Ecological site F094AA006MI
Snowy Sandy Drift

Last updated: 10/03/2019
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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.

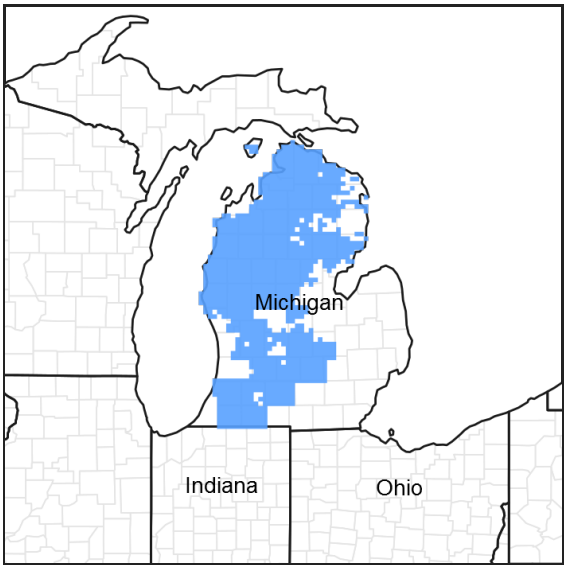

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 094A–Northern Michigan Sandy Highlands

This area is dominated by outwash plains and moraines. The terrain can be steep on the moraines and flat in the areas of outwash. Elevation ranges from 177 to 520 m (580 to 1705 ft). Local topographic relief averages 14 m and ranges up to 188 m (45 to 615 ft). This area is covered entirely by drift. Bedrock consisting of Devonian limestone and dolomite with interbedded shale, chert, and anhydrite stringers is at various depths below the surface because of the curvature of the Michigan basin. However, bedrock exposures completely absent, as the depth of glacial drift ranges from 60 to 300 m (200-1000 ft). The Au Sable, Manistee, Au Gres, and Pine Rivers are the major streams draining this MLRA, in both the Lake Michigan and Lake Huron watersheds. The Muskegon River has its headwaters in this area.

About 70 percent of this area is forested, and about 15 percent is cropland or hayland. About one-third of the area is in small, privately owned holdings, and another one-third consists of national and State forests. The forests are used mainly for timber production and recreation. Dairy and beef operations are very important enterprises in the area. Forage and feed grains for dairy cattle and other livestock are the principal crops. Wheat, oats, corn, potatoes, and hay also are grown in the area. The Huron and Manistee National Forests, Hartwick Pines State Park, Camp Grayling (Department of Defense), Pigeon River Country State Forest are among the most notable conservation lands in the area. Reaches of the Au Sable and Pine Rivers are National Wild and Scenic Rivers.

Summary of existing land use:
Upland Forest (58%)
Hardwood (41%)
Conifer (15%)
Swamps and Marshes (14%)
Developed (11%)
Agricultural (10%)
Grassland (5%)

Classification relationships

According to the USFS (Bailey) system of ecoregions, the site is located mostly within 212Hc (Interlobate End and Ground Moraines), 212He (Kalkaska Sandy Moraines), and 212Hi (Wolverine Moraines) subsections. According to the EPA (Omernik) system of ecoregions, the site is located in western 50ac (Onaway Moraines), western 50ad (Vanderbilt Moraines), and 50af (Cadillac Hummocky Moraines) level IV ecoregions. This site roughly corresponds to PArVHa, in the Kotar system. This site corresponds to the Dry Ice Contact Sand Hills, ecological land type phases 20-23, in the USFS Ecological Land Type system.

Ecological site concept

The central concept of Snowy Sandy Drift is uplands with a seasonal high watertable greater than 100 cm in depth (excessively drained to moderately well drained) and lacking a dark brown spodic (Bhs) horizon in the soil profile (may have a Bs or Bw horizon). Site occurs on sandy drift (outwash, ice contact, or lake plains) where soil textures are sand or loamy sand (upper 50 cm >70% sand). Site is in the heavy annual snowfall belt, mostly west of Houghton Lake where fire was rare. Vegetation trending towards mesophytic forest with a poor herb understory and a low fire frequency.

Table 1. Dominant plant species

Tree	(1) *Fagus grandifolia* (2) *Pinus strobus*
Shrub	Not specified
Herbaceous	(1) *Maianthemum canadense*

Physiographic features

Site occurs mostly on sandy outwash plains, with minor amounts of coarse textured ice contact, glacial till, and lake plain deposits with similar properties. Landforms are mostly gently sloping, but there are no upper limits to slope defined.

Table 2. Representative physiographic features

Landforms	(1) Outwash plain (2) Kame

Climatic features

Mean annual temperatures are 5.8 to 7.4 °C (42 to 45 °F). The warmest six months average 14.2 to 15.9 °C (58 to 61 °F). Mean July temperatures range from 18.6 to 20.6 °C (65 to 69 °F). Mean January temperatures range from -8.3 to -5.7 °C (17 to 22 °F). The maximum monthly average daily highs are 24.9 to 27.5 °C (77 to 82 °F). The minimum monthly average daily lows are -13.2 to -10 °C (8 to 14 °F). Temperatures generally decrease with elevation and latitude. Mean annual precipitation ranges from 770 to 910 mm (30 to 36 in). Average 0 °C (32 °F) frost-free season ranges from 73 to 144 days. Average -2 °C (28 °F) freeze-free season is 106 to 172 days. Mean annual snowfall ranges from 1.5 to 4.1 m (60 to 160 in). Mean annual extreme minimum temperatures range from -33.3 to -23.1 °C (-28 to -10 °F), or hardiness zones 4a to 6a.

Table 3. Representative climatic features

Frost-free period (average)	115 days
Freeze-free period (average)	142 days
Precipitation total (average)	889 mm

Climate stations used

- (1) GAYLORD 9SSW [USC00203099], Gaylord, MI
- (2) CADILLAC [USW00014817], Cadillac, MI
- (3) GAYLORD [USC00203096], Gaylord, MI
- (4) BIG RAPIDS WTR WKS [USC00200779], Big Rapids, MI
- (5) KALKASKA [USC00204257], Kalkaska, MI
- (6) BOYNE FALLS [USC00200925], Boyne City, MI
- (7) EAST JORDAN [USC00202381], East Jordan, MI
- (8) LAKE CITY EXP FARM [USC00204502], Lake City, MI

Influencing water features

Lower slope positions and finer substrates may have a seasonal high water table 100-200 cm in depth. Well drained upper slope positions are 200 cm or more from the water table.

Soil features

Soils are well drained to excessively well drained sands. They are commonly classified Alfic Haplorthods, Entic Haplorthods, and Lamellic Udipsamments, and commonly mapped as Montcalm, Rubicon, and Blue Lake series or components. The top 50 cm has a typical pH of 5.7 and is 90% sand and 0.7% organic matter. At depth, pH ranges up to 6.4, and texture averages 85% sand and 5% clay. Depth to impeded hydraulic conductivity or root restrictive layers averages >200 cm. Depth to carbonates averages >200 cm.

Ecological dynamics

Snowy Sandy Drift tends to share the same ecological dynamics as Natureserve/Landfire system, Laurentian-Acadian Pine-Hemlock-Hardwood Forest. Stand replacing fires occurred every 250-950 years, with light surface fires every 140-550 years. Overstory was dominated by a mix of fire dependent, early successional pine (Pinus spp.) or oak (Quercus spp.), and late successional beech (*Fagus grandifolia*) and maple (Acer spp.). Understory is composed of shade-tolerant, acid-tolerant forbs such as Canada mayflower (*Maianthemum canadense*). Kotar community, PArVHa (*Pinus strobus-Acer rubrum*/Vaccinium spp.-*Hamamelis virginiana*), understory indicator species include: *Aralia nudicaulis*, *Epigaea repens*, *Eurybia macrophylla*, *Gaultheria procumbens*, *Gaylussacia baccata*, *Hamamelis virginiana*, *Maianthemum canadense*, *Maianthemum racemosum*, *Pteridium aquilinum*, and *Vaccinium angustifolium* (Wild Sarsaparilla, Trailing-arbutus, Big-leaved Aster, Teaberry, Black Huckleberry, Witch-hazel, Canada Mayflower, Feathery Solomon's-plume, Bracken Fern, and Northern Lowbush Blueberry).

State and transition model

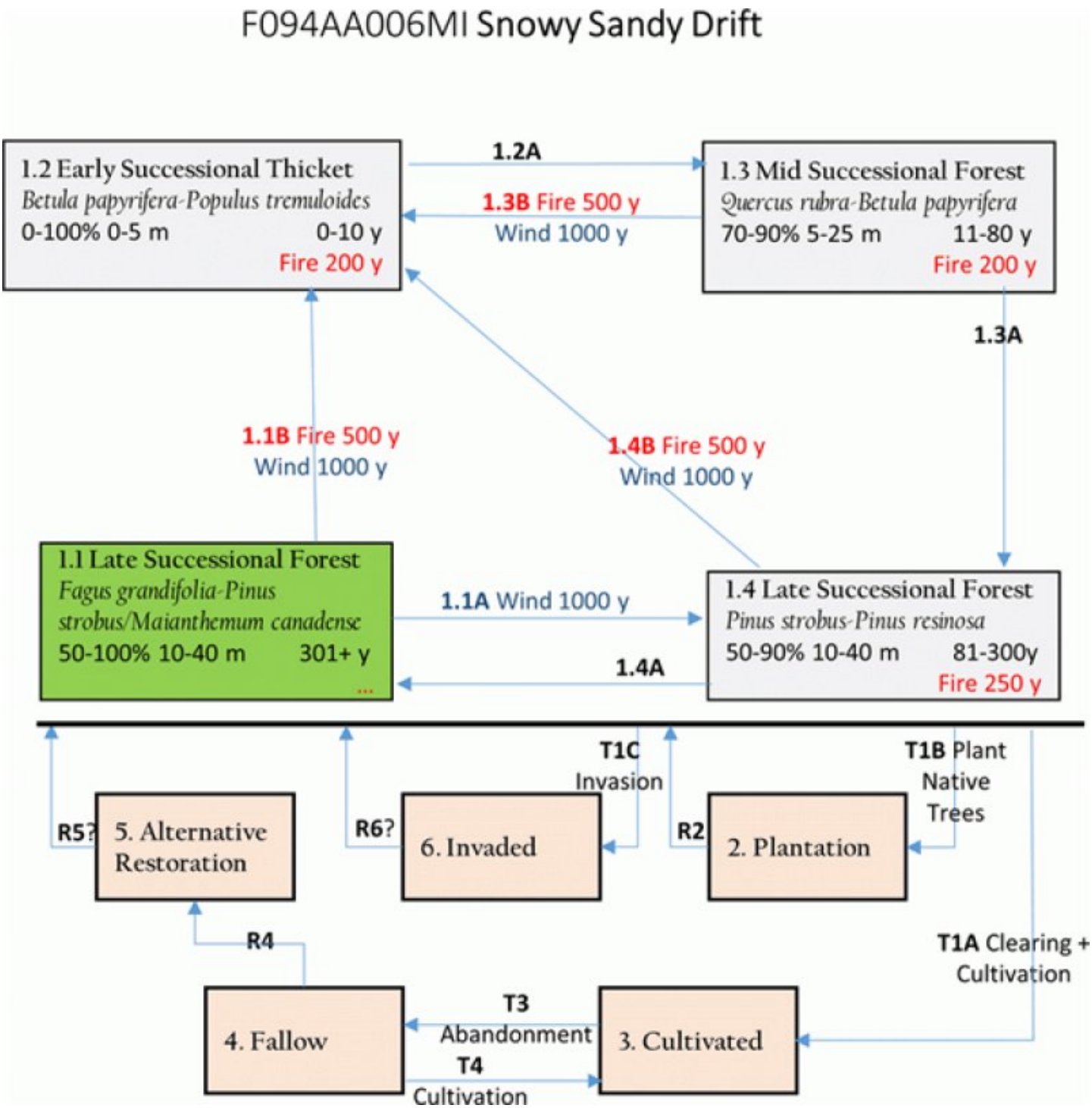
F094AA006MI Snowy Sandy Drift
1.2 Early Successional Thicket
Betula papyrifera-Populus tremuloides
0-100% 0-5 m
0-10 y
Fire 200 y
1.2A
1.3B Fire 500 y
Wind 1000 y
1.3 Mid Successional Forest
Quercus rubra-Betula papyrifera
70-90% 5-25 m
11-80 y
Fire 200 y
1.3A
1.1B Fire 500 y
Wind 1000 y
1.4B Fire 500 y
Wind 1000 y
1.1 Late Successional Forest
Fagus grandifolia-Pinus strobus/Maianthemum canadense
50-100% 10-40 m
301+ y
1.1A Wind 1000 y
1.4A
1.4 Late Successional Forest
Pinus strobus-Pinus resinosa
50-90% 10-40 m
81-300y
Fire 250 y
T1C Invasion
T1B Plant Native Trees
R5?
5. Alternative Restoration
R6?
6. Invaded
R2
2. Plantation
R4
T1A Clearing + Cultivation
4. Fallow
T3 Abandonment
T4 Cultivation
3. Cultivated

Figure 6. stm

Legend

1.1A	Extreme winds every 1000 years
1.1B	Replacement fire every 500 years or extreme wind every 1000 years
1.2A	Succession
1.3A	Succession
1.3B	Replacement fire every 500 years or extreme wind every 1000 years
1.4A	Succession
1.4B	Replacement fire every 500 years or extreme wind every 1000 years
R2	Restoration
R4	Restoration
R5	Restoration?
R6	Restoration?
T1A	Clearing + cultivation of crops
T1B	Clearing + plant native trees in rows
T1C	Invasive species introduction
T3	Abandonment + invasive species
T4	Cultivation

Figure 7. Legend

State 1
Reference State

Community 1.1
Mesophytic Conifer Forest: Pinus strobus - Tsuga canadensis Great Lakes Forest

Community 1.2
Dry-Mesophytic Hardwood Forest: Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium Forest

Community 1.3
Native Ruderal Forest: Populus (tremuloides, grandidentata) - Betula (populifolia, papyrifera) Ruderal Woodland

Community 1.4
Pine Forest: Pinus resinosa - Pinus strobus - (Quercus rubra) / Corylus cornuta Forest

Pathway 1.1A
Community 1.1 to 1.2

Blowdown/clearcut followed by fire a few years after, destroying conifer regeneration, deferentially favoring oak regeneration.

Conservation practices

Prescribed Burning
Forest Stand Improvement

Pathway 1.1B
Community 1.1 to 1.3

Blowdown/clearcut

Conservation practices

Early Successional Habitat Development/Management
Forest Stand Improvement

Pathway 1.1C
Community 1.1 to 1.4

Crown fire, or blowdown/clearcut with fire in close succession.

Conservation practices

Prescribed Burning
Forest Stand Improvement

Pathway 1.2A
Community 1.2 to 1.1

Succession

Pathway 1.2C
Community 1.2 to 1.3

Blowdown/clearcut

Pathway 1.2B
Community 1.2 to 1.4

Crown fire, or blowdown/clearcut with fire in close succession.

Conservation practices

Prescribed Burning
Forest stand improvement for habitat and soil quality

Pathway 1.3A
Community 1.3 to 1.1

Succession

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Pathway 1.3C
Community 1.3 to 1.2

Succession if fire consumed any subsequent pine regeneration.

Pathway 1.3B
Community 1.3 to 1.4

Light fire removes the leaf litter, allowing for pine seedlings to establish followed by succession.

Pathway 1.4A
Community 1.4 to 1.1

Succession.

Pathway 1.4C
Community 1.4 to 1.2

Blowdown/clearcut followed by fire a few years after, destroying conifer regeneration, deferentially favoring oak regeneration.

Pathway 1.4B
Community 1.4 to 1.3

Blowdown, clearcut, or crown fire, with establishment of clonal tree species.

State 2
Cultural State

Community 2.1
Sustainable Agriculture

Community 2.2
Unsustainable Agriculture

Community 2.3
Conservation Feature.

Can be a grassed waterway, conservation reserve, a small patch pollinator garden, or other land taken out of its primary cultural production to mitigate or reduce impacts of adjacent land use, and is not by itself a permanent restoration of a complete native biological community and associated ecosystem services.

Pathway 2.1A
Community 2.1 to 2.2

Apply unsustainable farming techniques.

Pathway 2.1B
Community 2.1 to 2.3

Establish conservation feature.

Conservation practices

Conservation Cover
Grassed Waterway

Pathway 2.2A
Community 2.2 to 2.1

Apply sustainable farming techniques.

Conservation practices

Conservation Crop Rotation
Cover Crop
Nutrient Management
Integrated Pest Management (IPM)

Pathway 2.2B
Community 2.2 to 2.3

Establish conservation feature.

Conservation practices

Conservation Cover
Grassed Waterway

Pathway 2.3A
Community 2.3 to 2.1

Revert to sustainable agriculture.

Conservation practices

Conservation Crop Rotation
Cover Crop
Nutrient Management

Integrated Pest Management (IPM)

Pathway 2.3B
Community 2.3 to 2.2

Revert to unsustainable agriculture.

State 3
Seminatural State

Community 3.1
Ruderal Meadow & Shrubland: Dactylis glomerata - Festuca spp. - Solidago canadensis Ruderal Mesic Meadow Alliance

Community 3.2
Exotic Ruderal Forest: Acer platanoides - Ailanthus altissima - Pinus spp. Exotic Ruderal Forest Alliance

Pathway 3.1A
Community 3.1 to 3.2

Succession

Pathway 3.2A
Community 3.2 to 3.1

Blowdown/clearcut

Transition T1A
State 1 to 2

Clear vegetation; cultivate domesticated species

Transition T1B
State 1 to 3

Clear vegetation, invasive species introduced

Restoration pathway R2
State 2 to 1

Remove domesticated species; restore native species

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Tree/Shrub Establishment
Restoration and Management of Rare and Declining Habitats
Upland Wildlife Habitat Management
Herbaceous Weed Control

Transition T2A

State 2 to 3

Abandoned, succession

Restoration pathway R3
State 3 to 1

Control invasive species; restore native species

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Tree/Shrub Establishment
Restoration and Management of Rare and Declining Habitats
Upland Wildlife Habitat Management
Herbaceous Weed Control

Transition T3A
State 3 to 2

Clear vegetation; cultivate domesticated species

Additional community tables

Other references

A PROVISIONAL ECOLOGICAL SITE is a conceptual grouping of soil map unit components within a major land resource area (MLRA) based on the similarities in response to management. A provisional ecological site is a first approximation based on a cursory literature review, personal experience, and limited field reconnaissance. As more adequate literature review, expert opinion, and intensive plot data are collected, the site concept is subject to shifting, broadening, narrowing, subdivision, or re-aggregation in definition. Likewise, the community dynamics will be more elaborate in content, and may also change in structure, upon reaching approved status.

Future work, as described in a project plan, to validate the information in this provisional ecological site description is needed. This will include field activities to collect low and medium intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the project plan are to be conducted by the Ecological Site Technical Team.

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Contributors

Gregory J. Schmidt

Approval

Nels Barrett, 10/03/2019

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The following individuals made substantive comments regarding the development of the Provisional Ecological Sites: Randy Swaty, The Nature Conservancy; Trevor Hobbs, USFS; Richard A. Corner, USFS; Andy Henriksen, NRCS; Dan Zay, NRCS.

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	
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:

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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:**
