGM criteria: recharge, Depressional. The loamy sites are often adjacent to Loamy Uplands but located on a lower landscape position in the drainage sequence.

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. These sites are often adjacent to Loamy Uplands but located on a lower landscape position in the drainage sequence.

Similar sites

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 found in a similar landscape as Loamy Uplands but are coarser textured and in a different drainage sequence.
F092XY015WI	**Clayey Uplands** These sites are deep, moderately well to well drained soils that formed in clayey till or glaciolacustrine deposits. Some sites have a sandy or loamy mantle. Sites have a seasonally high water table but does not remain saturated for extended periods. Sites range from strongly acid to moderately alkaline, with carbonates present in many sites. These sites are found in a similar landscape as Loamy Uplands but are finer textured and in a different drainage sequence.
F092XY009WI	**Loamy Sandstone Uplands** These sites are shallow loamy soils that overly sandstone bluffs along the shore of Lake Superior. They are moderately well drained soils but have a seasonally high water table. The soils range from strongly acid to neutral. These sites are truncated which differs them from Loamy Uplands.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Acer rubrum*
Shrub	(1) *Corylus cornuta* (2) *Diervilla lonicera*
Herbaceous	(1) *Eurybia macrophylla* (2) *Pteridium aquilinum*

Physiographic features

This site occurs on knolls, ridges, hillslopes, interfluves, terraces, and ravines located on till plains, lake plains, and outwash plains. Landform shape ranges from linear to convex. Elevation of the landforms range from 185 to 330 meters above sea level. Slopes range from 0 to 50 percent. Slope stability within ravines may be compromised by stream cutting leading to slumping or mass movement slope failure. This site occurs on all slope aspects.

Table 2. Representative physiographic features

Landforms	(1) Lake plain (2) Till plain (3) Outwash plain
Runoff class	Medium to very high
Elevation	185–330 m
Slope	0–50%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

Loamy Upland PESD is distributed throughout the MLRA, but is most concentrated on the eastern edge. The annual average precipitation ranges from 29-34 inches, with a range of 56-167 inches of annual average snowfall (PRISM, 1981-2010). Being so concentrated on the eastern edge of the PESD near Gurney and Hurley, WI, this PESD is likely to receive heavy amounts of snow in the winter. The higher end of the range (167 inches) better reflects the most of this PESD. The annual average minimum temperature ranges from 29-34oF, and the maximum temperature ranges from 47-52oF (PRISM, 1981-2010). The length of the freeze free period ranges from 156 to 194 days, with an average of 171 days (Table 2). The length of the frost-free period ranges from 130 to 166 days, with an average of 144 days (Table 2).

Climate stations used

- (1) ASHLAND 3S [USC00470347], Ashland, WI
- (2) ASHLAND EXP FARM [USC00470349], Ashland, WI
- (3) ASHLAND KENNEDY MEM AP [USW00094929], Ashland, WI
- (4) BAYFIELD 6 N [USC00470603], Bayfield, WI
- (5) MADELINE ISLAND [USC00474953], La Pointe, WI
- (6) FOXBORO [USC00472889], Foxboro, WI

Influencing water features

Water is received primarily through precipitation. Water is lost from the site primarily through runoff or evapotranspiration.

Permeability of the soil ranges from very slow to moderately slow. Runoff potential is medium to very high, but may be negligible to medium on low slope areas where there is a sandy mantle over the loamy or silty deposits. The hydrologic group of this site is predominantly B or C, but where there is a sandy loamy or silty deposits the hydrologic group is A.

Enough water will percolate into some soil areas that will result in a perched seasonally high water table (episaturation) at a depth of 0 to 76 cm that may occur during any month, but will range to greater than 152 cm under dry conditions. Other soil areas will not exhibit any significant saturation at any depth for any significant period. Water that percolates into the soil is generally lost through plant uptake and evapotranspiration. There is potential for ground water recharge.

Soil features

The soils of this site are represented by the Alcona, Annalake, Denomie, Fence, Gichigami, Gogebic, Menominee, Morganlake, Rockland, and Wakefield soil series. These soils are predominantly classified as Haplorthods (Alcona, Annalake, Fence, Menominee, and Morganlake) and Glossudalfs (Denomie and Gichigami), but include sites that are Fragiorthods (Gogebic and Wakefield) and Eutrudepts (Rockland).

This ecological site is characterized by very deep, moderately well to well drained soils formed in loamy and silty till (Denomie and Gichigami), in stratified silty glaciolacustrine deposits (Fence), or in stratified loamy glaciolacustrine or glaciofluvial deposits (Alcona and Annalake). Some areas include soil formed in a sandy glaciofluvial mantle over the loamy to silty deposits (Menominee and Morganlake). Some small areas include soil formed in either loamy till having a developed fragipan (Gogebic and Wakefield) or in loamy colluvium (Rockland).

The average gravel content within the soil can be as much as 15 percent, while the average content of cobbles and stones can be as much as 5 percent. Soil reaction (pH) in the upper 100 cm ranges from very strongly acid to strongly alkaline. Carbonates occur as shallow as 58 cm, but may be absent within 200 cm.

Table 3. Representative soil features

Parent material	(1) Glaciolacustrine deposits (2) Glaciofluvial deposits (3) Colluvium
Surface texture	(1) Silt loam (2) Fine sandy loam (3) Loamy sand

Drainage class	Moderately well drained to well drained
Permeability class	Very slow to moderately slow
Soil depth	203 cm
Surface fragment cover >3"	0–1%
Available water capacity (0-152.4cm)	9.73–19.35 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Soil reaction (1:1 water) (0-101.6cm)	4.6–8.5
Subsurface fragment volume <=3" (0-101.6cm)	1–15%
Subsurface fragment volume >3" (0-101.6cm)	0–5%

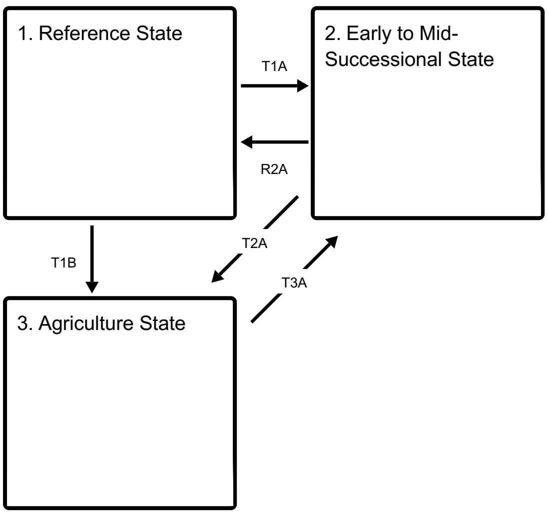
Ecological dynamics

Historically, mature forests on this ecological site were dominated by shade tolerant sugar maple and hemlock, often with an admixture of yellow birch (Wilde, 1933, Finley, 1976). This association was self-maintained with new cohorts of advance regeneration gaining canopy status through gaps formed by small-scale disturbances and natural mortality in the dominant canopy. Scattered large individuals of less shade tolerant white pine also were common component of mesic hardwood forests. These, presumably became established following relatively rare disturbances that included fire (Schulte and Mladenoff, 2005).

Current stands on this Ecological Site represent the entire array of potential successional stages from pure aspen, or aspen-white birch, stands to sugar maple dominated mixed northern hardwoods stands. Succession to sugar maple dominance is evident everywhere where seed sources are present. However, hemlock regeneration is scarce. In old forests hemlock finds optimal conditions for germination and seedling establishment on rotten logs, stumps and mounds that normally have warmer surfaces and better moisture retention than the forest floor (USDA, 1990). Most present forest communities lack these conditions.

State and transition model

Ecosystem states



T1A - Major stand replacing disturbance e.g. blow-down and fire, or clear-cutting, followed by fire.

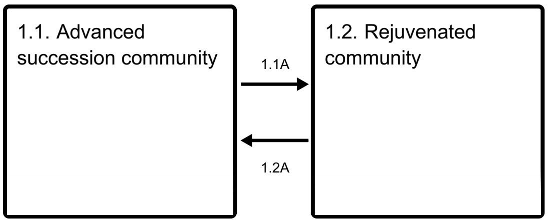
T1B - Elimination of forest cover, application of agricultural practices.

R2A - Time and natural succession.

T2A - Elimination of forest cover, application of agricultural practices.

T3A - Cessation of agricultural practices, natural, or artificial afforestation.

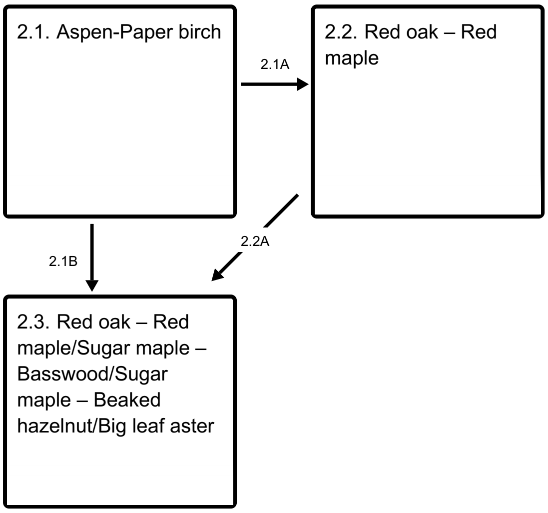
State 1 submodel, plant communities



1.1A - Natural mortality in the oldest age classes, sporadic small-scale blow-downs and ice storms, create openings for entry of mid-tolerant species, such as red oak and red maple.

1.2A - Time and natural succession

State 2 submodel, plant communities

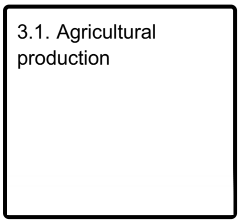


2.1A - Red oak and red maple regenerating under aspen -- paper birch canopy

2.1B - Time and natural succession.

2.2A - Time and natural succession.

State 3 submodel, plant communities



State 1
Reference State

The reference plant community is categorized as mesic forest community dominated by mixed deciduous species, primarily sugar maple (*Acer saccharum*), and sporadic occurrence of several conifer species. Although forest communities can vary greatly in terms of species composition and stand structure, depending on type, degree and frequency of disturbance, two common phases predominate:

Community 1.1
Advanced succession community

In the absence of major, stand-replacing disturbance this community is dominated by sugar maple, yellow birch (*Betula alleghaniensis*) and eastern hemlock (Tsuga Canadensis), often with scattered occurrence of old white pines. This was the most common condition in pre-European settlement forests. The tree sapling and shrub layer in this community is not well developed due to dense shade created by multy-story tree canopy. Most common, but low coverage shrub species are beaked hazelnut (*Corylus cornuta*), fly-honeysuckle (*Lonicera canadensis*) and bush honeysuckle (Diervila lonicera). The herb layer is relatively species rich, but moderate in abundance. The dominant herbs typically include big-leaf aster (Aster macrophyllus), wild sarsaparilla (*Aralia nudicaulis*), yellow beadlily (*Clintonia borealis*), rosey twisted stalk (Streptopus roseus), and wild lily of the valley (*Maianthemum canadense*). It is important to note that in most current mature stands hemlock is significantly under-represented compared to historic conditions. This apparently is due to seed source elimination during the early logging era and herbivory by currently high white tail deer populations.

Community 1.2
Rejuvenated community

Disturbances described in Pathway 1.1A lead to increased species and structural diversity of the forest community. Depending on seed source, red oak, red maple and, in many cases, white pine, regenerate in the canopy openings and in time join sugar maple and hemlock in the dominant canopy. White pine easily exceeds the height of the deciduous canopy and often remains on the site, as scattered individuals, for up to four centuries. This exceptional longevity virtually assures perpetual white pine seed source on the site. The relative density of the shrub and herb layers also increases during this stage. Species composition remains relatively unchanged but abundance changes can be significant. Particularly beaked hazelnut can form dense thickets and big leaf aster often forms continuous carpets. Many other herb species that were present with very low abundance in the advanced-succession community typically form much larger population clusters.

Pathway 1.1A
Community 1.1 to 1.2

Natural mortality in the oldest age classes, sporadic small scale blow-downs and ice storms, create openings for entry of mid-tolerant species such as red oak and red maple

Pathway 1.2A
Community 1.2 to 1.1

In the absence of canopy reducing disturbances natural succession leads to community dominance by the most shade-tolerant species resulting in return to community phase 1.1.

State 2
Early to Mid-Successional State

Following disturbances described in Transition T1A a wide range of forest community phases may come into temporary existence, the three most common ones are described here.

Community 2.1
Aspen-Paper birch

These two species have a very narrow window of environmental and ecological conditions for successful establishment. Main requirements are exposed mineral soil and elimination, most effectively by fire, of on site seed sources of potential competing vegetation. In addition, adequate soil moisture must be available for initial seedling development. Once seedlings are firmly established height growth of both species is relatively rapid and able to outgrow most competitive species. Paper birch seedlings and saplings tolerate partial shade and often become members of mixed species communities. This is not true for aspen which requires continuous full-sun exposure for survival. Aspen stands are initially very dense due to sprouting from extensive lateral roots, but rapid natural thinning ensues as stems compete for available light. Aspen and paper birch do not reproduce under their own canopies and, depending on seed source, are succeeded by either mid-shade-tolerant species such as red oak, red maple and white pine, (Pathway 2.1B) - or directly by very tolerant species such as sugar maple, basswood, balsam fir and white spruce (Pathway 2.1A).

Community 2.2
Red oak – Red maple

This community phase may occur via two different origins: 1. By sprouting from stumps or by local seed source, following stand-leveling disturbance, or 2. By invading and succeeding a pioneer aspen-birch community. For this reason, tree species composition and community structure in early stages of development vary considerably, from pure canopy dominance by red oak and red maple, singly, or in combination, to modest, or strong presence of mature, or decaying, aspen and/or paper birch. The shrub layer, dominated by beaked hazelnut (*Corylus cornuta*), typically reaches its best development in this community phase.

Community 2.3
Red oak – Red maple/Sugar maple – Basswood/Sugar maple – Beaked hazelnut/Big leaf aster

This community phase represents distinct transition into mid-successional state, by strong presence in second canopy, or in reproductive layers, of shade-tolerant species, sugar maple, basswood, eastern hemlock, or balsam fir and white spruce. Sporadic occurrence of individual white pine trees also is common. Eastern hemlock, although historically a prominent member of mature communities on this site, is today under-represented presumably due to lack of seed source and selective browsing by the white-tailed deer.

Pathway 2.1A
Community 2.1 to 2.2

Aspen and paper birch do not reproduce under their own canopies and, depending on seed source, are succeeded by very tolerant species such as sugar maple, basswood, balsam fir and white spruce.

Pathway 2.1B
Community 2.1 to 2.3

Aspen and paper birch do not reproduce under their own canopies and, depending on seed source, are succeeded by either mid-shade-tolerant species such as red oak, red maple and white pine

Pathway 2.2A
Community 2.2 to 2.3

Succession by shade-tolerant species, sugar maple, basswood and in some cases also balsam fir and white spruce.

State 3
Agriculture State

Indefinite period of applying agricultural practices.

Community 3.1
Agricultural production

This community phase consists of agricultural crop production most likely hay, but some row crops could be present as well.

Transition T1A
State 1 to 2

Major stand-replacing disturbance. In pre-European settlement time this most often was a severe blow down, some times followed by fires. Such blow downs have been estimated to occur in this part of Wisconsin every 300 to 400 years (Stearns….Mladenoff….). In post settlement virtually every acre has been logged either by clear cutting or successive cuts targeting species marketable at that time. Post logging slash fires also have been significant factor in most areas. These disturbances created the environment suitable for natural regeneration of many shade-intolerant species and for commercial planting.

Transition T1B
State 1 to 3

Land is cleared for agricultural production.

Restoration pathway R2A
State 2 to 1

Abandonment of agricultural practices and allowing natural vegetation to colonize the site or apply artificial afforestation. The time required for forest community to reach the reference state conditions may exceed 100 years.

Transition T2A
State 2 to 3

Removal of forest cover, tilling and application of other agricultural techniques to grow agricultural crops.

Transition T3A
State 3 to 2

Abandonment of agricultural practices and allowing natural vegetation to colonize the site or apply artificial afforestation.

Additional community tables

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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	11/21/2024
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:

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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:**
