Minnesota Land Cover Classification System

User Manual

Version 5.4

Minnesota Department of Natural Resources
Central Region

2004

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Preface

The Minnesota Land Cover Classification System (MLCCS) integrates classification of cultural features, non-native vegetation, natural and semi-natural vegetation into a comprehensive land cover classification system. This system is heavily based on two native vegetation classification standards:

> The US National Vegetation Classification System (NVCS). This standard was developed in partnership with The Nature Conservancy and the nationwide state Natural Heritage programs. It represents the first standardized classification of the terrestrial ecological communities of the United States ever developed at a scale fine enough to be used in making local, site-specific conservation decisions. The Federal Geographic Data Committee endorsed it in 1997 as the standard approach to be used by all federal agencies. A copy of this system may be obtained via the world wide web at http://consci.tnc.org/library/pubs/class/index.html
>
> Minnesota's Native Vegetation: A Key to Natural Communities, version 1.5. This standard was developed by the Minnesota DNR Natural Heritage and Nongame Research Program (NHNRP), primarily based on vegetation data collected by the Minnesota County Biological Survey (MCBS) and pre-existing literature on plant communities in Minnesota and adjacent states. A copy of this key may be obtained by contacting DNR Ecological Services, 500 Lafayette Rd., St. Paul , MN, 55155, or by calling 651-296-2835.

Both of these standards have undergone revisions, shifting toward an ecological basis for classifying natural communities. Revisions to the MLCCS will occur when the changes to the NVCS and the Minnesota Key to Natural Communities become formalized, possible in 2004.

The MLCCS uses the natural community terminology developed by the NHNRP. These same terms are used by the Minnesota County Biological Survey (MCBS) on maps of natural communities in the state. However, the MLCCS designates land cover at a given point in time, including areas that would not meet the minimal quality and/or size criteria used by MCBS. Therefore, there will sometimes be differences between mapped polygons in MCBS data layers and MLCCS data layers in the same place.

Comments and suggestions on the Cultural or Natural/Semi-Natural classifications will be appreciated. Please address comments to:

Bart Richardson
Minnesota Department of Natural Resources
1200 Warner Rd.
St. Paul, MN 55106
Phone: 651-772-6150
email: bart.richardson@dnr.state.mn

Introduction

The Minnesota Department of Natural Resources (DNR) Metro Region, along with other federal, state, regional and local units of government, has developed a natural resource inventory classification system to accurately map all land cover types. The system is unique in that it categorizes urban and built-up areas strictly in land cover terms. For natural resources, the system fully incorporates the Minnesota's Native Vegetation: A Key to Natural Communities, version 1.5 developed by the Minnesota DNR Natural Heritage and Nongame Research Program (NHNRP), and the newly developed The US National Vegetation Classification System (NVCS) developed in partnership with The Nature Conservancy and the nationwide state Natural Heritage programs.

The overall objective of the Minnesota Land Cover Classification System (MLCCS) is to standardize land cover identification and interpretation. The MLCCS was developed as a result of unanswered questions regarding natural resource identification, protection and restoration efforts in the seven-county metropolitan area.

Common questions are:

- Where are the natural resources that need protection in face of development?
- Where are the degraded natural sites that would benefit from restoration efforts?
- What is the degradation that has occurred?
- Where are sites adjacent to existing natural areas that could be restored to natural communities?
- What should the restored community be?
- What is the imperviousness of the watershed?
- What are the actual vegetation cover types associated with various land use classes?

The MLCCS provides a standardized method to collect data that can be used to answer these questions. The MLCCS is unique in that it emphasizes vegetation land cover instead of land use, thus creating a land cover inventory especially useful for resource managers and planners.

The classification system is a five-level hierarchical design, permitting a gradation of refinement relevant to any land cover mapping project. The very highest level, or the system level, is the division between Natural/Semi-Natural cover types and Cultural cover types. Cover types in the Natural/Semi-Natural system are composed of all naturally occurring types and are subdivided into Forests, Woodlands, Shrublands, Herbaceous, Nonvascular, Sparse Vegetation and Water. The Cultural classification system is composed of cover types influenced by humans, and are subdivided into Areas with > 4% Artificial Surfaces and Cultural Vegetation.

The Natural/Semi-Natural classification system is a hybrid of the US National Vegetation

Classification System (NVCS) and Minnesota's Native Vegetation: A Key to Natural Communities, version 1.5 developed by the Minnesota DNR Natural Heritage and Nongame Research Program (NHNRP). The NVCS is used for the top three levels of the system, identifying the physiognomic attributes of the vegetation. Thus, level one identifies the general growth patterns (forest, woodland, shrubland, etc.); level two identifies plant types (deciduous, coniferous, grasslands, forbs, etc.); and level three identifies the hydrology of the soil (upland, seasonally flooded, saturated, etc.) or a refinement of plant type (tall grass, forbs, etc.). Levels four and five identify the actual plant species composition and uses Minnesota's Native Vegetation: A Key to Natural Communities community type definitions (e.g. floodplain forest, rich fen sedge subtype, jack pine barrens, etc.).

The Cultural classification system is designed to identify the presence of artificial surfaces (impervious surfaces) and vegetation patterns. Most other cultural classification systems, such as the USGS's Anderson system, employ land use terminology: Urban, Commercial or Residential. The MLCCS continues to use physiognomic attributes regardless of the area's land use. Level one identifies where artificial surfaces are present (artificial surfaces vs. cultivated land). Level two identifies the dominant vegetation (trees, shrubs, herbaceous). Level three identifies the plant type (deciduous, coniferous, etc.). Level four identifies the percent of imperviousness or upland versus hydric soils. Level five identifies the specific plant species in the area.

For each polygon identified, modifiers may be added to further define the characteristics of the site. Possible modifier codes include imperviousness, land use, vegetation disturbances or management, natural quality, tree species, forestry (e.g., percent canopy and DBH) and water regimes.

Typical data needed to identify land cover using the MLCCS includes Minnesota County Biological Surveys, County Soil Surveys, National Wetland Inventory, Color infrared aerial photographs, digital orthophoto quadrangles and rare features data from the Natural Heritage Information System (obtained by filling out a Data Request Form, available on the DNR's web site, or obtained from the Section of Ecological Services, MN DNR). This base information is usually sufficient to identify polygons to the third level of the MLCCS codes. Field inspection by ecologists is usually required for modifier attributes and to identify natural community types in the fourth and fifth levels of the MLCCS. Field inspection is also used to confirm and refine polygon delineation.

The Classification System

Land Cover vs. Land Use

Information on land cover and land use is required in many aspects of land use planning and policy development. It also is required for monitoring and/or modeling environmental change. Many land use/cover classification systems and innumerable maps have been created, most of which blur the difference between land use and land cover. With the escalating concern of land conversion by population growth, there is an urgent need for better matching of land cover and its use. With the rapid increase of available spatial data, along with wider use of remote sensing, it is increasingly possible to map, evaluate and monitor land cover and land use over large areas.

The distinction between land cover and land use is fundamental. In previous classifications and legends, the two have often been confused. They should strictly be defined as follows:

Land Cover is the observed physical cover, as seen from the ground or through remote sensing, including the vegetation (natural or planted) and human constructions (buildings, roads, etc.) that cover the earth's surface. Water, ice, bare rock, or sand surfaces count as land cover.

Land Use is based upon function, the purpose for which the land is being used. Thus, a land use can be defined as a series of activities undertaken to produce one or more goods or services. A given land use may take place on one or more than one piece of land, and several land uses may occur on the same piece of land. Definition of land use in this way provides a basis for precise and quantitative economic and environmental impact analysis, and permits precise distinctions between land uses if required.

There are many classification systems in existence, yet few of them purely address land cover. Existing land cover classification systems either revert to land use definitions in urban/built up and agricultural areas, or simply do not interpret these areas.

The MLCCS identifies land cover in areas traditionally identified by land use (e.g., urban, built up and agricultural areas) by identifying the structure of the vegetation present and including the presence of human activities as it presents itself from above. Cultural Systems are areas where the total vegetation cover is less than 96% because of direct human alteration (e.g., presence or roads, buildings) or areas where the dominant vegetation has been maintained, planted or cultivated (e.g., agricultural lands, parks, windbreaks). The MLCCS only identifies the types of vegetation present. Buildings, roads and other manmade surfaces are all considered artificial surfaces. These artificial surfaces are lumped together as impervious surfaces. Thus the MLCCS may identify a typical residential area as: *Short grasses and mixed trees with 26% to 50% impervious cover*.

Native communities are included in the Cultural Systems, but an impervious component has been added. These communities contain the species of natural communities, though due to the presence of impervious surfaces, they may no longer function as such. Examples of this type of cover are large-lot residential developments located in natural areas such as oak forests or

woodlands. While there is significant native and natural vegetation remaining, the presence of the matrix of roads and buildings removes it from being considered a natural community. The MLCCS may identify such a community as: *Oak (forest or woodland) with 11% to 25% impervious cover*.

One of the major innovations of the MLCCS is the application of a pure land cover standard to inventory all lands. The MLCCS recognizes that all lands, regardless of use, have some ecological importance. Watershed management is one ecological application perfectly suited for the MLCCS. Managing the interaction of human activities and the health of a watershed's terrestrial and aquatic ecosystems is dependent, in part, on the knowledge of what the land cover's vegetative and impervious components are. It does not matter to a lake if the impervious surface is a residential roof or a road; the effects are the same. The goal of the MLCCS is to provide a land cover classification system for standardized identification and interpretation by a broad base of users.

Schematic Tables

System Overview

Super System	Terrestrial								
System	Cultural		Natural / Semi-natural						
Level 1	Artificial surfaces with <96% Vegetation	Cultural Vegetation	Forests	Woodland	Shrubland	Herbaceous	Nonvascular	Sparse Vegetation	Open Water
numerical code	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000

Cultural Land Cover System

	10,000														
level 1	**Artificial surfaces and associated areas (up to 96% vegetation cover)** - Areas which have an artificial cover which is the result of human activities such as construction (e.g.; buildings, pavement), extraction sites (e.g.; open mines, quarries, pits) and waste disposal sites. This class is determined by the presence of manmade impervious surface. Pavement is an artificially covered surface for a thoroughfare. Surfaces may include concrete, asphalt, gravel, or brick materials.														
level 2	Trees			Shrubs		Herbaceous						Minimal Vegetation			
level 3	Conifers	Decid-uous	Mixed Con./Dec.	Mixed shrubs	Shrubs w/trees	Grasses w/trees	Grasses			Gardens		Buildings / Pavement		Exposed earth	
level 4	% imper-vious	% imper-vious	% imper-vious	% imper-vious	% imper-vious	% imper-vious	% impervious			% impervious		% impervious		% impervious	
level 5	Genus or community types (Alliance)					Genus | grass	short | long grass		prairie	vege-table	flow-ers	pave-ment	build-ings	mines, pits, etc.	

	20,000										
level 1	**Planted or Cultivated Vegetation (greater than 96% vegetation cover)** - Cultivated is vegetation that is planted or treated with the intent on harvest, often on an annual basis. Regular modification of cover is expected. Planted vegetation refers to sites where the natural vegetation has been removed or modified and replaced with different types of vegetative cover resulting from anthropic activities. This vegetation is usually non-native and requires human activities to be maintained over the long term. Nurseries, tree stands (e.g. tree farms or windbreaks), pastures and ball fields are included in this group. Restorations or replanting of natural communities are not considered in this category because although they are planted, they are intended to mimic natural cover.										
level 2	Trees			Shrubs and vines			Planted Herbaceous			Cultivated Herbaceous	
level 3	Conifers	Decid-uous	Mixed Con./Dec.	Conifers	Decid-uous	Mixed Con./Dec	Grasses w/trees	Grasses	Grasses and Forbs	Row Cropland	Close Grown Cropland
level 4	Upland Soils | Hydric Soils						Upland Soils | Hydric Soils			Upland Soils | Hydric Soils	
level 5	Genus or community types (Alliance)						short grass | long grass			Crop species	

Natural / Semi-Natural Land Cover System

	30,000		
level 1	**Forests** - Trees with their crowns overlapping (generally forming 60 - 100% cover)		
level 2	Coniferous forest	Deciduous forest	Mixed coniferous - deciduous forest
level 3	Soil Hydrology [Upland | Saturated | Temporarily flooded | Seasonally flooded]		
level 4	MN DNR Natural Heritage's community types		
level 5	MN DNR Natural Heritage's community subtypes		

	40,000		
level 1	**Woodland** - Open stands of trees with crowns not usually touching (generally forming 25 - 60% cover). Canopy tree cover may be less than 25% in cases where it exceeds shrub, dwarf-shrub, herb, and nonvascular cover, respectively.		
level 2	Coniferous woodland	Deciduous woodland	Mixed coniferous - deciduous woodland
level 3	Soil Hydrology [Upland Soils]		
level 4	MN DNR Natural Heritage's community types		
level 5	MN DNR Natural Heritage's community subtypes		

	50,000	
level 1	**Shrubland** - Shrubs generally greater than 0.5 m tall (dwarf-shrubland are low-growing shrubs usually under 0.5 m tall) with individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees generally less than 25% cover). Shrub cover may be less than 25% where it exceeds tree, herb, and nonvascular cover, respectively. Vegetation dominated by woody vines is generally treated in this class.	
level 2	Coniferous / Evergreen shrubland	Deciduous shrubland
level 3	Soil Hydrology [Upland | Saturated | Temporarily flooded | Seasonally flooded]	
level 4	MN DNR Natural Heritage's community types	
level 5	MN DNR Natural Heritage's community subtypes	

	60,000				
level 1	**Herbaceous** - Herbs (graminoids, forbs, and ferns) dominant (generally forming at least 25% cover; trees, shrubs, and dwarf-shrubs generally with less than 25% cover). Herb cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and nonvascular cover, respectively.				
level 2	Grasslands or emergent vegetation	Grasslands with sparse trees (savannas)	Perennial forb vegetation	Hydromorphic rooted vegetation	Annual grasslands or forb vegetation
level 3	Tall grass | Medium-tall grass | Temporarily flooded | Saturated | Seasonally flooded | Semipermanently flooded | Intermittently exposed | Permanently flooded	Grassland with sparse deciduous trees | Grassland with sparse coniferous or mixed deciduous / coniferous trees	Saturated | Upland	Semipermanently flooded | Intermittently exposed | Permanently flooded	Seasonally flooded
level 4	MN DNR Natural Heritage's community types			National Vegetation Classification System Alliances	
level 5	MN DNR Natural Heritage's community subtypes			National Vegetation Classification System Associations	

	70,000
level 1	**Nonvascular** - Nonvascular cover (bryophytes, non-crustose lichens, and algae) dominant (generally forming at least 25% cover). Nonvascular cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and herb cover, respectively.
level 2	Lichen
level 3	Lichen vegetation with sparse trees
level 4	MN DNR Natural Heritage's community types

	80,000						
level 1	**Sparse Vegetation** - Abiotic substrate features dominant. Vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources (total vegetation cover is typically less than 25% and greater than 0%)						
level 2	Consolidated Rock		Boulder, Gravel, Cobble, or Talus		Unconsolidated Material		
level 3	Cliffs	Level Bedrock	Lowland Talus / Scree	Cobble / Gravel Beaches and Shores	Sand Flats	Temporarily Flooded Sand Flats	Seasonally / Temporarily Flooded Mud Flats
level 4	National Vegetation Classification System Alliances						
level 5	National Vegetation Classification System Associations						

	90,000			
level 1	**Open Water** - This major cover type is to be used for open water with no emergent vegetation. Emergent vegetation in rivers, intermittent streams, lakes and wetlands are to be classified under the Herbaceous Vegetation cover type. Open water divisions and classifications are based on the National Wetlands Inventory Cowardin classifications.			
level 2	River (Riverine)		Lake (Lacustrine)	Wetland Open Water (Palustrine)
level 3	Slow river	Fast River	Limnetic | Semipermanently flooded | Intermittently exposed | Permanently flooded | Littoral	Intermittently exposed | Permanently flooded | Open water
level 4			Floating Algae | Floating Vascular Vegetation (NWI classifications)	

National Vegetation Classification System: Schematic Tables

The MLCCS is modeled after the US National Vegetation Classification System (NVCS). The following tables show how the NVCS is designed and organized, and how it was adapted and changed to create the MLCCS.

NVCS schematic table

SYSTEM: TERRESTRIAL

FORMATION CLASS (Based on the structure of the vegetation, e.g. forest, woodland, shrubland, herbaceous, nonvascular, sparse vegetation.)
FORMATION SUBCLASS (Based on the growth-form characteristics, e.g. evergreen / deciduous, or perennial / annual, or grass / forb)
FORMATION GROUP (Based on leaf characters, e.g. broad-leaf, needle-leaf, microphyllus, and xeromorphic. Also, defined on macroclimatic types, e.g. tropical, temperate, etc.)
FORMATION SUBGROUP (The division between natural/semi-natural and cultural, e.g. natural, semi-natural, cultural, or planted vegetation)
physiognomic levels **FORMATION** (Vegetation types that share a definite physiognomy or structure, e.g. tall or medium grassland, or hydrologic modifiers from the NWI)

ALLIANCE (A physiognomically uniform group of plant associations sharing one or more dominant or diagnostic species, which typically are found in the uppermost stratum of the vegetation.)
floristic levels **ASSOCIATION** (A plant community type of definite floristic composition, uniform habitat conditions, and uniform physiognomy)

NVCS - MLCCS: Natural / Semi-Natural Communities

SYSTEM: Natural / Semi-Natural (NVCS formation's in **bold** were used in the MLCCS)

level 1 **FORMATION CLASS** [Forest | Woodland | Shrubland | Herbaceous | Nonvascular | Sparse Vegetation | Open Water]
level 2 **FORMATION SUBCLASS** [Coniferous (Evergreen) | Deciduous | Mixed Conif.-Decid. | Grassland | Forbs | Perennial | Annual | Cliffs, rocks, etc.]
FORMATION GROUP < leaf characteristics - not applied in MN >
FORMATION SUBGROUP < Natural vs. cultural - defined at system level in MN >
level 3 **FORMATION** [Soil Hydrology, e.g.: Upland | Saturated | Temporarily, Seasonally or Semi-permanently flooded]
physiognomic levels

level 4 **ALLIANCE** [MN DNR Natural Heritage's Community Types or NVCS alliances]
level 5 **ASSOCIATION** [MN DNR Natural Heritage's Community Subtypes or NVCS associations]
floristic levels

NVCS - MLCCS: Cultural Land Cover

SYSTEM: Cultural

level 1 **SUBSYSTEM** [Artificial surfaces with < 96% Vegetation | Cultural vegetation ≥ 96%]
level 2 **FORMATION CLASS** [Trees | Shrub / Vines | Herbaceous | Cultivated Herb. | Minimal Veg.]
level 3 **FORMATION SUBCLASS** [Coniferous | Deciduous | Mixed C-D | Grasses | Row Crops | Exposed Earth | Buildings & Pavement]
level 4 **PERCENT IMPERVIOUS or SOIL HYDROLOGY** [10% | 25% | 50% | 75% | 90% || Upland | Hydric]
physiognomic levels

level 5 **ALLIANCE** [Genus - general | short grass | long grass | Crop type | Mine / quarry / buildings / pavement]
floristic levels

The Classification System
Land Cover Coding Schemes

The MLCCS is a typical hierarchical classification system. The organization of the numerical and alphanumerical codes reflect this multi-level nested hierarchy.

Numerical codes

The numerical codes use a five digit number. The digits are organized left to right and each digit represents a level of the classification system; the first digit represents level one, the second digit represents level two, etc.

The five levels of the MLCCS are represented by a five digit number:

level one	level two	level three	level four	level five
first digit	second digit	third digit	fourth digit	fifth digit

Examples:
30000 - Interpreted to the first level, thus represents *Forests*
32000 - Interpreted to the second level, thus represents *Deciduous forest*
32100 - Interpreted to the third level, thus represents *Upland deciduous forest*
32110 - Interpreted to the fourth level, thus represents *Oak forest*
32113 - Interpreted to the fifth level, thus represents *Oak forest dry subtype*

Alphanumerical codes

The alphanumerical codes use a unique combination of numbers and letters (characters) for each level. The unique character clusters for each level are separated by periods.

level one	level two	level three	level four	level five
arabic number	two lowercase letters	two uppercase letters	three characters	three characters

Examples:

3	Interpreted to the first level, thus represents *Forests*
3.de	Interpreted to the second level, thus represents *Deciduous forest*
3.de.UP	Interpreted to the third level, thus represents *Upland deciduous forest*
3.de.UP.nOA	Interpreted to the fourth level, thus represents *Oak forest*
3.de.UP.nOA.nOD	Interpreted to the fifth level, thus represents *Oak forest dry subtype*

See "Definitions of the alphanumeric characters" insert link

Remote Sensing Coding Schemes

Remote sensing information is tracked with two attribute fields - **img_code** for the five digit land cover code and **img_type** for the image used.

Numerical land cover codes interpreted from remote sensing

If a land cover code has been derived from remote sensing, then the five digit numerical code is placed in the img_code field. This field should be populated whenever a land cover code has be derived from remote sensing techniques, even if there is also a land cover code derived from field inspection. A polygon may contain a land cover codes in the both the img_code field and the fld_code field. As the remote sensing source may be dated, many times these codes will be different. If the land cover code has only been derived from field inspection, then an img_code is not necessary.

Remote sensing image type codes

The remote sensing source is tracked in the img_type field. This refers to the type and date of the image used for remote sensing interpretation of the land cover code. Different remote sensing sources can be reference for specific polygons, or the user can list all the remote sensing sources used for the entire project. Format for the sources should be "Year (YYYY) Originator and Type". For example, typical remote sensing sources:
2000 Met Council BW DOQ
2003 FSA Color DOQ
1994 DNR CIR

The information should be entered as a text string with a pipe "|" used to delimit the items. For example, assuming all of the above sources were used for the project, the img_type field would be populated with "2003 FSA Color DOQ | 2000 Met Council BW DOQ | 1994 DNR CIR". List sources in chronological order, with the most current first.

Field Work Coding Schemes

Field work derived information is tracked with three attribute fields - **fld_code** for the five digit land cover code, **fld_date** for the date of the field work, and **fld_level** for the level of which the site was field visited.

Numerical land cover codes interpreted from field visits

If a land cover code has been derived from visiting the site in the field, then the five digit numerical code is placed in the fld_code field. This field should be populated whenever a land cover code has be derived from a field site visit, even if there is also a land cover code derived from remote sensing interpretation. A polygon may contain a land cover codes in the both the img_code field and the fld_code field. As the remote sensing source may be dated, many times these codes will be different. If the land cover code has only been derived from field inspection, then an img_code is not necessary.

Field date codes

The fld_date field tracks the date the site was visited. This can reflect either the exact day of the visit or generalized to the month or year. The format for the information is an eight character string representing "year month day" (yyyymmdd). Thus, July 16, 2004 would be entered as 20040716. Use "01" as a place holder to represent if the day or month has not been tracked. Thus, 20040701 represents July, 2004 (not July 1, 2004), and 20040101 represents the year 2004 (not January 1, 2004). If field work was done on the first day of the month and one wants to record a date of the field, use a date of "02" instead of "01". Thus, 20040702 represents field work done on July 1, 2004 and/or July 2, 2004.

Field check levels

A site visit level code must be used for all polygons that have been field visited and have a fld_code value. The numerical code represents the degree the site was visited. These codes can be applied to all land cover types; artificial, cultural, natural or semi-natural. Natural communities must be field checked to be given a natural quality ranking. The natural quality ranking are based on the DNR's Natural Heritage Element Occurrence Ranking Guidelines (see below "Natural Quality Modifiers" and appendix 2: Element Occurrence system). Valid field check level codes are:

0 = site not visited

1 = viewed the site from a distance
Was not able to walk to the site, but was able to discern the dominant vegetation. Masses of invasive species may be visible, and thus were recorded (buckthorn, reed canary grass, crown vetch, etc). Depending on the perceived quantity of invasive species, a natural quality ranking of D may or may not be discernable.

2 = visited the edge of the site
Walked or drove to the edge of the site, and was able to inventory some invasive species and speculate on its natural quality. Depending on the perceived quantity of invasive species, a natural quality ranking of C or D may or may not be discernable.

3 = visited part of the site
Walked into the site and was able to confidently inventory most invasive species present and assess its natural quality - A, B, C or D. Wetlands that are inventoried from the edges in several places should be given this field check level.

4 = visited the entire site
Was able to inventory all invasive species present and assess the site's natural quality - A, B, C or D.

Modifier Coding Schemes

Modifiers are to be used to further define a site and are considered equal in weight to the initial MLCCS code. In cases where a site has been field checked, appropriate modifiers should be applied. Polygon attribute tables will accommodate modifiers from each grouping of modifier codes. Definitions for many of the modifiers are included, however most modifiers are self explanatory. Field inspections should be conducted when applying modifier codes. Modifiers can be applied while doing the initial air photo interpretation, though caution should be used in making modifier decisions only on air photo interpretation. With practice and experience, a person may be able to gain confidence to apply modifiers from air photo interpretation only.

- Percentage of Impervious Cover. Enables one to give an exact percentage of imperviousness to a polygon, thus improving stormwater run-off model results.
- Current Land Use. List of most common land uses. Permits the tracking of a polygon's land use classification.
- Modifiers that identify the current vegetation management practices on a site.
- Modifiers that identify types of natural disturbances to the community.
- Modifiers that identify the natural quality of a site.
- Invasive species.
- Modifiers that identify the successional stage of a forest.
- Percentage of tree canopy cover.
- Average diameter of trees within a forest
- Water regime (NWI modifiers)
- Built water features
- Wetland features
- Stream features
- Spring features

Natural quality modifiers

The natural plant community sites can be given a natural quality ranking, based on the DNR's Natural Heritage's Element Occurrence Ranking Guidelines* (EOR). As stated in the EOR document:

> Element Occurrence (EO) Ranking Guidelines describe the manner in which occurrences of specific Minnesota natural communities are ranked by ecologists. On a continuum of "A" through "D," and "A" rank indicates an excellent quality natural community, while "D" indicates a poor quality natural community. To assess quality, ecologists primarily consider the presence or absence of unnatural human-induced disturbances such as logging, plowing, overgrazing and development.
>
> These guidelines were written by Minnesota Natural Heritage Program ecologists based primarily on field experience to date, and will be modified as more data are collected. The authors have a great deal of field experience in some natural communities, and less in others. The guidelines are designed to be used by experienced ecologists who have some knowledge of the community across its entire range in the state.

Refer to the EOR Guidelines to evaluate the specific natural communities. Non-native, altered and disturbed communities should only be given a non-native ranking (NN or NA). Valid codes and general definitions modifier m_34X are:

A = highest quality natural community, no disturbances and natural processes intact. Site must be visited entirely or partially to accurately assess its natural quality at this level (fld_level = 3 or 4).

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* http://files.dnr.state.mn.us/ecological_services/nhnrp/eoranks2001.pdfp/eoranks2001.pdf

B = good quality natural community. Has its natural processes intact, but shows signs of past human impacts. Low levels of exotics. Site must be visited entirely or partially to accurately assess its natural quality at this level (fld_level = 3 or 4).

C = moderate condition natural community with obvious past disturbance but is still clearly recognizable as a native community. Not dominated by weedy species in any layer. Minimally, the site must be visited from the edge to accurately assess its natural quality at this level (fld_level = 2, 3 or 4).

D = poor condition of a natural community. Includes some natives, but is dominated by non-natives and/or is widely disturbed and altered. Herbaceous communities may be assessed with this ranking from a distance (fld_level = 1) if large masses of invasive species are present and the entire community is visible.

NA = Native species present in an altered / non-native plant community. This NA ranking can only be used if the site is field checked from the edge or to a greater degree (fld_level 2, 3, or 4), thus confirming the presence of native species within a non-native community.

NN = Altered / non-native plant community. These semi-natural communities do not qualify for natural quality ranking. Using NN signifies the site has been field checked and confirms it is a semi-natural community.

Inventory Process

The standardized MLCCS inventory methodology

Materials

Printed materials:

DNR's Natural Heritage's Element Occurrence Ranking Guidelines
http://files.dnr.state.mn.us/ecological_services/nhnrp/eoranks2001.pdfp/eoranks2001.pdf
Soil Survey books
Field guide books (see Appendix 7)
Color Infrared Photos[+] and a stereoscope
Color Aerial Photos
MLCCS Manual and MLCCS Dichotomous Field Key
[+] Photos available from DNR Forestry: http://maps.dnr.state.mn.us/forestry/photos/

Digital materials:

Minnesota County Biological Survey natural community polygons*
National Wetlands Inventory polygons*
Soil polygons*
Ecological Classification System*
Pre-settlement Vegetation data (Marschner map)*
Digital Orthophoto Quads (1 meter resolution or better)*
Color Infrared Photos (rectified)[+]
Color Aerial Photos - various counties or Farm Service Agency
MLCCS dichotomous key for the Palm
* Can be downloaded without charge from the DNR data deli: http://deli.dnr.state.mn.us/
[+] Unrectified images available from DNR Forestry: http://maps.dnr.state.mn.us/forestry/photos/

Procedure

Create hardcopy base maps

Tile project site into print areas at a 1:3,000 or greater scale. Have the most current DOQs as the base layer, with NWI and MCBS polygon outlines on top. Label the Cowardin class from the NWI and the natural community from the MCBS.

Broadly delineate level 1 & 2

Divide the study area into broad physiognomic plant characteristic, as depicted in level 1 and level 2. For example, delineate the boundaries between herbaceous, forest and shrub communities. Artificial surfaces and planted communities can likewise be delineated at level 1 or level 2. These are obvious boundaries visible from aerial photos, and is typically done with colored pencils on the printed 1:3,000 DOQs.

The Minimum Mapping Unit and levels 3, 4, & 5

Minimum Mapping Unit is 0.5 hectare for natural vegetation (1.23 acres) and 1 hectare for cultural communities (2.47 acres). Consequently, all land cover types that meet this minimum size must be delineated. The size of the minimum mapping unit (MMU) was selected to ensure detailed and accurate data while balancing typical budget constraints. If the project budget permits, a smaller MMU can be applied. This commonly occurs when delineating wetlands or municipal parks. Adherence to the MMU is especially important when delineating level 4 & 5 natural communities. Also associated with the MMU is a recommended minimum polygon width of 50 feet.

Sampling techniques and the dichotomous key

Standardized interpretation of the vegetation communities and ecological systems is the primary goal of this manual. MLCCS data generation relies heavily on aerial photo interpretation complemented by field work. The Federal Geographic Data Committee (FGDC) Vegetation Classification guidelines require that field data be collected "using standard and documented sampling methods." To standardize the interpretation of natural communities, the use of the dichotomous key is mandatory. The MLCCS key is a visual sampling of the dominant plant species in the community, with the general ecology of the site taken into consideration. It is imperative that field staff new to the MLCCS use the dichotomous key until they fully understand how the MLCCS defines all plant communities in their project area. Failure to use the MLCCS key will result in non-standard plant community interpretation, and will most likely result in the data not being included in the regionwide DNR-endorsed GIS layer.

Also associated with the standardized data collection is the Field Check Form, on the final page of the manual for easy duplication. This form helps further to standardize natural community interpretation.

Modifiers to land cover codes

The modifier attribute fields have been set up to permit the application of multiple modifiers for each polygon. The modifier fields are grouped around a common theme, from which the user can choose one modifier code. The exception to this rule are the modifiers for invasive plant species, in that each plant species is given its own unique attribute field. All invasive plant species identified in natural/semi-natural field checked polygons must be recorded. The use of natural community quality modifies are also strongly encouraged.

Interpretation and digitizing standards

Line Quality and Accuracy

Line error should be no more than 1/8" at a 1:3,000 scale. This represents approximately 30 feet horizontal accuracy. This accuracy standard applies to both the interpretation of polygon boundaries on the DOQs, and to digitizing these field-interpreted polygons into a GIS.

Interpretation / Label Quality and Accuracy

Land cover interpretation accuracy goal is 100% at level 1, 95% at level 3 and 90% at level 4/5. Field checking all (or most) public property in the project site is strongly recommended. There should be 100% accuracy between the labels on the field maps (paper) and the digitized versions.

Polygon Attribute Table standards

One problem typically encountered with land cover inventory projects in rapidly developing areas is the quickly changing cover type of the landscape. To address this problem, specific fields have been created that refer to the land cover interpretation source and date. For example, field item "img_code" tracks the land cover code interpreted from aerial photos, while "img_type" tracks the type and date of the image used. Thus, img_code = 32160 and img_type = "1991 USGS BW DOQ | 1994 DNR CIR", refers to a polygon of aspen forest derived from 1991 USGS DOQs and 1994 color infrared aerial photographs. When this site is field checked, it might be determined to be a different land cover type than was interpreted off the aerial photo. To record this change, use the "fld_code" field to track the land cover type derived from field inspection and "fld_date" tracks the date the field visit occurred. With values in both img_code and fld_code, one can discern how the land cover has changed in relative short window of time.

The attribute field item C_NUM should be populated with the most current classification code from the img_code and fld_code fields. The C_NUM field is the final land cover code for MLCCS data, and is used for cartographic products and data analysis. Field item C_ALPHA is the alphanumeric equivalent of C_NUM, and automatically populated when using the MLCCS digitizing extension. This item will greatly facilitates sorting and analyzing the data for horizontally common features, such as "saturated" (c_alpha = WB), "26-50% impervious" (c_alpha = i50) or "altered / non-native communities" (c_alpha = nAT). See "Definitions of the alphanumeric characters" for complete details.

Polygon Attribute Table format

ITEM NAME	DESCRIPTION	RULES FOR POPULATING VALUES	DEFINITION
AREA	Area in square meters	Automatically generated in GIS software.	number
PERIMETER	Perimeter of polygon in meters	Automatically generated in GIS software.	number
MLCCSPY3_#	Internal Arc/Info polygon ID	The degree the polygon was field checked, from the field check form.	number
MLCCSPY3_ID	Arc/Info polygon ID	The degree the polygon was field checked, from the field check form.	number
UNIQUE_ID	Project defined polygon ID	A unique number assigned to each polygon to help track it for field checking. The DNR assigns the numbers based on the USGS DOQ quarter-quad number and a print tiling scheme. Not mandatory.	16 characters
C_NUM	Final land cover code as 5 digit number	This field will duplicate the most accurate land cover code for each polygon - either field visit (fld_code) or remote sensing (img_code). Mandatory	5 digit number
C_ALPHA	Final land cover code in alphanumeric format	The alphanumeric code equivalent to C_NUM. Automatically populated with MLCCS tools.	16 characters
C_TEXT	Final land cover code as a text description	A text description of the land cover code. Automatically populated with MLCCS tools.	125 characters
FLD_CODE	Land cover code derived from field work.	The land cover code derived from field interpretation. Can be applied to any land cover type. Must be present if invasive species or natural quality modifiers are used.	5 digit number

FLD_DATE	Date of field work (year-month-day with no delimiters, e.g. 20043019)		8 characters
FLD_LEVEL	Field check level (from the Field Check Form in the manual)	The degree the polygon was field visited: 0 = site not visited 1 = viewed the site from a distance 2 = visited the edge of the site 3 = visited part of the site 4 = visited the entire site See manual page for details. Mandatory if FLD_CODE is populated.	1 digit number
IMG_CODE	Land cover code derived from aerial photo or image interpretation	The land cover code derived by remote sensing, typically using aerial photos or satellite images. Several images can be used in concert. Not mandatory if the land cover of the site was initially interpreted from field work.	5 digit number
IMG_TYPE	List of date and type of images, e.g. [2003 FSA color DOQ | 2000 Met Council BW DOQ]	List the most current image first, descending in chronological order. Use "yyyy source and image type" with a pipe "|" as delimiters. Standard entries: 2003 FSA color DOQ 2000 Met Council BW DOQ 1994 DNR CIR	250 characters

M_0XX	Modifiers for percent imperviousness, 000 = 0% to 100 = 100%	Valid values are 000 to 100	3 digit number
M_2XX	Modifiers for cultural land use	Valid values are 210 to 276	3 digit number
M_30X	Modifiers for vegetation management	Valid values are 301, 302, or as a list "301, 302"	16 characters
M_31X	Modifiers for management type	Valid values are 310 to 315, or as a list, e.g. "310, 311, 315"	25 characters
M_32X	Modifiers for natural community disturbance types	Valid values are 321 to 329, or as a list, e.g. "321, 323, 326"	50 characters
M_33X	Old modifiers for the quality of the natural community. NO LONGER USED.	NO LONGER USED.	3 digit number
M_34X	Modifiers for the quality of the natural community, based on DNR's Natural Heritage Element Occurrence Rank (EOR).	Valid values are: A = highest quality natural community B = good quality natural community C = moderate condition natural community D = poor condition of a natural community NA = Native species present in an altered/non-native plant community NN = Altered / non-native plant community FLD_LEVEL must be => 3 for a A or B ranking FLD_LEVEL must be => 2 for a C or D ranking FLD_LEVEL must be => 1 for a NA or NN ranking	2 characters

M_400	Overgrown Savanna	Valid value is 400. FLD_LEVEL must be => 2	3 digit number
M_401	Overgrown Woodland	Valid value is 401. FLD_LEVEL must be => 2	3 digit number
M_402	Purple Loosestrife	Valid values are: 0 = unknown, or if field checked, plants not observed 1 = observed, unknown quantity 2 = 1 to 5% coverage 3 = 6 to 25% coverage 4 = 26 to 50% coverage 5 = 51 to 75% coverage 6 = 76 to 100% coverage FLD_LEVEL must be => 1	3 digit number
M_403	Eurasian Watermilfoil	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_404	Curly-leaf Pondweed	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_405	Flowering Rush	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_406	Narrow-leaf Cattail	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_407	Crown Vetch	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 1	3 digit number

M_408	Common Buckthorn	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 1	3 digit number
M_409	Leafy Spurge	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 1	3 digit number
M_410	Tartarian Honey Suckle	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_411	Garlic Mustard	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_412	Reed Canary Grass	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 1	3 digit number
M_413	Smooth Brome	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_414	Spotted Knapweed	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_415	Exotic Thistle	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_416	Siberian elm	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_417	Phragmites	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_418	Grecian Foxglove	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number

M_419	Amur Maple	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_420	Black locust	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_421	Absinthe sage - *Artemisia absinthium*	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_499	Other invasive species	Valid values are 1, 2, 3, 4, 5, 6 FLD_LEVEL must be => 2	3 digit number
M_5XX	Modifiers for tree species	500 to 546 or as a list, e.g. "512, 524, 530"	50 characters
M_60X	Modifiers for forest dynamics	601 to 604	3 digit number
M_61X	Modifiers for percentage of tree canopy, numerical range	610 to 616	3 digit number
M_62X	Modifiers for cover size (average diameter of trees)	621 to 629	3 digit number
M_71X	Modifiers for NWI regimes	710 to 716	3 digit number
M_72X	Modifiers for built water features	720 to 726 or as a list, e.g. "720, 723"	25 characters
M_73X	Modifiers for wetland features	730 to 734 or as a list, e.g. "730, 733"	25 characters

M_74X	Modifiers for stream features	740, 741 or as a list, "740, 741"	16 characters
M_75X	Modifier for spring features	750	3 digit number
NOTES	Comment field		250 characters
SOURCE	Author of data (interpretation and digitizing)	Mandatory field - state "organization, ecologist, digitizer (if different)", e.g. "ACD, R. Biske" or "EOR, M Arikian, J. Naber"	100 characters
ACRES	Polygon area calculated in acres	Automatically populated with MLCCS tools	250 characters

Error checking techniques

Polygon Attribute Table

- The polygon attribute table must conform with the DNR standard and all MLCCS codes must be placed in the appropriate interpretation date column. Data with values only in C_NUM will not be accepted.
- All polygons with codes associated with field interpretation must have a field check value (visited entirely, visited partially, etc.).

Digitizing Quality

- All polygons are digitized at a view scale between 1:4,000 and 1:3,000.
- Curved lines are smoothly depicted at 1:3,000.
- All slivers and gaps are eliminated.
- All polygons have attributes.
- No multi-part polygons exist.

Interpretation Quality

- All polygons must be interpreted to level 4 or 5, except for cultivated and planted communities (20,000 codes).
- Every polygon must be proofed against the most recent DOQ available. If the cover type on the DOQ differs from an older CIR, the cover type of the DOQ should be used.
- In areas that cannot be field visited, the cover type should be inferred from adjacent sites that can be visited and have the same CIR signature.
- The MLCCS dichotomous key must be used for natural cover types.
- Natural communities that do not normally occur in the area should be questioned and rechecked in the field.
- Natural cover polygons that have been field checked should be given a natural quality ranking and should include invasive species modifiers where applicable.

The DNR's proofing procedure

1. Digitizing Errors
    - Using the DNR's edit tool extension, identify gaps, overlaps and null polygons
    - Identify slivers by querying acres less than 0.10.
    - Check between 25% and 50% of polygons for line quality.

2. Polygon Attribute Errors
    - Are all the relevant field names present (c_num, c_alpha, fld_level, etc.)
    - Fields are populated when appropriate.
    - Some polygons with fld_code values should also have invasive species modifiers.

3. Interpretation Errors
    - Sort and query for natural communities that are not likely to occur. If found, are they field derived or remotely sensed?
    - Check all polygons against most recent DOQs.
    - Randomly spot check 10% against CIRs.
    - Randomly spot check 1-5% natural community polygons in the field.

Sources of the classification system and methodology:

Federal Geographic Data Committee
http://www.fgdc.gov/standards/status/sub2_1.html

The Nature Conservancy / NatureServe
http://www.natureserve.org/prodServices/ecomapping.jsp
http://www.natureserve.org/library/seeingforest.pdf

National Park Service
http://biology.usgs.gov/npsveg/standards.html

US Fish & Wildlife Service
http://www.fws.gov/data/gisveg.html
http://www.fws.gov/data/guidmap.html
http://www.fws.gov/data/fwsnvcs.html

MLCCS Dichotomous Key

Instructions to MLCCS Key

If you answer YES to any of the questions at a given step, follow directions for YES. Otherwise, follow directions for NO. Skipping into the middle of this key when trying to classify a community will reduce the chances of accurate classification. Many of the MLCCS community types were originally described by the Natural Heritage Program of the Minnesota Department of Natural Resources in the 1993 publication Minnesota's Native Vegetation: a Key to Natural Communities. Open water types came from the U.S. Fish and Wildlife Service publication Classification of Wetland Habitats and Deepwater Habitats of the United States (Cowardin et al. 1979), which was used by the National Wetlands Inventory. Other community types came from the U.S. National Vegetation Classification System (developed by The Nature Conservancy) or were created specifically for the MLCCS. The names of many natural community types include species names. These species are considered typical, but do not occur in every example, and many other species also occur in the communities. Not all examples of a community should be classified as subtypes, even when they exist. Do not use subtypes unless they accurately describe the vegetation under consideration (see the community definitions section).

If you are using this key for the first time, go to Instructions to MLCCS Key

1) Does open water (including non-rooted vegetation) cover >96% of the area?
   YES, go to 90000
   NO, go to 2
2) Is total vegetation cover <96% because of direct human alteration (such as roads, buildings, or bulldozing)?
   YES, go to 10000
   NO, go to 3
3) Is total vegetation cover <25%?
   YES, go to 9
   NO, go to 4
4) Was the vegetation planted for cultivation, pasture, windbreak, soil conservation, or other human use (including tree plantations, tree nurseries, and hayfields, but NOT prairie or forest restorations)? Is the vegetation actively maintained for recreation (such as a ball field), visibility (such as roadsides), or in a park-like or yard-like fashion?
   YES, go to 20000
   NO, go to 5
5) Is the cover of herbaceous plants (including rooted plants that float or are submerged, but excluding dwarf-shrubs) from an aerial view greater than the cover of trees, shrubs, and nonvascular (moss or lichen) vegetation, respectively? (Generally >25% herbaceous cover)
   YES, go to 60000
   NO, go to 6
6) Is the cover of trees (including seedlings or saplings if few tall trees are present) from an aerial view greater than the cover of shrubs, herbaceous plants, and nonvascular vegetation, respectively? (Generally >25% tree cover)
   YES, go to 7
   NO, go to 8

7) Do most tree crowns (including seedlings or saplings if few tall trees are present, but NOT including small trees stunted by frequent fire) overlap, generally forming 60-100% cover?

YES, go to 30000
NO, go to 40000

8) Is the cover of shrubs (including dwarf-shrubs, such as cranberry) from an aerial view greater than the cover of trees, herbaceous plants, and nonvascular vegetation, respectively? (Generally >25% shrub cover)

YES, go to 50000
NO, go to 70000

9) Is the substrate usually submerged, except during periods of extreme drought?

YES, go to 90000
NO, go to 80000

10000 ARTIFICIAL SURFACES AND ASSOCIATED AREAS

1) Does vegetation cover <25% of the area?

YES, go to 2
NO, go to 3

2) Is the unvegetated area an agricultural field that is temporarily unplanted?

YES, go to 24000 Cultivated Herbaceous Vegetation
NO, go to 14000 Artificial surfaces with Less than 25% Vegetation Cover

3) Is the cover of trees from an aerial view greater than the cover of shrubs or herbaceous plants, respectively? (Generally >25% tree cover)

YES, go to 11000 Artificial surfaces with Trees Dominant
NO, go to 4

4) Is the cover of shrubs or vines from an aerial view greater than the cover of trees or herbaceous plants, respectively? (Generally >25% shrub cover)

YES, go to 12000 Artificial surfaces with Coniferous and/or Deciduous Shrub Vegetation
NO, go to 13000 Artificial surfaces with Herbaceous Dominant Vegetation

11000 ARTIFICIAL SURFACES WITH TREES DOMINANT

A) Coniferous species contribute >75% of the total tree cover, go to 11100
B) Deciduous (excluding tamarack (Larix)) species contribute >75% of the total tree cover, go to 11200
C) Coniferous and deciduous species each contribute 25-75% of the total tree cover, go to 11300

11100 ARTIFICIAL SURFACES WITH CONIFEROUS TREES

11110 4% to 10% Impervious Cover with Coniferous Trees
11111 Jack Pine (forest or woodland)* (see 31120 or 41110)
11112 White / Red Pine Forest (see 31130 or 31140)
11113 Spruce-Fir Forest* (see 31160)
11114 Eastern Red Cedar Woodland (see 41130)
11115 Northern Conifer Woodland* (see 41120)
11116 Planted Red Pine

11117 Planted White Pine
11118 Planted Spruce/Fir
11119 Other Planted Conifers

11120 11% to 25% Impervious Cover with Coniferous Trees
11121 Jack Pine (forest or woodland)* (see 31120 or 41110)
11122 White / Red Pine Forest (see 31130 or 31140)
11123 Spruce-Fir Forest* (see 31160)
11124 Eastern Red Cedar Woodland (see 41130)
11125 Northern Conifer Woodland* (see 41120)
11126 Planted Red Pine
11127 Planted White Pine
11128 Planted Spruce/Fir
11129 Other Planted Conifers

11130 26% to 50% Impervious Cover with Coniferous Trees
11131 Jack Pine (forest or woodland)* (see 31120 or 41110)
11132 White / Red Pine Forest (see 31130 or 31140)
11133 Spruce-Fir Forest* (see 31160)
11134 Eastern Red Cedar Woodland (see 41130)
11135 Northern Conifer Woodland* (see 41120)
11136 Planted Red Pine
11137 Planted White Pine
11138 Planted Spruce/Fir
11139 Other Planted Conifers

11140 51% to 75% Impervious Cover with Coniferous Trees
11141 Jack Pine (forest or woodland)* (see 31120 or 41110)
11142 White / Red Pine Forest (see 31130 or 31140)
11143 Spruce-Fir Forest* (see 31160)
11144 Eastern Red Cedar Woodland (see 41130)
11145 Northern Conifer Woodland* (see 41120)
11146 Planted Red Pine
11147 Planted White Pine
11148 Planted Spruce/Fir
11149 Other Planted Conifers

11200 ARTIFICIAL SURFACES WITH DECIDUOUS TREES

11210 4% to 10% Impervious Cover with Deciduous Trees
11211 Oak (forest or woodland) (see 32110 or 42120)
11212 Northern Hardwood Forest* (see 32120)
11213 Maple-Basswood Forest (see 32150)
11214 Boxelder-Green Ash-Cottonwood-Elm Forest (see 32170)
11215 Aspen-Birch Forest* (see 32140)
11216 Aspen (forest or woodland) (see 32160, 32230, 32330, or 42110)
11217 Planted Ash
11218 Planted Oak
11219 Other Deciduous Trees

11220 11% to 25% Impervious Cover with Deciduous Trees
- 11221 Oak (forest or woodland) (see 32110 or 42120)
- 11222 Northern Hardwood Forest* (see 32120)
- 11223 Maple-Basswood Forest (see 32150)
- 11224 Boxelder-Green Ash-Cottonwood-Elm Forest (see 32170)
- 11225 Aspen-Birch Forest* (see 32140)
- 11226 Aspen (forest or woodland) (see 32160, 32230, 32330, or 42110)
- 11227 Planted Ash
- 11228 Planted Oak
- 11229 Other Deciduous Trees

11230 26% to 50% Impervious Cover with Deciduous Trees
- 11231 Oak (forest or woodland) (see 32110 or 42120)
- 11232 Northern Hardwood Forest* (see 32120)
- 11233 Maple-Basswood Forest (see 32150)
- 11234 Boxelder-Green Ash-Cottonwood-Elm Forest (see 32170)
- 11235 Aspen-Birch Forest* (see 32140)
- 11236 Aspen (forest or woodland) (see 32160, 32230, 32330, or 42110)
- 11237 Planted Ash
- 11238 Planted Oak
- 11239 Other Deciduous Trees

11240 51% to 75% Impervious Cover with Deciduous Trees
- 11241 Oak (forest or woodland) (see 32110 or 42120)
- 11242 Northern Hardwood Forest* (see 32120)
- 11243 Maple-Basswood Forest (see 32150)
- 11244 Boxelder-Green Ash-Cottonwood-Elm Forest (see 32170)
- 11245 Aspen-Birch Forest* (see 32140)
- 11246 Aspen (forest or woodland) (see 32160, 32230, 32330, or 42110)
- 11247 Planted Ash
- 11248 Planted Oak
- 11249 Other Deciduous Trees

11300 ARTIFICIAL SURFACES WITH MIXED CONIFEROUS AND DECIDUOUS TREES

11310 4% to 10% Impervious Cover with Mixed Coniferous/Deciduous trees
- 11311 Mixed Pine-Hardwood Forest* (see 33110)
- 11312 White Pine-Hardwood Forest (see 33140)
- 11313 Northern Hardwood-Conifer Forest* (see 33130)
- 11314 Planted Mixed Coniferous/Deciduous Trees

11320 11% to 25% Impervious Cover with Mixed Coniferous/Deciduous Trees
- 11321 Mixed Pine-Hardwood Forest* (see 33110)
- 11322 White Pine-Hardwood Forest (see 33140)
- 11323 Northern Hardwood-Conifer Forest* (see 33130)
- 11324 Planted Mixed Coniferous/Deciduous Trees

11330 26% to 50% Impervious Cover with Mixed Coniferous/Deciduous Trees
- 11331 Mixed Pine-Hardwood Forest* (see 33110)
- 11332 White Pine-Hardwood Forest (see 33140)
- 11333 Northern Hardwood-Conifer Forest* (see 33130)
- 11334 Planted Mixed Coniferous/Deciduous Trees

11340 51% to 75% Impervious Cover with Mixed Coniferous/Deciduous Trees
- 11341 Mixed Pine-Hardwood Forest* (see 33110)
- 11342 White Pine-Hardwood Forest (see 33140)
- 11343 Northern Hardwood-Conifer Forest* (see 33130)
- 11344 Planted Mixed Coniferous/Deciduous Trees

12000 ARTIFICIAL SURFACES WITH CONIFEROUS AND/OR DECIDUOUS SHRUB VEGETATION

Do trees comprise >10% cover?
- YES, go to 12200 Artificial surfaces with Coniferous and/or Deciduous Shrubs with Sparse Trees
- NO, go to 12100 Artificial surfaces with Coniferous and/or Deciduous Shrubs

12100 ARTIFICIAL SURFACES WITH CONIFEROUS AND/OR DECIDUOUS SHRUBS

12110 4% to 10% Impervious Cover with Coniferous and/or Deciduous Shrubs
- 12111 Short Grasses with Planted Coniferous and/or Deciduous Shrubs
- 12112 Long Grasses (>1ft.) with Planted Coniferous and/or Deciduous Shrubs
- 12113 Other Coniferous and/or Deciduous shrubs

12120 11% to 25% Impervious Cover with Coniferous and/or Deciduous Shrubs
- 12121 Short Grasses with Planted Coniferous and/or Deciduous Shrubs
- 12122 Long Grasses (>1ft.) with Planted Coniferous and/or Deciduous Shrubs
- 12123 Other Coniferous and/or Deciduous shrubs

12130 26% to 50% Impervious Cover with Coniferous and/or Deciduous Shrubs
- 12131 Short Grasses with Planted Coniferous and/or Deciduous Shrubs
- 12132 Long Grasses (>1ft.) with Planted Coniferous and/or Deciduous Shrubs
- 12133 Other Coniferous and/or Deciduous shrubs

12140 51% to 75% Impervious Cover with Coniferous and/or Deciduous Shrubs
- 12141 Short Grasses with Planted Coniferous and/or Deciduous Shrubs
- 12142 Long Grasses (>1ft.) with Planted Coniferous and/or Deciduous Shrubs
- 12143 Other Coniferous and/or Deciduous shrubs

12200 ARTIFICIAL SURFACES WITH CONIFEROUS AND/OR DECIDUOUS SHRUBS AND SPARSE TREES

12210 4% to 10% Impervious Cover with Coniferous and/or Deciduous Shrubs and Sparse Trees
- 12211 Oak Woodland Brushland (see 42120)
- 12212 Other Coniferous and/or Deciduous Shrubs and Trees

12220 11% to 25% Impervious Cover with Coniferous and/or Deciduous Shrubs and Sparse Trees
- 12221 Oak Woodland Brushland (see 42120)
- 12222 Other Coniferous and/or Deciduous Shrubs and Trees

12230 26% to 50% Impervious Cover with Coniferous and/or Deciduous Shrubs and Sparse Trees
- 12231 Oak Woodland Brushland (see 42120)
- 12232 Other Coniferous and/or Deciduous Shrubs and Trees

12240 51% to 75% Impervious Cover with Coniferous and/or Deciduous Shrubs and Sparse Trees
- 12241 Oak Woodland Brushland (see 42120)
- 12242 Other Coniferous and/or Deciduous Shrubs and Trees

13000 ARTIFICIAL SURFACES WITH HERBACEOUS DOMINANT VEGETATION

1) Do trees comprise >10% cover?
   - YES, go to 13100 Artificial surfaces with Perennial Grasses with Sparse Trees
   - NO, go to 2
2) Is the vegetation cultivated?
   - YES, go to 13300 Artificial surfaces with Cultivated Herbaceous Vegetation
   - NO, go to 13200 Artificial surfaces with Perennial Grasses

13100 ARTIFICIAL SURFACES WITH PERENNIAL GRASSES WITH SPARSE TREES

13110 4% to 10% Impervious Cover with Perennial Grasses and Sparse Trees
- 13111 Jack Pine Barrens* (see 62210)
- 13112 Oak Savanna (see 62120 and 62130)
- 13113 Aspen Openings* (see 62110)
- 13114 Short Grasses (<1ft.) and Mixed Trees
- 13115 Non-Native Dominated Long Grasses and Mixed Trees

13120 11% to 25% Impervious Cover with Perennial Grasses and Sparse Trees
- 13121 Jack Pine Barrens* (see 62210)
- 13122 Oak Savanna (see 62120 and 62130)
- 13123 Aspen Openings* (see 62110)
- 13124 Short Grasses (<1ft.) and Mixed Trees
- 13125 Non-Native Dominated Long Grasses and Mixed Trees

13130 26% to 50% Impervious Cover with Perennial Grasses and Sparse Trees
- 13131 Jack Pine Barrens* (see 62210)
- 13132 Oak Savanna (see 62120 and 62130)
- 13133 Aspen Openings* (see 62110)
- 13134 Short Grasses (<1ft.) and Mixed Trees
- 13135 Non-Native Dominated Long Grasses and Mixed Trees

13140 51% to 75% Impervious Cover with Perennial Grasses and Sparse Trees
- 13141 Jack Pine Barrens* (see 62210)
- 13142 Oak Savanna (see 62120 and 62130)
- 13143 Aspen Openings* (see 62110)
- 13144 Short Grasses (<1ft.) and Mixed Trees
- 13145 Non-Native Dominated Long Grasses and Mixed Trees

13200 ARTIFICIAL SURFACES WITH PERENNIAL GRASSES

13210 4% to 10% Impervious Cover with Perennial Grasses
- 13211 Short Grasses (<1ft.)
- 13212 Non-Native Dominated Long Grasses
- 13213 Mesic Prairie (see 62110)
- 13214 Dry Prairie (see 61210)

13220 11% to 25% Impervious Cover with Perennial Grasses
- 13221 Short Grasses (<1ft.)
- 13222 Non-Native Dominated Long Grasses
- 13223 Mesic Prairie (see 62110)
- 13224 Dry Prairie (see 61210)

13230 26% to 50% Impervious Cover with Perennial Grasses
- 13231 Short Grasses (<1ft.)
- 13232 Non-Native Dominated Long Grasses
- 13233 Mesic Prairie (see 62110)
- 13234 Dry Prairie (see 61210)

13240 51% to 75% Impervious Cover with Perennial Grasses
- 13241 Short Grasses (<1ft.)
- 13242 Non-Native Dominated Long Grasses
- 13243 Mesic Prairie (see 62110)
- 13244 Dry Prairie (see 61210)

13300 ARTIFICIAL SURFACES WITH CULTIVATED HERBACEOUS VEGETATION (gardens)

13310 4% to 10% Impervious Cover with Cultivated Herbaceous Vegetation
- 13311 Vegetables
- 13312 Forbs (flowers)

13320 11% to 25% Impervious Cover with Cultivated Herbaceous Vegetation
- 13321 Vegetables
- 13322 Forbs (flowers)

13330 26% to 50% Impervious Cover with Cultivated Herbaceous Vegetation
- 13331 Vegetables
- 13332 Forbs (flowers)

13340 51% to 75% Impervious Cover with Cultivated Herbaceous Vegetation
13341 Vegetables
13342 Forbs (flowers)

14000 ARTIFICIAL SURFACES WITH LESS THAN 25% VEGETATION COVER
Do buildings and/or pavement compose more than 76% impervious cover?
YES, go to 14100 BUILDINGS AND/OR PAVEMENT
NO, go to 14200 EXPOSED EARTH

14100 BUILDINGS AND/OR PAVEMENT
Is there more than 90% impervious cover?
YES, go to 14120 91% to 100% Impervious Cover
NO, go to 14110 76% to 90% Impervious Cover

14110 76% to 90% Impervious Cover
A) Buildings contribute >75% of the total impervious cover, 14111 Buildings
B) Pavement contributes >75% of the total impervious cover, 14112 Pavement
C) A mix of buildings and pavement in that each contribute between 25-65% of the total impervious cover, 14113 Buildings and Pavement

14120 91% to 100% Impervious Cover
A) Buildings contribute >75% of the total impervious cover, 14121 Buildings
B) Pavement contributes >75% of the total impervious cover, 14122 Pavement
C) Buildings and pavement each contribute 25-75% of the total impervious cover, 14123 Buildings and Pavement

14200 EXPOSED EARTH
14210 0% to 10% Impervious Cover - Exposed Earth
14211 Mines
14212 Sand and Gravel Pits
14213 Landfill
14214 Other Exposed / Transitional Land

14220 11% to 25% Impervious Cover - Exposed Earth
14221 Mines
14222 Sand and Gravel Pits
14223 Landfill
14224 Other Exposed / Transitional Land

14230 26% to 50% Impervious Cover - Exposed Earth
14231 Mines
14232 Sand and Gravel Pits
14233 Landfill
14234 Other Exposed / Transitional Land

20000 PLANTED OR CULTIVATED VEGETATION

1) Is the cover of trees from an aerial view greater than the cover of shrubs/vines or herbaceous plants, respectively? (Generally >25% tree cover)

YES, go to 21000 Planted, Maintained or Cultivated Tree Vegetation

NO, go to 2

2) Is the cover of shrubs or vines from an aerial view greater than the cover of trees or herbaceous plants, respectively? (Generally >25% shrub/vine cover)

YES, go to 22000 Planted, Maintained or Cultivated Shrub and/or Vine Vegetation

NO, go to 3

3) Is the herbaceous vegetation cultivated with crops, including hay, sod, fallow and temporarily unplanted fields?

YES, go to 24000 Cultivated Herbaceous Vegetation

NO, go to 23000 Planted or Maintained Herbaceous Vegetation

21000 PLANTED, MAINTAINED OR CULTIVATED TREE VEGETATION

A) Coniferous species contribute >75% of the total tree cover, go to 21100

B) Deciduous (excluding tamarack (Larix)) species contribute >75% of the total tree cover, go to 21200

C) Coniferous and deciduous species each contribute 25-75% of the total tree cover, go to 21300

21100 PLANTED, MAINTAINED OR CULTIVATED CONIFEROUS TREES

21110 Upland Soils with Planted, Maintained or Cultivated Coniferous Trees

21111 Spruce/Fir
21112 White Pine
21113 Red Pine
21114 Other Coniferous trees

21200 PLANTED, MAINTAINED OR CULTIVATED DECIDUOUS TREES

21210 Upland Soils with Planted, Maintained or Cultivated Deciduous Trees

21211 Fruit Trees (apple, cherry, plum, etc)
21212 Walnut
21213 Other Deciduous Trees

21300 PLANTED, MAINTAINED OR CULTIVATED MIXED CONIFEROUS AND DECIDUOUS TREES

21310 Upland Soils with Planted, Maintained or Cultivated Mixed Coniferous/Deciduous Trees

21320 Hydric Soils with Planted, Maintained or Cultivated Mixed Coniferous/Deciduous Trees

22000 PLANTED, MAINTAINED OR CULTIVATED SHRUB AND/OR VINE VEGETATION

A) Coniferous species contribute >75% of the total tree cover, go to 22100

B) Deciduous (including cranberry) species contribute >75% of the total tree cover, go to 22200

C) Coniferous and deciduous species each contribute 25-75% of the total tree cover, go to 22300

22100 PLANTED, MAINTAINED OR CULTIVATED CONIFEROUS SHRUBS

22110 Upland Soils with Planted, Maintained or Cultivated Coniferous Shrubs
22120 Hydric Soils with Planted, Maintained or Cultivated Coniferous Shrubs
22130 Mixed plantings

22200 PLANTED, MAINTAINED OR CULTIVATED DECIDUOUS SHRUB/VINE VEGETATION (including cranberry)

22210 Upland Soils with Planted, Maintained or Cultivated Deciduous Shrub/Vine Vegetation
- 22211 Blackberry
- 22212 Blueberry
- 22213 Grape
- 22214 Raspberry-black
- 22215 Raspberry-red
- 22216 Other Shrub/Vine Vegetation

22220 Artificially Flooded or Saturated Soils
- 22221 Cranberry

22300 PLANTED, MAINTAINED OR CULTIVATED MIXED CONIFEROUS-DECIDUOUS SHRUB/VINE VEGETATION

22310 Upland Soils with Planted, Maintained or Cultivated Mixed Coniferous-Deciduous Shrub/Vine Vegetation

22320 Hydric Soils with Planted, Maintained or Cultivated Mixed Coniferous-Deciduous Shrub/Vine Vegetation

23000 PLANTED OR MAINTAINED HERBACEOUS VEGETATION

1) Do trees comprise >10% cover?
   - YES, go to 23100 Planted or Maintained Grasses with Sparse Tree Layer
   - NO, go to 2
2) Do grasses comprise >75% of the herbaceous vegetation?
   - YES, go to 23200 Planted or Maintained Grasses
   - NO, go to 23300 Planted or Maintained Grasses and Forbs

23100 PLANTED OR MAINTAINED GRASSES WITH SPARSE TREE COVER

23110 Upland Soils with Planted or Maintained Grasses and Sparse Tree Cover

Is the grass <1 foot tall?
- YES, 23111 Short Grasses
- NO, 23112 Long Grasses

23120 Hydric Soils with Planted or Maintained Grasses and Sparse Tree Cover

Is the grass <1 foot tall?
- YES, 23121 Short Grasses
- NO, 23122 Long Grasses

23200 PLANTED OR MAINTAINED GRASSES

23210 Upland Soils with Planted or Maintained Grasses

Is the grass <1 foot tall?
- YES, 23211 Short Grasses

NO, 23212 Long Grasses

23220 Hydric Soils with Planted or Maintained Grasses
Is the grass <1 foot tall?
YES, 23221 Short Grasses
NO, 23222 Long Grasses

23300 PLANTED OR MAINTAINED GRASSES AND FORBS
23310 Upland Soils with Planted or Maintained Grasses and Forbs
Is the grass <1 foot tall?
YES, 23311 Short Grasses and Forbs
NO, 23312 Long Grasses and Forbs

23320 Hydric Soils with Planted or Maintained Grasses and Forbs
Is the grass <1 foot tall?
YES, 23321 Short Grasses and Forbs
NO, 23322 Long Grasses and Forbs

24000 CULTIVATED HERBACEOUS VEGETATION

24100 CULTIVATED ROW CROPLAND
24110 Upland Soils - Cultivated Row Cropland
24111 Beans (all types except soybeans)
24112 Corn
24113 Sorghum
24114 Soybeans
24115 Sugar Beets
24116 Potato
24117 Pumpkins
24118 Sunflowers
24119 Other Vegetable and truck crops

24120 Hydric Soils - Cultivated Row Cropland
24121 Beans (all types except soybeans)
24122 Corn
24123 Sorghum
24124 Soybeans
24125 Sugar Beets
24126 Potato
24127 Pumpkins
24128 Sunflowers
24129 Other Vegetable and truck crops

24200 CULTIVATED CLOSE GROWN OR SOLID SEEDED CROPLAND
24210 Upland Soils - Cultivated Close Grown Cropland
24211 Wheat
24212 Oats

24213 Barley
24214 Sod
24215 Not planted
24216 Fallow
24217 Hayfield
24218 All other close grown cropland

24220 Hydric Soils -Cultivated Close Grown Cropland
24221 Wheat
24222 Oats
24223 Rice
24224 Barley
24225 Sod
24226 Not planted
24227 Fallow
24228 Hayfield
24229 All other close grown cropland

24230 Artificially Flooded or Saturated Soils - Cultivated Close Grown Cropland
24231 Rice

30000 FORESTS

A) Coniferous species contribute >75% of the total tree cover.
Coniferous forest go to 31000

B) Deciduous (excluding tamarack (Larix)) species contribute >75% of the total tree cover.
Deciduous forest go to 32000

C) Coniferous and deciduous species each contribute 25-75% of the total tree cover.
Mixed forest go to 33000

31000 CONIFEROUS FOREST

Hydrology Options

A) Forest flooded or saturated frequently enough that the vegetation includes at least 50% cover by hydrophytic species (see Appendix 1-A). (Cowardin's PFO4B is an example.)
Wetland coniferous forest go to 31200

B) Forest dominated by non-hydrophytic species.
Upland coniferous forest go to 31100

31100 UPLAND CONIFEROUS FOREST

1) Is eastern red cedar the dominant conifer?
YES, 41130 Eastern Red Cedar Woodland
NO, go to 2

2) Is the canopy dominated by pines?
YES, go to 3
NO, go to 5

3) Are the pines dominated by white pines?
YES, 31140 White Pine Forest

NO, go to 4

4) Do jack pines comprise >70% of the pines?
YES, go to Jack Pine questions
NO, 31130 Red Pine Forest

5) Is the canopy dominated by white cedar?
YES, go to Upland White Cedar questions
NO, go to 6

6) Is the canopy dominated by black spruce?
YES, 31110 Black Spruce-Feathermoss Forest
NO, go to Spruce-Fir questions

Jack Pine questions

1) Does the forest occur northeast of a line stretching between Duluth and the eastern tip of Upper Red Lake?
YES, go to 2
NO, go to 5

2) Does the forest occur on rocky ridges with an understory of red oaks and red maples?
YES, 31123 Jack Pine Forest, Jack Pine-Oak Subtype
NO, go to 3

3) Does the forest have a low-shrub layer (including bush honeysuckle and blueberry), few forbs, and a cover of feathermosses?
YES, 31124 Jack Pine Forest, Jack Pine-Black Spruce Subtype
NO, go to 4

4) Is the forest growing on relatively deep soils, with saplings of balsam fir, paper birch, or black spruce, and a well-developed tall shrub layer?
YES, 31121 Jack Pine Forest, Jack Pine-Fir Subtype
NO, 31120 Jack Pine Forest

5) Does the forest occur south of Upper Red Lake?
YES, go to 6
NO, 31120 Jack Pine Forest

6) Are red pines and paper birches common, with abundant tall shrubs, including beaked hazel, juneberry, and downy arrowwood?
YES, 31122 Jack Pine Forest, Hazel Subtype
NO, go to 7

7) Are tall shrubs absent or nearly so, with a ground layer composed of dwarf-shrubs (especially blueberry), feathermosses, and prairie grasses and forbs?
YES, 31125 Jack Pine Forest, Blueberry Subtype
NO, 31120 Jack Pine Forest

Upland White Cedar questions

1) Does the forest contain hummock and hollow topography with a seasonally saturated hydrology?
YES, 31151 Upland White Cedar Forest, Wet-Mesic Subtype
NO, go to 2

2) Is the forest on a well-drained slope?
YES, 31150 Upland White Cedar Forest
No, 31152 Upland White Cedar Forest, Mesic Subtype

Spruce-Fir questions

1) Are most conifers white spruce, with lesser amounts of balsam fir?
   YES, 31161 Spruce-Fir Forest, White Spruce-Balsam Fir Subtype
   NO, go to 2
2) Is the canopy dominated by balsam fir and paper birch, with lesser amounts of black spruce, white cedar, white spruce, quaking aspen, white pine, and mountain ash?
   YES, 31162 Spruce-Fir Forest, Fir-Birch Subtype
   NO, 31160 Spruce-Fir Forest

31200 SATURATED CONIFEROUS FOREST

1) Does black spruce comprise >50% of the canopy?
   YES, go to 6
   NO, go to 2
2) Is the canopy dominated by white cedar, with *Sphagnum* mosses mostly absent?
   YES, go to White Cedar Swamp questions
   NO, go to 3
3) Is the canopy dominated by white pine?
   YES, go to 4
   NO, go to 5
4) Is the substrate saturated and NOT seasonally flooded (see Cowardin definitions)?
   YES, 32320 Mixed Hardwood Swamp
   NO, 32420 Mixed Hardwood Swamp - Seasonally Flooded
5) Is peat >1m thick, with most tamaracks <3m tall?
   YES, 51120 Poor Fen, Scrub Tamarack Subtype
   NO, go to Tamarack Swamp questions
6) Do feathermosses predominate over *Sphagnum* mosses in the ground layer? Do minerotrophic species (e.g. white cedar, bog birch, bog willow, tufted loosestrife, and *Potentilla palustris*) contribute significant cover?
   YES, 31230 Black Spruce Swamp
   NO, go to 7
7) Are shade-tolerant species (such as lingonberry, creeping snowberry, three-leaved false Solomon's-seal, and the sedge *Carex trisperma*) common? Are *Carex oligosperma* and *C. pauciflora* rare?
   YES, go to Black Spruce Bog questions
   NO, 51110 Open *Sphagnum* Bog

Tamarack Swamp questions

1) Does the swamp occur in an area of groundwater seepage?
   YES, 31211 Tamarack Swamp, Seepage Subtype
   NO, go to 2
2) Is there a continuous or nearly continuous mat of Sphagnum mosses below such fen species as bog birch, leatherleaf (and other ericaceous dwarf-shrubs), cinnamon fern, and the sedges Carex lasiocarpa, and C. prairea?
   YES, 31213 Tamarack Swamp, *Sphagnum* Subtype
   NO, 31212 Tamarack Swamp, Minerotrophic Subtype

White Cedar Swamp questions

Does the swamp occur in an area of groundwater seepage?

YES, 31221 White Cedar Swamp, Seepage Subtype

NO, 31220 White Cedar Swamp

Black Spruce Bog questions

Are minerotrophic indicator species (e.g. white cedar, bog birch, bog willow, tufted loosestrife, *Potentilla palustris, Carex leptalea, C. paupercula,* and *C. tenuiflora*) completely absent? Does the water have pH <4.2 and calcium ion concentration <2.2 mg/l?

YES, 31242 Black Spruce Bog, Raised Subtype

NO, 31241 Black Spruce Bog, Intermediate Subtype

32000 DECIDUOUS FOREST

Hydrology Options

A) Substrate NOT subject to floodplain inundations and always dominated by non-hydrophytic species (see Appendix 1-A hydrophytic species). Soils do not have hydric characteristics, such as gleying or mottling.

Upland go to 32100

B) Surface water is present for brief periods during many growing seasons, but the water table usually lies well below the soil surface for most of the season, leaving the soil dry. Dead plants decompose quickly, leaving little thatch on the ground. Plants that grow both in uplands and wetlands are characteristic. Soils typically have some hydric characteristics, such as gleying or mottling. This water regime is typical of active river floodplains. (Cowardin's PFO1A is an example, but other examples are considered upland by Cowardin.)

Temporarily Flooded go to 32200

C) The substrate is saturated to the surface (or close to it) for at least 2 weeks during the growing season, but surface water is seldom present. The soil is often peat. (Cowardin's PFO1B is an example.)

Saturated go to 32300

D) Surface water is present for extended periods, especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface**.** (Cowardin's PFO1C is an example.)

Seasonally Flooded go to 32400

32100 UPLAND DECIDUOUS FOREST

1) Do oaks comprise >30% of the canopy?

YES, go to 2

NO, go to 5

2) Is the canopy comprised of open-grown oaks with low spreading branches (10-70% cover), surrounded by younger trees?

YES, 42120 Oak Woodland-Brushland

NO, go to 3

3) Do oaks comprise >60% of the canopy?

YES, go to Oak Forest questions

NO, go to 4

4) Does sugar maple, basswood, or yellow birch occupy nearly all the non-oak portion of the canopy?

YES, go to 6

NO, go to Oak Forest questions

5) Do sugar maples, basswoods, elms, or yellow birches dominate the canopy?

YES, go to 6

NO, go to 7

6) Are coniferous trees and their associated herbaceous species (including club mosses) absent? (White pine, but no other conifers, may comprise up to 5% of the canopy.) Is yellow birch rare? Are spring ephemerals, such as trout lilies, wild leeks, and Dutchman's breeches, common?

YES, 32150 Maple-Basswood Forest

NO, 32120 Northern Hardwood Forest

7) Is the tree canopy >70% aspen, paper birch, or balsam poplar?

YES, go to 8

NO, go to 10

8) Is the tree canopy <10% paper birch

YES, 32160 Aspen Forest

NO, go to 9

9) Is the tree canopy <10% aspen or balsam poplar?

YES, go to Paper Birch Forest questions

NO, go to Aspen-Birch Forest questions

10) Does the soil appear to be influenced by occasional flooding or a seasonally high water table?

YES, 32220 Lowland Hardwood Forest

NO, 32170 Altered/Non-native Deciduous Forest

Oak Forest questions

1) Do bedrock outcrops intermingle with the forest on northeastern Minnesota ridge tops?

YES, 32111 Oak Forest, Red Maple Subtype

NO, go to 2

2) Are northern red oaks a dominant species? Are fire-sensitive species, such as basswood, green ash, and bitternut hickory often present in the canopy? Are tree trunks generally tall and straight with few spreading lower branches?

YES, 32112 Oak Forest, Mesic Subtype

NO, go to 3

3) Are northern pin oaks and white oaks dominant species? Does the area have nutrient-poor, well-drained sandy soils typical of outwash plains, river terraces, and beach ridges. Does american hazel dominate the shrub layer, with wild geranium and virginia creeper on the ground layer?

YES, 32113 Oak Forest, Dry Subtype

NO, 32110 Oak Forest

Paper Birch Forest questions

1) Are saplings of balsam fir or white spruce conspicuous in the understory?

YES, 32132 Paper Birch Forest, Spruce-Fir Subtype

NO, go to 2

2) Are saplings of sugar maple and other northern hardwoods conspicuous in the understory?
YES, 32131 Paper Birch Forest, Northern Hardwoods Subtype
NO, 32130 Paper Birch Forest

Aspen-Birch Forest questions

1) Are saplings of balsam fir or white spruce conspicuous in the understory?
YES, 32142 Aspen-Birch Forest, Spruce-Fir Subtype
NO, go to 2

2) Are saplings of sugar maple and other northern hardwoods conspicuous in the understory?
YES, 32141 Aspen-Birch Forest, Northern Hardwoods Subtype
NO, 32140 Aspen-Birch Forest

32200 TEMPORARILY FLOODED DECIDUOUS FOREST

1) Is the forest dominated by aspen or balsam poplar?
YES, 32230 Aspen Forest - Temporarily Flooded
NO, go to 2

2) Is the forest growing just ABOVE the active floodplain of a river or stream, in an inactive floodplain, or at the upper edge of a wetland basin (outside a floodplain), making flooding events rare?
YES, go to 3
NO, go to 4

3) Is the forest comprised of only 1 or 2 tree species, usually cottonwood, green ash, boxelder, or elm, with understory vegetation lacking in diversity?
YES, 32240 Altered/Non-native Temporarily Flooded Deciduous Forest
NO, 32220 Lowland Hardwood Forest

4) Is the forest growing in the active floodplain of a river or stream and is the forest dominated by some combination of silver maple, cottonwood, black willow, American elm, slippery elm, green ash, boxelder, bur oak, and swamp white oak?
YES, go to Floodplain Forest questions
NO, go to 5

5) Is the tree canopy cover <70% AND do herbaceous species comprise >30% of ground cover not under the trees?
YES, go to 62100 Grassland with Sparse Deciduous Trees
NO, go to Floodplain Forest questions

Floodplain Forest questions

1) Does silver maple comprise >70% of the canopy?
YES, 32211 Floodplain Forest, Silver Maple Subtype
NO, go to 2

2) Is the forest dominated by swamp white oak?
YES, 32212 Floodplain Forest, Swamp White Oak Subtype
NO, 32210 Floodplain Forest

32300 SATURATED DECIDUOUS FOREST

1) Is the forest dominated by aspen or balsam poplar?
YES, 32330 Aspen Forest - Saturated

NO, go to 2

2) Does black ash comprise >50% of the canopy?
YES, go to Black Ash Swamp questions
NO, go to 3

3) Is the forest comprised of only 1 or 2 tree species, usually cottonwood, green ash, boxelder, or elm, with understory vegetation lacking in diversity?
YES, 32340 Altered/Non-native Deciduous Forest – Saturated Soil
NO, go to 4

4) Is the substrate saturated for most of the growing season, consisting of muck or shallow peat as opposed to mineral soil?
YES, go to Mixed Hardwood Swamp questions
NO, 32220 Lowland Hardwood Forest

Black Ash Swamp questions

Does the forest occur in an area of groundwater seepage?
YES, 32311 Black Ash Swamp, Seepage Subtype
NO, 32310 Black Ash Swamp

Mixed Hardwood Swamp questions

Does the forest occur in an area of groundwater seepage?
YES, 32321 Mixed Hardwood Swamp, Seepage Subtype
NO, 32320 Mixed Hardwood Swamp

32400 SEASONALLY FLOODED DECIDUOUS FOREST

Does black ash comprise >50% of the canopy?
YES, 32410 Black Ash Swamp - Seasonally Flooded
NO, go to 2

2) Is the forest comprised of only 1 or 2 tree species, usually cottonwood, green ash, boxelder, or elm, with understory vegetation lacking in diversity?
YES, 32430 Altered/Non-native Deciduous Forest – Seasonally Flooded
NO, 32420 Mixed Hardwood Swamp - Seasonally Flooded

33000 MIXED CONIFEROUS/DECIDUOUS FOREST

1) Is the substrate flooded or saturated frequently enough that the vegetation includes at least 50% cover by hydrophytic species (see Appendix 1-A)?
YES, go to 2
NO, go to 33100 Upland Mixed Coniferous/Deciduous Forest

2) Do conifers comprise >50% of the canopy?
YES, go to 31200 Saturated Coniferous Forest
NO, go to 3

3) Is the substrate saturated, and NOT seasonally flooded (see Cowardin definitions)?
YES, 32320 Mixed Hardwood Swamp
NO, 32420 Mixed Hardwood Swamp - Seasonally Flooded

33100 UPLAND MIXED CONIFEROUS/DECIDUOUS FOREST

1) Is eastern red cedar the dominant conifer?
YES, go to 43000 Mixed Coniferous-Deciduous Woodland

NO, go to 2

2) Are deciduous trees predominantly oak, aspen, paper birch, or red maple?
YES, go to 3
NO, go to 5

3) Are pines the only conifers present?
YES, go to 4
NO, 33120 Boreal Hardwood-Conifer Forest

4) Is white pine the dominant conifer?
YES, go to White Pine-Hardwood Forest questions
NO, 33110 Mixed Pine-Hardwood Forest

5) Are pines the only conifers present?
YES, go to White Pine-Hardwood Forest questions
NO, go to Northern Hardwood-Conifer Forest questions

Northern Hardwood-Conifer Forest questions

1 Is the forest north and east of Todd County AND is the canopy dominated by yellow birch and white cedar?
YES, 33131 Northern Hardwood-Conifer Forest, Yellow Birch-White Cedar Subtype
NO, go to 2

2) Is the forest southeast of the Twin Cities AND are >20% of the trees white cedars?
YES, 31150 Upland White Cedar Forest
NO, 33130 Northern Hardwood-Conifer Forest

White Pine-Hardwood Forest questions

1) Is the forest southeast of the Twin Cities?
YES, go to 2
NO, 33140 White Pine-Hardwood Forest

2) Is the forest growing on a dry bluff or on a sandy outwash plain or lake plain?
YES, 33141 White Pine-Hardwood Forest, Dry Subtype
NO, 33142 White Pine-Hardwood Forest, Mesic Subtype

40000 WOODLAND

A) Coniferous species contribute >75% of the total tree cover.
go to 41000 Coniferous woodland

B) Deciduous (excluding tamarack (*Larix*)) species contribute >75% of the total tree cover.
go to 42000 Deciduous woodland

C) Coniferous and deciduous species each contribute 25-75% of the total tree cover
go to 43000 Mixed woodland

41000 CONIFEROUS WOODLAND

Is the substrate flooded or saturated frequently enough that the vegetation includes at least 50% cover by hydrophytic species (see Appendix 1-A)?
YES, go to 31200 Saturated Coniferous Forest
NO, go to 41100 Upland Coniferous Woodland

41100 UPLAND CONIFEROUS WOODLAND

1) Do herbaceous species comprise >30% of ground cover not below the tree canopies?

YES, go to 62200 Grassland with Sparse Coniferous or Mixed Coniferous/Deciduous Trees
NO, go to 2

2) Has the woodland been created from a forest by logging or windstorm?
YES, go to 3 (and use the appropriate disturbance modifier)
NO, go to 5

3) Is the understory vegetation dominated by deciduous tree species?
YES, go to 33000 Mixed Coniferous/Deciduous Forest
NO, go to 4

4) Is the understory vegetation dominated by coniferous tree species?
YES, go to 31000 Coniferous Forest
NO, go to 5

5) Is the woodland dominated by red cedar?
YES, 41130 Eastern Red Cedar Woodland
NO, go to 6

6) Is the woodland dominated by jack pine?
YES, go to 7
NO, go to 8

7) Is the shrub layer tall (generally >1.5m), dense, and continuous with a sparse herbaceous layer that includes dry forest species AND prairie species (see Appendix 1-B) capable of persisting beneath the dense shrubs? (The ground layer does not generally include many species typical of Northern (Laurentian) Granite/Metamorphic Rock Outcrop (81131), such as lichens, mosses, and others listed in the community definitions section.)
YES, 41110 Jack Pine Woodland
NO, 41120 Northern Conifer Woodland

8) Does northern white cedar comprise >20% of the canopy?
YES, go to 30000 Forest
NO, go to 9

9) Do lichens and mosses comprise >30% of the non-tree cover?
YES, 71110 Northern Conifer Scrubland
NO, 41120 Northern Conifer Woodland

42000 DECIDUOUS WOODLAND

Hydrology Options

A) Substrate NOT subject to floodplain inundations and always dominated by non-hydrophytic species (see Appendix 1-A hydrophytic species). Soils do not have hydric characteristics, such as gleying or mottling.

Upland go to 42100

B) Surface water is present for brief periods during many growing seasons, but the water table usually lies well below the soil surface for most of the season, leaving the soil dry. Dead plants decompose quickly, leaving little thatch on the ground. Plants that grow both in uplands and wetlands are characteristic. Soils typically have some hydric characteristics, such as gleying or mottling. This water regime is typical of active river floodplains. (Cowardin's PFO1A is an example, but other examples are considered upland by Cowardin.)

Temporarily Flooded go to 42200

C) The substrate is saturated to the surface (or close to it) for at least 2 weeks during the growing season, but surface water is seldom present. The soil is often peat. (Cowardin's PFO1B is an example.)

Saturated go to 42300

D) Surface water is present for extended periods, especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface**.** (Cowardin's PFO1C is an example.)

Seasonally Flooded go to 42400

42100 UPLAND DECIDUOUS WOODLAND

1) Do herbaceous species comprise >30% of ground cover not below the tree canopies?
   YES, go to 62100 Grassland with Sparse Deciduous Trees
   NO, go to 2
2) Has the woodland been created from a forest by logging or windstorm?
   YES, go to 3 (and use the appropriate disturbance modifier)
   NO, go to 4
3) Is the shrub layer dominated by tree species?
   YES, go to 32100 Upland Deciduous Forest
   NO, go to 4
4) Does aspen comprise >70% of tree cover?
   YES, 42110 Aspen Woodland
   NO, go to 5
5) Do oaks comprise >30% of tree cover?
   YES, 42120 Oak Woodland-Brushland
   NO, 42130 Altered/non-native Deciduous Woodland

42200 TEMPORARILY FLOODED DECIDUOUS WOODLAND

1) Do herbaceous species comprise >30% of ground cover not below the tree canopies?
   YES, go to 62000 Grassland with Sparse Trees
   NO, go to 2
2) Is the woodland comprised of only 1 or 2 tree species, usually cottonwood, green ash, boxelder, or elm, with understory vegetation lacking in diversity??
   YES, 42210 Altered/non-native deciduous woodland - temporarily flooded
   NO, go to 32200

42300 SATURATED DECIDUOUS WOODLAND

1) Do herbaceous species comprise >30% of ground cover not below the tree canopies?
   YES, go to 62000 Grassland with Sparse Trees
   NO, go to 2
2) Is the woodland comprised of only 1 or 2 tree species, usually cottonwood, green ash, boxelder, or elm, with understory vegetation lacking in diversity?
   YES, 42310 Altered/non-native deciduous woodland - saturated
   NO, go to 32300

42400 SEASONALLY FLOODED DECIDUOUS WOODLAND

1) Do herbaceous species comprise >30% of ground cover not below the tree canopies?

YES, go to 62000 Grassland with Sparse Trees
NO, go to 2

2) Is the woodland comprised of only 1 or 2 tree species, usually cottonwood, green ash, boxelder, or elm, with understory vegetation lacking in diversity?
YES, 42410 Altered/non-native deciduous woodland - seasonally flooded
NO, go to 32400

43000 MIXED CONIFEROUS-DECIDUOUS WOODLAND

1) Is the substrate flooded or saturated frequently enough for the vegetation to include at least 50% cover by hydrophytic species (see Appendix 1-A)?
YES, go to 30000 Forest
NO, go to 2

2) Do herbaceous species comprise >30% of ground cover not below the tree canopies?
YES, go to 62200 Grassland with Sparse Coniferous or Mixed Coniferous/Deciduous Trees
NO, go to 3

3) Do oaks comprise >30% of all trees AND are most conifers red cedars?
YES, 42120 Oak Woodland-Brushland
NO, go to 4

4) Do spruces, firs, jack pines, or white cedars comprise >20% of tree cover?
YES, go to 41100 Upland Coniferous Woodland
NO, go to 43110 Altered/non-native Mixed Woodland

50000 SHRUBLAND

1) Is tree cover >30%?
YES, go to 40000 Woodland
NO, go to 2

2) Are shrubs dominated by conifers or evergreens, including broad-leaved dwarf-shrubs (and excluding red cedars)?
YES, go to 51000 Coniferous/Evergreen Shrubland
NO, go to 3

3) Is the shrub layer dominated by tree species (including black willow)?
YES, go to 32000 Deciduous Forest
NO, go to 52000 Deciduous Shrubland

51000 CONIFEROUS/EVERGREEN SHRUBLAND

Is the substrate saturated to the surface for extended periods during the growing season, with surface water seldom present?
YES, go to 51100 Saturated Needle-Leaved or Microphyllous Evergreen Shrubland
NO, go to 30000 Forest or 40000 Woodland

51100 SATURATED NEEDLE-LEAVED OR MICROPHYLLOUS EVERGREEN SHRUBLAND (e.g. Cowardin's PSS2B or PSS4B)

1) Do tamaracks dominate the shrub layer?
YES, go to 2
NO, go to 3

2) Is peat >1m thick, with most tamaracks <3m tall?
YES, 51120 Poor Fen, Scrub Tamarack Subtype
NO, 31210 Tamarack Swamp
3) Are bog birch (*Betula pumila*), *Carex lasiocarpa*, and *C. chordorrhiza* common?
YES, go to 52300 Saturated Deciduous Shrubland
NO, go to 4
4) Are shade-tolerant species, such as lingonberry, creeping snowberry, three-leaved false Solomon's-seal, and the sedge *Carex trisperma,* common? Are *Carex oligosperma* and *C. pauciflora* rare?
YES, 31240 Black Spruce Bog
NO, go to Open *Sphagnum* Bog questions

Open *Sphagnum* Bog questions
Are a few minerotrophic indicator species (e.g. white cedar, bog birch, bog willow, tufted loosestrife, *Potentilla palustris, Carex leptalea, C. paupercula,* and *C. tenuiflora*) present? Does the water have pH >4.1 and calcium ion concentration >2.2 mg/l?
YES, 51111 Open *Sphagnum* Bog, Intermediate Subtype
NO, 51112 Open *Sphagnum* Bog, Raised Subtype

52000 DECIDUOUS SHRUBLAND
Hydrology Options
A) Substrate NOT subject to floodplain inundations and always dominated by non-hydrophytic species (see Appendix 1-A for hydrophytic species). Soils do not have hydric characteristics, such as gleying or mottling.
go to 52100 Upland deciduous shrubs
B) Surface water is present for brief periods during many growing seasons, but the water table usually lies well below the soil surface for most of the season, leaving the soil dry. Dead plants decompose quickly, leaving little thatch on the ground. Plants that grow both in uplands and wetlands are characteristic. Soils typically have some hydric characteristics, such as gleying or mottling. This water regime is typical of active river floodplains. (Cowardin's PSS1A is an example, but others are considered upland by Cowardin.)
go to 52200 Temporarily Flooded deciduous shrubs
C) The substrate is saturated to the surface (or close to it) for at least 2 weeks during the growing season, but surface water is seldom present. The soil is often peat. (Cowardin's PSS1B is an example.)
go to 52300 Saturated deciduous shrubs
D) Surface water is present for extended periods, especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface. (Cowardin's PSS1C is an example.)
go to 52400 Seasonally Flooded deciduous shrubs
E) Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface. (Cowardin's PSS1F is an example.)
go to 52500 Semipermanently Flooded deciduous shrubs

52100 UPLAND DECIDUOUS SHRUBLAND
1) Is tree cover >10%?

YES, go to 42000 Deciduous Woodland
NO, go to 2

2) Is either the shrub layer or the herbaceous layer dominated by non-native species?
YES, 52130 Non-Native Dominated Upland Shrubland
NO, go to 3

3) Is the herbaceous layer dominated by prairie species (see Appendix 1-B) AND is it typical of that found in far northwestern Minnesota AND is shrub cover generally no more than 50% AND are shrubs mostly willows, cherries, hazel, bog birch, or shrubby cinquefoil AND are they evenly distributed throughout the prairie?
YES, go to Mesic Brush-Prairie questions
NO, go to 52120 Native Dominated Disturbed Upland Shrubland

Mesic Brush-Prairie questions

Is the soil predominantly a coarse-textured gravel, with porcupine grass (*Stipa spartea*) the dominant grass species?
YES, 52111 Mesic Brush-Prairie, Sand-Gravel Subtype
NO, 52110 Mesic Brush-Prairie

52200 TEMPORARILY FLOODED DECIDUOUS SHRUBLAND

1) Is most of the vegetation (shrubs and herbaceous species) native to Minnesota?
YES, go to 2
NO, 52220 Non-Native Dominated Temporarily Flooded Shrubland

2) Do shrubs comprise >70% cover?
YES, go to 3
NO, go to 4

3) Are shrubs dominated by bog birch and *Spirea* (meadowsweet and steeplebush)?
YES, 52230 Bog birch-*Spirea* Meadow – Temporarily Flooded
NO, 52210 Native-Dominated Temporarily Flooded Shrubland

4) Is the herbaceous layer dominated by prairie species (see Appendix 1-B) AND is the shrubland in northwestern Minnesota?
YES, 52320 Wet Brush-Prairie
NO, 52350 Wet Meadow, Shrub Subtype

52300 SATURATED DECIDUOUS SHRUBLAND

1) Is most of the vegetation (shrubs and herbaceous species) native to Minnesota?
YES, go to 2
NO, 52330 Non-Native Dominated Saturated Shrubland

2) Is the herbaceous layer dominated by prairie species (see Appendix 1-B) AND is the shrubland in northwestern Minnesota?
YES, go to Wet Brush-Prairie questions
NO, go to 3

3) Does the shrubland occur in an area of groundwater seepage?
YES, 52340 Shrub Swamp, Seepage Subtype
NO, go to 5

4) Do tall shrubs (>1.5m) cover >70%?
YES, go to 5
NO, go to 6

5) Is speckled alder the most abundant shrub species?
YES, 52370 Alder Swamp - Saturated
NO, 52360 Willow Swamp – Saturated
6) Is the herbaceous vegetation mostly emergents >1m tall?
YES, 52360 Willow Swamp – Saturated
NO, go to 7
7) Are the leaves of most grasses and sedges >3mm wide? Is peat <0.5m deep? (Dominant species often include *Calamagrostis canadensis*, *Carex lacustris*, and *C. stricta*.)
YES, go to 8
NO, go to 9
8) Are shrubs dominated by bog birch and *Spirea* (meadowsweet and steeplebush)?
YES, 52380 Bog birch-*Spirea* Meadow
NO, 52350 Wet Meadow, Shrub Subtype
9) Does the fen occur on a floating mat of peat at the edge of a shallow lake OR does the fen have a patterned topography with strings (hummocks usually dominated by shrubs such as bog birch and leatherleaf) and flarks (flat hollows) dominated by sedges, mosses, and other herbaceous vegetation?
YES, go to 61000 Herbaceous Vegetation
NO, go to Shrub Fen questions

Shrub Fen questions
Are the following species common: *Carex livida, C. buxbaumii, Pedicularis lanceolata, Eleocharis compressa, Muhlenbergia glomerata,* and *Lobelia kalmii*? Does groundwater have pH >5.9 and calcium ion concentration >10mg/l?
YES, 52312 Rich Fen, Shrub Subtype
NO, 52311 Poor Fen, Shrub Subtype

Wet Brush-Prairie questions
Does the shrubland occur in an area of groundwater seepage?
YES, 52321 Wet Brush-Prairie, Seepage Subtype
NO, 52320 Wet Brush-Prairie

52400 SEASONALLY FLOODED DECIDUOUS SHRUBLAND
1) Is most of the vegetation (shrubs and herbaceous species) native to Minnesota?
YES, go to 2
NO, 52440 Non-Native Dominated Seasonally Flooded Shrubland
2) Does the shrubland occur in an area of groundwater seepage?
YES, 52340 Shrub Swamp, Seepage Subtype
NO, go to 3
3) Are shrubs dominated by bog birch and *Spirea* (meadowsweet and steeplebush)?
YES, 52450 Bog birch-*Spirea* Meadow – Seasonally Flooded
NO, go to 4
4) Is shrub cover <70% AND is most herbaceous vegetation made up of grasses and sedges?
YES, 52420 Wet Meadow, Shrub Subtype – Seasonally Flooded
NO, go to 5
5) Is speckled alder the most abundant shrub species in the canopy?
YES, 52410 Alder Swamp

NO, 52430 Willow Swamp

52500 SEMIPERMANENTLY FLOODED DECIDUOUS SHRUBLAND

1) Is most of the vegetation (shrubs and herbaceous species) native to Minnesota?
   YES, go to 2
   NO, 52540 Non-Native Dominated Semipermanently Flooded Shrubland
2) Is the vegetation growing on floating mats?
   YES, go to 3
   NO, 52520 Willow Swamp – Semipermanently Flooded
3) Are shrubs dominated by bog birch and *Spirea* (meadowsweet and steeplebush)?
   YES, 52530 Bog birch-*Spirea* Meadow
   NO, 52510 Wet Meadow, Shrub Subtype – Semipermanently Flooded

60000 HERBACEOUS VEGETATION

1) Is the vegetation dominated by species that either float on the water's surface or are completely submerged?
   YES, go to 64000 Hydromorphic Rooted Vegetation
   NO, go to 2
2) Is tree cover >10%?
   YES, go to 62000 Grassland with Sparse Trees
   NO, go to 3
3) Is the vegetation dominated by annual species (those that grow for only one year, such as those on bare mud left when the water level drops)?
   YES, go to 65000 Annual Grassland or Forb Vegetation
   NO, go to 4
4) Do either ferns or forbs (herbaceous species that are not grasses, sedges, or rushes) dominate the vegetation?
   YES, go to 63000 Perennial Forb Vegetation
   NO, go to 61000 Grasslands and Emergent Vegetation

61000 GRASSLANDS AND EMERGENT VEGETATION

When determining the hydrology (see below) keep in mind the time of year and the recent weather. Be especially aware of whether water levels at the time of the field check are higher or lower than average. 'Temporarily' and 'seasonally flooded' wetlands lie above the average water level, but they normally have surface water during spring flooding. Recent rain can add surface water to a 'saturated' wetland, making it appear 'temporarily' or 'seasonally flooded.' At the end of the summer a dry wetland showing signs of recent surface water may be 'seasonally flooded,' but if a drought is occurring, it may also be 'semipermanently flooded' or even 'intermittently exposed,' depending on how severe the drought is. A soil core is especially helpful in determining the average water level. See also diagrams and photos on pages 11-13 and 73-131 in Cowardin et al. 1979.

Hydrology Options

A) Substrate NOT subject to floodplain inundations and always dominated by non-hydrophytic species (see Appendix 1-A for hydrophytic species). Soils do not have hydric characteristics, such as gleying or mottling.

YES, go to Upland Herbaceous

B) Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season, leaving the soil dry. Dead plants decompose quickly, leaving little thatch on the ground. Plants that grow both in uplands and wetlands are characteristic. Soils typically have hydric characteristics, such as gleying or mottling. This water regime is typical of active river floodplains. (Cowardin's PEMA is an example, but other examples are considered upland by Cowardin.)

YES, go to 61300 Temporarily Flooded

C) The substrate is saturated to the surface (or close to it) for extended periods during the growing season, but surface water is seldom present. The soil is often peat. (Cowardin's PEMB and PMLB are examples.)

YES, go to 61400 Saturated

D) Surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface. (Cowardin's PEMC is an example.)

YES, go to 61500 Seasonally Flooded

E) Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface. (Cowardin's PEMF and L2EM2F are examples.)

YES, go to 61600 Semipermanently Flooded

F) Surface water is present throughout the year except in years of extreme drought. (Cowardin's PEMG and L2EM2G are examples.)

YES, go to 61700 Intermittently Exposed

G) Water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes. (Cowardin's L2EM2H is an example.)

YES, go to 61800 Permanently Flooded

UPLAND HERBACEOUS

Are grasses with seedheads >1m tall?

YES, go to 61100 Tall Upland Herbaceous Vegetation

NO, go to 61200 Medium-Tall Upland Herbaceous Vegetation

61100 TALL UPLAND HERBACEOUS VEGETATION

1) Do native prairie grasses (see Appendix 1-B) dominate the herbaceous layer?

YES, go to 2

NO, 61120 Tall Non-Native Dominated Herbaceous Vegetation

2) Is the substrate composed of sand or gravel (sometimes with a thin organic surface layer), or any texture on steep slopes?

YES, go to Dry Prairie questions

NO, go to 3

3) Is shrub cover >30% AND is the vegetation typical of that found in far northwestern Minnesota AND are shrubs mostly willows, cherries, hazel, bog birch, or shrubby cinquefoil, AND are they evenly distributed throughout the prairie?

YES, 52110 Mesic Brush-Prairie

NO, go to Mesic Prairie questions

Mesic Prairie questions

1) Is the prairie growing on thin soil (<1.25m), with patches of bedrock often exposed?
   YES, go to 2
   NO, 61110 Mesic Prairie
2) Is the bedrock composed of quartzite or granite?
   YES, 61112 Mesic Prairie, Crystalline Bedrock Subtype
   NO, go to 3
3) Is the bedrock composed of dolomite or limestone?
   YES, 61111 Mesic Prairie, Carbonate Bedrock Subtype
   NO, 61110 Mesic Prairie

61200 MEDIUM-TALL UPLAND HERBACEOUS

1) Do native prairie grasses (see Appendix 1-B) dominate the herbaceous layer?
   YES, go to 2
   NO, 61220 Medium-Tall Non-Native Dominated Herbaceous Vegetation
2) Is the substrate composed of sand or gravel (sometimes with a thin organic surface layer), or any texture on steep slopes?
   YES, go to Dry Prairie questions
   NO, go to 3
3) Is shrub cover >30% AND is the vegetation typical of that found in far northwestern Minnesota AND are shrubs mostly willows, cherries, hazel, bog birch, or shrubby cinquefoil AND are they evenly distributed throughout the prairie?
   YES, 52110 Mesic Brush-Prairie
   NO, 61110 Mesic Prairie

Dry Prairie questions

1) Is the prairie growing on the pure (or nearly pure) sand of dunes or steep alluvial deposits?
   YES, 61211 Dry Prairie, Barrens Subtype
   NO, go to 2
2) Is the prairie on a steep slope?
   YES, go to 3
   NO, 61213 Dry Prairie, Sand-Gravel Subtype
3) Is the prairie on a bluff with thin soils and patches of exposed bedrock?
   YES, 61212 Dry Prairie, Bedrock Bluff Subtype
   NO, go to 4
4) Is the prairie on alluvium (as opposed to till or depositional slopes) with coarse-textured soils (as opposed to fine- to medium-textured)?
   YES, 61213 Dry Prairie, Sand-Gravel Subtype
   NO, 61214 Dry Prairie, Hill Subtype

61300 TEMPORARILY FLOODED HERBACEOUS VEGETATION

1) Does cattail comprise >50% of the vegetation?
   YES, 61340 Cattail Marsh
   NO, go to 2
2) Do non-native species dominate the vegetation?
   YES, 61330 Temporarily Flooded Non-Native Dominated Herbaceous Vegetation
   NO, go to 3
3) Do prairie species (see Appendix 1-B) dominate?

YES, go to 4
NO, 61320 Wet Meadow - Temporarily Flooded

4) Is the prairie growing on sand along the shore of a river or lake, and dominated by species typical of dry prairies (see Appendix 1-B)?
YES, 61210 Dry Prairie
NO, go to 5

5) Is shrub cover >30% AND is the vegetation typical of that found in northwestern Minnesota AND are willows, bog birch, and meadowsweet the dominant shrubs?
YES, 52320 Wet Brush-Prairie
NO, go to 6

6) Is the prairie growing along the western edge of Minnesota where high concentrations of dissolved salts influence species composition (including *Distichlis stricta, Muhlenbergia asperifolia, Spartina* gracilis, and *Plantago eripoda*)?
YES, 61311 Wet Prairie, Saline Subtype
NO, 61310 Wet Prairie

61400 SATURATED HERBACEOUS VEGETATION

1) Do non-native species (such as pasture grasses or purple loosestrife) dominate the wetland?
YES, 61480 Saturated altered/non-native herbaceous vegetation
NO, go to 2

2) Do cattails comprise >50% of the vegetation?
YES, go to 3
NO, go to 4

3) Is the vegetation fairly diverse, even if cattails form a monotypic canopy?
YES, 61430 Cattail Marsh - Saturated
NO, 61480 Saturated altered/non-native herbaceous vegetation

4) Do prairie grasses (see Appendix 1-B) dominate?
YES, go to 5
NO, go to 6

5) Is shrub cover >30% AND is the vegetation typical of that found in northwestern Minnesota?
YES, 52320 Wet Brush-Prairie
NO, go to Wet prairie - saturated questions

6) Do *Sphagnum* mosses form a continuous (or nearly continuous) mat?
YES, go to 7
NO, go to 8

7) Is *Carex lasiocarpa* or *C. chordorrhiza* common?
YES, go to Poor fen questions
NO, go to Open bog questions

8) Are the leaves of most grasses and sedges >3mm wide? Is peat <0.5m deep? (Dominant species often include *Calamagrostis canadensis*, *Carex lacustris*, and *C. stricta*.)
YES, go to 9
NO, go to 10

9) Is ground water cold and moving, often in rivulets running from discharge springs?
YES, 63210 Seepage Meadow
NO, 61420 Wet Meadow

10) Are *Sphagnum* mosses present?
YES, go to 11

NO, go to 12

11) Are the following species common: *Carex livida, C. buxbaumii, Pedicularis lanceolata, Eleocharis compressa, Muhlenbergia glomerata,* and *Lobelia kalmii*? Does groundwater have pH >5.9 and calcium ion concentration >10mg/l?

YES, go to Rich fen questions

NO, go to Poor Fen questions

12) Does groundwater with high concentrations of dissolved salts (calcium) discharge from the soil, often forming a visible marl precipitate? Are species associated with calcareous seepage fens (see Appendix 1-C)?

YES, go to Calcareous seepage fen questions

NO, go to Rich fen questions

Wet prairie - saturated questions

1) Does the prairie occur in an area of groundwater seepage, with significant shrub cover, especially bog birch?

YES, 61412 Wet Prairie, Seepage Subtype

NO, go to 2

2) Is the prairie growing along the western edge of Minnesota where high concentrations of dissolved salts influence species composition (including *Distichlis stricta, Muhlenbergia asperifolia, Spartina* gracilis, and *Plantago eripoda*)?

YES, 61411 Wet prairie saline subtype - saturated soils

NO, 61410 Wet prairie - saturated soils

Calcareous seepage fen questions

Does the fen occur north or east of Todd County AND contain some species characteristic of boreal peatlands, including bog rosemary, small cranberry, and pitcher plant (as opposed to some prairie species (see Appendix 1-B) and aquatic emergents like cattail, hard-stemmed bulrush, and common reed)?

YES, 61441 Calcareous seepage fen boreal subtype

NO, 61442 Calcareous seepage fen prairie subtype

Poor fen questions

Does the fen have a patterned topography with strings (hummocks usually dominated by shrubs such as bog birch and leatherleaf) and flarks (flat hollows) with a *Sphagnum* lawn and *Carex oligosperma, Equisetum fluviatile, Menyanthes trifoliata*, and *Scheuchzeria palustris*?

YES, 61452 Poor fen patterned subtype

NO, 61451 Poor fen sedge subtype

Rich Fen questions

1) Does the fen occur on a floating mat of peat at the edge of a shallow lake?

YES, 61462 Rich Fen, Floating Mat Subtype - Saturated soils

NO, go to 2

2) Does the fen have a patterned topography with strings (hummocks usually dominated by shrubs such as bog birch, leatherleaf, and shrubby cinquefoil) and flarks (flat hollows) with brown mosses and *Carex interior, C. lasiocarpa, C. livida, Equisetum fluviatile*, and *Menyanthes trifoliata*?

YES, 61463 Rich Fen, Patterned Subtype

NO, 61461 Rich Fen, Sedge Subtype

Open Bog questions

Have pool formations developed near bog crests? Are *Rhynchospora alba* and *Utricularia cornuta* present? Do hollows contain *Sphagnum cuspidatum*?

YES, 61471 Open *Sphagnum* Bog, Schlenke Subtype
NO, 61472 Graminoid Bog

61500 SEASONALLY FLOODED HERBACEOUS VEGETATION

1) Do cattails comprise >50% of the vegetation?
   YES, go to 2
   NO, go to 3
2) Is the vegetation fairly diverse, even if cattails form a monotypic canopy?
   YES, 61510 Cattail Marsh - Seasonally Flooded
   NO, 61530 Seasonally Flooded Altered/Non-Native Herbaceous Vegetation
3) Do non-native species dominate the wetland?
   YES, 61530 Seasonally Flooded Altered/Non-Native Dominated Herbaceous Vegetation
   NO, go to 4
4) Is the vegetation dominated by grasses or sedges generally <1m tall?
   YES, 61540 Wet Meadow – Seasonally Flooded
   NO, 61520 Mixed Emergent Marsh - Seasonally Flooded

61600 SEMIPERMANENTLY FLOODED HERBACEOUS VEGETATION

1) Do cattails comprise >50% of the vegetation?
   YES, go to 2
   NO, go to 3
2) Is the vegetation fairly diverse, even if cattails form a monotypic canopy?
   YES, 61610 Cattail marsh
   NO, 61630 Semipermanently flooded altered/non-native herbaceous vegetation
3) Do non-native species dominate the wetland?
   YES, 61630 Semipermanently flooded altered/non-native dominated herbaceous vegetation
   NO, go to 4
4) Is the vegetation dominated by grasses or sedges generally <1m tall?
   YES, go to 5
   NO, 61620 Mixed Emergent Marsh
5) Are the leaves of most grasses and sedges >3mm wide? (Dominant species often include *Calamagrostis canadensis* and *Carex lacustris*.)
   YES, go to Wet meadow questions
   NO, 61650 Rich fen floating mat subtype – semipermanently flooded

Wet Meadow – Semipermanently Flooded questions

Is the vegetation growing on floating mats?

YES, 61641 Wet meadow floating mat subtype
NO, 61640 Wet Meadow – Semipermanently Flooded

61700 INTERMITTENTLY EXPOSED HERBACEOUS VEGETATION

1) Do cattails comprise >50% of the vegetation?
   YES, go to 2
   NO, go to 3
2) Is the vegetation fairly diverse, even if cattails form a monotypic canopy?
   YES, 61710 Cattail Marsh - Intermittently Exposed
   NO, 61730 Intermittently Exposed Altered/Non-Native Herbaceous Vegetation
3) Do non-native species dominate the wetland?
   YES, 61730 Intermittently Exposed Altered/Non-Native Dominated Herbaceous Vegetation
   NO, go to 4
4) Is the vegetation growing on floating mats?
   YES, 61740 Rich Fen, Floating Mat Subtype - Intermittently Exposed
   NO, 61720 Mixed Emergent Marsh - Intermittently Exposed

61800 PERMANENTLY FLOODED HERBACEOUS VEGETATION

1) Do cattails comprise >50% of the vegetation?
   YES, go to 2
   NO, go to 3
2) Is the vegetation fairly diverse, even if cattails form a monotypic canopy?
   YES, 61810 Cattail Marsh - Permanently Flooded
   NO, 61830 Permanently Flooded Altered/Non-Native Herbaceous Vegetation
3) Do non-native species dominate the wetland?
   YES, 61830 Permanently Flooded Altered/Non-Native Dominated Herbaceous Vegetation
   NO, go to 4
4) Is the vegetation growing on floating mats?
   YES, 61840 Rich Fen, Floating Mat Subtype
   NO, 61820 Mixed Emergent Marsh - Permanently Flooded

62000 GRASSLAND WITH SPARSE TREES

1) Are >25% of the trees conifers?
   YES, go to 62200 Grassland with Sparse Coniferous or Mixed Coniferous/Deciduous Trees
   NO, go to 2
2) Is the substrate subject to occasional floodplain inundations OR flooded/saturated frequently enough that the vegetation includes at least 50% cover by hydrophytic species (see Appendix 1-A)? Does the soil appear to be influenced by a seasonally high water table?
   YES, go to 3
   NO, go to 62100 Grassland with Sparse Deciduous Trees
3) Do non-native species dominate the wetland?
   YES, go to Sparse Tree Hydrological Questions
   NO, go to 4
4) Do trees cover >30% of the area?
   YES, go to 32000 Deciduous Forest
   NO, go to 61000 Grasslands and Emergent Vegetation

62100 GRASSLAND WITH SPARSE DECIDUOUS TREES

1) Do non-native species dominate the herbaceous layer?
YES, 62140 Non-Native Dominated Herbaceous Vegetation with Sparse Deciduous Trees
NO, go to 2
2) Is the vegetation growing on a bluff with thin soils and patches of exposed bedrock?
YES, 61212 Dry Prairie, Bedrock Bluff Subtype
NO, go to 3
3) Is the vegetation in northwestern Minnesota AND do aspens or balsam poplars comprise >50% of the tree cover?
YES, go to Aspen Openings questions
NO, go to 4
4) Do oaks comprise >30% of the tree cover?
YES, go to 5
NO, go to 61000 Grasslands and Emergent Vegetation
5) Is the substrate composed of sand or gravel (sometimes with a thin organic surface layer), or any texture on steep slopes?
YES, go to Dry oak savanna questions
NO, 62130 Mesic Oak Savanna

Aspen Openings questions
Is the soil coarse-textured, containing >10% gravel?
YES, 62111 Aspen Openings, Sand-Gravel Subtype
NO, 62110 Aspen Openings

Dry oak savanna questions
1) Is the prairie growing on the pure (or nearly pure) sand of dunes or steep alluvial deposits?
YES, 62122 Dry Oak Savanna, Barrens Subtype
NO, go to 2
2) Is the savanna on a steep slope?
YES, go to 3
NO, 62123 Dry Oak Savanna, Sand-Gravel Subtype
3) Is the savanna on alluvium (as opposed to till or depositional slopes) with coarse-textured soils (as opposed to fine- to medium-textured)?
YES, 62123 Dry Oak Savanna, Sand-Gravel Subtype
NO, 62121 Dry Oak Savanna, Hill Subtype

62200 GRASSLAND WITH SPARSE CONIFEROUS OR MIXED CONIFEROUS/DECIDUOUS TREES
1) Do non-native species dominate the herbaceous layer?
YES, 62220 Non-Native Dominated Herbaceous Vegetation with Sparse Coniferous or Mixed Coniferous/Deciduous Trees
NO, go to 2
2) Do jack pines comprise >50% of the total tree cover?
YES, 62210 Jack Pine Barrens
NO, go to 62100 Grasslands with Sparse Deciduous Trees

SPARSE TREES HYDROLOGICAL QUESTIONS

A) Surface water is present for brief periods during many growing seasons, but the water table usually lies well below the soil surface for most of the season, leaving the soil dry. Dead plants decompose quickly, leaving little thatch on the ground. Plants that grow both in uplands and wetlands are characteristic. Soils typically have some hydric characteristics, such as gleying or mottling. This water regime is typical of active river floodplains. (Cowardin's PFO1A is an example, but other examples are considered upland by Cowardin.)

62310 Altered/non-native grassland with sparse deciduous trees - temporarily flooded

B) The substrate is saturated to the surface (or close to it) for at least 2 weeks during the growing season, but surface water is seldom present. The soil is often peat. (Cowardin's PFO1B is an example.)

62410 Altered/non-native grassland with sparse deciduous trees - saturated soils

C) Surface water is present for extended periods, especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface**.** (Cowardin's PFO1C is an example.)

62510 Altered/non-native grassland with sparse deciduous trees - seasonally flooded

63000 PERENNIAL FORB VEGETATION
Is the substrate saturated to the surface for extended periods during the growing season, with surface water seldom present?
YES, go to 63200 Saturated Forb Vegetation
NO, go to 63100 Upland Forb Vegetation

63100 UPLAND FORB VEGETATION
Is the vegetation growing at the base of a north-facing dolostone talus slope AND is it dominated by *Adoxa moschatellina, Circaea alpina, Cornus canadensis, Cystopteris bulbifera, Impatiens pallida, Maianthemum canadense, Mertensia paniculata,* or *Mitella nuda*?
YES, 63110 Talus Slope, Algific Subtype
NO, go to 61000 Grasslands and Emergent Vegetation

63200 SATURATED FORB VEGETATION (e.g. Cowardin's PEMB)
Does the community occur in an area of groundwater seepage?
YES, 63210 Seepage Meadow
NO, go to 61000 Grasslands and Emergent Vegetation

64000 HYDROMORPHIC ROOTED VEGETATION

64100 STANDING WATER WITH HYDROMORPHIC VEGETATION (e.g. Cowardin's PABF, PABG, PABH, L2ABF, L2ABG, and L2ABH)
Do water lilies (including lotus (*Nelumbo*)) dominate the vegetation?
YES, go to Water lily questions
NO, 64120 Midwest Pondweed Submerged Aquatic Wetland

Water lily questions

1) Is white water lily (*Nymphaea odorata*) present and northern water lily (*Nymphaea tetragona*) absent?

YES, go to 2

NO, 64112 Boreal Water Lily Aquatic Wetland

2) Is the vegetation in unmoving water in a shallow depression, backwater slough, pond, or small lake (not in open water or slowly moving water)? Is the subspecies *advena* of yellow water lily (*Nuphar lutea*) present and NOT subspecies *pumila* or *variegata*?

YES, 64111 Water Lily Open Marsh

NO, 64113 Northern Water Lily Aquatic Wetland

65000 ANNUAL HERBACEOUS VEGETATION

Is surface water present for extended periods, especially early in the growing season, but absent by the end of the season in most years? (When surface water is absent, the water table is often near the land surface.)

YES, go to 65100 Seasonally Flooded Annual Forb Vegetation

NO, go to 61000 Grasslands and Emergent Vegetation

65100 SEASONALLY FLOODED ANNUAL FORB VEGETATION (e.g. Cowardin's PEMC)

Is the vegetation dominated by *Salicornia rubra* on an exposed mudflat?

YES, go to 65110 Slender Glasswort Saline Meadow

NO, go to 61000 Grasslands and Emergent Vegetation

70000 NONVASCULAR VEGETATION

Is the substrate saturated to the surface for extended periods during the growing season, with surface water seldom present?

YES, go to 61400 Saturated Herbaceous Vegetation

NO, go to 71000 Lichen Vegetation

71000 LICHEN VEGETATION

1) Do trees comprise >10% cover?

YES, go to 71100 Lichen Vegetation with Sparse Trees

NO, go to 2

2) Do shrubs or herbaceous vegetation cover most of the area not covered by lichens or mosses?

YES, go to 50000 Shrubland or 60000 Herbaceous Vegetation

NO, go to 80000 Sparse Vegetation

71100 LICHEN VEGETATION WITH SPARSE TREES

1) Do lichens and mosses comprise <30% of non-tree cover?

YES, 41120 Northern Conifer Woodland

NO, go to 2

2) Do conifers comprise >50% of the tree canopy?

YES, 71110 Northern Conifer Scrubland

NO, go to 40000 Woodland

80000 SPARSE VEGETATION

1) Is the unvegetated area primarily solid rock?
YES, go to 81000 Consolidated Rock
NO, go to 2
2) Does the unvegetated area consist predominantly of either sand or mud (not including gravel)?
YES, go to 83000 Unconsolidated material
NO, go to 82000 Boulder, gravel, cobble, or talus

81000 CONSOLIDATED ROCK (cliffs, bedrock, etc.)
1) Is the rock face vertical or nearly so AND >3m tall?
YES, go to 81100 Cliffs with Sparse Vegetation
NO, go to 2
2) Is the bedrock on the shoreline of a lake or river?
YES, go to 81200 Level Bedrock with Sparse Vegetation
NO, go to 81100 Cliffs with Sparse Vegetation

81100 CLIFFS WITH SPARSE VEGETATION
1) Is the rock face vertical or nearly so AND >3m tall?
YES, go to 2
NO, go to Rock outcrop/butte
2) Is there continuous groundwater seepage over the rock surface?
YES, go to Wet cliff questions
NO, go to Open cliff questions

Open cliff questions
1) Is the cliff along the shore of Lake Superior?
YES, go to 2
NO, go to 3
2) Is the cliff primarily composed of basalt or diabase rock?
YES, 81111 Great Lakes Shore Basalt/Diabase Cliff
NO, 81116 Great Lakes Shoreline Granite/Metamorphic Cliff
3) Is the cliff primarily composed of sandstone?
YES, go to 4
NO, go to 5
4) Are *Aralia nudicaulis, Asarum canadense, Mitella diphylla, Cystopteris bulbifera*, or *C. fragilis* common, often on north- or east-facing slopes?
YES, 81115 Midwest Sandstone Moist Cliff
NO, 81114 Midwest Sandstone Dry Cliff
5) Is the cliff primarily composed of limestone or dolostone?
YES, 81113 Midwest Dry Limestone/Dolostone Cliff
NO, 81112 Northern (Laurentian) Igneous/Metamorphic Dry Cliff

Wet cliff questions
Is the cliff primarily composed of dolostone, with cool air seeping from fissures, even in summer?
YES, 81121Maderate Cliff
NO, 81122 Midwest Sedimentary Dripping Cliff

Rock outcrop/butte questions
Does the rock outcrop occur in the northern conifer-hardwood zone (essentially north of Sherburne County and west as far as Lake of the Woods)?

YES, 81131Northern (Laurentian) Granite/Metamorphic Rock Outcrop
NO, 81132 Midwest Quartzite-Granite Rock Outcrop

81200 LEVEL BEDROCK WITH SPARSE VEGETATION (e.g. Cowardin's L2RS and R3RS1)

Open Level Bedrock questions

1) Is the substrate along the shore of Lake Superior?
   YES, go to 3
   NO, go to 2
2) Is the substrate composed of sandstone along the bank of a river?
   YES, 81215 River Ledge Sandstone Pavement
   NO, 81211 Inland Lake Igneous/Metamorphic Bedrock Shore
3) Is the substrate primarily composed of sandstone?
   YES, 81214 Great Lakes Sandstone Bedrock Shore
   NO, go to 4
4) Is the substrate primarily composed of limestone or dolostone?
   YES, 81213 Great Lakes Limestone - Dolostone Bedrock Lakeshore
   NO, 81212 Great Lakes Basalt (Conglomerate) Bedrock Lakeshore

82000 BOULDER, GRAVEL, COBBLE, OR TALUS
Is the substrate on the shoreline of a lake or river?

YES, go to 82200 Cobble/Gravel Beaches and Shores
NO, go to 82100 Lowland or Submontane Talus/Scree Slopes

82100 LOWLAND OR SUBMONTANE TALUS/SCREE SLOPES

Lowland talus questions

1) Is the substrate primarily composed of limestone or dolostone?
   YES, 82112 Midwest Limestone - Dolomite Talus
   NO, go to 2
2) Is the substrate primarily composed of sandstone?
   YES, 82113 Northern Sandstone Talus
   NO, go to 3
3) Is the substrate primarily composed of basalt or diabase?
   YES, 82114 Northern Basalt/Diabase Open Talus
   NO, 82111 Northern Granite/Metamorphic Talus

82200 COBBLE/GRAVEL BEACHES AND SHORES (e.g. Cowardin's R2US1, R3US1, and L2US1)

Cobble/Gravel Shore questions

1) Is the substrate along the shore of Lake Superior?
   YES, go to 2
   NO, go to 3
2) Is the substrate primarily composed of basalt or diabase?

YES, 82211 Great Lakes Basalt/Diabase Cobble-Gravel Lakeshore
NO, 82213 Great Lakes Non-alkaline Cobble-Gravel Shore

3) Is the substrate along the shore of a river?
YES, 82212 Riverine Igneous/Metamorphic Cobble-Gravel Shore
NO, 82214 Inland Lake Igneous/Metamorphic Cobble-Gravel Shore

83000 UNCONSOLIDATED MATERIAL (soil, sand, and ash)

1) Is the substrate predominantly sand?
YES, go to 2
NO, go to 83300 Seasonally/Temporarily Flooded Mud Flats

2) Is the substrate along the shore of an inland lake?
YES, go to 3
NO, go to 83200 Temporarily Flooded Sand Flats

3) Does the lower beach zone have submergent and floating-leaved aquatics tolerant of stranding?
YES, go to 83100 Sand Flats
NO, go to 83200 Temporarily Flooded Sand Flats

83100 SAND FLATS (e.g. Cowardin's R2US, R3US, and L2US)

Is the substrate along a freshwater lake or pond?
YES, 83111 Inland Freshwater Strand Beach
NO, 83110 Inland Strand Beach

83200 TEMPORARILY FLOODED SAND FLATS (e.g. Cowardin's R2USA, R3USA, and L2USA)

Sand Flats Temporarily Flooded Sparse Vegetation questions

Is the substrate along the shore of a lake?
YES, 83211 Lacustrine Sand Flats - Bars
NO, 83212 Riverine Sand Flats - Bars

83300 SEASONALLY/TEMPORARILY FLOODED MUD FLATS (e.g. Cowardin's R2US3, R3US3, and L2US3)

Non-tidal Mud Flat Seasonally/Temporarily Flooded Sparse Vegetation questions

1) Is the substrate along a river?
YES, 83312 River Mud Flats
NO, go to 2

2) Is vegetation dominated by plant species tolerant of high concentrations of dissolved salts, such as *Salicornia rubra*, *Puccinellia nuttalliana*, and *Scirpus paludosis* (*maritimus*)?
YES, 83313 Saline Spring Mud Flats
NO, 83311 Lake Mud Flats

90000 WATER

1) Is the water within a channel?
YES, go to 2
NO, go to 3

2) Is water >2 meters (6.6 feet) deep at low water AND is flow not visible due to channel damming?

YES, go to 92000 Lake
NO, go to 91000 River

3) Does water cover >8 hectares (20 acres) OR is water depth >2 meters in the deepest part of the basin at times of low water?
YES, go to 92000 Lake
NO, go to 93000 Wetland - Open Water

91000 RIVER

Is the substrate comprised mostly of rock, cobble, or gravel with occasional patches of sand? Is the gradient high and the water velocity fast? Is dissolved oxygen concentration near saturation? (Little floodplain is present.)
YES, 91200 Fast Moving Linear Open Water Habitat
NO, 91100 Slow Moving Linear Open Water Habitat

92000 LAKE (Lacustrine)

1) Do non-rooted plants (including algae) cover <25% of the area?
YES, go to 2
NO, go to 3

2) Is water depth <2 meters (6.6 feet) at times of low water?
YES, 92500 Littoral Open Water
NO, 92100 Limnetic Open Water

3) Does water cover the land surface throughout the year in all years, even during drought?
YES, go to 92400 Permanently Flooded Littoral Aquatic Bed
NO, go to 4

4) Is surface water present throughout the year except in years of extreme drought?
YES, go to 92300 Intermittently Exposed Littoral Aquatic Bed
NO, go to 92200 Semipermanently Flooded Littoral Aquatic Bed

92200 SEMIPERMANENTLY FLOODED LITTORAL AQUATIC BED (e.g. Cowardin's L2AB1F and L2AB4F)

Is vegetation dominated by floating vascular plants?
YES, 92220 Floating Vascular Vegetation
NO, 92210 Floating Algae

92300 INTERMITTENTLY EXPOSED LITTORAL AQUATIC BED (e.g. Cowardin's L2AB1G and L2AB4G)

Is vegetation dominated by floating vascular plants?
YES, 92320 Floating Vascular Vegetation
NO, 92310 Floating Algae

92400 PERMANENTLY FLOODED LITTORAL AQUATIC BED (e.g. Cowardin's L2AB1H and L2AB4H)

Is vegetation dominated by floating vascular plants?
YES, 92420 Floating Vascular Vegetation
NO, 92410 Floating Algae

92500 LITTORAL OPEN WATER (e.g. Cowardin's L2UBG and L2UBH)

93000 WETLAND - OPEN WATER (Palustrine)

1) Do non-rooted plants (including algae) cover <25% of the area?
   YES, 93300 Open Water
   NO, go to 2
2) Does water cover the land surface throughout the year in all years, even during drought?
   YES, go to 93200 Permanently Flooded Littoral Aquatic Bed
   NO, go to 93100 Intermittently Exposed Littoral Aquatic Bed

93100 INTERMITTENTLY EXPOSED LITTORAL AQUATIC BED (e.g. Cowardin's PAB1G and PAB4G)

Is vegetation dominated by floating vascular plants?
   YES, 93120 Floating Vascular Vegetation
   NO, 93110 Floating Algae

93200 PERMANENTLY FLOODED LITTORAL AQUATIC BED (e.g. Cowardin's PAB1H and PAB4H)

Is vegetation dominated by floating vascular plants?
   YES, 93220 Floating Vascular Vegetation
   NO, 93210 Floating Algae

93300 PALUSTRINE OPEN WATER (e.g. Cowardin's PUBF, PUBG, and PUBH)

Definitions of Codes

Definition & Use of + Codes

Some of the following codes are designated as common in the metro area. This does not mean that they are the only codes used in the Twin Cities metro area. The list of common codes is not comprehensive. Use these codes when appropriate, but do not use them to the exclusion of a code that more accurately describes the land cover that is present. The common codes, if used exclusively, will fail to adequately describe many of the habitats and land cover polygons encountered in the metro area. Failure to use the key in Section C, relying solely on the descriptions of common codes, will result in data that are inaccurate and inconsistent with those collected by others using the MLCCS System. The codes that have been found to be common are marked with a + after the code title.

Cited sources for the definitions:

Mn DNR Natural Heritage description - Minnesota Department of Natural Resources, Natural Heritage Program, *Minnesota's Native Vegetation: a Key to Natural Communities*, version 1.5, 1993.

NVCS description - US National Vegetation Classification draft documents of the *International Classification of Ecological Communities: Terrestrial Vegetation of the Great Plains and Great Lakes*. Compiled by The Nature Conservancy and edited by Don Faber-Langendoen and Kristin Snow, April 2000.

Artificial surfaces and associated areas

10000 Artificial surfaces and associated areas - Areas of vegetative alteration, with a vegetative cover of < 96%. Vegetation may be planted, cultivated, or pre-development vegetation that has been altered or fragmented by humans. Areas which contain artificial cover which is the result of human activities such as construction (e.g. buildings, pavement), extraction sites (e.g. open mines, quarries, pits) and waste disposal sites. This class is determined by the presence of manmade impervious surface. For areas of planted or cultivated vegetation where the vegetative cover exceeds 96%, use the 20000 Subsystem (Planted or Cultivated Vegetation). For areas where pre-development vegetation exceeds 96%, use the Natural/Semi-Natural Classifications. This subsystem loosely correlates to typical land uses such as those defined as residential, industrial, transportation, etc.

Artificial surfaces with trees as the dominant vegetation cover

11000 Artificial surfaces with trees as the dominant vegetation cover. Areas with 25% to 96% vegetation cover, with tree cover canopy dominant, generally exceeding 25% of the vegetative cover. Areas of less than 25% vegetation cover should be classified under Artificial surfaces with less than 25% vegetation cover.

Artificial surfaces with coniferous trees

11100 Artificial surfaces with coniferous trees. Areas with 25% to 96% vegetation cover, with tree cover canopy dominant, generally exceeding 25% of the vegetative cover and coniferous trees generally contributing greater than 75% of the total tree cover.

11110 4% to 10% Impervious cover with coniferous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover, and the vegetation cover is dominated by coniferous trees (see definition 11100).

11111 Jack pine (forest or woodland) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover with Jack Pine, see classification number 31120 or 41110 for vegetation definition.

11112 White / red pine (forest) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 31130 or 31140 for vegetation definition.

11113 Spruce-fir (forest) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 31160 for vegetation definition.

11114 Eastern red cedar (woodland) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 41130 for vegetation definition.

11115 Northern conifer (woodland) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 41120 for vegetation definition.

11116 Planted red pine with 4% to 10% impervious cover. Areas of planted red pine consisting of greater than 70% of the canopy cover with a matrix of 4% to 10% impervious cover.

11117 Planted white pine with 4% to 10% impervious cover. Areas of planted white pine consisting of greater than 50% of the canopy cover with a matrix of 4% to 10% impervious cover.

11118 Planted Spruce/Fir with 4% to 10% impervious cover. Areas of planted spruce or fir species consisting of greater than 50% of the canopy cover with a matrix of 4% to 10% impervious cover.

11119 Other planted conifers with 4% to 10% impervious cover. Areas of planted conifer species (not defined above), mixed plantings, and mixed planted/pre-development trees, where no species dominate the tree cover with a matrix of 4% to 10% impervious cover.

11120 11% to 25% Impervious cover with coniferous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover and the vegetation cover is dominated by coniferous trees (see definition 11100).

11121 Jack pine (forest or woodland) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover with Jack Pine, see classification number 31120 or 41110 for vegetation definition.

11122 White / red pine (forest) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 31130 or 31140 for vegetation definition.

11123 Spruce-fir (forest) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 31160 for vegetation definition.

11124 Eastern red cedar (woodland) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 41130 for vegetation definition.

11125 Northern conifer (woodland) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 41120 for vegetation definition.

11126 Planted red pine with 11% to 25% impervious cover. Areas of planted red pine consisting of greater than 70% of the canopy cover with a matrix of 11% to 25% impervious cover.

11127 Planted white pine with 11% to 25% impervious cover. Areas of planted white pine consisting of greater than 50% of the canopy cover with a matrix of 11% to 25% impervious cover.

11128 Planted Spruce/Fir with 11% to 25% impervious cover. Areas of planted spruce or fir species consisting of greater than 50% of the canopy cover with a matrix of 11% to 25% impervious cover.

11129 Other planted conifers with 11% to 25% impervious cover. Areas of planted conifer species (not defined above), mixed plantings, and mixed planted/pre-development trees, where no species dominate the tree cover with a matrix of 11% to 25% impervious cover.

11130 26% to 50% Impervious cover with coniferous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover and the vegetation cover is dominated by coniferous trees (see definition 11100).

11131 Jack pine (forest or woodland) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover with Jack Pine, see classification number 31120 or 41110 for vegetation definition.

11132 White / red pine (forest) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 31130 or 31140 for vegetation definition.

11133 Spruce-fir (forest) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 31160 for vegetation definition.

11134 Eastern red cedar (woodland) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 41130 for vegetation definition.

11135 Northern conifer (woodland) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 41120 for vegetation definition.

11136 Planted red pine with 26% to 50% impervious cover. Areas of planted red pine consisting of greater than 70% of the canopy cover with a matrix of 26% to 50% impervious cover.

11137 Planted white pine with 26% to 50% impervious cover. Areas of planted white pine consisting of greater than 50% of the canopy cover with a matrix of 26% to 50% impervious cover.

11138 Planted Spruce/Fir with 26% to 50% impervious cover. Areas of planted spruce or fir species consisting of greater than 50% of the canopy cover with a matrix of 26% to 50% impervious cover.

11139 Other planted conifers with 26% to 50% impervious cover. Areas of planted conifer species (not defined above), mixed plantings, and mixed planted/pre-development trees, where no species dominate the tree cover with a matrix of 26% to 50% impervious cover.

11140 51% to 75% Impervious cover with coniferous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover and the vegetation cover is dominated by coniferous trees (see definition 11100).

11141 Jack pine (forest or woodland) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover with Jack Pine, see classification number 31120 or 41110 for vegetation definition.

11142 White / red pine (forest) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 31130 or 31140 for vegetation definition.

11143 Spruce-fir (forest) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 31160 for vegetation definition.

11144 Eastern red cedar (woodland) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 41130 for vegetation definition.

11145 Northern conifer (woodland) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 41120 for vegetation definition.

11146 Planted red pine with 51% to 75% impervious cover. Areas of planted red pine consisting of greater than 70% of the canopy cover with a matrix of 51% to 75% impervious cover.

11147 Planted white pine with 51% to 75% impervious cover. Areas of planted white pine consisting of greater than 50% of the canopy cover with a matrix of 51% to 75% impervious cover.

11148 Planted Spruce/Fir with 51% to 75% impervious cover. Areas of planted spruce or fir species consisting of greater than 50% of the canopy cover with a matrix of 51% to 75% impervious cover.

11149 Other planted conifers with 51% to 75% impervious cover. Areas of planted conifer species (not defined above), mixed plantings, and mixed planted/pre-development trees, where no species dominate the tree cover with a matrix of 51% to 75% impervious cover.

Artificial surfaces with deciduous tree cover

11200 Artificial surfaces with deciduous tree cover. Areas with 25% to 96% vegetation cover, with tree cover canopy dominant, generally exceeding 25% of the vegetative cover and deciduous trees generally contributing greater than 75% of the total tree cover.

11210 4% to 10% Impervious cover with deciduous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover, and the vegetation cover is dominated by deciduous trees (see definition 11200).

11211 Oak (forest or woodland) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 32110 or 42120 for vegetation definition.

11212 Northern hardwood (forest) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 32120 for vegetation definition.

11213 Maple-basswood (forest) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 32150 for vegetation definition.

11214 Box elder and green ash (forest) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 32170 for vegetation definition.

11215 Aspen-birch (forest) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 32140 for vegetation definition.

11216 Aspen (forest, woodland) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 32160, 32230, 32330, or 42110 for vegetation definition.

11217 Planted ash with 4% to 10% impervious cover. Areas of planted ash consisting of greater than 70% of the canopy cover with a matrix of 4% to 10% impervious cover.

11218 Planted oak with 4% to 10% impervious cover. Areas of planted oak consisting of greater than 30% of the canopy cover with a matrix of 4% to 10% impervious cover.

11219 Other deciduous trees with 4% to 10% impervious cover. Areas of planted deciduous tree species (not defined above), mixed plantings, and mixed planted/ Pre-development trees, where no species dominate the tree cover with a matrix of 4% to 10% impervious cover.

11220 11% to 25% Impervious cover with deciduous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover,

and the vegetation cover is dominated by deciduous trees (see definition 11200). Generally single home sites on one acre lots will be classified under this classification.

11221 Oak (forest or woodland) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 32110 or 42120 for vegetation definition.

11222 Northern hardwood (forest) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 32120 for vegetation definition.

11223 Maple-basswood (forest) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 32150 for vegetation definition.

11224 Box elder and green ash (forest) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 32170 for vegetation definition.

11225 Aspen-birch (forest) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover see classification number 32140 for vegetation definition.

11226 Aspen (forest, woodland) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 32160, 32230, 32330, or 42110 for vegetation definition.

11227 Planted ash with 11% to 25% impervious cover. Areas of planted ash consisting of greater than 70% of the canopy cover with a matrix of 11% to 25% impervious cover.

11228 Planted oak with 11% to 25% impervious cover. Areas of planted oak consisting of greater than 30% of the canopy cover with a matrix of 11% to 25% impervious cover.

11229 Other deciduous trees with 11% to 25% impervious cover. Areas of planted deciduous tree species (not defined above), mixed plantings, and mixed planted/ Pre-development trees, where no species dominate the tree cover with a matrix of 11% to 25% impervious cover. Generally single home sites with 0.5 to 1 homes per acre, will be classified under this classification.

11230 26% to 50% Impervious cover with deciduous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover, and the vegetation cover is dominated by deciduous trees (see definition 11200). Generally single home sites with 2 to 3 homes per acre, will be classified under this classification.

11231 Oak (forest or woodland) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 32110 or 42120 for vegetation definition.

11232 Northern hardwood (forest) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 32120 for vegetation definition.

11233 Maple-basswood (forest) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 32150 for vegetation definition.

11234 Box elder and green ash (forest) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 32170 for vegetation definition.

11235 Aspen-birch (forest) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 32140 for vegetation definition.

11236 Aspen (forest, woodland) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 32160, 32230, 32330, or 42110 for vegetation definition.

11237 Planted ash with 26% to 50% impervious cover. Areas of planted ash consisting of greater than 70% of the canopy cover with a matrix of 26% to 50% impervious cover.

11238 Planted oak with 26% to 50% impervious cover. Areas of planted oak consisting of greater than 30% of the canopy cover with a matrix of 26% to 50% impervious cover.

11239 Other deciduous trees with 26% to 50% impervious cover. Areas of planted deciduous tree species (not defined above), mixed plantings, and mixed planted/ Pre-development trees, where no species dominate the tree cover with a matrix of 26% to 50% impervious cover.

11240 51% to 75% Impervious cover with deciduous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover, and the vegetation cover is dominated by deciduous trees (see definition 11200). Generally single home sites with 4 to 5 homes per acre, will be classified under this classification.

11241 Oak (forest or woodland) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 32110 or 42120 for vegetation definition.

11242 Northern hardwood (forest) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 32120 for vegetation definition.

11243 Maple-basswood (forest) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 32150 for vegetation definition.

11244 Box elder and green ash (forest) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 32170 for vegetation definition.

11245 Aspen-birch (forest) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 32140 for vegetation definition.

11246 Aspen (forest, woodland) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 32160, 32230, 32330, or 42110 for vegetation definition.

11247 Planted ash with 51% to 75% impervious cover. Areas of planted ash consisting of greater than 70% of the canopy cover with a matrix of 51% to 75% impervious cover.

11248 Planted oak with 51% to 75% impervious cover. Areas of planted oak consisting of greater than 30% of the canopy cover with a matrix of 51% to 75% impervious cover.

11249 Other deciduous trees with 51% to 75% impervious cover. Areas of planted deciduous tree species (not defined above), mixed plantings, and mixed planted/ Pre-development trees, where no species dominate the tree cover with a matrix of 51% to 75% impervious cover.

Artificial surfaces with mixed coniferous and deciduous tree cover

11300 Artificial surfaces with mixed coniferous and deciduous tree cover. Areas with 25% to 96% vegetation cover, with tree cover canopy dominant, generally exceeding 25% of the vegetative cover and coniferous tree species and deciduous tree species, each contributing 25% to 75% of the total tree cover.

11310 4% to 10% Impervious cover with mixed coniferous/deciduous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover, and the vegetation cover is dominated by a mix of coniferous and deciduous trees (see definition 11300). Generally single home sites on two acre lots will be classified under this classification.

11311 Mixed pine-hardwood (forest) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 33110 for vegetation definition.

11312 White pine-hardwood (forest) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 33140 for vegetation definition.

11313 Northern hardwood-conifer (forest) with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 33120 or 33130 for vegetation definition.

11314 Planted mixed coniferous/deciduous trees with 4% to 10% impervious cover+. Areas with a matrix of 4% to 10% impervious cover and mixed coniferous-deciduous tree species (not defined above), mixed plantings, and mixed planted/pre-development trees, where no species dominate the tree cover.

11320 11% to 25% Impervious cover with mixed coniferous/deciduous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover, and the vegetation cover is dominated by a mix of coniferous and deciduous trees (see definition 11300). Generally single home sites on one acre lots will be classified under this classification.

11321 Mixed pine-hardwood (forest) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 33110 for vegetation definition.

11322 White pine-hardwood (forest) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 33140 for vegetation definition.

11323 Northern hardwood-conifer (forest) with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 33120 or 33130 for vegetation definition.

11324 Planted mixed coniferous/deciduous trees with 11% to 25% impervious cover+. Areas with a matrix of 11% to 25% impervious cover and mixed coniferous-deciduous tree species (not defined above), mixed plantings, and mixed planted/pre-development trees, where no species dominate the tree cover. Generally single home sites with 0.5 to 1 homes per acre, will be classified under this classification.

11330 26% to 50% Impervious cover with mixed coniferous/deciduous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover, and the vegetation cover is dominated by a mix of coniferous and deciduous trees (see definition 11300). Generally single home sites with 2 to 3 homes per acre, will be classified under this classification.

11331 Mixed pine-hardwood (forest) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 33110 for vegetation definition.

11332 White pine-hardwood (forest) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 33140 for vegetation definition.

11333 Northern hardwood-conifer (forest) with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 33120 or 33130 for vegetation definition.

11334 Planted mixed coniferous/deciduous trees with 26% to 50% impervious cover. Areas with a matrix of 26% to 50% impervious cover and mixed coniferous-deciduous tree species (not defined above), mixed plantings, and mixed planted/pre-development trees, where no species dominate the tree cover.

11340 51% to 75% Impervious cover with mixed coniferous/deciduous trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover, and the vegetation cover is dominated by a mix of coniferous and deciduous trees (see definition 11300). Generally single home sites with 4 to 5 homes per acre, will be classified under this classification.

11341 Mixed pine-hardwood (forest) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 33110 for vegetation definition.

11342 White pine-hardwood (forest) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 33140 for vegetation definition.

11343 Northern hardwood-conifer (forest) with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 33120 or 33130 for vegetation definition.

11344 Planted mixed coniferous/deciduous trees with 51% to 75% impervious cover. Areas with a matrix of 51% to 75% impervious cover and mixed coniferous-deciduous tree species (not defined above), mixed plantings, and mixed planted/pre-development trees, where no species dominate the tree cover.

Artificial surfaces with coniferous and/or deciduous shrub dominant vegetation

12000 Artificial surfaces with coniferous and/or deciduous shrub dominant vegetation. Areas with 25% to 96% vegetation cover, with individual shrubs or clumps of shrubs dominant, generally forming more than 25% of the vegetative cover. Tree canopy generally contributes less than 25% of the vegetative cover. Areas contain coniferous shrubs and/or deciduous shrubs. Areas of less than 25% vegetation cover should be under code 14000 Artificial surfaces with less than 25% vegetation cover.

Artificial surfaces with coniferous and/or deciduous shrubs

12100 Artificial surfaces with coniferous and/or deciduous shrubs. Areas with 25% to 96% vegetation cover, with coniferous and/or deciduous shrub cover dominant, though each generally greater than 25% of the total vegetation cover. Trees contribute <10% cover.

12110 4% to 10% Impervious cover with coniferous and/or deciduous shrubs. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover, and the vegetation cover is dominated by coniferous and/or deciduous shrubs (see definition 12100).

12111 Short grasses with planted or maintained coniferous and/or deciduous shrubs, 4-10% impervious cover. . Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover, and the vegetation cover is dominated by areas of planted and/or maintained shrubs with short grasses.

12112 Long grasses with planted or maintained coniferous and/or deciduous shrubs, 4-10% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover, and the vegetation cover is dominated by areas of planted and/or maintained shrubs with long grasses.

12113 Other coniferous and/or deciduous shrubs with 4-10% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover and the vegetation cover is dominated by areas of coniferous and/or deciduous invasive and/or pre-development shrubs. Grasses are either long or short.

12120 11% to 25% Impervious cover with coniferous and/or deciduous shrubs. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover, and the vegetation cover is dominated by coniferous and/or deciduous shrubs (see definition 12100).

12121 Short grasses with planted or maintained coniferous and/or deciduous shrubs, 11% to 25% impervious cover. . Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover, and the vegetation cover is dominated by areas of planted and/or maintained shrubs with short grasses.

12122 Long grasses with planted or maintained coniferous and/or deciduous shrubs, 11% to 25% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover, and the vegetation cover is dominated by areas of planted and/or maintained shrubs with long grasses.

12123 Other coniferous and/or deciduous shrubs with 11% to 25% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover and the vegetation cover is dominated by areas of coniferous and/or deciduous invasive and/or pre-development shrubs. Grasses are either long or short.

12130 26% to 50% Impervious cover with coniferous and/or deciduous shrubs. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover, and the vegetation cover is dominated by coniferous and/or deciduous shrubs (see definition 12100). Generally single home sites, two to five homes per acre, will be classified under this classification.

12131 Short grasses with planted or maintained coniferous and/or deciduous shrubs, 26% to 50% impervious cover. . Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover, and the vegetation cover is dominated by areas of planted and/or maintained shrubs with short grasses.

12132 Long grasses with planted or maintained coniferous and/or deciduous shrubs, 26% to 50% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover, and the vegetation cover is dominated by areas of planted and/or maintained shrubs with long grasses.

12133 Other coniferous and/or deciduous shrubs with 26% to 50% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover and the vegetation cover is dominated by areas of coniferous and/or deciduous invasive and/or pre-development shrubs. Grasses are either long or short.

12140 51% to 75% Impervious cover with coniferous and/or deciduous shrubs. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover, and the vegetation cover is dominated by coniferous and/or deciduous shrubs (see definition 12100). Generally single home sites, three per acre, will be classified under this classification.

12141 Short grasses with planted or maintained coniferous and/or deciduous shrubs, 51% to 75% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover, and the vegetation cover is dominated by areas of planted and/or maintained shrubs with short grasses.

12142 Long grasses with planted or maintained coniferous and/or deciduous shrubs, 51% to 75% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover, and the vegetation cover is dominated by areas of planted and/or maintained shrubs with long grasses.

12143 Other coniferous and/or deciduous shrubs with 51% to 75% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover and the vegetation cover is dominated by areas of coniferous and/or deciduous invasive and/or pre-development shrubs. Grasses are either long or short.

Artificial surfaces with coniferous and/or deciduous shrubs with sparse trees

12200 Artificial surfaces with coniferous and/or deciduous shrubs with sparse trees. Areas with 25% to 96% vegetation cover, with coniferous shrub and/or deciduous shrub cover dominant, generally greater than 25% of the total vegetation cover. Trees generally contribute 10-25% vegetation cover.

12210 4% to 10% Impervious cover with coniferous and/or deciduous shrubs and sparse trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover and the vegetation cover has trees though is dominated by coniferous shrub and/or deciduous shrubs (see definition 12200).

12211 Oak woodland brushland with 4 - 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 42120 for vegetation definition.

12212 Other mixed coniferous-deciduous shrubs with trees with 4 - 10% impervious cover. Areas with a matrix of 4% to 10% impervious cover with vegetation dominated by coniferous and/or deciduous shrub species (not defined above), mixed plantings, and mixed planted/pre-development shrubs. Trees are present though not dominant. Grasses are either short or long.

12220 11% to 25% Impervious cover with coniferous and/or deciduous shrubs and sparse trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover and the vegetation cover has trees though is dominated by coniferous shrub and/or deciduous shrubs (see definition 12200).

12221 Oak woodland brushland with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 42120 for vegetation definition.

12222 Other mixed coniferous-deciduous shrubs with trees with 11% to 25% impervious cover. Areas with a matrix of 11% to 25% impervious cover with vegetation dominated by coniferous and/or deciduous shrub species (not defined above), mixed plantings, and mixed planted/pre-development shrubs. Trees are present though not dominant. Grasses are either short or long.

12230 26% to 50% Impervious cover with coniferous and/or deciduous shrubs and sparse trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover and the vegetation cover has trees though is dominated by coniferous shrub and/or deciduous shrubs (see definition 12200).

12231 Oak woodland brushland with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 42120 for vegetation definition.

12232 Other mixed coniferous-deciduous shrubs with trees with 26% to 50% impervious cover. Areas with a matrix of 26% to 50% impervious cover with vegetation dominated by coniferous and/or deciduous shrub species (not defined above), mixed plantings, and mixed planted/pre-development shrubs. Trees are present though not dominant. Grasses are either short or long.

12240 51% to 75% Impervious cover with coniferous and/or deciduous shrubs and sparse trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover and the vegetation cover has trees though is dominated by coniferous shrub and/or deciduous shrubs (see definition 12200).

12241 Oak woodland brushland with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 42120 for vegetation definition.

12242 Other mixed coniferous-deciduous shrubs with trees with 51% to 75% impervious cover. Areas with a matrix of 51% to 75% impervious cover with vegetation dominated by coniferous and/or deciduous shrub species (not defined above), mixed plantings, and mixed planted/pre-development shrubs. Trees are present though not dominant. Grasses are either short or long.

Artificial surfaces with herbaceous dominant vegetation

13000 Artificial surfaces with herbaceous dominant vegetation. Areas with 25% to 96% vegetation cover, with herbaceous vegetation dominant, generally forming at least 25% of the vegetative cover, with trees and shrubs generally less than 25% of the vegetative cover. Areas of less than 25% vegetation cover should be classified under 14000 Artificial surfaces with less than 25% vegetation cover.

Artificial surfaces with perennial grasses with sparse trees

13100 Artificial surfaces with perennial grasses with sparse trees. Long and/or short grasses are dominant, generally greater than 25% of the total vegetation cover. Grass species often are typical of lawns, parks, and roadsides. Trees generally contribute 10-25% vegetative cover. Shrubs may be present though are not dominant, and generally contribute less than 25% vegetative cover.

13110 4% to 10% Impervious cover with perennial grasses with sparse trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover and the vegetation cover is dominated by grasses with few trees (see definition 13100).

13111 Jack pine barrens with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 62210 for vegetation definition.

13112 Oak savanna with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 62120 and 62130 for vegetation definition.

13113 Aspen openings with 4% to 10% impervious cover. Pre-development vegetation with a matrix of 4% to 10% impervious cover, see classification number 62110 for vegetation definition.

13114 Short grasses and mixed trees with 4% to 10% impervious cover. Areas of short grasses with a matrix of 4% to 10% impervious cover. Planted grass species typical of "turf" (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing, with mixed planted/pre-development trees and/or shrubs.

13115 Long grasses and mixed trees with 4% to 10% impervious cover. Areas with a matrix of 4% to 10% impervious cover with vegetation dominated with mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat. Some species may be native, but they do not dominate. Forbs may also be present. Mowing may occur, though infrequently. Mixed planted/pre-development trees and/or shrubs may also be present.

13120 11% to 25% Impervious cover with perennial grasses with sparse trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover and the vegetation cover is dominated by grasses with few trees (see definition 13100).

13121 Jack pine barrens with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 62210 for vegetation definition.

13122 Oak savanna with 11% to 25% impervious cover. Pre-development vegetation with a matrix 11% to 25% impervious cover, see classification number 62120 and 62130 for vegetation definition.

13123 Aspen openings with 11% to 25% impervious cover. Pre-development vegetation with a matrix of 11% to 25% impervious cover, see classification number 62110 for vegetation definition.

13124 Short grasses and mixed trees with 11% to 25% impervious cover. Areas of short grasses with a matrix of 11% to 25% impervious cover. Planted grass species typical of "turf" (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing, with mixed planted/pre-development trees and/or shrubs.

13125 Long grasses and mixed trees with 11% to 25% impervious cover. Areas with a matrix of 11% to 25% impervious cover with vegetation dominated with mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat. Some species may be native, but they do not dominate. Forbs may also be present. Mowing may occur, though infrequently. Mixed planted/pre-development trees and/or shrubs may also be present.

13130 26% to 50% Impervious cover with perennial grasses with sparse trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover and the vegetation cover is dominated by grasses with few trees (see definition 13100).

13131 Jack pine barrens with 26% to 50% impervious cover. Pre-development vegetation with a matrix of 26% to 50% impervious cover, see classification number 62210 for vegetation definition.

13132 Oak savanna with 26% to 50% impervious cover. Pre-development vegetation with a matrix 26% to 50% impervious cover, see classification number 62120 and 62130 for vegetation definition.

13133 Aspen openings with 26% to 50% impervious cover. Pre-development vegetation with a matrix 26% to 50% impervious cover, see classification number 62110 for vegetation definition.

13134 Short grasses and mixed trees with 26% to 50% impervious cover. Areas of short grasses with a matrix of 26% to 50% impervious cover. Planted grass species typical of 'turf' (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing, with mixed planted/pre-development trees and/or shrubs.

13135 Long grasses and mixed trees with 26% to 50% impervious cover. Areas with a matrix of 26% to 50% impervious cover with vegetation dominated with mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat. Some species may be native, but they do not dominate. Forbs may also be present. Mowing may occur, though infrequently. Mixed planted/pre-development trees and/or shrubs may also be present.

13140 51% to 75% Impervious cover with perennial grasses with sparse trees. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover and the vegetation cover is dominated by grasses with few trees (see definition 13100).

13141 Jack pine barrens with 51% to 75% impervious cover. Pre-development vegetation with a matrix of 51% to 75% impervious cover, see classification number 62210 for vegetation definition.

13142 Oak savanna with 51% to 75% impervious cover. Pre-development vegetation with a matrix 51% to 75% impervious cover, see classification number 62120 and 62130 for vegetation definition.

13143 Aspen openings with 51% to 75% impervious cover. Pre-development vegetation with a matrix 51% to 75% impervious cover, see classification number 62110 for vegetation definition.

13144 Short grasses and mixed trees with 51% to 75% impervious cover. Areas of short grasses with a matrix of 51% to 75% impervious cover. Planted grass species typical of 'turf' (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing, with mixed planted/pre-development trees and/or shrubs.

13145 Long grasses and mixed trees with 51% to 75% impervious cover. Areas with a matrix of 51% to 75% impervious cover with vegetation dominated with mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat. Some species may be native, but they do not

dominate. Forbs may also be present. Mowing may occur, though infrequently. Mixed planted/pre-development trees and/or shrubs may also be present.

Artificial surfaces with perennial grasses

13200 Artificial surfaces with perennial grasses. Grass species are dominant, generally greater than 25% of the total vegetation cover. Shrubs may be present, though are not dominant, and generally contribute less than 25% vegetation cover. Trees contribute <10% cover.

13210 4% to 10% Impervious cover with perennial grasses. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover, and the vegetation cover is dominated by long and/or short grasses (see definition 13200).

13211 Short grasses with 4% to 10% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover, and the vegetation cover is dominated by planted grass species typical of "turf" (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing. These grasses are regularly maintained to heights below one foot.

13212 Non-native dominated long grasses with 4% to 10% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover, and the vegetation cover is dominated by mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native or non-native, but non-native species dominate. Forbs may also be present. Mowing may occur, though infrequently, generally resulting in heights over one foot.

13213 Mesic prairie with 4% to 10% impervious cover. Pre-development vegetation or successful prairie restoration (i.e. native species dominate) with a matrix of 4% to 10% impervious cover, see classification number 61110 for vegetation definition.

13214 Dry prairie with 4% to 10% impervious cover. Pre-development vegetation or successful prairie restoration (i.e. native species dominate) with a matrix of 4% to 10% impervious cover, see classification number 61210 for vegetation definition.

13220 11% to 25% Impervious cover with perennial grasses. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover. Generally single home sites on one acre lots will be classified under this classification.

13221 Short grasses with 11% to 25% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover, and the vegetation cover is dominated by planted grass species typical of 'turf' (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing. These grasses are regularly maintained to heights below one foot.

13222 Non-native dominated long grasses with 11% to 25% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of

the total cover, and the vegetation cover is dominated by mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native or non-native, but non-native species dominate. Forbs may also be present. Mowing may occur, though infrequently, generally resulting in heights over one foot.

13223 Mesic prairie with 11% to 25% impervious cover. Pre-development vegetation or successful prairie restoration (i.e. native species dominate) with a matrix of 11% to 25% impervious cover, see classification number 61110 for vegetation definition.

13224 Dry prairie with 11% to 25% impervious cover. Pre-development vegetation or successful prairie restoration (i.e. native species dominate) with a matrix of 11% to 25% impervious cover, see classification number 61210 for vegetation definition.

13230 26% to 50% Impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover. Generally single home sites, two to five homes per acre, will be classified under this classification.

13231 Short grasses with 26% to 50% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover, and the vegetation cover is dominated by planted grass species typical of "turf" (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing. These grasses are regularly maintained to heights below one foot.

13232 Non-native dominated long grasses with 26% to 50% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover, and the vegetation cover is dominated by mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native or non-native, but non-native species dominate. Forbs may also be present. Mowing may occur, though infrequently, generally resulting in heights over one foot.

13233 Mesic prairie with 26% to 50% impervious cover. Pre-development vegetation or successful prairie restoration (i.e. native species dominate) with a matrix of 26% to 50% impervious cover, see classification number 61110 for vegetation definition.

13234 Dry prairie with 26% to 50% impervious cover. Pre-development vegetation or successful prairie restoration (i.e. native species dominate) with a matrix of 26% to 50% impervious cover, see classification number 61210 for vegetation definition.

13240 51% to 75% Impervious cover with perennial grasses. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover. Generally single home sites, three per acre, will be classified under this classification.

13241 Short grasses with 51% to 75% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover, and the vegetation cover is dominated by planted grass species typical of "turf" (bluegrass, fescue, etc).

Species composition is typical of regular and frequent mowing. These grasses are regularly maintained to heights below one foot.

13242 Non-native dominated long grasses with 51% to 75% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover, and the vegetation cover is dominated by mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native or non-native, but non-native species dominate. Forbs may also be present. Mowing may occur, though infrequently, generally resulting in heights over one foot.

13243 Mesic prairie with 51% to 75% impervious cover. Pre-development vegetation or successful prairie restoration (i.e. native species dominate) with a matrix of 51% to 75% impervious cover, see classification number 61110 for vegetation definition.

13244 Dry prairie with 51% to 75% impervious cover. Pre-development vegetation or successful prairie restoration (i.e. native species dominate) with a matrix of 51% to 75% impervious cover, see classification number 61210 for vegetation definition.

Artificial surfaces with cultivated herbaceous vegetation (gardens)

13300 Artificial surfaces with cultivated herbaceous vegetation (gardens). Cultivated herbaceous species are dominant, generally greater than 25% of the total vegetation cover. Trees and/or shrubs may be present, though are not dominant, and each generally contribute less than 25% vegetation cover. Neighborhood vegetable gardens, and local flower gardens are typical of this classification.

13310 4% to 10% Impervious cover with cultivated herbaceous vegetation. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover and the vegetation is dominated with cultivated herbaceous species (see definition 13300).

13311 Vegetables with 4% to 10% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover and the vegetation cover is dominated by planted, maintained or cultivated vegetables.

13312 Forbs (flowers) with 4% to 10% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 4% to 10% of the total cover and the vegetation cover is dominated by planted, maintained or cultivated forbs (flowers).

13320 11% to 25% Impervious cover with cultivated herbaceous vegetation. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover and the vegetation is dominated with cultivated herbaceous species (see definition 13300).

13321 Vegetables with 11% to 25% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover and the vegetation cover is dominated by planted, maintained or cultivated vegetables.

13322 Forbs (flowers) with 11% to 25% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 11% to 25% of the total cover and the vegetation cover is dominated by planted, maintained or cultivated forbs (flowers).

13330 26% to 50% Impervious cover with cultivated herbaceous vegetation. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover and the vegetation is dominated with cultivated herbaceous species (see definition 13300).

13331 Vegetables with 26% to 50% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover and the vegetation cover is dominated by planted, maintained or cultivated vegetables.

13332 Forbs (flowers) with 26% to 50% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 26% to 50% of the total cover and the vegetation cover is dominated by planted, maintained or cultivated forbs (flowers).

13340 51% to 75% Impervious cover with cultivated herbaceous vegetation. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover and the vegetation is dominated with cultivated herbaceous species (see definition 13300).

13341 Vegetables with 51% to 75% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover and the vegetation cover is dominated by planted, maintained or cultivated vegetables.

13342 Forbs (flowers) with 51% to 75% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 51% to 75% of the total cover and the vegetation cover is dominated by planted, maintained or cultivated forbs (flowers).

Artificial surfaces with less than 25% vegetation cover

14000 Artificial surfaces with less than 25% vegetation cover. Areas with exposed earth, pavement, and/or buildings contributing 75 -100% cover. Typical of this category are areas relatively devoid of vegetation due to human alteration, generally contributing less than 25% total cover. Vegetative cover may consist of any combination of trees, shrubs, and herbaceous vegetation. Non-vegetative cover consists of impervious surfaces such as buildings and/or pavement, or pervious areas devoid of vegetation such as extraction mining operations or areas where the landscape is being graded for future development. Areas of agricultural fields without vegetation present would generally be classified under Formation Class: Cultivated herbaceous vegetation (24000).

Buildings and/or Pavement

14100 Buildings and/or Pavement. Areas where the sum of buildings, pavement and other impermeable surfaces averages greater than 75% cover. Vegetative cover may consist of any

combination of trees, shrubs, and herbaceous vegetation. Vegetation may be planted and/or pre-development vegetation.

14110 76% to 90% Impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 76% to 90% of the total cover. Vegetative cover may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be planted and/or pre-development vegetation. Generally industrial districts will be classified under this classification.

14111 Buildings with 76% to 90% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 76% to 90% of the total cover and the sum of buildings contributes greater than 75% of the impervious cover. Vegetative cover may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be planted and/or pre-development vegetation.

14112 Pavement with 76% to 90% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 76% to 90% of the total cover and the sum of pavement contributes greater than 75% of the impervious cover. Vegetative cover may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be planted and/or pre-development vegetation.

14113 Buildings and pavement with 76% to 90% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 76% to 90% of the total cover where neither buildings or pavement exceed 75% of the non-vegetative cover.

14120 Average 91% to 100% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 91% to 100% of the total cover. Vegetative cover may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be planted and/or pre-development vegetation. Generally commercial and business districts will be classified under this classification.

14121 Buildings with 91% to 100% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 91% to 100% of the total cover and the sum of buildings contributes greater than 75% of the impervious cover. Vegetative cover may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be planted and/or pre-development vegetation.

14122 Pavement with 91% to 100% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 91% to 100% of the total cover and the sum of pavement contributes greater than 75% of the impervious cover. Vegetative cover may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be planted and/or pre-development vegetation.

14123 Buildings and pavement with 91% to 100% impervious cover. Areas where the sum of buildings, pavement and other impermeable surfaces averages 91% to 100% of the total cover where neither buildings or pavement exceed 75% of the non-vegetative cover

Exposed Earth

14200 Exposed Earth. Areas with exposed earth dominant, generally exceeding 75% cover. Vegetative cover may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation. Typical of this classification are areas where cover has been altered by human activities with buildings, pavement and vegetation contributing less than 25% cover. Typical land uses such as mining operations, active land conversion by grading, abandoned railroad yards, and other 'abandoned' sites relatively devoid of vegetation may be classified as exposed earth.

14210 0% to 10% impervious cover - exposed earth. Areas of exposed earth dominant (see definition 14200) where the sum of buildings, pavement and other impermeable surface averages 0% to 10% of the total cover.

14211 Mines with 0% to 10% impervious cover. Exposed rock typical of open extraction of minerals or rock with a matrix of 0% to 10% impervious cover. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation.

14212 Sand and Gravel Pits with 0% to 10% impervious cover. Active or inactive open extraction of sand and gravel with a matrix of 0% to 10% impervious cover. Sites may be either active or inactive. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation.

14213 Landfill with 0% to 10% impervious cover. Active or inactive exposed dumping sites with a matrix of 0% to 10% impervious cover. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation.

14214 Other Exposed / Transitional Land with 0% to 10% impervious cover. Areas of exposed earth (not defined above) with a matrix of 0% to 10% impervious cover. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation. Areas include active earth moving, abandoned railroad yards, and old building sites where little or no vegetation is present.

14220 11% to 25% Impervious cover - exposed earth. Areas of exposed earth dominant (see definition 14200) where the sum of buildings, pavement and other impermeable surface averages 11% to 25% of the total cover.

14221 Mines with 11% to 25% impervious cover. Exposed rock typical of open extraction of minerals or rock with a matrix of 11% to 25% impervious cover. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation.

14222 Sand and Gravel Pits with 11% to 25% impervious cover. Active or inactive open extraction of sand and gravel with a matrix of 11% to 25% impervious cover. Sites may be either active or inactive. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation.

14223 Landfill with 11% to 25% impervious cover. Active or inactive exposed dumping sites with a matrix of 11% to 25% impervious cover. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation.

14224 Other Exposed / Transitional Land with 11% to 25% impervious cover. Areas of exposed earth (not defined above) with a matrix of 11% to 25% impervious cover. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation. Areas include active earth moving, abandoned railroad yards, and old building sites where little or no vegetation is present.

14230 26% to 50% Impervious cover - exposed earth. Areas of exposed earth dominant (see definition 14200) where the sum of buildings, pavement and other impermeable surface averages 26% to 50% of the total cover.

14231 Mines with 26% to 50% impervious cover. Exposed rock typical of open extraction of minerals or rock with a matrix of 26% to 50% impervious cover. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation.

14232 Sand and Gravel Pits with 26% to 50% impervious cover. Active or inactive open extraction of sand and gravel with a matrix of 26% to 50% impervious cover. Sites may be either active or inactive. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation.

14233 Landfill with 26% to 50% impervious cover. Active or inactive exposed dumping sites with a matrix of 26% to 50% impervious cover. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation.

14234 Other Exposed / Transitional Land with 26% to 50% impervious cover. Areas of exposed earth (not defined above) with a matrix of 26% to 50% impervious cover. Vegetative cover is less than 25% of the total cover and may consist of any combination of trees, shrubs, and herbaceous vegetation. Vegetation may be either planted or pre-development vegetation. Areas include active earth moving, abandoned railroad yards, and old building sites where little or no vegetation is present.

Planted or Cultivated Vegetation

20000 Planted or cultivated vegetation (greater than 96% vegetation cover). Areas of vegetative alteration, with a vegetative cover of 96 - 100%. Natural vegetation has often been removed or modified and replaced with different types of vegetative cover resulting from anthropic activities. Vegetation may be either planted, cultivated, treated with annual management and/or otherwise altered by humans. Soils usually have been mechanically or physically altered for the establishment of vegetation. This formation class generally includes typical land uses of agriculture, parks, golf courses, or other such land use where the vegetation is cultivated, planted or maintained, and impervious surface contributes less than 5% of the area. Areas where natural succession is occurring on previously disturbed soils, restorations, or re-planting of natural communities are not considered in this category because although planted, they are intended to mimic natural cover and should be classified under Natural/Semi-Natural Systems.

Planted, maintained or cultivated tree vegetation

21000 Planted, maintained or cultivated tree vegetation. Areas with individual trees, rows of trees, or clumps of trees dominant, generally forming more than 25% vegetative cover. Typically the herbaceous layer is periodically mowed, though unmowed areas may also exist. Typical of this formation class are associated land uses such as Christmas tree farms, tree nurseries, orchards, tree plantations, windbreaks, and some wooded parkland.

Planted, maintained or cultivated coniferous trees

21100 Planted, maintained or cultivated coniferous trees. Areas with the tree cover dominant, generally exceeding 25% of the vegetative cover and where the coniferous trees generally contribute greater than 75% of the total tree cover.

21110 Upland soils with planted, maintained, or cultivated coniferous trees.
Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling).

21111 Spruce/fir trees on upland soils

21112 White pine trees on upland soils

21113 Red pine trees on upland soils

21114 Coniferous trees on upland soils. Coniferous tree vegetation not defined above. Trees are generally permanent, though regular maintenance may occur over the long term.

Planted, maintained or cultivated deciduous trees

21200 Planted, maintained or cultivated deciduous trees. Areas where the deciduous trees generally contribute greater than 75% of the total tree cover.

21210 Upland Soils with planted, maintained or cultivated deciduous trees Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling)

21211 Fruit Trees (apple, cherry, plum, etc.) on upland soils

21212 Walnut trees on upland soils

21213 Deciduous trees on upland soils. Deciduous tree vegetation not defined above. Trees are generally permanent, though regular maintenance may occur over the long term.

Planted, maintained or cultivated mixed coniferous/deciduous trees

21300 Planted, maintained or cultivated mixed coniferous/deciduous trees. Areas with trees dominant, both coniferous tree species and deciduous tree species each contributing 25% to 75% of the total tree cover.

21310 Upland soils with planted, maintained or cultivated mixed coniferous/deciduous trees Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling).

21320 Hydric soils with planted, maintained or cultivated mixed coniferous/deciduous trees. Areas where surface water is present for brief or extended periods during the growing season. The water table may or may not be near the surface and may have been artificially lowered. Common of this classification are drained or partially drained wetlands, where vegetation has been converted to upland varieties. Hydrophytic vegetation may still be present.

Planted, maintained or cultivated shrub and/or vine vegetation

22000 Planted, maintained or cultivated shrub and/or vine vegetation - Areas with individual, rows, or clumps of shrubs/vines dominant, generally forming at least 25% vegetative cover, with trees and other herbaceous cover generally contributing less than 25% of the vegetative cover. Typical of this formation class are land uses such as berry farms, nurseries, vineyard and landscaped shrubbery.

Planted, maintained or cultivated coniferous shrubs

22100 Planted, maintained or cultivated coniferous shrubs. Areas with coniferous shrubs dominant, generally greater than 75% of the total shrub cover.

22110 Upland soils with planted, maintained or cultivated coniferous shrubs Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling)

22120 Hydric soils with planted, maintained or cultivated coniferous shrubs Areas where surface water is present for brief or extended periods during the growing season. The water table may or may not be near the surface and may have been artificially lowered. Common of this classification are drained or partially drained wetlands, where vegetation has been converted to upland varieties. Hydrophytic vegetation may still be present.

22130 Mixed Plantings. Shrub vegetation not defined above. Shrubs are generally permanent, though regular maintenance may occur over the long term.

Planted, maintained or cultivated deciduous shrub/vine vegetation

22200 Planted, maintained or cultivated deciduous shrub/vine vegetation. Areas with deciduous shrubs and/or vines dominant, generally greater than 75% of the total shrub cover.

22210 Upland soils with planted, maintained or cultivated deciduous shrub/vine vegetation Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling)

22211 Blackberry

22212 Blueberry

22213 Grape

22214 Raspberry-black

22215 Raspberry-red

22216 Other shrub/vine vegetation. Shrub/vine vegetation not defined above. Shrub/vine vegetation is generally permanent, though regular maintenance may occur over the long term.

22220 Artificially flooded or saturated soils with planted, maintained or cultivated deciduous shrub/vine vegetation. Substrate is saturated to the surface for extended periods during the growing season. Surface water may or may not be present. Periodic flooding may be controlled by pumps or siphons in combination with dikes or dams.

22221 Cranberry

Planted, maintained or cultivated mixed coniferous-deciduous shrub/vine vegetation

22300 Planted, maintained or cultivated mixed coniferous-deciduous shrub/vine vegetation. Areas where mixed coniferous and deciduous shrub/vine cover is dominant. Coniferous and deciduous species each contribute 25% to 75% of the total shrub/vine cover.

22310 Upland Soils with planted, maintained or cultivated mixed coniferous-deciduous shrub/vine vegetation. Areas not flooded, or saturated by groundwater, for more than a few

days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling).

22320 Hydric soils with planted, maintained or cultivated mixed coniferous-deciduous shrub/vine vegetation. Areas where surface water is present for brief or extended periods during the growing season. The water table may or may not be near the surface and may have been artificially lowered. Common of this classification are drained or partially drained wetlands, where vegetation has been converted to upland varieties. Hydrophytic vegetation may still be present.

Planted or maintained herbaceous vegetation

23000 Planted or maintained herbaceous vegetation - Areas with planted or maintained herbaceous vegetation dominant, generally forming at least 75% vegetative cover, with trees and shrubs generally less than 25% of the vegetative cover. Typical of this formation class is associated land uses such as city parks, roadsides, pastures, large lawns, and ball fields.

Planted or maintained grasses with sparse tree cover

23100 Planted or maintained grasses with sparse tree cover. Grass species are dominant, generally greater than 75% of the total vegetation cover. Grass species often are typical of lawns, parks, and roadsides. Trees generally contribute 10-25% vegetative cover. Shrubs may or may not be present.

23110 Upland Soils with planted or maintained grasses with sparse tree cover. Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling)

23111 Short grasses with sparse tree cover on upland soils. Planted or maintained grass species typical of "turf" (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing. These grasses are regularly maintained to heights below one foot.

23112 Long grasses with sparse tree cover on upland soils. Mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native and/or non-native, but non-native species dominate. Forbs may also be present. Mowing may occur, though infrequently, generally resulting in heights over one foot.

23120 Hydric Soils with planted or maintained grasses with sparse tree cover. Areas where surface water is present for brief or extended periods during the growing season. The water table may or may not be near the surface and may have been artificially lowered. Common on this classification are drained or partially drained wetlands, where vegetation has been converted to upland varieties. Hydrophytic vegetation may still be present.

23121 Short grasses with sparse tree cover on hydric soils. Planted or maintained grass species typical of "turf" (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing. These grasses are regularly maintained to heights below one foot.

23122 Long grasses with sparse tree cover on hydric soils. Mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native and/or non-native, but non-native species dominate. Forbs may also be present. Mowing may occur, though infrequently, generally resulting in heights over one foot.

Planted or maintained grasses

23200 Planted or maintained grasses. Grass species are dominant, generally greater than 75% of the total vegetation cover. Grass species often are typical of lawns, parks, and roadsides. Trees and shrubs each contribute <10% cover. Forbs may be present, though contribute less than 25% of the vegetative cover.

23210 Upland soils with planted or maintained grasses. Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling)

23211 Short grasses upland soils.+ Planted or maintained grass species typical of 'turf' (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing. These grasses are regularly maintained to heights below one foot.

23212 Long grasses upland soils. Mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native and/or non-native, but non-native species dominate. Forbs may also be present. Mowing may occur, though infrequently, generally resulting in heights over one foot.

23220 Hydric soils with planted or maintained grasses. Areas where surface water is present for brief or extended periods during the growing season. The water table may or may not be near the surface and may have been artificially lowered. Common of this classification are drained or partially drained wetlands, where vegetation has been converted to upland varieties. Hydrophytic vegetation may still be present.

23221 Short grasses hydric soils. Planted or maintained grass species typical of 'turf' (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing. These grasses are regularly maintained to heights below one foot.

23222 Long grasses hydric soils. Mixed planted and/or native grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native and/or non-native, but non-native species dominate. Forbs may also be present. Mowing may occur, though infrequently, generally resulting in heights over one foot.

Planted or maintained grasses and forbs

23300 Planted or maintained grasses and forbs. Grass and forb species are dominant, generally greater than 75% of the total vegetation cover. Grass species often are typical of lawns, parks, and roadsides. Forb species may be found in pure stands or as a grass-forb mixture, generally contributing greater than 25% vegetative cover. Trees and shrubs each contribute <10% cover.

23310 Upland Soils with planted or maintained grasses and forbs. Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling).

23311 Short grasses and forbs on upland soils. Planted or maintained grass and forb species typical of "turf" (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing. These grasses are regularly maintained to heights below one foot.

23312 Long grasses and forbs on upland soils. Mixed planted and/or native grass and forb species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native and/or non-native, but non-native species dominate. Mowing may occur, though infrequently, generally resulting in heights over one foot.

23320 Hydric soils with planted grasses and forbs. Areas where surface water is present for brief or extended periods during the growing season. The water table may or may not be near the surface and may have been artificially lowered. Common of this classification are drained or partially drained wetlands, where vegetation has been converted to upland varieties. Hydrophytic vegetation may still be present.

23321 Short grasses and forbs on hydric soils. Planted or maintained grass species typical of "turf" (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing. These grasses are regularly maintained to heights below one foot.

23322 Long grasses and forbs on hydric soils. Mixed planted and/or native grass and forb species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native and/or non-native, but non-native species dominate. Mowing may occur, though infrequently, generally resulting in heights over one foot.

Cultivated Herbaceous Vegetation

24000 Cultivated Herbaceous Vegetation. Areas with cultivated herbaceous vegetation dominant, generally forming at least 90% vegetative cover. Generally no trees or shrubs are present, unless forming narrow edge rows and small non- cultivated patches (less than one acre) within or adjacent to cultivated lands. Typical of this formation class is agricultural cropland.

Cultivated Row Cropland

24100 Cultivated Row Cropland. Areas used for the production of adapted crops for harvest. Vegetation is found in evenly spaced rows, generally with greater than 1' between rows.

Management usually consists of cultural treatments such as weed control, fertilization, irrigation, and reseeding.

24110 Upland Soils - cropland Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling)

24111 Beans (all types except soybeans)

24112 Corn

24113 Sorghum

24114 Soybeans

24115 Sugar Beets

24116 Potato

24117 Pumpkins

24118 Sunflowers

24119 Other Vegetable and truck crops

24120 Hydric soils - row cropland. Areas where surface water is present for brief or extended periods during the growing season. The water table may or may not be near the surface and may have been artificially lowered. Common of this classification are drained or partially drained wetlands, where vegetation has been converted to upland varieties. Hydrophytic vegetation may still be present.

24121 Beans (all types except soybeans) on hydric soils

24122 Corn on hydric soils

24123 Sorghum on hydric soils

24124 Soybeans on hydric soils

24125 Sugar Beets on hydric soils

24126 Potato on hydric soils

24127 Pumpkins on hydric soils

24128 Sunflowers on hydric soils

24129 Other Vegetable and truck crops on hydric soils

Close grown or solid seeded cropland

24200 Close grown or solid seeded cropland. Areas used for the production of adapted crops for harvest. Vegetation is found in closely spaced rows or by broadcast seeding. Management usually consists of cultural treatments such as weed control, fertilization, irrigation, and reseeding.

24210 Upland Soils - close grown cropland Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling)

24211 Wheat

24212 Oats

24213 Barley

24214 Sod

24215 Not planted

24216 Fallow

24217 Hayfield

24218 All other close grown cropland on upland soils

24220 Hydric soils - close grown cropland. Areas where surface water is present for brief or extended periods during the growing season. The water table may or may not be near the surface and may have been artificially lowered. Common of this classification are drained or partially drained wetlands, where vegetation has been converted to upland varieties. Hydrophytic vegetation may still be present.

24221 Wheat on hydric soils

24222 Oats on hydric soils

24223 Rice on hydric soils

24224 Barley on hydric soils

24225 Sod on hydric soils

24226 Not planted on hydric soils

24227 Fallow on hydric soils

24228 Hayfield on hydric soils

24229 All other close grown cropland on hydric soils

24230 Artificially flooded or saturated soils - close grown cropland. Substrate is saturated to the surface for extended periods during the growing season. Surface water may or may not be present. Periodic flooding may be controlled by pumps or siphons in combination with dikes or dams.

24231 Rice

Forests

30000 Forests - Trees with their crowns overlapping (generally forming 60 - 100% cover). Forests are defined primarily by the dominant species present, not by the current height of the cover. For example, if the area is composed by young elms and ashes that are only 15 feet tall, it would be classified as a forest or woodland depending on the density of the tree species. If the area is composed of willows and dogwoods also 15 feet tall, it would be classified as shrubland.

Coniferous forests

31000 Coniferous forest* - Coniferous forest - coniferous species generally contribute >75% of the total tree cover

Upland coniferous forests

31100 Upland coniferous forest* - Temperate conical/rounded-crowned or subpolar needle-leaved evergreen forest.

Mn DNR Natural Heritage description: Coniferous Forests are upland forest communities that occur mainly in the conifer-hardwood forest zone but also as small stands on the Paleozoic Plateau in southeastern Minnesota and in other parts of the deciduous forest-woodland zone. In general, Red Pine Forest and Jack Pine Forest occur on dry fire-prone sites, while forests composed of northern conifers (such as white spruce, balsam fir, white cedar, and black spruce) occur on mesic fire-protected sites. White Pine Forest occurs on sites ranging from wet to dry. In areas prone to fire or other disturbances, aspen and paper birch trees are common deciduous associates. In fire-protected areas, mesic northern hardwoods, such as sugar maple, basswood, and yellow birch, are common associates. The tall-shrub layer ranges from continuous to sparse, and varies locally in composition. The groundlayer is composed primarily of forest (rather than prairie) herbs, and often feathermosses. Herbs capable of growing in acid needle litter--such as clintonia (*Clintonia borealis*)), partridge-berry (*Mitchella repens*), and rose twisted-stalk (*Streptopus roseus*)--and herbs that commonly grow among feathermosses--such as wintergreen (*Gaultheria procumbens*), pyrola (*Pyrola* spp.), and cow-wheat (*Melampyrum linneare*)--are characteristic of Coniferous Forests.

The canopy trees of Coniferous Forests sometimes occur in mixtures, but often form relatively pure stands. The pines all require fire for stand regeneration, however the fire regime differs among the species (see below). White spruce and white cedar are sensitive to fire and occur in areas that rarely burn. Black spruce is adapted to fire as it has semi-serotinous cones. In extreme northern Minnesota trees growing in Black Spruce Bogs readily seed into adjacent burned uplands.

31110 Black spruce-feathermoss forest

Key-based definition: An upland forest with >75% conifers, of which <50% are pines, <50% white cedar, and >50% black spruce.

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* NVCS's Evergreen classification has been changed to coniferous, thus moving tamarack forests from the NVCS deciduous classification to a coniferous classification.

Mn DNR Natural Heritage description: Black Spruce-Feather Moss Forest occurs in the conifer-hardwood forest zone in northeastern Minnesota, primarily in the BWCAW and surrounding areas. It is the only upland forest community in which black spruces dominate the tree canopy. Jack pines are also sometimes present in the canopy, along with lesser amounts of balsam fir, quaking aspen, white spruce, paper birch, and other tree species. Although the understory in the community typically is open, clumps of black spruce and other tree saplings sometimes form a tall-shrub layer. The low-shrub layer and herb layer are depauperate and usually dominated by ericaceous species, although bunchberry (*Cornus canadensis*) is abundant on some sites. The moss layer is conspicuous, continuous, and dominated by feathermosses (e.g., *Pleurozium schreberi*). Black Spruce - Feathermoss Forest sometimes intergrades with Jack Pine Forest (Jack Pine - Black Spruce Subtype).

31120 Jack pine forest

Key-based definition: An upland forest with >75% conifers, of which >70% are jack pines.

Mn DNR Natural Heritage description: Jack Pine Forest occurs on dry to dry-mesic, fire-prone sites in the conifer-hardwood forest zone. On the dry sites, jack pine trees usually form almost pure stands. On the dry-mesic sites, oaks, balsam firs, black spruces, and red pines may be present with the jack pines as minor canopy co-dominants. The composition of the understory in the community is highly variable, with regional floristic differences between stands on the Canadian Shield of northeastern Minnesota and those on outwash plains in central Minnesota, and local differences (correlating with differences in soil organic matter) among stands on the outwash plains. Descriptions of the understory vegetation appear below, in descriptions of the subtypes of the community.

Jack Pine Forest is dependent on fire for regeneration. On the Canadian Shield, jack pines are of the closed-cone (serotinous) ecotype. Therefore the regeneration of the community usually occurs following intense forest fires that open the cones and burn away the forest litter, exposing mineral seedbeds. These stands are even aged, usually originating from a single hot fire. On outwash plains southwest of the Canadian Shield, jack pines are of the open-cone ecotype, with (at least some) cones opening up eventually with age or during hot weather. In these stands, most pine regeneration still occurs immediately following fires. If pine regeneration is poor following a fire, aspens and birches may seed into a site for several years along with jack pines, but eventually are supplanted by the jack pines. Stands of jack pines in the outwash plains often have cohorts of seedling- and sapling-sized jack pines that presumably are the offspring of parent trees that have survived minor disturbances (such as ground fires).

There are three recognized sections of Jack Pine Forest, the Central Section, the Northeast Section, and the Northwest Section.

31121 Jack pine forest jack pine-fir subtype

See description of 31120 Jack pine forest

Mn DNR Natural Heritage description: The Northeast Section, which occurs primarily on the Canadian Shield, has three subtypes. The Jack Pine-Fir Subtype occurs on relatively deep soils, often on north-facing slopes. It has saplings of balsam fir, paper birch, or black spruce in the

understory, a well-developed shrub layer composed of beaked hazel, mountain maple, fly honeysuckle, and round-leaved dogwood, and a groundlayer of dry-mesic forest herbs (especially large-leaved aster (*Aster macrophyllus*)) and grasses.

31122 Jack pine forest hazel subtype

See description of 31120 Jack pine forest

Mn DNR Natural Heritage description: The Central Outwash Plain Section has two recognized subtypes. The most common is the Hazel Subtype, which has red pines and paper birches as common canopy or understory associates, and abundant tall shrubs including beaked hazel, juneberry, and downy arrowwood. The groundlayer is composed of forest species. Soils usually have greater than 2.5% organic matter. These stands grade into Red Pine forest.

31123 Jack pine forest jack pine-oak subtype

See description of 31120 Jack pine forest

Mn DNR Natural Heritage description: The Northeast Section, which occurs primarily on the Canadian Shield, has three subtypes. The Jack Pine-Oak Subtype occurs on rocky ridges. It is strongly dominated by jack pine, with an understory of northern red oak and red maple saplings and a groundlayer of drought-resistant forbs and grasses. This subtype often grades into Northern Coniferous Woodland.

31124 Jack pine forest jack pine-black spruce subtype

See description of 31120 Jack pine forest

Mn DNR Natural Heritage description: The Northeast Section, which occurs primarily on the Canadian Shield, has three subtypes. The Jack Pine-Black Spruce Subtype is dominated by jack pine, with black spruce trees, saplings, and seedlings present. It has a low-shrub layer of bush honeysuckle and blueberry, few forbs, and a cover of feathermosses. It often grades into Black Spruce-Feathermoss Forest.

31125 Jack pine forest blueberry subtype

See description of 31120 Jack pine forest

Mn DNR Natural Heritage description: The Central Outwash Plain Section has two recognized subtypes. The less common subtype, the Blueberry Subtype, consists of nearly pure stands of jack pines with very few, if any, tall shrubs. The groundlayer is composed of feathermosses, ericaceous half-shrubs (especially blueberries), and prairie forbs and grasses. These open stands usually occur on soils with less than 2.5% organic matter. Structurally, they resemble Black Spruce-Feathermoss Forests and the Jack Pine-Black Spruce Subtype of the Northeast Section.

31130 Red pine forest

Key-based definition: An upland forest with >75% conifers, of which >50% are pines. Red pines and jack pines together comprise >50% of the pines, and jack pines are <70%.

Mn DNR Natural Heritage description: Red Pine Forest occurs in the conifer-hardwood forest zone on landforms where fires are common. These include areas of thin soil over bedrock, and coarse-textured ice-contact features such as ice-contact moraines, tunnel valleys, and kames. Red pine trees dominate the canopy, which also contains lesser amounts of jack pines on dry sites and white pines, white spruces, or balsam firs on mesic sites. Hardwoods, including paper birches, northern red oaks, red maples, and quaking aspens, sometimes form a subcanopy beneath the pine canopy. The tall-shrub layer is usually patchy, and is composed mostly of beaked hazel and juneberry. The groundlayer is composed of forest herbs and feathermosses. A continuous (>75%) cover of mosses (with *Pleurozium schreberi* being dominant) is common in shrub canopy openings.

Red Pine Forest is a fire-maintained community. Reconstructions of the fire regime using fire scars on red pine trees suggest that a combination of ground fires every 20 or so years and severe crown fires every 100 to 150 years were characteristic in the community before logging, settlement, and fire suppression. The ground fires kept the understory relatively open and exposed mineral soils for seed germination and continued regeneration of red pine. In the absence of fire, many of Minnesota's native red pine stands have become much brushier or are beginning to succeed to forests of mesic hardwoods and white pine. Except for some areas in the BWCAW, the Chippewa National Forest, and Itasca State Park, most of the native red pine groves have been converted by logging to other forest community types (especially Mixed Pine-Hardwood Forest) composed of the minor canopy species usually present in Red Pine Forests.

Floristic differences between stands of Red Pine Forest on the Canadian Shield and those on ice-contact features to the southwest may result in identification of Red Pine Forest subtypes. On dry-mesic sites, Red Pine Forest grades into Jack Pine Forest or Mixed Pine-Hardwood Forest. On mesic sites and sites with less frequent fire, Red Pine Forest grades into or succeeds to White Pine Forest, Boreal Hardwood-Coniferous Forest, or Northern Hardwood-Coniferous Forest.

31140 White pine forest

Key-based definition: An upland forest with >75% conifers, of which >50% are pines, and >50% of those are white pines.

Mn DNR Natural Heritage description: White Pine Forest is a dry to dry-mesic coniferous forest present mainly in the conifer-hardwood forest zone and occasionally in the deciduous forest-woodland zone. White pine trees dominate the canopy. They may be mixed with red pines and hardwoods, especially paper birches. Stands that originate following fire are often composed almost entirely of even-aged white pines. In the absence of periodic ground fires, hardwoods and other conifers increase in and dominate the understory. Balsam fir, white spruce, and white cedar are important in the understory in northeastern Minnesota, while southward sugar maple, northern red oak, red maple, and ironwood are important understory species. Stands of White Pine Forest usually have a moderately developed tall-shrub layer composed of bush honeysuckle, beaked hazel, mountain maple, round-leaved dogwood, and downy arrowwood. Prevalent groundlayer herbs include large-leaved aster (*Aster macrophyllus*), Canada mayflower

(*Maianthemum canadense*), wild sarsaparilla (*Aralia nudicaulis*), bunchberry (*Cornus canadensis*), and common strawberry (*Fragaria virginiana*).

White Pine Forest occurs on moister sites--that typically burned less intensely in the past--than Red Pine Forest. White pine grows best on moderately well-drained deep loams and sandy loams. In northern Minnesota the best-developed White Pine Forests occur on mesic sites along lake margins and lower slopes. In north-central Minnesota, White Pine Forest occurs mostly on glacial till, while mixtures of white pine and red pine occur frequently on rugged moraines.

White Pine Forest is an early successional community, but is long lasting because white pine may live for several hundred years and can replace itself by gap-phase reproduction. White Pine Forest is a major old-growth forest type in Minnesota, although recruitment of white pine into the tree canopy is greatly reduced in parts of Minnesota (especially the northeast) where conditions are conducive to infestation by white pine blister rust. In northern Minnesota, White Pine Forest grades into Red Pine Forest on drier sites or where there is high fire frequency.

There are three recognized sections of White Pine Forest in Minnesota (Southeast, Central, and Northeast.

31150 Upland white cedar forest

Key-based definition: An upland forest or woodland in northeastern Minnesota with >75% conifers, <50% pines, and >50% white cedars OR in southeastern Minnesota with >20% white cedars.

Mn DNR Natural Heritage description: Upland White Cedar Forest is a mesic to wet-mesic coniferous forest of upland sites. It occurs almost exclusively in the conifer-hardwood forest zone (there are two known outlying stands in the Mississippi River Valley in extreme southeastern Minnesota). Within the conifer-hardwood forest zone, the community is most common in northeastern Minnesota, especially near the north shore of Lake Superior.

The canopy of Upland White Cedar Forest is dominated by white cedar, which may occur in extensive, nearly pure stands, in mixtures with other canopy species, or as small groves in a matrix of brushy forest. The most common subdominant canopy species are balsam fir, yellow birch, paper birch, white spruce, and black spruce. Older stands have many fallen logs and leaning trees.

Deciduous shrubs (especially mountain maple, with smaller amounts of speckled alder and beaked hazel) and conifer seedlings and saplings (spruce and especially balsam fir) dominate the understory of the community. The groundlayer contains a variety of species characteristic of mesic to wet-mesic sites; starflower (*Trientalis borealis*), wild sarsaparilla (*Aralia nudicaulis*), clintonia (*Clintonia borealis*), oak fern (*Gymnocarpium dryopteris*), large-leaved aster (*Aster macrophyllus*), bunchberry (*Cornus canadensis*), and dwarf blackberry (*Rubus pubescens*) are common. Three-flowered bedstraw (*Galium triflorum*) and naked bishop's-cap (*Mitella nuda*) are modal species in the community. In general, the understory and groundlayer of Upland White Cedar Forest are rich in species in stands on level, wet-mesic sites and less diverse on drier slopes.

Many of the existing Upland White Cedar Forests are over 100 years old and forests on some sites are well over 200 years old. These old-growth forests occur in fire-protected areas, typically on mineral soils. Upland White Cedar Forest occurs on diverse topographies, from very steep, well-drained slopes to gentle, wet-mesic slopes that grade into depressions containing White Cedar Swamp or other lowland types. Along the north shore of Lake Superior, Upland

White Cedar Forest occurs down-slope from Northern Hardwood Forest and upslope from several lowland conifer forest types. Soils in Upland White Cedar Forests tend to have relatively high levels of calcium. It appears that many of the existing stands of the community originated following catastrophic fires on sites where fire is usually rare. Browsing by deer can have a significant impact on white cedar reproduction; in areas with moderate to high deer populations, few white cedars reach the sapling size class or grow into the canopy. Where white cedar reproduction is poor, some occurrences of the community appear to be succeeding to Northern Hardwood Forest dominated by yellow birch, while others may succeed to Spruce-Fir Forest.

There are three recognized geographic sections of Upland White Cedar Forest, the Northern Section, the Lake Superior Section, and the Southeast Section. Mesic and Wet-Mesic subtypes occur in the Northern and Lake Superior sections.

31151 Upland white cedar forest wet-mesic subtype

See description of 31150 Upland white cedar forest

31152 Upland white cedar forest mesic subtype

See description of 31150 Upland white cedar forest

31160 Spruce-fir forest

Key-based definition: An upland forest with >75% conifers, <50% red cedar, <50% pines, <50% white cedar, and <50% black spruce.

Mn DNR Natural Heritage description: Spruce-Fir Forest is a mesic coniferous forest of the northern portion of the conifer-hardwood forest zone. The canopy is dominated by white spruce or balsam fir, or a combination of these species with black spruce. White spruce and balsam fir are shade-tolerant, late-successional species, but they often occur on landscapes where fire frequencies are high. White spruce and, especially, balsam fir are susceptible to periodic outbreaks of spruce budworm. Structurally, the understory of Spruce-Fir Forest is quite variable.

Spruce-Fir Forest grades into Boreal Hardwood-Conifer Forest where hardwoods increase in abundance, and into Upland White Cedar Forest on sites with richer, moister soils. Old-growth Spruce-Fir Forest may develop on sites protected from catastrophic disturbance. Where deer populations are low, some stands of Spruce-Fir Forest eventually succeed to Upland White Cedar Forest.

31161 Spruce-fir forest white spruce-balsam fir subtype

See description of 31160 Spruce-fir forest

Mn DNR Natural Heritage description: There are two recognized subtypes of Spruce-Fir Forest, a Fir-Birch subtype, and a White Spruce-Balsam Fir subtype. These subtypes were delimited primarily from plant associations described in the scientific literature. The White Spruce-Balsam Fir Subtype has a canopy dominated by white spruce, with lesser amounts of balsam fir. The tall-shrub layer in this subtype is moderately dense, and is composed of balsam fir saplings,

mountain maples, and beaked hazels. Some stands may have a poorly developed shrub layer, and a groundlayer of feather mosses.

31162 Spruce-fir forest fir-birch subtype

See description of 31160 Spruce-fir forest

Mn DNR Natural Heritage description: There are two recognized subtypes of Spruce-Fir Forest, a Fir-Birch subtype, and a White Spruce-Balsam Fir subtype. These subtypes were delimited primarily from plant associations described in the scientific literature. The Fir-Birch Subtype is dominated by balsam fir and paper birch, and often contains black spruce and white cedar, and small amounts of white spruce, quaking aspen, white pine and mountain ash.

Saturated coniferous forests

31200 Saturated coniferous forest* - Saturated temperate or subpolar needle-leaved evergreen forest. The substrate is saturated to the surface for extended periods during the growing season, but water is seldom present.

31210 Tamarack swamp

Key-based definition: Saturated vegetation with >30% tree cover on <0.5m of peat with >50% tamaracks (>3m tall).

Mn DNR Natural Heritage description: Tamarack Swamp is present throughout the deciduous forest-woodland and conifer-hardwood forest zones. It occurs on minerotrophic muck and shallow peat along rivers and in shallow lake basins, and on nutrient-poor, mildly-acidic to acidic peat in ice-block basins or large peatland systems. Tamarack is either the only canopy species or is mixed with black spruce, paper birch, yellow birch, white pine, black ash, American elm, or red maple. In northern Minnesota, tamarack may grow in association with alder, red-osier dogwood, willow species, and mountain fly honeysuckle. The sedge *Carex stricta* is common under relatively open stands of tamarack; cyperus-like sedge (*Carex pseudo-cyperus*) and black chokeberry (*Aronia melanocarpa*) are often present on tear-drop islands in large peatland complexes.

In the absence of catastrophic disturbances, Tamarack Swamps may succeed Shrub Swamps, Rich Fens, Poor Fens, and possibly Hardwood Swamp Forests. Fire, flooding, and insect infestations (e.g., larch sawfly) often reverse this succession. Windthrow, disease, and selective cutting of tamaracks in dense stands help maintain tamarack cover by creating gaps in the canopy in which the very shade-intolerant tamarack seedlings and saplings are able to grow.

Tamarack Swamp differs from Mixed Hardwood Swamp in part by having at least 50% of its canopy cover formed by tamarack. This may not be easy to determine (either from aerial photographs or in the field) because tamaracks are often slender and conical so may be numerous yet still contribute little to the total tree canopy cover. The same problem exists in Shrub Swamps where tamaracks occur as "spires" above the shrub layer. Tamarack Swamp differs from Bog communities in the pH of its surface waters and by having minerotrophic species that do not occur in true bogs [such as *Betula pumila, Carex leptalea, C. paupercula, C. tenuiflora, Lysimachia thrysiflora, Potentilla palustris*, *Salix pedicellaris,* and *Thuja occidentalis*].

31211 Tamarack swamp seepage subtype

See description of 31210 Tamarack swamp

Mn DNR Natural Heritage description: The Seepage Subtype is local and rare. At present, it is documented only along the St. Croix River and along the Sauk River in Stearns County, where it occurs in groundwater seepage areas at the bases of river terrace slopes. The canopy of the seepage subtype is mixed, containing yellow birches, basswoods, and black ashes in addition to tamaracks.

31212 Tamarack swamp minerotrophic subtype

See description of 31210 Tamarack swamp

Mn DNR Natural Heritage description: In minerotrophic wetlands in the deciduous forest-woodland zone, the understory of the community commonly contains speckled alder, winterberry, blue-joint (*Calamagrostis canadensis*), broad-leaved cattail (*Typha latifolia*), and jewel-weed (*Impatiens capensis*).

31213 Tamarack swamp sphagnum subtype

See description of 31210 Tamarack swamp

MnDNR Natural Heritage description: On less minerotrophic sites in the deciduous forest-woodland and conifer-hardwood forest zones, Tamarack Swamp typically has a continuous hummocky mat of sphagnum mosses below such fen associates as bog birch, leatherleaf and other ericaceous species, cinnamon fern (*Osmunda cinnamomea*), wiregrass sedge (*Carex lasiocarpa*), and prairie sedge (*Carex prairea*).

31220 White cedar swamp

Key-based definition: Saturated vegetation with >30% tree cover, of which >50% conifers, of which >50% are white cedar.

Mn DNR Natural Heritage description: White Cedar Swamp occurs primarily in the conifer-hardwood forest zone, with scattered stands in the deciduous forest-woodland zone. White cedars dominate the tree canopy, either forming pure, dense, even-aged stands or mixed, uneven-aged stands with various amounts of black spruces, balsam firs, white spruces, balsam poplars, or black ashes. The shrub layer is composed of speckled alder and associated species. Shrub cover ranges from sparse to dense, depending on the density of the tree canopy. There is usually a layer of mosses in the understory, although mosses tend to be sparse in densely shaded stands.

White Cedar Swamp occurs on wet mineral soils or well-decomposed peat soils on level to gently sloping (<3%) terrain along the margins of peatlands, along drainage courses, and in shallow depressions. White cedar is a fire-sensitive species and consequently tends to grow in moist habitats where the vegetation and litter is rarely dry enough to burn, or in areas protected from fire by topographic breaks. Ecologically, white cedar acts both as a pioneer species,

colonizing recently disturbed sites, and as a late-successional species, regenerating in older, closed stands by layering. White cedar is a long-lived tree and therefore White Cedar Swamp forms mature and old-growth stands in the absence of catastrophic disturbance.

31221 White cedar swamp seepage subtype

See description of 31220 White cedar swamp

Mn DNR Natural Heritage description: There is one subtype of White Cedar Swamp, a Seepage Subtype, which occurs in groundwater seepage areas. Following the completion of studies of old-growth cedar stands, additional subtypes may be defined by nutrient levels, as some stands are very poor in nutrients and have small, very slow-growing cedar trees in comparison with other stands.

31230 Black spruce swamp

Key-based definition: Saturated vegetation with >30% tree cover, of which >50% are black spruces, where feathermosses predominate over sphagnum mosses and minerotrophic species contribute significant cover.

Mn DNR Natural Heritage description: Black Spruce Swamp occurs primarily in the conifer-hardwood forest zone, with scattered outlying stands in the deciduous forest-woodland zone. The canopy is dominated by black spruces, often growing in pure stands or in association with tamaracks or white cedars. The shrub layer, if present, contains speckled alders. The groundlayer is dominated by sedges (*Carex trisperma*, *C. leptalea*), cotton-grasses (*Eriophorum* spp.), or ericaceous shrubs (labrador tea, bog-rosemary, swamp laurel, creeping snowberry). The moss layer is usually continuous, with feathermosses predominant, although they may be mixed with minerotrophic sphagnum species.

Black Spruce Swamp occurs on shallow to deep, moderately acidic peat. Nutrient levels in the community vary with the depth and degree of decomposition of the peat. Under certain conditions, Black Spruce Swamps will succeed to Black Spruce Bogs, as the surface waters in the community become acidified and there is an increase in the abundance of peat-forming sphagnum mosses. Black Spruce Swamp differs from Black Spruce Bog by containing species that grow in minerotrophic environments [such as *Betula pumila, Carex leptalea, C. paupercula, C. tenuiflora, Lysimachia thrysiflora, Potentilla palustris*, *Salix pedicellaris,* and *Thuja occidentalis*]. Black spruce is long-lived in swamps or bogs, and may form mature and old-growth stands.

There are no subtypes of Black Spruce Swamp in this classification. The following subtypes appear in the literature on boreal forests: black spruce-sphagnum, black spruce-alder, black spruce-herb, black spruce-sedge, black spruce-half shrub, and black spruce-seepage.

31240 Black spruce bog

Key-based definition: Bog with >30% tree cover, mostly black spruce, where shade tolerant species are common in the groundlayer.

Mn DNR Natural Heritage description: Black Spruce Bog occurs mainly in the conifer-hardwood forest zone, and occasionally in the deciduous forest-woodland zone. Stunted black spruce trees (<10m tall) dominate the canopy, which may also contain scattered tamaracks. Tree canopy cover is variable but usually greater than 30%. The groundlayer is dominated by ericaceous shrubs (Labrador tea, leatherleaf, swamp laurel, bog-rosemary), the sedge *Carex trisperma*, or the cotton-grass *Eriophorum spissum*. There is a continuous carpet of sphagnum mosses (usually *Sphagnum fuscum* and *S. angustifolium* (recurvum aggregate)), which form hummocks and hollows. Feather mosses (*Pleurozium schreberi*), *Dicranum undulatum*, and *Polytrichum strictum* are abundant at the bases of trees. Plant species that cause this type to differ from Open Sphagnum Bog include lingonberry (*Vaccinium vitis-idaea*), creeping snowberry (*Gaultheria hispidula*), three-leaved-false Solomon's-seal (*Smilacina trifolia*) and the sedge *Carex trisperma*.

Black Spruce Bog is best developed on drier sites--such as the crests and upper slopes of raised bogs--within bog complexes. In these complexes, vigorously growing acidophilus sphagnum mosses prevent most tree reproduction except that of black spruce and tamarack, which can reproduce by layering. Soils in Black Spruce Bogs are composed of deep, highly fibric peat.

Black Spruce Bog commonly grades into Black Spruce Swamp, from which it succeeds, but is distinguishable because it lacks the minerotrophic species present in Black Spruce Swamp [such as *Betula pumila, Carex leptalea, C. paupercula, C. tenuiflora, Lysimachia thrysiflora, Potentilla palustris*, *Salix pedicellaris,* and *Thuja occidentalis*]. Open Sphagnum Bog can develop from Black Spruce Bog when water is channeled onto treed bog slopes and stunts or kills the trees. Although the amount of canopy tree cover may overlap between Black Spruce Bog and Open Sphagnum Bog, the two types can be separated by the abundance of shade-tolerant versus shade-intolerant species present. Distinguishing between these two types is difficult where the tree canopy in a Black Spruce Bog has recently been destroyed by fire or mistletoe.

31241 Black spruce bog intermediate subtype

See description of 31240 Black spruce bog

31242 Black spruce bog raised subtype

See description of 31240 Black spruce bog

Mn DNR Natural Heritage description: The Raised Subtype occurs only on sites that are genuinely ombrotrophic (rain nourished) with pH <4.2 and $[Ca^{2+}]$ 2.2 mg/l, and it lacks minerotrophic species.

Deciduous forests

32000 Deciduous forest - deciduous tree species generally contribute >75% of the total tree cover

Upland deciduous forests

32100 Upland deciduous forest - Cold-deciduous forest (e.g., broadleaf forests of the Midwest) (Lowland or submontane in NVCS nomenclature).

Mn DNR Natural Heritage description: Deciduous Forests occur primarily in the deciduous forest-woodland zone; they are less common in the prairie zone and the conifer-hardwood forest zone. On dry sites, the most common canopy dominants of Deciduous Forests are oak, aspen, and birch trees. Sugar maple, basswood, elm, and ash trees are common dominants on moist sites. Pines, especially white pine, sometimes form a minor part of the forest canopy. Where the forest canopy is broken or interrupted (typically in oak-dominated forests) there is usually a dense layer of tall shrubs, including hazelnuts, dogwoods, prickly ashes, and cherries. Beneath the denser canopies formed by mesic tree species such as sugar maple, the shrub layer is sparse or absent.

The canopy tree species of Deciduous Forests occur in combinations determined primarily by environmental features (including soil texture, parent material, presence of hardpans and firebreaks, depth to the water table, topography, aspect, and local climate) that affect soil moisture and the local fire regime. These features produce a gradient of Deciduous Forest types from dry, fire-prone forests composed of fire-adapted species, to mesic forests composed of fire-sensitive species.

Many of the dry Deciduous Forests in the deciduous forest-woodland and prairie zones appear to have succeeded from deciduous brushland and savanna in the past 100 to 125 years following widespread forest fragmentation and fire suppression. Mesic Deciduous Forests in these zones occur in areas protected from fire, especially areas of rough topography and along bodies of water. In the conifer-hardwood forest zone, mesic Deciduous Forests occur on sites with impeded drainage (having impermeable banding or textural pans in the soils) and in areas of locally high precipitation or humidity, such as along the shore of Lake Superior. The dry deciduous forests of the conifer-hardwood zone, especially Aspen, Aspen-Birch, and Paper Birch forests, occur on fire-prone sites and are considered early successional communities.

32110 Oak forest^{+}

Key-based definition: An upland deciduous forest with >30% oaks, but NOT cases where open grown oaks cover 10-70% and are surrounded by younger trees, or where oaks are <60% and sugar maples, basswoods, and yellow birches comprise all the rest.

Mn DNR Natural Heritage description: Oak Forest is widespread in Minnesota. It is most common on dry to dry-mesic sites in the deciduous forest-woodland zone but also occurs occasionally in the southern and western parts of the conifer-hardwood zone, and in stream valleys in the prairie zone.

At least 30% of the tree canopy in an Oak Forest is made up of oak trees. Most often aspen, paper birch, or black cherry trees make up the remainder of the canopy. The actual composition of the community, however, varies considerably in response to variation in soil moisture, soil type, fire history, and climate. The driest stands of Oak Forest are dominated by northern pin oaks and white oaks, with black oaks, shagbark hickories, and sometimes bur oaks important in southeastern Minnesota. These stands occur on nutrient-poor, well-drained sandy soils on outwash plains, river terraces, and beach ridges. They have relatively open canopies, with between 70% and 80% cover. The canopy height is usually between 13 and 17 meters.

Because of the open canopy, the shrub layer is often very dense. American hazel dominates the shrub layer, which also often contains gray-bark dogwood, blueberries, and blackberries. Some of the more common groundlayer species are the sedge (*Carex pensylvanica*), wild geranium (*Geranium maculatum*), Virginia creeper (*Parthenocissus inserta*), wild sarsaparilla (*Aralia nudicaulis*), and hog-peanut (*Amphicarpa bracteata*).

Commonly, at least some of the oak trees in the dry stands have multiple stems and thick, spreading lower branches, indicating that these trees grew up in a disturbed and more open setting. Minnesota public land survey records indicate, in fact, that many of these dry stands were oak savanna or oak woodland before European settlement and with fire suppression have succeeded to forest. Oak regeneration is rare in these stands now, as the oak species reproduce poorly under forest canopies. In the absence of fire, relatively mesic or fire-sensitive species such as bitternut hickory, basswood, and red maple, are increasing in abundance in the community.

Northern red oaks, white oaks, or bur oaks dominate the more mesic stands of Oak Forest. These stands occur on sites that had fewer severe fires before European settlement than the sites on which dry Mixed Oak Forest occurs. These mesic stands most likely were always forest, rather than woodland or savanna. They have tall (> 20 meters), straight, single-stemmed trees that lack spreading lower branches. Commonly, mesic fire-sensitive tree species are present with the oaks in these stands, especially in the understory. These species include basswood, green ash, bitternut hickory, big-toothed aspen, and butternut.

The shrub layer in mesic stands is sparser than in dry stands and, correspondingly, the forb layer is denser and more diverse and there are more graminoid species. Like the drier stands, however, there is little oak regeneration, and most mesic Oak Forests appear to be succeeding to Maple-Basswood forest. Heavy selective logging of the oaks in mesic stands may accelerate this trend, producing young stands of Maple-Basswood Forest. The mesic stands often grade into drier stands of Maple-Basswood Forest, but differ from them by having a somewhat denser shrub layer and the herbs woodrush (*Luzula acuminata*) and pointed-leaved tick-trefoil (*Desmodium glutinosum*) in their understory.

Another variant of Oak Forest occurs in northeastern Minnesota, principally on ridgetops and upper slopes, where the forest intermingles with bedrock outcrops. These forests contain northern red oak, bur oak, pin oak, and red maple. They originated mainly following the logging and burning of stands of Red Pine Forest in the 1800s and early 1900s.

In general, most existing stands of Oak Forest have been disturbed by grazing or selective cutting, or have been fragmented by development. Natural stands of mesic Mixed Oak Forest are rare. Drier stands are more common, in part because relative to the mesic forests they occur on sites with soils less suitable for cultivation. Additionally, dry Oak Forests may have increased in extent somewhat following fire suppression, succeeding from oak savanna and woodland. Disturbed stands of oak forest commonly have dense subcanopies of prickly ash, or of the exotic species common buckthorn and Tartarian honeysuckle, which have also now invaded many undisturbed stands. Disturbance through grazing may also be partly responsible for the lack of regeneration in Oak Forests, especially in stands with heavy soils that compact readily with trampling.

Oak Forest is divided geographically into Southeast, Big Woods, Central, Northwest, and Northeast Sections. There are also three recognized subtypes (Dry, Mesic, and Red Maple), corresponding to the floristic and structural variation in the community described above.

32111 Oak forest red maple subtype

See description of 32110 Oak Forest

Mn DNR Natural Heritage description: Another variant of Oak Forest occurs in northeastern Minnesota, principally on ridgetops and upper slopes, where the forest intermingles with bedrock outcrops. These forests contain northern red oak, bur oak, pin oak, and red maple. They originated mainly following the logging and burning of stands of Red Pine Forest in the 1800s and early 1900s.

32112 Oak forest mesic subtype

See description of 32110 Oak Forest

Mn DNR Natural Heritage description: Northern red oaks, white oaks, or bur oaks dominate the more mesic stands of Oak Forest. These stands occur on sites that had fewer severe fires before European settlement than the sites on which dry Mixed Oak Forest occurs. These mesic stands most likely were always forest, rather than woodland or savanna. They have tall (> 20 meters), straight, single-stemmed trees that lack spreading lower branches. Commonly, mesic fire-sensitive tree species are present with the oaks in these stands, especially in the understory. These species include basswood, green ash, bitternut hickory, big-toothed aspen, and butternut.

The shrub layer in mesic stands is sparser than in dry stands and, correspondingly, the forb layer is denser and more diverse and there are more graminoid species. Like the drier stands, however, there is little oak regeneration, and most mesic Oak Forests appear to be succeeding to Maple-Basswood forest. Heavy selective logging of the oaks in mesic stands may accelerate this trend, producing young stands of Maple-Basswood Forest. The mesic stands often grade into drier stands of Maple-Basswood Forest, but differ from them by having a somewhat denser shrub layer and the herbs woodrush (*Luzula acuminata*) and pointed-leaved tick-trefoil (*Desmodium glutinosum*) in their understory.

Natural stands of mesic Mixed Oak Forest are rare. Drier stands are more common, in part because relative to the mesic forests they occur on sites with soils less suitable for cultivation.

32113 Oak forest dry subtype

See description of 32110 Oak Forest

Mn DNR Natural Heritage description: The driest stands of Oak Forest are dominated by northern pin oaks and white oaks, with black oaks, shagbark hickories, and sometimes bur oaks important in southeastern Minnesota. These stands occur on nutrient-poor, well-drained sandy soils on outwash plains, river terraces, and beach ridges. They have relatively open canopies, with between 70% and 80% cover. The canopy height is usually between 13 and 17 meters.

Because of the open canopy, the shrub layer is often very dense. American hazel dominates the shrub layer, which also often contains gray-bark dogwood, blueberries, and blackberries. Some of the more common groundlayer species are the sedge (*Carex pensylvanica*), wild geranium (*Geranium maculatum*), Virginia creeper (*Parthenocissus inserta*), wild sarsaparilla (*Aralia nudicaulis*), and hog-peanut (*Amphicarpa bracteata*).

Commonly, at least some of the oak trees in the dry stands have multiple stems and thick, spreading lower branches, indicating that these trees grew up in a disturbed and more open setting. Minnesota public land survey records indicate, in fact, that many of these dry stands were oak savanna or oak woodland before European settlement and with fire suppression have succeeded to forest. Oak regeneration is rare in these stands now, as the oak species reproduce poorly under forest canopies. In the absence of fire, relatively mesic or fire-sensitive species such as bitternut hickory, basswood, and red maple, are increasing in abundance in the community.

Dry Oak Forests may have increased in extent somewhat following fire suppression, succeeding from oak savanna and woodland. Disturbed stands of oak forest commonly have dense subcanopies of prickly ash, or of the exotic species common buckthorn and Tartarian honeysuckle, which have also now invaded many undisturbed stands.

32120 Northern hardwood forest

Key-based definition: An upland deciduous forest where sugar maples, basswoods, and yellow birches dominate the canopy or where they dominate along with oaks (with <60% oak cover). Conifer trees have up to 25% cover, club mosses are common, and spring ephemerals are relatively rare (compared to Maple-Basswood Forest).

Mn DNR Natural Heritage description: Northern Hardwood Forest is a mesic forest community present mainly in the conifer-hardwood forest zone, with small stands on the Paleozoic Plateau in southeastern Minnesota. The canopy is dominated by dry-mesic to mesic hardwoods, especially sugar maple, basswood, and yellow birch. Northern red oak may be co-dominant in the canopy on drier sites; black ash and American elm may be co-dominant on wetter sites. Northern Hardwood Forest shares many of its tree species with Maple-Basswood Forest but differs from Maple-Basswood Forest by having a significant conifer component, including white pine (now present most often as stumps), balsam fir, white spruce, and white cedar.

The understory is multilayered and patchy. It is composed of shrubs and seedlings and saplings of the canopy trees. Some of the shrub species commonly present are fly honeysuckle, beaked hazel, leatherwood, mountain maple, chokecherry, and red-berried elder. The height and abundance of these shrubs vary with the degree of shading from canopy trees. In general, the shrubs are tallest beneath tree-fall canopy gaps.

The groundlayer is composed of a combination of northern and southern mesic herb species (i.e., those with distributions either mainly north or mainly south of the forest tension zone). The relatively few spring ephemerals present and the occurrence of club mosses in the groundlayer help differentiate Northern Hardwood Forest from Maple-Basswood Forest.

Northern Hardwood Forest occurs on loamy or sandy loam soils on fire-protected sites, especially on the rugged Sugar Hills Moraine and in the Lake Superior Highlands. In north-central Minnesota, Northern Hardwood Forest often occurs on sites with fine-textured subsurface layers that prevent or slow the downward movement of water and nutrients. Northern Hardwood Forest is a late-successional community with old-growth potential. Regeneration occurs primarily by gap-phase replacement so stands usually are uneven aged.

The Northern Hardwood Forest type includes most stands classified as Northern Hardwood-Conifer Forest in the 1983 community classification. Other stands previously classified as Northern Hardwood-Conifer Forest remain as Northern Hardwood-Conifer Forest in this classification or are included in the Red Maple Subtype of Oak Forest. There are two

sections of Northern Hardwood Forest in Minnesota, a Northern Section, occurring mainly north of the tension zone, and a Southeast Section, which occurs in southeastern Minnesota on steep north-facing slopes and bluffs. Northern Hardwood Forests in the Southeast Section contain such characteristically northern species as balsam fir, yellow birch, and American yew and often are associated with Moist Cliff communities.

32130 Paper birch forest

Key-based definition: An upland deciduous forest with >60% paper birches and <10% aspen or balsam poplar.

Mn DNR Natural Heritage description: Paper Birch Forest occurs primarily in the conifer-hardwood zone, especially in northeastern Minnesota, with small stands present also on shaded north-facing slopes in the deciduous forest-woodland zone. The canopy of Paper Birch Forests is strongly dominated by paper birch trees. The tall-shrub layer typically contains beaked hazel and mountain maple. Seedlings and saplings of mid- and late-successional tree species are often present in the understory; balsam fir is an especially common understory species in northeastern Minnesota. Little data are available on the groundlayer composition of the community, especially in regard to how it may differ from that of the closely related Aspen-Birch Forest community. However, blue-bead lily (*Clintonia borealis*), stiff clubmoss (*Lycopodium annotinum*), and mosses appear to be more common in Paper Birch Forests, while large-leaved aster (*Aster macrophyllus*) is more common in Aspen-Birch Forests.

Paper Birch Forest usually originates following fire. In the absence of disturbance the community tends to succeed to many of the community types to which Aspen-Birch Forest succeeds (see above). Like Aspen-Birch Forest, Paper Birch Forest has a Spruce-Fir Subtype and a Northern Hardwoods Subtype.

32131 Paper birch forest northern hardwoods subtype

See description of 32130 Paper birch forest

Mn DNR Natural Heritage description: Northern Hardwoods Subtype in which saplings of sugar maple and other northern hardwoods are conspicuous in the understory.

32132 Paper birch forest spruce-fir subtype

See description of 32130 Paper birch forest

Mn DNR Natural Heritage description: Spruce-Fir Subtype in which saplings of balsam fir or white spruce are conspicuous in the understory.

32140 Aspen-birch forest

Key-based definition: An upland deciduous forest with 10-60% cover by paper birches AND either aspens or balsam poplars.

Mn DNR Natural Heritage description: Aspen-Birch Forest occurs almost exclusively on upland sites in the conifer-hardwood forest zone. The community is dominated by trees of quaking aspen, bigtooth aspen (typically in clones), and paper birch, with at least 10% of the canopy cover made up of either aspen or birch. The tall-shrub layer tends to be dense and is most often composed of beaked hazel, mountain maple, and saplings of late-successional tree species. The groundlayer is usually very diverse.

Aspen-Birch Forest is an early successional community that originates following catastrophic disturbances, especially fire and clear-cutting. In the absence of catastrophic disturbances, Aspen-Birch Forest may succeed to Spruce-Fir Forest, Boreal Hardwood-Conifer Forest, Northern Hardwood Forest, Northern Hardwood-Conifer Forest, Maple-Basswood Forest, or even Upland White Cedar Forest. Where white pine is present in the understory, Aspen-Birch Forest may succeed to White Pine Forest.

Aspen-Birch Forest now covers a large portion of northern Minnesota because of logging and repeated post-logging fires, which eliminated most of the local pine seed sources. There are two recognized subtypes: the Spruce-Fir Subtype in which saplings of balsam fir or white spruce are conspicuous in the understory, and the Northern Hardwoods Subtype in which saplings of sugar maple and other northern hardwoods are conspicuous in the understory.

32141 Aspen-birch forest northern hardwoods subtype

See description of 32140 Aspen-birch forest

Mn DNR Natural Heritage description: Northern Hardwoods Subtype in which saplings of sugar maple and other northern hardwoods are conspicuous in the understory.

32142 Aspen-birch forest spruce-fir subtype

See description of 32140 Aspen-birch forest

Mn DNR Natural Heritage description: Spruce-Fir Subtype in which saplings of balsam fir or white spruce are conspicuous in the understory.

32150 Maple-basswood forest+

Key-based definition: An upland deciduous forest where sugar maples, basswoods, and elms dominate the canopy or where they dominate along with oaks (with <60% oak cover). Conifers trees and club mosses are absent, yellow birches are rare, and spring ephemerals are common.

Mn DNR Natural Heritage description: Maple-Basswood Forest is a mesic community of the deciduous forest-woodland zone, especially the portion from southeastern to west-central Minnesota. It also occurs occasionally in the conifer-hardwood forest zone and as isolated stands in the prairie zone on sites well protected from fire.

The tree canopy of Maple-Basswood Forests is dominated mostly by basswoods, sugar maples, and (formerly) American elms. Other mesic trees, such as slippery elms, northern red oaks, bur oaks, white ashes, and green ashes, are sometimes dominant locally. The canopy is very dense, with tall, straight, relatively narrow-crowned trees. The understory is multi-layered and patchy. It is composed of saplings and seedlings of the canopy species (especially sugar

maple), along with American hornbeam, ironwood, bitternut hickory, pagoda dogwood, and leatherwood.

Because the tree canopy permits so little light to reach the forest floor during the summer, Maple-Basswood Forests have a suite of forb species that bloom, produce seeds, and die back in May and early June before tree leaves are fully developed. These species--the spring ephemerals and the winter annuals--include spring beauties (*Claytonia* spp.), Dutchman's breeches (*Dicentra cucullaria*), trout-lilies (*Erythronium* spp.), and cleavers (*Galium aparine*). Other herbs, such as the sedge *Carex pedunculata*, bottlebrush grass (*Hystrix patula*), and bearded short-husk (*Brachyelytrum erectum*), are commonly present in the groundlayer but usually not abundant.

Maple-Basswood Forest occurs only on protected sites, where catastrophic forest crown fires were rare historically. Across most of its range, the community develops most commonly on well-drained loamy soils that lack mottling or other evidence of water-table levels within the tree-rooting zone. In north-central Minnesota, Maple-Basswood Forests develop on soils with fine-textured subsurface layers that slow the downward movement of water and nutrients. Maple-Basswood Forest is a late-successional community, tending to succeed Mixed Oak Forest (and other forest types) on mesic sites. It is self-perpetuating in the absence of catastrophic disturbance and climate change because the dominant tree species readily reproduce by gap-phase replacement. The very shade-tolerant sugar maple seedlings and saplings, especially, may exist in a suppressed state in the understory for many years until the death of a mature tree when one or a few grow rapidly into the canopy gap. Maple-Basswood Forests often develop into old-growth forests, because catastrophic disturbances are rare in the community and because the dominant tree species are long-lived (> 250 years). The trend in most stands of Maple-Basswood Forest is toward greater dominance by sugar maple.

Maple-Basswood Forest grades into Oak Forest where the frequency of fire increases in the landscape. It grades into Lowland Hardwood Forest in low areas where elms and ashes become more abundant and where the water table is at least seasonally within the tree rooting zone. Conifers are absent or uncommon in most of the range of Maple-Basswood Forest, but grow with sugar maple, basswood, and other mesic species in northeastern and southeastern Minnesota. The mixed stands in northeastern Minnesota are classified as Northern Hardwood Forest. In southeastern Minnesota they are classified as White-Pine Hardwood forest.

Undisturbed stands of Maple-Basswood Forest are rare. The soils on which the forest grows are suitable for cultivation so much of the community has been cleared for cropland. Remaining stands have often been grazed or selectively cut for lumber or fuelwood. Heavy grazing causes compaction of the soils and the almost complete destruction of the understory, resulting in even-aged woodlots with large mature trees in the canopy, little reproduction, and few native shrubs and herbs. Selective logging of the less shade-tolerant species (northern red oak, white oak, bitternut hickory, and walnut) has been common since European settlement, and has hastened dominance by sugar maple and basswood in many stands. The composition of the community has also been altered throughout its range by Dutch elm disease, which has killed most of the mature elm trees, and in many stands by the loss of interior groundlayer species following forest fragmentation. Common buckthorn and Tartarian honeysuckle sometimes invade stands of Maple-Basswood Forest, but rarely attain the high densities they may have in Oak Forest. Maple-sugaring is one human activity associated with Maple-Basswood forests that appears to have little impact on the structure and composition of the community, as some of the best remaining tracts of Maple-Basswood Forest have long histories of maple sugar production.

There are five recognized sections of Maple-Basswood Forest (Southeast, Big Woods, East Central, West Central, and Northern). Subtypes likely will be recognized along a moisture gradient, following analysis of plot data.

32160 Aspen Forest

Key-based definition: An upland deciduous forest with >60% aspen or balsam poplar and <10% paper birches.

Mn DNR Natural Heritage description: Aspen Forest occurs throughout the deciduous forest-woodland zone, with isolated patches in the prairie zone. The community develops primarily on sites with wet, poorly drained soils and high water tables, although the water table is usually not high enough to affect the groundlayer composition of the community or to cause peat accumulation.

The tree canopy most often is dominated by quaking aspens. Paper birches, balsam poplars, bur oaks, pin oaks, green ashes, or basswoods are minor canopy trees, although they may be abundant in the understory as seedlings and saplings. On low, poorly drained sites balsam poplars are sometimes more abundant than quaking aspens in the tree canopy.

The understory of Aspen Forests tends to be brushy. American hazelnut is almost always abundant in the understory. Other shrubs vary in presence and abundance with soil moisture, which ranges from wet-mesic to dry. The groundlayer is composed mostly of forest herbs and grasses capable of surviving in the shade under the dense shrub layer. These species include wild sarsaparilla (*Aralia nudicaulis*), Canada mayflower (*Maianthemum canadense*), the sedge *Carex pensylvanica*, false melic grass (*Schizachne purpurascens*), and mountain rice-grass (*Oryzopsis asperifolia*).

Aspen Forest is an early-successional community. With prolonged absence of fire or other disturbances, Aspen Forests succeed to mid-successional forests composed of the minor canopy tree species listed above. An analysis of land survey records indicates that relatively pure stands of quaking aspen historically occurred on level terrain rather than on rough topography, suggesting that these stands were maintained by fire and windthrow. The aspen trees were present most commonly on somewhat poorly drained mineral soils, especially drumlin fields and other landforms with heavy soils, while paper birch, pin oak, and bur oak trees associated with the aspens were probably present on local areas of better drained soils.

Plots of aspen trees from early public land survey records show that aspen also occurred on areas of relict prairie soils within the deciduous forest-woodland zone. These sites are now mainly forested, but the land survey records indicate that the aspen trees previously were scattered widely enough on them to constitute woodland rather than forest. This is consistent with the surveyors' written descriptions of these sites, which state that they had relatively dense shrub layers dominated by American hazelnut, and groundlayers dominated by prairie forbs and graminoids. Aspen forests that occur on prairie soils and have prairie understories eventually may be recognized as a subtype of Aspen Forest or as a phase of Aspen Woodland, following further research and analysis of survey records. No sections of Aspen Forest are anticipated.

32170 Altered/non-native deciduous forest +

Key-based definition: This upland deciduous forest is not dominated by oaks, aspens, balsam poplars, paper birches, yellow birches, sugar maples, or basswoods. Boxelder, green ash, and

cottonwood are typical canopy dominants, sometimes together and sometimes singly. Elms are common associates. Hackberries, aspens, oaks, and basswoods may also be present. The shrub layer is often dominated by buckthorn and Tartarian honeysuckle, but gooseberries and elderberries can also be common. The ground layer is also dominated by species tolerant of disturbances, including white snakeroot, motherwort, and garlic mustard. Occasionally, when higher quality forests are nearby, the understory can be more diverse.

Temporarily flooded deciduous forests

32200 Temporarily flooded deciduous forest - Temporarily flooded cold-deciduous forest (e.g., alluvial bottomland hardwoods). Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season. Plants that grow both in uplands and wetlands are characteristic of the temporarily flooded regime.

32210 Floodplain forest

Key-based definition: Vegetation with >30% tree cover that is subject to occasional floodplain inundations and is dominated by some combination of silver maple, cottonwood, black willow, American elm, slippery elm, boxelder, bur oak, and swamp white oak.

Mn DNR Natural Heritage description: Floodplain Forest is a seasonally wet forest community that occurs throughout Minnesota on the active floodplains of major rivers and their tributary streams. The canopy of the community is dominated by deciduous tree species tolerant of inundation, abrasion, and other disturbances associated with flooding. The canopy is variable in composition, either composed of a mixture of tree species or strongly dominated by a single tree species.

The species composition of Floodplain Forests varies both geographically and in relation to such features as substrate type or flood cycles. Along the Red River in northwestern Minnesota, the canopy is generally a mixture of American elms, slippery elms, green ashes, cottonwoods, and bur oaks. Basswoods, box elders, and willows occur less frequently. On smaller northwestern rivers, a mixture of bur oaks, elms, green ashes, and aspens is common, with some areas having only bur oaks. In southern Minnesota, silver maples, black willows, and cottonwoods are common canopy dominants. They occur either in nearly pure stands or in mixed stands. Scattered individuals or patches of river birch, American elm, slippery elm, green ash, and swamp white oak are also common in stands in southern Minnesota. (The geographic variation that occurs among these mixed forests in different parts of Minnesota may be related to differences in substrate and flood regimes among different rivers, however more research is needed.)

The tree canopy cover is highly variable within Floodplain Forests. The canopy is continuous in some stands while other stands have open areas caused by repeated erosion, ice-scouring, and soil and debris deposition, all of which prevent the growth of trees and shrubs. In recent decades, Dutch elm disease has also caused significant canopy openings in Floodplain Forests in which mature American elm trees were abundant in the canopy. Areas beneath tree-canopy openings in the forests are either dominated by short-lived herbaceous plants or, where erosion and disturbance from flooding tend to be repeated and severe, remain unvegetated. The

common herbaceous plants in these open patches include those mentioned above in the Floodplain Forest class description.

Additional Floodplain Forest subtypes likely will be identified following collection of more data. Divisions probably will be based at least partially on successional status, as Floodplain Forests dominated by black willows and cottonwoods are short-lived, early successional communities that develop on recently disturbed sites, while those dominated by elms, oaks, ashes, and silver maples are longer-lived, later-successional communities with potential for old growth. Geographic sections may also be delineated by watersheds.

32211 Floodplain forest silver maple subtype +

See description of 32210 Floodplain forest

Mn DNR Natural Heritage description: The Silver Maple subtype occurs mainly in the deciduous forest-woodland zone along the Minnesota, lower Mississippi, and St. Croix rivers and their tributaries, although there are some stands to the north in the conifer-hardwood forest zone, such as along the Prairie River in Carlton and southern St. Louis counties. The Silver Maple Subtype seems to be best developed in broad, deep glacial meltwater-cut river valleys that have been filling with coarse alluvium ever since the glacial meltwaters subsided. (The Mississippi and St. Croix river valleys are exemplary of these.)

As the name implies, silver maples dominate the tree canopy in this subtype, and are present in the subcanopy and shrub layer as well. Green ashes, cottonwoods, and American elms are often present in the canopy, but are most common as seedlings and saplings. Trees such as hackberry, bur oak, and box elder are sometimes present in the community, but most often occur only on natural levees along active river channels.

The understory of the Silver Maple Subtype is open, with less than 25% cover by tree seedlings and saplings. Herbs in the nettle family, including wood nettle (*Laportea canadensis*) and clearweed (*Pilea pumila*), dominate the groundlayer. Woody and herbaceous climbers are common, especially wild grape (*Vitis riparia*), wild cucumber (*Echinocystis lobata*), bur-cucumber (*Sicyos angulatus*), groundnut (*Apios americana*), and hog-peanut (*Amphicarpa bracteata*).

32212 Floodplain forest swamp white oak subtype

See description of 32210 Floodplain forest

Mn DNR Natural Heritage description: The Swamp White Oak Subtype is uncommon in Minnesota, occurring only in the extreme southeastern part of the state on the Mississippi River floodplain and possibly along some smaller rivers. The tree canopy is dominated by swamp white oaks, and generally also contains silver maples, green ashes, American elms, and bur oaks. Upland tree species such as basswood and sugar maple are also present in some stands. Further inventories of stands of the Swamp White Oak Subtype are needed in order to determine whether its understory species are distinct from those of other floodplain forests.

The Swamp White Oak Subtype is thought to develop primarily on floodplain sites where soil has accumulated or mounded and that are therefore drier than the sites on which most other variants of Floodplain Forest develop. This may be because seedlings of swamp white oak survive most readily in better drained areas. Additionally, mature swamp white oak trees are

more fire tolerant than most other floodplain tree species, and these drier floodplain sites may have been more likely to experience fire in the past. The presence of scattered open-grown oak trees in some occurrences of the subtype provide evidence for a previous savanna-like structure, possibly maintained or initiated by fire.

32220 Lowland hardwood forest +

Key-based definition: A forest with >30% tree cover that is dominated by trees typical of mesic uplands, floodplains, or wetlands (but not aspens or balsam poplars) and is growing just above an active floodplain, in an inactive floodplain, or at the upper edge of wetland basin. The forest is comprised of more than 2 tree species and includes diverse understory vegetation.

Mn DNR Natural Heritage description: Lowland Hardwood Forest is a wet-mesic forest that is present throughout Minnesota. It is transitional between the terrestrial and palustrine systems, occurring on sites with seasonally high water tables (within the tree-rooting zone) but that do not flood regularly and that have mineral rather than peat soils. In accord with the poorly drained sites on which the Lowland Hardwood Forests occur, species tolerant of periodic soil saturation dominate the tree canopy. American elms and black ashes are common canopy dominants, but most stands are mixed, with slippery elms, rock elms, basswoods, bur oaks, hackberries, yellow birches, green ashes, black ashes, quaking aspens, balsam poplars, and paper birches as important species. The tall-shrub layer is usually discontinuous and is composed of a mixture of upland and lowland shrubs. The ground layer is composed mostly of upland herbs that do not root to the water-table.

Lowland Hardwood Forest usually occurs in fire-protected areas, although even in unprotected areas the community burns infrequently because the woody vegetation is usually hydrated, especially in the spring. Lowland Hardwood Forest soils differ from Hardwood Swamp Forest soils by being mineral rather than peaty and from the mineral soils of other mesic upland forest types by being seasonally saturated (at depths greater than 0.5 meters).

Lowland Hardwood Forest is often composed of late-successional species, but few stands in Minnesota have old canopy trees, presumably because of windthrow and infrequent episodes of killing floods. Lowland Hardwood Forest is topographically transitional between upland forests and forested peatlands and is best developed on flat terrain where such transition zones are broad (e.g., on river terraces above normal flood levels, on loamy ground moraine, and on drumlin fields).

Currently, there are no recognized subtypes or sections of Lowland Hardwood Forest. Following further field review, stands of Lowland Hardwood Forest may be reclassified as wet subtypes of Aspen-Birch or Aspen Forest, or dry subtypes of Hardwood Swamp Forest.

32230 Aspen forest - temporarily flooded

See description of 32160 Aspen forest

Key-based definition: A forest with >30% tree cover and temporarily flooded hydrology that is dominated by aspen or balsam poplar.

32240 Altered/non-native temporarily flooded deciduous forest +

Key-based definition: A forest with >30% tree cover and temporarily flooded hydrology. This type also grows just above active floodplains, in inactive floodplains, and at the upper edges of wetland basins. The forest is comprised of only 1 or 2 species, usually cottonwood, green ash, boxelder, or elm (but not aspens or balsam poplars), and buckthorn is a common shrub. The understory vegetation lacks diversity. Reed canary grass, nettles, and *Carex blanda* often form monotypes. This forest is a result of severe disturbance, not just logging.

Saturated deciduous forests

32300 Saturated deciduous forest. Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season.

Mn DNR Natural Heritage description: Hardwood Swamp Forests are minerotrophic wetland communities that occur on muck and shallow peat substrates on wet sites in the deciduous forest-woodland and conifer-hardwood forest zones. They have tree canopies dominated by broad-leaved deciduous species, including black ash, paper birch, yellow birch, red maple, American elm, slippery elm, green ash, quaking aspen, or, rarely, balsam poplar. Tamarack is sometimes the most abundant tree species present in a stand, but never forms more than 50% of the total tree cover (if so, the swamp is classified as a Tamarack Swamp). White pines or white cedars also occur in the community on occasion. The tree canopy cover ranges from dense (especially in even-aged or drained stands) to sparse, but there is always at least 30% cover by trees over 5 meters tall.

Hardwood Swamp Forests form fairly distinct, often narrow zones at the margins of wetland basins or along streams. They form more extensive stands in shallow, poorly drained depressions or lake basins and in groundwater seepage areas on level terrain at the bases of hills or terrace slopes. Hardwood Swamp Forests often are long-lived communities on nutrient-rich low-disturbance sites. Flooding (especially that caused by beaver dams) and windthrow occasionally kill canopy trees in Hardwood Swamp Forests, causing regression to Shrub Swamps or Wet Meadows. It is usually difficult to identify boundaries between Hardwood Swamp Forests and Shrub Swamps where the two community classes intergrade or form complex patches. Hardwood Swamp Forests also grade into Tamarack Swamp. (Tamaracks tend to dominate Swamp Forests where the organic substrate is poorer in nutrients, thicker, less decomposed, more acidic, or more continuously saturated.)

Hardwood Swamp Forests differ from Floodplain Forests and from Lowland Hardwood Forests by having an organic substrate and continuously or nearly continuously saturated soils during normal years. They also differ from Lowland Hardwood Forests by lacking upland herbs in the groundlayer. Hardwood Swamp Forests and Floodplain Forests may be difficult to separate where low-gradient streams flow across flat lowlands as, for example, along the Rum River on the Anoka Sand Plain in Isanti County.

32310 Black ash swamp

Key-based definition: A forest with saturated hydrology and >30% tree cover, of which >50% is black ash.

Mn DNR Natural Heritage description: Black Ash Swamp is dominated by black ash trees, which occur either in almost pure stands or in mixed stands with other hardwoods. Common tree canopy associates include green ashes, paper birches, yellow birches, red maples, and (rarely) bur oaks. In northern Minnesota, white cedars and balsam firs are sometimes present in the canopy. The understory composition varies considerably and, at present, there are insufficient data to delineate subtypes of Black Ash Swamp or to give a statewide summary of the community. The descriptions below are for areas in Minnesota for which information is available.

On the Anoka Sand Plain, Black Ash Swamp tends to occur as narrow zones or as small inclusions in wetland complexes. (When black ash occurs in larger swamp areas here, most often it is mixed with other deciduous tree species in Mixed Hardwood Swamps rather than forming Black Ash Swamps). Where the canopy is dense, there are usually few shrubs and the ground cover is dominated by shade-tolerant herbs such as naked bishop's-cap (*Mitella nuda*), lady fern (*Athyrium angustum*), or clearweed (*Pilea pumila*), and bryophytes. Cinnamon fern (*Osmunda cinnamomea*) is sometimes abundant on moderately shady sites. In open, minerotrophic areas the groundlayer is composed of Wet Meadow species, and there is a shrub layer of alder, winterberry, and other species.

In eastern St. Louis County, Black Ash Swamp occurs in draws on the Vermillion moraine and the Toimi drumlin field. It also occurs as inclusions in disturbed white cedar stands. On the Aitkin lacustrine plain and elsewhere in St. Louis and Itasca Counties, Black Ash Swamp is floristically similar to White Cedar Swamp, to Shrub Swamps, and to Wet Meadow, communities with which it intergrades. The tree canopy cover ranges from nearly closed (in post-fire, even-aged stands) to open (usually in stands in wetland complexes). Where the tree canopy is open, the understory vegetation is patchy, ranging from open, mixed alder and willow swamps to minerotrophic sedge meadows. Associated tree species include white cedar, red maple, paper birch, balsam fir, and mountain ash, with speckled alder dominant in the shrub layer. Sensitive fern (*Onoclea sensibilis*), northern bugleweed (*Lycopus uniflorus*), common mint (*Mentha arvensis*), and marsh skullcap (*Scutellaria galericulata*) are characteristic herbs. In eastern Marshall County, Black Ash Swamp occurs at the bases of beach-ridge slopes; most likely these sites are areas of groundwater seepage.

At present, there are no recognized sections of Black Ash Swamp. There is one recognized subtype (the Seepage Subtype), which occurs along the St. Croix River and its tributaries in Washington, Chisago, and Pine counties.

32311 Black ash swamp seepage subtype

See description of 32310 Black ash swamp

Mn DNR Natural Heritage description: In Washington and Chisago counties, very local, small stands of Black Ash Swamp occur in seepage zones at the bases of river terrace slopes; these stands are classified as Seepage Subtypes of Black Ash Swamp. Skunk cabbage (*Symplocarpus foetidus*) and dense tussocks of the fine-bladed sedge, *Carex bromoides* are characteristic in seepage Black Ash Swamps, and the subtype also provides habitat for two rare species, bog bluegrass (*Poa paludigena*) and water-pennywort (*Hydrocotyle americana*). Black Ash Swamp and Mixed Hardwood Swamp are often closely associated and difficult to separate from one-another in these seepage zones.

32320 Mixed hardwood swamp

Key-based definition: A forest with saturated hydrology, growing on muck or shallow peat. Tree cover is >30%, of which <50% is black ash and <50% is tamaracks, white cedars, and black spruces combined.

Mn DNR Natural Heritage description: Mixed Hardwood Swamp is present in the deciduous forest-woodland and conifer-hardwood forest zones. The community has a mixed canopy of hardwoods, including paper birches, yellow birches, American elms, black ashes, red maples, quaking aspens, and green ashes. Black ashes, although commonly present, never form more than 50% of the canopy cover in the community. Tamarack or white pine are also occasionally co-dominant canopy tree species. The tree canopy cover ranges from sparse to dense, with the density of the shrub cover varying inversely with the density of the tree canopy.

Mixed Hardwood Swamp occurs most commonly on muck and shallow peat on lake plains and floodplains. It is a long-lived community and has old-growth potential. Like Black Ash Swamp, Mixed Hardwood Swamp varies considerably in its composition across Minnesota. The descriptions below are for specific areas for which information exists.

On the Anoka Sand Plain, Mixed Hardwood Swamp is common in shallow wetlands, especially near upland margins. On sites that are not too wet, Mixed Hardwood Swamp may succeed minerotrophic Alder Swamp. Common canopy dominants on the Sandplain are tamaracks, paper birches, red maples, yellow birches, and black ashes. Occasionally, white pines form a patchy supercanopy above the hardwood canopy. Speckled alders and poison sumacs are the most common shrubs. Other associated species are interrupted fern (*Osmunda claytoniana*), mad-dog skullcap (*Scutellaria lateriflora*), marsh marigold (*Caltha palustris*), the sedge *Carex stipata*, and mosses, including some sphagnum hummocks. Mixed Hardwood Swamps on the Anoka Sandplain harbor two rare plant species, halberd leaved tearthumb (*Polygonum arifolium*) and yellow bartonia (*Bartonia virginica*). Mixed Hardwood Swamp is perhaps the most species-rich community in east-central Minnesota.

32321 Mixed hardwood swamp seepage subtype

See description of 32320 Mixed hardwood swamp

Mn DNR Natural Heritage description: A seepage subtype of Mixed Hardwood Swamp occurs in groundwater seepage areas at the bases of terrace slopes near the St. Croix River in Washington, Chisago, and Pine counties. The groundlayer commonly contains skunk cabbage (*Symplocarpus foetidus*) and dense tussocks of the fine-bladed sedge, *Carex bromoides*. Basswood often is present in the tree canopy. The Seepage Subtype is habitat for two rare species, bog bluegrass (*Poa paludigena*) and water-pennywort (*Hydrocotyle americana*).

32330 Aspen forest - saturated soils

See description of 32160 Aspen forest

Key-based definition: A forest with saturated hydrology and >30% tree cover that is dominated by aspen or balsam poplar.

32340 Altered/non-native saturated soils deciduous forest

Key-based definition: A forest with >30% tree cover and saturated flooded hydrology . The forest is comprised of only 1 or 2 tree species, usually cottonwood, green ash, boxelder, or elm, and buckthorn is a common shrub. The understory vegetation lacks diversity. Reed canary grass, nettles, and *Carex blanda* often form monotypes. This forest is a result of severe disturbance, not just logging.

Seasonally flooded deciduous forests

32400 Seasonally flooded deciduous forest. Surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface.

32410 Black ash swamp - seasonally flooded

See description of 32310 Black ash swamp

Key-based definition: A forest with seasonally flooded hydrology and >30% tree cover, of which >50% is black ash.

32420 Mixed hardwood swamp - seasonally flooded[+]

See description of 32320 Mixed hardwood swamp

Key-based definition: A forest with seasonally flooded hydrology, growing on muck or shallow peat. Tree cover is >30%, of which <50% is black ash and <50% is tamaracks, white cedars, and black spruces combined.

32430 Altered/non-native seasonally flooded deciduous forest[+]

Key-based definition: A forest with seasonally flooded hydrology and >30% tree cover that is comprised of only 1 or 2 species, usually cottonwood, green ash, boxelder, or elm. The understory vegetation lacks diversity.

Mixed coniferous - deciduous forests

33000 Mixed coniferous[*] **- deciduous forest** - Mixed evergreen-deciduous forest - evergreen and deciduous species generally contribute 25-75% of total tree cover. (Includes semi-deciduous, semi-evergreen, mixed evergreen-deciduous xeromorphic, and mixed needle-leaved evergreen cold-deciduous woody vegetation.)

Upland mixed coniferous - deciduous forests

[*] NVCS's Evergreen classification has been changed to coniferous, thus moving tamarack forests from the NVCS deciduous classification to a coniferous classification.

33100 Upland mixed coniferous* - deciduous forest

Mn DNR Natural Heritage description: Mixed Coniferous-Deciduous Forests are upland forest communities made up of significant amounts of both coniferous trees and broad-leaved deciduous trees. They are most common in the conifer-hardwood forest zone but also occur in the deciduous forest-woodland zone. The communities in this class occur on dry to wet-mesic sites, may be early successional or late successional, and originate following either natural catastrophic disturbance or clear-cutting. The logging and burning of Coniferous forests that came with European settlement caused widespread loss of pine seed sources and the subsequent conversion of large acreages of Coniferous Forests to Mixed Coniferous-Deciduous Forests and Deciduous Forests.

There are four Mixed Coniferous-Deciduous Forest community types, which are delimited by dominant canopy species. The abundance and distributions of these dominant canopy species are determined mainly by landform, soils, and the frequency and nature of disturbance at a site.

33110 Mixed pine-hardwood forest

Key-based definition: An upland forest with 25-75% cover by pines (and no other conifers), where white pine is NOT the dominant pine.

Mn DNR Natural Heritage description: Mixed Pine-Hardwood Forest is a dry to dry-mesic forest of the conifer-hardwood forest and deciduous forest-woodland zones. Red pines or jack pines, or both, are important in the canopy, along with aspens, paper birches, and oaks. Mixed Pine-Hardwood Forest generally occurs on sites with coarse-textured soils where pre-European settlement fires were frequent and intense. Mixed Pine-Hardwood Forest is most common on sandy outwash plains, but also occurs on morainal topography.

33120 Boreal hardwood-conifer forest

Key-based definition: An upland forest with 25-75% cover by conifers, including spruce or fir, where deciduous species are limited to oak, aspen, paper birch, and red maple.

Mn DNR Natural Heritage description: Boreal Hardwood-Conifer Forest occurs in the conifer-hardwood forest zone of northern Minnesota. The tree canopy is dominated by a mixture of early successional hardwoods (primarily quaking aspen, paper birch, and red maple) and conifers (balsam fir, white spruce, white pine, jack pine, white cedar and black spruce). The proportions of these canopy trees vary significantly, in accordance with variation in soil depth and texture. Balsam fir, however, is important in the understory of Boreal Hardwood-Conifer Forests throughout the range of the community.

Mountain maple and beaked hazel are important species in the tall-shrub layer, which tends to be moderately dense. The low-shrub layer is not usually well-developed. Balsam fir dominates the seedling layer, but seedlings of other conifers and red maple are also sometimes important. The herb layer reflects the community's close affinity to Aspen-Birch Forest and

* NVCS's Evergreen classification has been changed to coniferous, thus moving tamarack forests from the NVCS deciduous classification to a coniferous classification.

Spruce-Fir Forest. Large-leaved aster (*Aster macrophyllus*) is the most important herbaceous species in the community, except in northwestern Minnesota, where it is replaced by Lindley's aster (*Aster ciliolatus*). Canada mayflower (*Maianthemum canadense*), clintonia (*Clintonia borealis*), bunchberry (*Cornus canadensis*), and wild sarsaparilla (*Aralia nudicaulis*) are common in the community throughout its range. Relatively high frequencies of twin-flower (*Linnaea borealis*) and starflower (*Trientalis borealis*) distinguish Boreal Hardwood-Conifer Forests from Aspen-Birch Forests.

Boreal Hardwood-Conifer Forest is an early to mid-successional community that develops following forest fires or logging. If undisturbed, it tends to succeed to Spruce-Fir Forest or Upland White Cedar Forest. Boreal Hardwood-Conifer forest grades into Mixed Pine-Hardwood Forest on more xeric sites, into Aspen-Birch Forest where quaking aspens and paper birches become abundant, into Upland White Cedar where white cedars become more abundant, and into Northern Hardwood-Conifer Forest where sugar maples, basswoods and yellow birches become more abundant.

33130 Northern hardwood-conifer forest

Key-based definition: An upland forest with 25-75% cover by conifers, including spruce or fir, where deciduous species are NOT limited to oak, aspen, paper birch, and red maple.

Mn DNR Natural Heritage description: Northern Hardwood-Conifer Forest is a mesic forest of the conifer-hardwood forest zone. The canopy is dominated by sugar maples or yellow birches, or both, along with whites pine, white spruces, white cedars, and balsam firs. Northern Hardwood-Conifer Forest occurs on moist sites but also occasionally on dry-mesic sites. The community is similar to Northern Hardwood Forest, but has a greater proportion of coniferous trees in its canopy. Northern Hardwood-Conifer Forest is a late- to mid-successional community, and is an important old-growth type. It commonly grades into Northern Hardwood Forest and Upland White Cedar Forest along the north shore of Lake Superior in northeastern Minnesota.

There are two sections of Northern Hardwood-Conifer Forest, a Southeast Section and a Northern Section. In southeastern Minnesota, Northern Hardwood - Conifer Forest occurs on the Paleozoic Plateau, typically as small stands on steep north-facing slopes.

33131 Northern hardwood-conifer forest yellow birch-white cedar subtype

See description of 33130 Northern hardwood-conifer forest

Mn DNR Natural Heritage description: One subtype is present in the Northern Section of Northern Hardwood - Conifer Forest, the Yellow Birch-White Cedar Subtype, which develops on mesic to wet-mesic sites and has a canopy dominated by yellow birches and white cedars.

33140 White pine-hardwood forest

Key-based definition: An upland forest with 25-75% cover by pines (and no other conifers), where white pine is the dominant pine.

Mn DNR Natural Heritage description: White Pine-Hardwood Forest occurs on dry to dry-mesic sites in the deciduous forest-woodland zone. White pines are the only conifers in the canopy and often form a supercanopy above the hardwood canopy. Northern red oak is an important canopy species along with sugar maple, white oak, and, in southeastern Minnesota, black oak and white ash. Eastern red cedars are often abundant in disturbed (especially by grazing) southeastern forests. On the Anoka Sandplain and in the St. Croix River Valley, the most common deciduous species in the canopy are northern pin oak and big-toothed aspen. The understory of the community commonly contains species that are common also in dry-mesic Maple-Basswood Forests and mesic Oak Forests.

White Pine-Hardwood Forest occurs on sites with well-drained to excessively well-drained sandy loams or coarser soils, and on slopes. It is generally a mid-successional community, with some potential for developing into old-growth forest because of the longevity of white pines, the oaks, and sugar maples. In the southern and western part of its range, White Pine-Hardwood forest often grades into Maple-Basswood Forest on dry-mesic sites, and into Mixed Oak Forest on dry sites. In the northern part of its range the community commonly grades into White Pine Forest.

There are two recognized sections of White Pine-Hardwood Forest, the Southeast Section and the North-Central Section. The Southeast Section has two subtypes, the Dry Subtype and the Mesic Subtype.

33141 White pine-hardwood forest dry subtype

See description of 33140 White pine-hardwood forest

NVCS description of an equivalent community (CEGL002481): This white pine-oak forest community is found in the upper Midwestern United States on dry typically sandy sites. It ranges from east-central Minnesota, central Wisconsin and central Michigan, south to northern Illinois and possibly northern Indiana. Stands occur on dry sandy soils, and in central Minnesota, Wisconsin, and Michigan, are typically formed on sandy outwash or lake plains. *Pinus strobus* dominates the canopy, or may form a supercanopy over a hardwood canopy. Typical canopy associates include *Pinus resinosa* (in parts of its range), *Quercus alba, Quercus rubra*, and *Acer rubrum*. Where soils are more sandy, *Populus grandidentata* and *Quercus ellipsoidalis* may be important. Shrub species include *Corylus americana* and *Gaylussacia baccata*. The herbaceous layer can contain *Aquilegia canadensis, Aralia nudicaulis, Aster macrophyllus, Aster sagittifolius, Carex pennsylvanica, Gaultheria procumbens, Lysimachia quadrifolia, Polygala paucifolia*, and *Pteridium aquilinum*.

33142 White pine-hardwood forest mesic subtype

See description of 33140 White pine-hardwood forest

NVCS description of an equivalent community (CEGL002480): White Pine - Red Oak Forest is found on dry-mesic to mesic sites with well-drained sandy loams or coarser soils, typically on morainal slopes and ridges. *Pinus strobus* is the dominant component of the overstory, often forming a supercanopy above the hardwood canopy. *Quercus rubra* is an important canopy species, along with *Acer saccharum* and *Quercus alba* in central Minnesota, and, farther eastward, *Fraxinus americana, Quercus velutina*, and occasional *Fagus grandifolia*. Northern

stands may contain *Acer rubrum, Betula papyrifera, Pinus resinosa, Pinus strobus, Populus grandidentata*, and *Populus tremuloides*, along with *Abies balsamea* in the understory. The shrub and vine layer in the southern part of the range contains *Cornus foemina, Corylus americana, Parthenocissus quinquefolia*, and *Vaccinium angustifolium*, and, farther north, *Corylus cornuta, Diervilla lonicera, Gaultheria procumbens, Vaccinium angustifolium*, and *Viburnum acerifolium*. Typical herbs in the southern part of the range include *Amphicarpaea bracteata, Aralia nudicaulis, Carex pensylvanica*, and *Geranium maculatum*; farther north, they include *Eurybia macrophylla (= Aster macrophyllus), Maianthemum canadense, Oryzopsis asperifolia, Polygala paucifolia, Polygonatum pubescens, Pteridium aquilinum*, and *Trientalis borealis*. Mosses include *Ptilidium pulcherrimum*, among others (Eyre 1980, MNNHP 1993, Chambers et al. 1997).

Woodland

40000 Woodland - Open stands of trees with crowns not usually touching (generally forming 25 - 60% cover). Canopy tree cover may be less than 25% in cases where it exceeds shrub, dwarf-shrub, herb, and nonvascular cover, respectively.

Coniferous woodland

41000 Coniferous* woodland - Evergreen woodland - evergreen species generally contribute >75% of the total tree cover.

Upland coniferous woodland

41100 Upland coniferous woodland

Mn DNR Natural Heritage description: Coniferous Woodlands occur in the conifer-hardwood forest and deciduous forest-woodland zones. They have interrupted tree canopies dominated by jack pines (or occasionally by black spruces and red pines), and have relatively continuous subcanopies of stunted oaks, young aspens, hazelnuts, cherries, or dogwoods. Areas under small openings in the tree canopy have either low-growing ericaceous shrubs, mosses, lichens, forest graminoids, and species characteristic of primary communities or dry prairie species.

Coniferous Woodlands are early successional communities but tend to persist for long periods, either because they occur on sites with soils poorly suited for tree growth, or because they occur on sites prone to repeated fire. For example, Coniferous Woodlands often originate following the burning of Coniferous Forests on sites with nutrient-poor droughty soils; although these woodlands then succeed toward coniferous forest, tree growth and canopy development are so slow that a distinct woodland persists on the site for long periods. Early land surveyors described stands of pine-dominated woodland on relatively rich prairie soils on outwash plains in the deciduous forest-woodland zone. These woodlands existed in areas (along rivers, old village sites) that appear to have been burned frequently by Native Americans, which promoted the regeneration of jack pine. Most of these areas are now cultivated and the remaining pine woodlots are succeeding to Mixed Oak Forest in the absence of fire. Modern communities that fit the general description of Coniferous Woodland include small relics of pine woodlands, overgrown coniferous savanna, and areas degraded by post-logging slash fires and erosion.

41110 Jack pine woodland

Key-based definition: Upland vegetation with 10-70% tree cover, of which >20% is by conifers other than red cedar, mostly jack pine. There is a tall, dense, continuous shrub layer, with some prairie species in the ground layer.

Mn DNR Natural Heritage description: Jack Pine Woodland occurs on outwash plains along the border between the conifer-hardwood forest and deciduous forest-woodland zones. The canopy is dominated by jack pines (the open-cone ecotype), with large red pines occasionally forming a

* NVCS's Evergreen classification has been changed to coniferous, thus moving tamarack forests from the NVCS deciduous classification to a coniferous classification.

sparse supercanopy above the jack pine canopy. Pin oak and bur oak grubs and juvenile aspens occur in the understory. The shrub layer is tall, dense, and continuous, with American hazel, downy arrowwood, juneberry, and prairie willow as dominant species. The groundlayer usually is sparse and is composed of dry woodland species and prairie species capable of persisting beneath the densely growing shrubs.

Jack Pine Woodland is best known from historical descriptions of pine woodlands that were present near prairie inclusions in forested regions. The prairie areas were gathering sites for Native Americans, and it is believed that the woodlands were largely maintained by fires set in the adjacent prairie openings. All of these pine woodlands occurred on prairie soils, which attests to their recent origin (within the past 600 years), when jack pines invaded areas of Brush-Prairie. Because the prairie soils are good agricultural soils, most Jack Pine Woodlands have been cleared for cropland and very few remain. Most of the remnants occur as scattered woodlots within agricultural areas and are succeeding to Mixed Oak Forest in the absence of fire.

41120 Northern conifer woodland

Key-based definition: Upland vegetation with 10-70% tree cover, of which <20% is by white cedar and >20% is by conifers other than red cedar. There is a patchy to continuous shrub layer less than 1.5 m tall, with some rock outcrop species in the ground layer that contribute <30% of the non-tree cover.

Mn DNR Natural Heritage description: Northern Conifer Woodland occurs in the conifer-hardwood forest zone, primarily on the thin rocky soils of the Canadian shield and less often on poor sandy soils in outwash areas. The canopy is sparse to patchy, with 10 to 70% cover, and is dominated by jack pines, sometimes mixed with upland black spruces or red pines. Northern red oaks, pin oaks, and, occasionally, bur oaks are present in the subcanopy.

The shrub layer is comparatively short (less than 1.5m tall) and ranges in cover from patchy to continuous. Prairie willows, Bebb's willows, juneberries, beaked hazels, bush honeysuckles, and blueberries are the common shrubs. Beneath the tree canopy the groundlayer is composed of species characteristic of xeric forests, while in rocky or sandy openings the predominant groundlayer species are species characteristic of Primary Communities, especially Rock Outcrop communities.

Northern Conifer Woodland is an early successional community maintained by fire. The community is physiognomically and floristically intermediate between Northern Conifer Scrubland and Coniferous Forest communities, particularly Jack Pine Forest. Some modern stands that are classified as Northern Conifer Woodland are actually Coniferous Forest or Mixed Coniferous-Hardwood Forest community types that have been degraded by intensive logging.

41130 Eastern Red Cedar Woodland

Key-based definition: Upland vegetation with >10% tree cover, of which >75% is by conifers, mostly red cedars. Herbaceous species contribute <30% of the non-tree cover. Red cedars sometimes form a nearly pure canopy in these communities, creating so much shade that few other plants are present. Aspens, oaks, and paper birches are sometimes mixed in with the cedars, allowing enough light for prickly ash, buckthorn, and Tartarian honeysuckle.

Deciduous woodland

42000 Deciduous woodland - deciduous tree species generally contribute to >75% of the total tree cover

Upland deciduous woodland

42100 Upland deciduous woodland

Mn DNR Natural Heritage description of natural woodlands: Deciduous Woodlands are communities of the deciduous forest-woodland zone, composed primarily of oak or aspen trees (or both) and brush, especially hazelnut and gray-bark dogwood. Deciduous Woodlands have patchy, interrupted tree canopies, much like Deciduous Savannas. However, woodlands differ from savannas in that the trees are set in a matrix of brush with, at most, widely scattered prairie openings. (In savannas, the understory vegetation is composed of prairie grasses and forbs.)

In the past, woodlands probably were maintained by a combination of periodic fires, grazing by native herbivores, and intensive use of openings by Native Americans. Fine-scale landscape features that favored tree growth in prairie regions (e.g., rough topography, heavy soils) or that promoted openings in forested regions (e.g., steep slopes, south to west aspects, sandy soils) contributed to the origination and maintenance of Deciduous Woodland. These patterns of openings and wooded areas are apparent only over large areas of the landscape; therefore, woodlands now occur mainly in the more remote areas of Minnesota, where the landscape is relatively unfragmented and large areas of native vegetation remain.

Presently, communities that resemble native woodland are fairly common in Minnesota. However, most of these are disturbance communities that formed recently from the grazing or selective logging of deciduous forests. Many other apparently natural woodlands are savannas in which the prairie understory was replaced by brush following the onset of fire suppression in Minnesota.

42110 Aspen woodland

Key-based definition: Upland vegetation with 10-70% tree cover, of which <25% is by conifers, with aspens comprising >70% of tree cover and herbaceous species comprising <30% of non-tree cover.

Mn DNR Natural Heritage description: Aspen Woodland occurs primarily in the deciduous forest-woodland zone, with scattered groves in the prairie zone. Quaking aspen is the dominant canopy species in the community across most of its range. In north-central Minnesota, however, big-toothed aspens occasionally dominate the canopy, and in the northwest, balsam poplars sometimes dominate low, moist areas. Bur oaks and green ashes are common associates throughout the community's range. Stands of Aspen Woodland have either dense canopies of even-aged immature trees, irregular canopies of young and old trees, or tall, even canopies of mature trees.

The woody understory in the community is well-developed, with 40-90% cover. The understory may contain plants, including tree species, of several different height classes or it may have a well-defined shrub layer. On drier sites, hazelnut, gray-bark dogwood, chokecherry, downy arrowwood, *Rosa* spp., and *Rubus* spp. are common understory shrubs. On wetter sites, the common understory shrubs are red-osier dogwood, gray-bark dogwood, pussy willow, Bebb's willow, bog birch, and meadow sweet. These species are particularly characteristic in Aspen

Woodlands in northwestern Minnesota that originated following the invasion of areas of wet-mesic Upland Prairie or Wet Meadow by aspen.

Aspen Woodland is a short-lived, early successional community intermediate between Upland Prairie (including Brush-Prairie) and Aspen or Oak Forests. Before European settlement, the distribution of Aspen Woodland in the prairie zone was determined by fire, with the community occurring in areas where fires were less frequent and intense than in open prairie areas. In the deciduous forest-woodland zone, Aspen Woodland probably was maintained by fire and occurred in association with Oak Forest, Aspen Forest, and some pine forests. Aspen Woodland has become more abundant in northwestern Minnesota because of fire suppression and perhaps wetland draining. Communities that originate following logging in the deciduous forest-woodland and conifer-hardwood forest zones often resemble Aspen Woodland but are not considered true Aspen Woodlands in this classification. When Aspen Woodland occurs with other related community types, such as Brush-Prairie and Aspen Openings, it tends to occur as narrow ecotonal bands between the other types or as small inclusions, and may be ignored in mapping.

There are insufficient data to delimit sections or subtypes of Aspen Woodland at this time. However, upland and lowland subtypes may be warranted, and a geographic section centered on the aspen parkland of northwestern Minnesota has been proposed. Further evaluation is necessary.

42120 Oak woodland-brushland +

Key-based definition: Upland vegetation with 10-70% tree cover, of which <25% is by conifers other than red cedar, with aspens comprising <70% of tree cover, oaks comprising >30%, and herbaceous species comprising <30% of non-tree cover. Forests with open grown oaks surrounded by younger trees are also included in this community.

Mn DNR Natural Heritage description: Oak Woodland-Brushland occurs on dry to mesic sites throughout the deciduous forest-woodland zone and locally in the prairie zone near the ecotone between the prairie zone and the deciduous forest-woodland zone. Oak Woodland is floristically and structurally intermediate between Oak Savanna and Oak Forest, with a patchy tree canopy and an understory dominated by shrubs and tree saplings.

The principal species in the tree canopy are bur oak, northern pin oak, white oak, and northern red oak. Aspens may form up to 70% of the tree canopy cover. The brush layer ranges in density from sparse (with 10-30% cover), to an impenetrable thicket. It is often especially dense in openings between clumps or groves of trees. Most of the floristic diversity in the community exists in the brush layer, which most commonly is composed of blackberries, raspberries, gooseberries, dogwoods, cherries, hazelnuts, prickly ashes, and sprouts of oak and quaking aspen. Prairie vegetation, if present, occurs only in small openings in the tree or shrub canopy. Except in these scattered prairie openings, the herbaceous layer is sparse and floristically poor. It is usually composed of woodland species capable of surviving in the dense shade beneath the brush layer.

Oak Woodland-Brushland is a fire-maintained community. It is most common on rich sites where trees and shrubs grow well but where recurrent fires prevent the formation of true forest. Historically, Oak Woodland-Brushland was probably one of the most extensive community types in Minnesota, comprising much of the vegetation described as oak barrens, brushland, and thickets by the early surveyors. The fires that maintained Oak Woodland-

Brushland usually started on nearby prairies. Following the conversion of these prairies to agricultural land, Oak Woodland-Brushland burned less frequently and rapidly succeeded to Oak Forest. Oak Woodland-Brushland is defined broadly enough here to include also communities in which the predominant cover is oak brush or oak-aspen brush (that originated following fire or limited human disturbance) instead of a well-developed tree canopy. There are four geographic sections of Oak Woodland-Brushland in Minnesota. These sections may be modified in the future as more information becomes available.

In the Southeast Section, Oak Woodland-Brushland is present on southwest-facing slopes on the blufflands and on outwash terraces of the Mississippi River and its tributaries. It generally occurs on more gentle slopes than Bluff Prairie or on lower slopes below Bluff Prairies. Bur oaks are common canopy dominants and northern red oaks are common associates. Northern pin oaks, basswoods, and black cherries may also occur in the canopy. White oaks are rare and aspens are absent. Chokecherries are common in the shrub layer, with shrub cover averaging 30-50%. On droughty sites with thin soils or steep slopes these woodlands may persist even in the absence of fire.

In the Big Woods Section, woodland dominated by white oak is present in areas with coarse-textured soils, such as on kames or eskers, or in areas prone to occasional fires. Natural woodlands are now extremely rare in this section because of logging, grazing, and fire suppression.

In the Central Section, Oak Woodland-Brushland historically occurred where there were firebreaks (such as on rough dune topography or on steep terrace slopes of the Mississippi River) in fire-prone regions. The dominant canopy species are either bur oak or northern pin oak; aspen are often present. Hazelnuts, chokecherries, gray-bark dogwoods, and *Rubus* spp. are common to abundant in the understory. Woodlands present in dune areas with nutrient-poor, droughty soils appear to persist for long periods even in the absence of fire.

In the Northwest Section, Oak Woodland-Brushland occurs on dry to dry-mesic sites on hilly moraines and glacial lake beach ridges. In the extreme northwest, the only oak species present is bur oak and the trees are often gnarly and relatively short. Aspens (either quaking aspens or balsam poplars or both) are always present. Southward, in Polk County, green ashes are occasionally present in the canopy. Hazelnuts, chokecherries, gray-bark dogwoods, *Viburnum* spp., *Rosa* spp., and *Rubus* spp. are common shrubs.

42130 Altered/non-native deciduous woodland[+]

Key-based definition: This upland vegetation has 10-70% tree cover, of which <25% is by conifers. Aspens comprise <70% of tree cover, and oaks comprise <30%. Herbaceous species comprise <30% of the non-tree cover. Boxelder, green ash, and cottonwood are typical canopy dominants, sometimes together and sometimes singly. Elms are common associates. Hackberries, aspens, oaks, and basswoods may also be present. The shrub layer is often dominated by buckthorn and Tartarian honeysuckle, but sumacs, gooseberries and elderberries can also be common. The ground layer is also dominated by species tolerant of disturbances, including white snakeroot, motherwort, and garlic mustard. Occasionally, when higher quality forests are nearby, the understory can be more diverse.

Temporarily flooded deciduous woodland

42200 Temporarily flooded deciduous woodland - Surface water present for brief periods during growing season, but water table usually lies well below soil surface.

42210 Altered/non-native deciduous woodland - temporarily flooded

Key-based definition: Temporarily flooded woodland with 10-70% tree cover. Aspens comprise <70% of tree cover, and oaks comprise <30%. Herbaceous species comprise <30% of the non-tree cover. Boxelder, green ash, and cottonwood are typical canopy dominants, sometimes together and sometimes singly. Elms are common associates. Hackberries and aspens may also be present. The shrub layer is often dominated by buckthorn and Tartarian honeysuckle. The ground layer is also dominated by species tolerant of disturbances, including reed canary grass, motherwort, nettle and garlic mustard.

Saturated deciduous woodland

42300 Saturated deciduous woodland - Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season.

42310 Altered/non-native deciduous woodland - saturated

Key-based definition: Woodland on saturated soils with 10-70% tree cover. Aspens comprise <70% of tree cover, and oaks comprise <30%. Herbaceous species comprise <30% of the non-tree cover. Boxelder, green ash, and cottonwood are typical canopy dominants, sometimes together and sometimes singly. Elms are common associates. Hackberries and aspens may also be present. The shrub layer is often dominated by buckthorn and Tartarian honeysuckle. The ground layer is also dominated by species tolerant of disturbances, including reed canary grass, motherwort, nettle and garlic mustard.

Seasonally flooded deciduous woodland

42400 Seasonally flooded deciduous woodland - Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is very variable, extending from saturated to a water table well below the ground surface. Includes Cowardin's Seasonal, Seasonal-Saturated, and Seasonal-Well Drained modifiers.

42410 Altered/non-native deciduous woodland - seasonally flooded

Key-based definition: Seasonally flooded woodland with 10-70% tree cover. Aspens comprise <70% of tree cover, and oaks comprise <30%. Herbaceous species comprise <30% of the non-tree cover. Ashes and willows are typical canopy dominants. The ground layer is often dominated by reed canary grass.

Mixed coniferous-deciduous woodland

43000 Mixed coniferous-deciduous woodland - deciduous and coniferous tree species each contribute 25-75% of the total tree cover.

Upland mixed coniferous-deciduous woodland

43100 Upland mixed coniferous-deciduous woodland - Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling).

43110 Altered/non-native mixed woodland

Key-based definition: This upland vegetation has 10-70% tree cover, with 25-75% of tree-cover by conifers. Oaks comprise <30% and conifers other than red cedar comprise <20%. Herbaceous species comprise <30% of the non-tree cover. This woodland is typically comprised of a mix of red cedars and deciduous trees such as aspen, elm, and paper birch, with occasional oaks. Prickly ash, buckthorn, Tartarian honeysuckle, and sumac are common shrubs.

Shrubland

50000 Shrubland - Shrubs and dwarf-shrubs with individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees generally less than 25% cover). Shrub cover may be less than 25% where it exceeds tree, herb, and nonvascular cover, respectively. Vegetation dominated by woody vines is generally treated in this class.

Coniferous / evergreen shrubland

51000 Coniferous / evergreen shrubland - Shrubs are dominated by conifers or evergreens, including broad-leaved dwarf-shrubs (and excluding red cedars).

Saturated evergreen dwarf-shrubland

51100 Saturated needle-leaved or microphyllous evergreen dwarf-shrubland (may include sparse dwarf-shrubland, e.g., dwarf-shrub bogs). Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season.

51110 Open sphagnum bog

Mn DNR Natural Heritage description: Open Sphagnum Bog occurs mainly in the conifer-hardwood forest zone, with occasional inclusions in the deciduous forest-woodland zone. Scattered and stunted (less than 10 m tall) black spruce and tamarack may be present, but tree cover is never greater than 30%. The groundlayer is dominated by ericaceous shrubs (leatherleaf, swamp laurel, bog-rosemary), sedges (*Carex* spp.), or cotton grasses (*Eriophorum* spp.). Other characteristic species are round-leafed sundew (*Drosera rotundifolia*) and pitcher plant (*Sarracenia purpurea*). The groundlayer also has a continuous mat of sphagnum mosses, usually dominated by *Sphagnum magellanicum* or *S. angustifolium*. Species useful in distinguishing Open Sphagnum Bog from Black Spruce Bog are *Carex oligosperma* and *Carex pauciflora*.

Open Sphagnum Bog develops in areas of Black Spruce Bog that become too wet to support black spruce. Although canopy tree cover may overlap between the two bog types, they are separable by differences in the abundance of shade-tolerant versus shade-intolerant species present. Distinguishing between the two types may be difficult where the canopy of a Black Spruce Bog has recently been destroyed by fire or mistletoe. Open Sphagnum Bog also grades into Poor Fen at the bases of raised bogs and in small isolated basins. Species typical of Poor Fens but absent from Open Sphagnum Bogs include *Carex aquatilis*, *C. lasiocarpa*, *C. chordorrhiza*, scheucherzia (*Scheucherzia palustris*), and beaked-sedge (*Rhynchospora alba*).

51111 Open sphagnum bog intermediate subtype

See description of 51110 Open sphagnum bog

Key-based definition: A sphagnum-covered bog where bog birch (*Betula pumila*), *Carex lasiocarpa*, and *C. chordorrhiza* and also shade tolerant species are all rare in the ground layer,

shrubs (including dwarf-shrubs) cover >50%, and a few minerotrophic indicator species are present (i.e. water has pH >4.1 and calcium ion concentration >2.2mg/l).

Mn DNR Natural Heritage description: The Intermediate Subtype is not genuinely ombrotrophic, but except for a few minerotrophic indicator species is nearly indistinguishable from "true" raised bogs.

51112 Open sphagnum bog raised subtype

See description of 51110 Open sphagnum bog

Key-based definition: A sphagnum-covered bog where bog birch (*Betula pumila*), *Carex lasiocarpa*, and *C. chordorrhiza* and also shade tolerant species are all rare in the ground layer, shrubs (including dwarf-shrubs) cover >50%, and NO minerotrophic indicator species are present (i.e. water has pH <4.1 and calcium ion concentration <2.2mg/l).

Mn DNR Natural Heritage description: The Raised Subtype occurs only in areas that are genuinely ombrotrophic (receiving nutrients from rainfall only, with pH 4.1 and $[Ca^{2+}]$ 2.2 mg/l) and lacks the minerotrophic species that occur in intermediate bogs.

51120 Scrub tamarack poor fen

See description of 61450 Poor Fen

Key-based definition: A saturated wetland with >1m of peat where tamaracks <3m tall dominate the shrub layer.

NVCS description of an equivalent community (CEGL005226): This tamarack and ericaceous scrub poor fen is found in the northern Great Lakes region of the United States and into central Canada, ranging from Minnesota into Ontario and elsewhere in Canada. Stands occur on peatlands with low exposure to minerotrophic groundwater including basin fens, shores above the level of the seasonal flooding, and larger peatlands. The water regime is saturated, and the substrate is fibric to mesic peat. The microtopography is low to intermediate hummocks with hollows. The vegetation is an open fen dominated by ericaceous shrubs, sedges, and sphagnum. The scattered tree layer of *Larix laricina* and *Picea mariana* > 2 m is less than 10%. The low shrub layer is dominated by *Betula pumila, Chamaedaphne calyculata, Larix laricina, Salix discolor*, and *S. pedicillaris*. The herb layer is somewhat low in diversity, with graminoids including the dominant *Carex lasiocarpa*, as well as *C. chordorrhiza* and *C. limosa*. Forbs include *Sarracenia purpurea*. Mosses include *Sphagnum capillifolium, S. fuscum* and *S. magellanicum*. Diagnostic features include the ericaceous and tree scrub cover, the somewhat lower species diversity compared to richer fen, and *Carex lasiocarpa* more common than *C. oligosperma*.

Deciduous shrubland

52000 Deciduous shrubland - Shrubs are NOT dominated by conifers or evergreens, including broad-leaved dwarf-shrubs

Upland deciduous shrubland

52100 Upland deciduous shrubland - Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling).

52110 Mesic brush-prairie

Key-based definition: Upland vegetation in far northwestern Minnesota with <10% tree cover, where the herbaceous layer is dominated by prairie species, and where willows, cherries, hazel, bog birch, or shrubby cinquefoil are evenly distributed throughout the prairie, covering 30-50% of the area.

Mn DNR Natural Heritage description: Mesic Brush-Prairie is the only type of Upland Brush-Prairie described by Mn DNR Natural Heritage. Upland Brush-Prairies are open communities composed of various amounts of low brush in a herbaceous matrix of prairie species (Appendix 1-B). The distributions of prairie grass and forb species in Upland Brush-Prairies correlate with changes in soil moisture along a gradient from wet-mesic to dry-mesic that parallels the moisture gradient-species distribution pattern present in mesic Upland Prairies. Upland Brush-Prairies differ from mesic Upland Prairies mainly by having many shrub species that do not occur in mesic Upland Prairies. Additionally, Upland Brush-Prairies frequently have significant numbers of small aspens, often with balsam poplars and, on drier sites, bur oak grubs and stunted trees.

Frequent fire is important in maintaining Upland Brush-Prairies, although there appears to be a threshold of fire frequency and intensity (see below), beyond which Upland Brush-Prairies are replaced on the landscape by brush-free prairie types. In the past, bison and elk activity may also have helped to maintain Brush-Prairie communities. Where they have not been otherwise tilled for cropland, most small remnants of Upland Brush-Prairie have succeeded to woodland because of suppression of wild fires.

Although brushy areas are a common feature of prairie throughout the deciduous forest-woodland zone, these areas usually are localized patches or thickets in depressions or in association with topographic and aquatic features that provide protection from fire. However, in the far northwestern part of the deciduous forest-woodland zone, brush is more uniformly distributed in the prairie (and species are present that are rarely or never present southward) and true Upland Brush-Prairie occurs.

On the pre-settlement landscape in northwestern Minnesota, Upland Brush-Prairie and the closely associated Wet Brush-Prairie were the predominant prairie types on the Glacial Lake Agassiz Interbeach Area, while just to the west on the Lake Agassiz Plain the prairies were mostly brush free. Southward within the Interbeach Area, brush prairies also gave way to standard prairie types, although Wet Brush-Prairie persisted farther southward than Upland Brush-Prairie. This suggests that a climatic gradient may have been important in causing the replacement of brush prairie, to the west and south, by brush-free prairie. That is, the cooler climate in the northwest reduced the frequency and severity of moisture stress and the intensity of fire so that, in general, brush would have a greater tendency to persist in prairie areas in the northwest. Superimposed on this climatic gradient, the Interbeach Area may have had a slight reduction in fire frequency, relative to the glacial lake plain to the west, because of its subtly greater relief and its edaphic heterogeneity. These differences may have been enough to tip the

balance and prevent elimination of woody species from the prairies in the northern part of the Interbeach Area.

The major grasses of Mesic Brush-Prairie are big bluestem (*Andropogon gerardii*), and prairie dropseed (*Sporobolus heterolepis*) on all sites, little bluestem (*Schizachyrium scoparium*), junegrass (*Koeleria macrantha*), and porcupine grass (*Stipa spartea*) on drier sites, and bog reed-grass (*Calamagrostis inexpansa*), prairie cordgrass (*Spartina pectinata*), and mat muhly (*Muhlenbergia richardsonis*) on moister sites. Wheatgrass (*Agropyron trachycaulum*) is also generally common in the community; Indiangrass (*Sorghastrum nutans*) is present only occasionally. Mesic Brush-Prairie contains the usual forbs of Mesic Prairie and a few species more typical of woodland, including black snakeroot (*Sanicula marilandica*), carrion-flower (*Smilax lasioneura*), spreading dogbane (*Apocynum androsaemifolium*), and the sedge *Carex pensylvanica*.

The brush layer within the community is generally less than 1.5 meters tall, with total cover ranging from 30 to 50 percent. The major shrub species present are slender willow, pussy willow, bog birch, and shrubby cinquefoil on wet-mesic sites; Bebb's willow on mesic to wet-mesic sites; hazel, saskatoon, and chokecherry on dry-mesic and mesic sites; and prairie willow and leadplant on better-drained sandy sites. Sand cherry is present on most sites, but is generally not abundant or important except on sandy sites. Quaking aspen suckers or small saplings often form dense thickets in the community; grubs and stunted trees of bur oak are common on dry sites. Scattered groves of larger aspen are also common, while larger oaks are present only occasionally.

Mesic Brush-Prairie generally occurs on somewhat poorly drained to well-drained, sandy clay loam to loamy fine sand soils. These soils form in lake-washed glacial till or in sandy lacustrine deposits (of variable thickness) over till. Mollisols predominate, but entisols are also common; most soils are strongly calcareous.

On the landscape, Mesic Brush-Prairie occurs on nearly level terrain, often in a mosaic with Wet Brush-Prairie and brushy Wet Meadow. Distinguishing between Mesic Brush-Prairie and Wet Brush-Prairie may be difficult in these cases, as the two communities share many species. In some sandy areas, Mesic Brush-Prairie grades into typical Mesic Prairie. Brush and trees may actually be common in the Mesic Prairies in these areas but are more localized (in clumps and thickets) than in Mesic Brush-Prairie. On beach ridges and other dry, gravelly sites Mesic Brush-Prairie grades into an oak scrub or savanna community. Where aspen cover increases, Mesic Brush-Prairie grades into Aspen Openings.

Mesic Brush-Prairie is a fire-dependent community. In the absence of fire, trees become more abundant in the community and it eventually succeeds to woodland. Examination of public land survey records from the late 1800s in fact indicates that tree cover is now greater in most Mesic Brush-Prairies in Minnesota than it was in the past. If fires occur in the community only occasionally, they may actually advance succession to woodland by stimulating aspen root suckering and the production of more aspen shoots.

Mesic Brush-Prairie has a very restricted distribution; there are no geographic sections of the community.

52111 Mesic brush-prairie sand-gravel subtype

See description of 52110 Mesic brush-prairie

Mn DNR Natural Heritage description: There is one recognized subtype, a Sand-Gravel Subtype, which occurs locally on coarse-textured outwash deposits. Occurrences of the Sand-Gravel subtype are dry-mesic to mesic prairies in which porcupine grass (*Stipa spartea*) is the major grass species. Leadplant and (especially) prairie willow are important shrubs.

52120 Native dominated disturbed upland shrubland

Key-based definition: This upland vegetation has >50% shrub cover and <10% tree cover, mostly native species in both the shrub layer and the ground layer, if present. The community can develop in very different ways, resulting in wide variation in species composition. First, in the absence of fire native prairies are sometimes overgrown with sumacs, plums, and grey dogwood (*Cornus racemosa*). Second, the same shrub species sometimes grow so thickly in old fields, that the non-native herbaceous layer is nearly obliterated. Third, when the trees of a woodland or forest are removed by windstorm, logging or disease, leaving a shrub layer dominated by shrub species (as opposed to seedlings of tree species), the result is this disturbed native community. In this case species composition depends on the type of forest or woodland that was disturbed.

52130 Altered/non-native dominated upland shrubland[+]

Key-based definition: This upland vegetation has >50% shrub cover and <10% tree cover, where either the herbaceous layer or the shrub layer or both are dominated by non-native species. Typical species include sumac, blackberry, prickly ash, Tartarian honeysuckle, and buckthorn growing over brome grass or Kentucky bluegrass.

Temporarily flooded deciduous shrubland

52200 Temporarily flooded deciduous shrubland. Surface water present for brief periods during growing season, but water table usually lies well below soil surface.

52210 Native dominated temporarily flooded shrubland

Key-based definition: This vegetation grows on temporarily flooded soils (typically river floodplains) with <30% tree cover and >50% shrub cover, predominantly native species. This community grows on mineral soil, distinguishing it from Willow Swamp, which grows on muck or peat. It commonly occurs on abandoned pastures or agricultural fields. Sandbar willow is often the only shrub species, but other native shrubs such as alder or red-osier dogwood may also be important. Sometimes the willows grow so thickly that the soil beneath them is bare. In other examples reed canary grass, blue-joint grass, or sedges may form an herbaceous layer.

52220 Altered/non-native dominated temporarily flooded shrubland

Key-based definition: This vegetation grows on temporarily flooded soils with <30% tree cover and >50% shrub cover, where either the herbaceous layer or the shrub layer or both are dominated by non-native species. Typically buckthorn dominates the shrub layer, but sandbar willows or other native species may also dominate as long as reed canary grass or other non-

native species dominate the herbaceous layer. Reed canary grass is the most common species in the herbaceous layer, but a wide variety of mesic upland and wetland species may be present.

52230 Bog birch, spiraea temporarily flooded shrubland

Key-based definition: This vegetation grows on temporarily flooded soils with <30% tree cover and >50% shrub cover, dominated by bog birch and *Spirea* (meadowsweet and/or steeplebush). This type has not yet been completely described.

Saturated deciduous shrubland

52300 Saturated deciduous shrubland. Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season.

52310 Shrub fen - Shrub fens are most common in the conifer-hardwood forest and deciduous forest-woodland zones. The ground cover of the community is dominated by wiregrass sedge (*Carex lasiocarpa*) and may have up to 70% cover by shrubs and small trees, most commonly bog birches, stunted tamaracks, sage-leaved willows, and shrubby cinquefoils.

52311 Poor fen shrub subtype

See description of 61450 Poor Fen

Key-based definition: A shrub-dominated, saturated wetland on peat >0.5m deep where bog birch (*Betula pumila*) is common, and grasses and sedges, such as *Carex lasiocarpa*, and *C. chordorrhiza*, are mostly <3mm wide. The community does not occur on the floating mat at the edge of a shallow lake and lacks the complex patterned topography of strings and flarks. The following species are NOT common: *Carex livida, C. buxbaumii, Pedicularis lanceolata, Eleocharis compressa, Muhlenbergia glomerata,* and *Lobelia kalmii*.

NVCS description of an equivalent community (CEGL002494): This bog birch - leatherleaf shrub moderately rich to poor fen is found in the northern Great Lakes region of the United States and Canada, and probably elsewhere, ranging from Minnesota east to possibly Maine, and northward into Canada in Manitoba eastward to possibly Quebec. Stands are found on the margins of water tracks of large peatlands, or in the interior of small basins that are relatively isolated from run-off. The shrub cover is at least 25%, dominated by a combination of *Betula pumila* and ericaceous shrubs, including *Andromeda polifolia, Chamaedaphne calyculata, Ledum groenlandicum*, and *Vaccinium oxycoccos*. Other minerotrophic shrubs include *Lonicera villosa, Rhamnus alnifolia, Rubus acaulis, Rubus pubescens*, and *Salix pedicellaris*. Scattered, small (2-10 m) tree stems of *Larix laricina, Picea mariana*, and *Thuja occidentalis* are present at low cover. There is a diverse forb, graminoid, and moss cover, at least in the richer examples of this type. The graminoids include *Carex chordorrhiza, Carex lasiocarpa, Carex leptalea*, and *Eriophorum viridi-carinatum*. Forbs include *Drosera rotundifolia, Equisetum fluviatile, Maianthemum trifolium, Menyanthes trifoliata, Comarum palustre (= Potentilla palustris), Sarracenia purpurea*, and *Solidago uliginosa*. The moss layer contains *Aulacomnium palustre, Pleurozium schreberi, Sphagnum angustifolium*, and *Sphagnum capillifolium*. Less frequent are *Campylium stellatum, Sphagnum fuscum*, and *Tomentypnum nitens*. Diagnostic features include

the combination of *Betula pumila* and ericaceous shrubs in the shrub layer, and both minerotrophic and oligotrophic graminoid and forb species.

52312 Rich fen shrub subtype

See description of 61460 Rich Fen

Key-based definition: A shrub-dominated, saturated wetland on peat >0.5m deep where bog birch (*Betula pumila*) is common, and grasses and sedges, such as *Carex lasiocarpa*, and *C. chordorrhiza*, are mostly <3mm wide. The community does not occur on the floating mat at the edge of a shallow lake and lacks the complex patterned topography of strings and flarks. The following species are often common: *Carex livida, C. buxbaumii, Pedicularis lanceolata, Eleocharis compressa, Muhlenbergia glomerata,* and *Lobelia kalmii*.

NVCS description of an equivalent community (CEGL002495) for northeastern Minnesota: This extremely rich boreal shrub fen community is found in the northern Great Lakes region of the United States and Canada, and probably elsewhere in central Canada, ranging from Minnesota and possibly Maine, northward to Manitoba, Ontario, and possibly Quebec. Stands occur in water tracks of large peatlands. Water pH is slightly acid to circumneutral (5.8-7.8). Shrubs dominate the stand, covering at least 25% of the area. Dominants include *Betula pumila, Pentaphylloides floribunda, Salix spp*. (including *Salix pedicellaris*). Scrubby forms of the tree species *Thuja occidentalis* and *Larix laricina* often occur with the shrubs on the hummocks. Other shrubs and dwarf-shrubs include *Andromeda polifolia, Chamaedaphne calyculata, Vaccinium oxycoccos* and others. The herbaceous layer is dominated by *Carex lasiocarpa, Carex buxbaumii, Carex livida*, and *Calamagrostis stricta*. Other graminoids include *Eriophorum alpinum (= Scirpus hudsonianus), Carex interior* and *Carex limosa*.

NVCS description of another equivalent community (CEGL002189) for southern and western Minnesota: This community type is found in the northern tallgrass prairie and adjacent prairie - forest border regions of the upper Midwestern United States where surface waters are circumneutral to somewhat alkaline, with moderate nutrient levels. It is typically found on relatively shallow peat. This community has a shrub layer with 25-70 percent cover, abundant herbaceous species, and sparse to abundant mosses. The most abundant shrub species are *Betula pumila, Pentaphylloides floribunda*, and *Salix spp*. Common herbaceous species include *Calamagrostis canadensis, Calamagrostis stricta, Carex aquatilis, Carex lasiocarpa, Eriophorum angustifolium, Euthamia graminifolia*, *Lobelia kalmii, Lycopus uniflorus,* and *Triadenum fraseri*. Where mosses are present they are dominated by species other than *Sphagnum spp*.

52320 Wet brush-prairie

Key-based definition: A wetland in northwestern Minnesota dominated by prairie species, with <30% tree cover and 30-50% shrub cover.

Mn DNR Natural Heritage description: Wet Brush-Prairie is an open wetland community of the northern part of the deciduous forest-woodland zone. It is composed of clumps or thickets of

low brush in a herbaceous matrix dominated by grasses characteristic of Wet Prairie. Some of the most important grasses in the community are prairie cordgrass (*Spartina pectinata*), bog reed-grass (*Calamagrostis inexpansa*), blue-joint (*Calamagrostis canadensis*), big bluestem (*Andropogon gerardii*), and mat muhly (*Muhlenbergia richardsonis*). Wheatgrass (*Agropyron trachycaulum*), prairie dropseed (*Sporobolus heterolepis*), fowl meadowgrass (*Poa palustris*), hair grass (*Deschamsia cespitosa*), and switchgrass (*Panicum virgatum*) are also common. *Carex lanuginosa*, *C. sartwellii*, *C. buxbaumii*, and *C. tetanica* are common sedge species in the community.

Forbs are moderately abundant in most Wet Brush-Prairies. The forbs present in the community are generally those also present in Wet Prairie. Brush height is usually less than 1.5 meters, and brush cover is generally 30 to 50 percent. Willows (mainly pussy and slender willows) are the principal brush species. Bog birch and meadowsweet are also important on some sites. Shrubby cinquefoil is less common. Wet Brush-Prairies also commonly contain thickets of quaking aspen and balsam poplar saplings, or even scattered groves of aspen and poplar trees. Wet Brush-Prairie appears to extend farther southward in the Glacial Lake Agassiz Interbeach Area than Mesic Brush Prairie.

Wet Brush-Prairie is a fire-dependent community. Tracts of Wet Brush-Prairie that do not burn frequently enough succeed to Aspen Woodland. Infrequent fire can actually promote increased aspen cover in Brush-Prairie as heat from fire stimulates aspen suckering. The tree cover in most areas of Wet Brush-Prairie appears to be greater now than that indicated by early public land surveyors (ca. 1850-1900), probably because of the effective suppression of wildfires in Minnesota since that period.

Soils in Wet Brush-Prairie range in texture from loamy fine sand to sandy clay loam and are poorly drained to very poorly drained. Most soils are mollisols but entisols are also present in the community. Most often, the soils are calcareous. On level terrain in extreme northwestern Minnesota, Wet Brush-Prairie occurs in a mosaic with Mesic Brush-Prairie and brushy Wet Meadow. These communities are not well separated floristically. Southward, the shrub species become more clumped and better separated from the prairie species, and Wet Brush-Prairie grades into Wet Prairie. Wet Brush-Prairie grades into Aspen Openings where aspen cover increases in the community relative to prairie cover.

52321 Wet brush-prairie seepage subtype

See description of 52320 Wet brush-prairie

52330 Altered/non-native dominated saturated shrubland

Key-based definition: This vegetation grows on saturated soils with <30% tree cover and >50% shrub cover, where either the herbaceous layer or the shrub layer or both are dominated by non-native species. Buckthorn is typically the dominant shrub, but red-osier dogwood, willows and other native species may also dominate as long as reed canary grass or other non-native species dominate the herbaceous layer. Reed canary grass is the most common species in the herbaceous layer, but a wide variety of mesic upland and wetland species may be present.

52340 Shrub swamp seepage subtype

Key-based definition: This vegetation grows on saturated soils with <30% tree cover and >50% shrub cover in areas of groundwater seepage.

Mn DNR Natural Heritage description: Seepage shrub swamps are wet, shrub-dominated communities on organic soils saturated by groundwater and with seepage streams occurring throughout. They are most commonly associated with prairie, wet meadow, or calcareous fen communities. In these areas, the shrub layer is commonly dominated by one or a mix of any of the following shrub species: bog birch, pussy willow, slender willow, and red-osier dogwood. Herbaceous layer is usually dominated by sedges, including prairie sedge (*Carex prairiea*), tussock sedge (*C. stricta*), and woolly sedge (*C. lanuginosa*). Seepage shrub swamps occasionally occur in association with forest communities, where they include species associated with seepage swamps such as speckled alder, skunk cabbage, jewelweed, and Carex bromoides.

52350 Wet meadow, shrub subtype

See description of 61420 Wet Meadow

Key-based definition: A wetland on saturated (but not seepage) soils with 50-70% cover by tall shrubs (not dominated by bog birch, meadowsweet or steeplebush) where peat is <0.5m deep and gaps are dominated by grasses and sedges (such as *Calamagrostis canadensis*, *Carex lacustris*, and *C. stricta*, NOT prairie species) >3mm wide.

NVCS description of an equivalent community (CEGL002187): This wet shrub meadow type is found in the northern prairie-forest border area of the midwestern United States and Canada, extending from Illinois to Manitoba. Stands may occur along stream courses or adjacent to lakes or in upland depressions. Soils are wet mineral, muck, or shallow peat (<0.5 m). Standing water is present in the spring and after heavy rains, but the water table draws down by mid-summer. Seepage areas may also occur. Shrub cover is at least 25 percent but does not become thick. Dominant species include *Cornus sericea, Salix bebbiana, Salix discolor, Salix petiolaris*, and *Spiraea alba*. Herbaceous species are typical of wet herbaceous meadows, and include the sedges *Carex aquatilis, Carex atherodes, Carex haydenii, Carex lacustris, Carex lanuginosa, Carex rostrata, Carex stricta*, or grasses *Calamagrostis canadensis* and *Calamagrostis stricta*. Forbs include *Asclepias incarnata, Aster lanceolatus, A. lateriflorus, A. novae-angliae, A. puniceus, Chelone glabra, Eupatorium maculatum*, and *Mentha arvensis*. In northern Illinois prairie meadow species may include *Asclepias purpurascens, Coreopsis tripteris, Gentianella quinquefolia*, and *Heliopsis helianthoides*.

52360 Willow swamp - saturated soils

See description of 52430 Willow swamp

Key-based definition: Vegetation on saturated soils (but not seepage) with <30% tree cover and >50% cover by tall shrubs, where <50% of the shrubs are alders and gaps are dominated by emergents >1m tall.

52370 Alder swamp - saturated soils

See description of 52410 Alder swamp

Key-based definition: Vegetation on saturated soils (but not seepage) with <30% tree cover and >70% cover by tall shrubs, of which alder is the most abundant species.

52380 Bog birch, spiraea swamp - saturated soils

Key-based definition: A wetland on saturated (but not seepage) soils with <70% cover by tall shrubs, where peat is <0.5m deep and gaps are dominated by grasses and sedges (such as *Calamagrostis canadensis*, *Carex lacustris*, and *C. stricta*, NOT prairie species) >3mm wide. Bog birch (*Betula pumila*), meadowsweet (*Spiraea alba*), or steeplebush (*Spiraea tomentosa*) dominate. This type has not yet been completely described.

Seasonally flooded deciduous shrubland

52400 Seasonally flooded deciduous shrubland. Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is very variable, extending from saturated to a water table well below the ground surface. Includes Cowardin's Seasonal, Seasonal-Saturated, and Seasonal-Well Drained modifiers.

Mn DNR Natural Heritage description: Shrub Swamps are minerotrophic, tall-shrub communities, most often present on mucks and shallow peat in the deciduous forest-woodland and conifer-hardwood forest zones. The major shrub species in these communities are speckled alder, willows (especially pussy willow, slender willow, and Bebb's willow), and red-osier dogwood. The shrub canopy ranges from interrupted, with many light gaps, to closed, with the ground well shaded below. Graminoid-dominated openings, if present, are not distinctly separated from shrub clumps. Poison sumac or alder buckthorn often dominate the canopy in disturbed swamps in east-central Minnesota.

Shrub Swamps are considered mid-successional communities, between Wet Meadow/Fen communities and Conifer or Hardwood Swamp Forests. However, Shrub Swamp communities are relatively stable in areas where water table fluctuations are small, as the loss or gain of woody vegetation in many wetland areas is linked to particularly dry or wet cycles that affect seedling establishment, flooding, windthrow, and fire frequency. Before European settlement, extensive areas of Shrub Swamp existed in shallow wetlands on outwash plains and in glacial lake basins. Where fires occurred relatively frequently in wetland areas, the wetland communities probably were open, mainly lacking shrubs or trees. Occasional fires or prolonged flooding (such as from beaver ponds) in Conifer Swamp or Hardwood Swamp may have been important in maintaining patches of Shrub Swamp in areas that are predominantly swamp forest. Artificially drained meadows or fens rapidly succeed to shrubby Wet Meadow or Fen, to Shrub Swamp, or to forested swamps.

52410 Alder swamp

Key-based definition: Vegetation on seasonally flooded soils with <30% tree cover and >70% cover by tall shrubs, of which alder is the most abundant species.

Mn DNR Natural Heritage description: Alder Swamp is a minerotrophic wetland with a canopy of tall shrubs dominated by speckled alder, often mixed with other shrub species such as willows, bog birch, poison sumac, or alder buckthorn. Common understory species in the community are tussock sedge (*Carex stricta*), prairie sedge (*Carex prairea*), lake-bank sedge (*Carex lacustris*), broad-leaved cattail (*Typha latifolia*), blue-joint (*Calamagrostis canadensis*), northern marsh fern (*Thelypteris palustris*), jewel-weed (*Impatiens capensis*), and *Sphagnum squarrosum*. The shrub canopy is usually continuous and dense, but may be interrupted, especially as a result of flooding. The understory graminoid cover tends to be sparse wherever the shrub canopy is especially dense. Graminoid-dominated openings are not distinctly separated from shrub clumps as in Wet Meadow or Fen communities. Trees, including northern white cedars, tamaracks, black ashes, and paper birches, are occasionally present in Alder Swamps, but have less than 30% cover.

52420 Wet meadow, shrub subtype - seasonally flooded

See description of 52350 Wet Meadow, shrub subtype and 61420 Wet Meadow

Key-based definition: A wetland with 50-70% cover by tall shrubs (not dominated by bog birch (*Betula pumila*), meadowsweet (*Spiraea alba*), or steeplebush (*Spiraea tomentosa*)) where peat is <0.5m deep and gaps are NOT dominated by emergents >1m tall. The leaves of most grasses and sedges (such as *Calamagrostis canadensis*, *Carex lacustris*, and *C. stricta*, NOT prairie species) are >3mm wide.

52430 Willow Swamp^{+}

Key-based definition: Vegetation on seasonally flooded soils with <30% tree cover and >50% cover by tall shrubs, where <50% of the shrubs are alders and gaps are dominated by emergents >1m tall.

Mn DNR Natural Heritage description: Willow Swamp is a minerotrophic wetland with a canopy of medium to tall (>1m) shrubs dominated by willows (especially pussy willow, slender willow, and Bebb's willow) and red-osier dogwood. Other shrubs, such as speckled alder, bog birch, poison sumac, and alder buckthorn, may be common in the tall shrub layer, although speckled alder is never the most abundant species present. Herbaceous species (especially graminoids) characteristic of Wet Meadow/Fen communities are common in the more open occurrences of the community. However, in Willow Swamps, unlike Wet Meadow/Fen communities, these graminoid-dominated patches are poorly separated from clumps of shrubs. The most common herbs are tussock sedge (*Carex stricta*), prairie sedge (*Carex prairea*), lake-bank sedge (*Carex lacustris*), broad-leaved cattail (*Typha latifolia*), blue-joint (*Calamagrostis canadensis*), northern marsh fern (*Thelypteris palustris*), and jewel-weed (*Impatiens capensis*).

Willow Swamps dominated by bog birch are closely related to the Shrub Subtype of Rich Fen but have more minerotrophic indicator species [such as *Alnus rugosa, Ilex verticillata*, *Impatiens capensis,* and *Lycopus uniflorus*] than are present in Rich Fens. Following fire in Conifer Swamps or in the Shrub Subtype of Rich Fens there may be initially a dense cover of willows (usually balsam willow and bog willow), but these stands are best classified as successional stages of Conifer Swamp or Rich Fen rather than as Willow Swamp. The dense

groves of sand-bar willow or juvenile black willow that occur on sand bars along rivers are not considered Shrub Swamp communities but instead River Beach communities, as they occur on mineral rather than peat or muck substrates.

52440 Altered/non-native dominated seasonally flooded shrubland

Key-based definition: This community grows on seasonally flooded soils with <30% tree cover and >50% shrub cover, where either the herbaceous layer or the shrub layer or both are dominated by non-native species. The vegetation has not been well characterized, but would probably include buckthorn, reed canary grass, or purple loosestrife.

52450 Bog birch, spiraea swamp - seasonally flooded

Key-based definition: This vegetation grows on seasonally flooded soils with <30% tree cover and >50% shrub cover, dominated by bog birch (*Betula pumila*), meadowsweet (*Spiraea alba*), or steeplebush (*Spiraea tomentosa*). This type has not yet been completely described.

Semipermanently flooded deciduous shrubland

52500 Semipermanently flooded deciduous shrubland. Surface water persists throughout the growing season in most years. Land surface is normally saturated when water level drops below soil surface. Includes Cowardin's Intermittently Exposed and Semipermanently Flooded modifiers.

52510 Wet meadow shrub - semipermanently flooded

See description of 52350 Wet Meadow, shrub subtype and 61420 Wet Meadow

Key-based definition: A floating shrubland in a semipermanently flooded basin that is NOT dominated by bog birch (*Betula pumila*), meadowsweet (*Spiraea alba*), or steeplebush (*Spiraea tomentosa*).

52520 Willow swamp - semipermanently flooded

See description of 52430 Willow Swamp

Key-based definition: A native species shrubland in a semipermanently flooded basin with <30% tree cover.

52530 Bog birch, spiraea swamp - semipermanently flooded

Key-based definition: A floating shrubland in a semipermanently flooded basin that is dominated by bog birch (*Betula pumila*), meadowsweet (*Spiraea alba*), or steeplebush (*Spiraea tomentosa*).

52540 Altered/non-native dominated semipermanently flooded shrubland

Key-based definition: This community grows on semipermanently flooded soils with <30% tree cover and >50% shrub cover, where either the herbaceous layer or the shrub layer or both are dominated by non-native species. The vegetation has not been well characterized, but would probably include buckthorn, reed canary grass, or purple loosestrife.

Herbaceous

60000 Herbaceous - Herbs (graminoids, forbs, and ferns) dominant (generally forming at least 25% cover; trees, shrubs, and dwarf-shrubs generally with less than 25% cover). Herb cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and nonvascular cover, respectively.

Grasslands or emergent vegetation

61000 Grasslands or emergent vegetation (perennial graminoid vegetation) - Perennial graminoid vegetation (grasslands). Perennial graminoids generally contribute to greater than 50% of total herbaceous canopy cover when the other cover types present (e.g. tree, shrub, dwarf-shrub, nonvascular) is less than 25% and herbaceous cover exceeds the cover types.

Tall grassland

61100 Tall grassland. Mature grass species 1 meter or higher.

61110 Mesic prairie

Key-based definition: Upland grassland dominated by prairie species, with <10% tree cover and <50% shrub cover (<30% in far northwestern Minnesota), and NOT growing on steep slopes or on sand- or gravel-dominated soil.

Mn DNR Natural Heritage description: Mesic Prairie is a type of Upland Prairie, which occurs primarily in the prairie zone, with scattered occurrences in the deciduous forest-woodland zone. It is dominated by grasses. The tall grasses, big bluestem (*Andropogon gerardii*) and Indiangrass (*Sorghastrum nutans*), are the major dominants on moist sites. Prairie dropseed (*Sporobolus heterolepis*) is common on both dry and moist sites. Forbs typically are abundant (but subdominant to the grasses) and may have high local diversity. Forb species composition varies with site moisture, although some forb species occur on almost all sites, moist or dry. Several low shrub or sub-shrub species are common on Upland Prairie; the most characteristic is leadplant (*Amorpha canescens*). Taller brush and trees are absent or scattered, however brush or woodland areas may be interspersed with prairie, usually in association with topographic and aquatic features that provide protection from fire.

The most important cause of variation in species composition in prairie communities is variation in soil moisture. The local soil moisture regime is determined by slope, aspect, proximity to the water table, and soil texture. On a regional scale, variation in species composition is primarily caused by climatic variation (i.e., the westward decline in precipitation and northward decline in temperature in Minnesota).

Upland Prairies occur on a range of landforms in the prairie zone, from nearly flat glacial lakeplains to steep morainic slopes. In the deciduous forest-woodland zone, prairies occur on droughty, level outwash areas and steep south- and west-facing slopes. The pre-European settlement distribution of prairie was related to the interaction of local fire frequency with growth rates of woody species: where conditions were favorable for rapid growth, more frequent fires were necessary to maintain prairie over savanna, woodland, or forest. Fragmentation of Upland Prairie since European settlement has reduced fire frequency throughout the prairie and

deciduous forest-woodland zones, and most prairie remnants have more brush and trees than were present in the past.

Mesic Prairie is a dry-mesic to wet-mesic grassland that occurs mainly in the prairie zone in southern and western Minnesota and sporadically in the deciduous forest-woodland zone. Mesic Prairie is dominated by grasses. Big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and prairie dropseed (*Sporobolus heterolepis*) are the major native species on most sites, with little bluestem (*Schizachyrium scoparium*) and porcupine grass (*Stipa spartea*) important on drier sites, and switchgrass (*Panicum virgatum*) and prairie cordgrass (*Spartina pectinata*) common on wetter sites. The introduced grass Kentucky bluegrass (*Poa pratensis*) is present at most sites; its is a function of the site's disturbance history.

Forbs are abundant (but usually subdominant to grasses) and have high local diversity. Forb species-composition also varies locally with soil moisture. There is greater regional variation among forbs than among grasses. Common forb species include purple prairie-clover (*Petalostemon purpureum*), white prairie-clover (*P. candidum*), ground-plum (*Astragalus crassicarpus*), prairie-turnip (*Psoralea esculenta*), rough blazing-star (*Liatris aspera*), Canada goldenrod (*Solidago canadensis*), stiff goldenrod (*S. rigida*), Missouri goldenrod (*S. missouriensis*), prairie thistle (*Cirsium flodmani*), smooth aster (*Aster laevis*), stiff sunflower (*Helianthus rigidus*), Maximilian sunflower (*H. maximiliani*), smooth rattlesnake-root (*Prenanthes racemosa*), white sage (*Artemisia ludoviciana*), wood lily (*Lilium philadelphicum*), white camas (*Zigadenus elegans*), heart-leaved alexanders (*Zizia aptera*), prairie larkspur (*Delphinium virescens*), downy phlox (*Phlox pilosa*), hoary puccoon (*Lithospermum canescens*), tall cinquefoil (*Potentilla arguta*), alum-root (*Heuchera richardsonii*), wood-betony (*Pedicularis canadensis*), northern bedstraw (*Galium boreale*), prairie bird-foot violet (*Viola pedatifida*), oval-leaved milkweed (*Asclepias ovalifolia*), and showy milkweed (*A. speciosa*). Purple coneflower (*Echinacea angustifolia*) is common on drier sites in the western part of the community's range. Leadplant, prairie rose, sand cherry, wolfberry, and prairie willow are common low-shrub or sub-shrub species. Fragrant false indigo is common on moister sites. Trees and taller brush often occur along the margins of wetlands adjacent to Mesic Prairies.

Mesic Prairie is a fire-dependent community. In the absence of fire, occurrences of Mesic Prairie are invaded by brush and trees. In the prairie zone, Mesic Prairie occurs on nearly level glaciolacustrine and glaciofluvial deposits, and on flat or gently rolling morainic landforms. In southeastern and, to a lesser extent, southwestern Minnesota, the glacial deposits are overlain by loess. Bedrock subtypes of Mesic Prairie exist in a few areas where bedrock is within about one-and-one-quarter meters of the ground surface and there are numerous small patches of exposed rock. Within the deciduous forest-woodland zone, Mesic Prairie usually occurs on level outwash areas or on broad, sandy river terraces.

The soils in Mesic Prairie are predominantly mollisols with thick, dark mineral surface layers that have high base saturation and dominantly bivalent cations. They range in texture and drainage from silty and somewhat poorly drained to sandy and somewhat excessively drained, with moderately well-drained to well-drained, loamy soils being most common. Mesic Prairie grades into Wet Prairie on moister sites and into the Hill and Sand-Gravel subtypes of Dry Prairie on drier sites. Separation of Mesic Prairie from other prairie types is based primarily on landform or substrate characteristics rather than on species composition, as floristic boundaries between Mesic Prairie and other prairie types are not well defined.

61111 Mesic prairie carbonate bedrock subtype

See description of 61110 Mesic Prairie

Mn DNR Natural Heritage description: The bedrock subtypes are rolling to level prairies on thin soils over bedrock. Carbonate Subtype occurs on dolomite or limestone bedrock. In both subtypes, the depth to bedrock is generally less than 1.25 meters, with bedrock often exposed at the ground surface.

61112 Mesic prairie crystalline bedrock subtype

See description of 61110 Mesic Prairie

Mn DNR Natural Heritage description: The bedrock subtypes are rolling to level prairies on thin soils over bedrock. The Crystalline Subtype occurs on either quartzite or granite bedrock. In both subtypes, the depth to bedrock is generally less than 1.25 meters, with bedrock often exposed at the ground surface.

61120 Tall grass altered/non-native dominated grassland

Key-based definition: This upland grassland is >1m tall, has <10% tree cover and <50% shrub cover, and is dominated by non-native species.

Medium-tall grassland

61200 Medium-tall grassland. Mature grass species less than 1 meter high.

61210 Dry prairie

Key-based definition: Upland grassland dominated by prairie species, with <10% tree cover and <50% shrub cover, where the substrate is composed of sand or gravel (sometimes with a thin organic surface layer), or any texture on steep slopes. (Some examples may occur on sandy soils in temporarily flooded areas.)

Mn DNR Natural Heritage description: Dry Prairie is a type of Upland Prairie, which occurs primarily in the prairie zone, with scattered occurrences in the deciduous forest-woodland zone. They are dominated by grasses. The tall grasses, big bluestem (*Andropogon gerardii*) and Indiangrass (*Sorghastrum nutans*), are the major dominants on moist sites. Prairie dropseed (*Sporobolus heterolepis*) is common on both dry and moist sites. Forbs typically are abundant (but subdominant to the grasses) and may have high local diversity. Forb species composition varies with site moisture, although some forb species occur on almost all sites, moist or dry. Several low shrub or sub-shrub species are common on Upland Prairie; the most characteristic is leadplant (*Amorpha canescens*). Taller brush and trees are absent or scattered, however brush or woodland areas may be interspersed with prairie, usually in association with topographic and aquatic features that provide protection from fire.

The most important cause of variation in species composition in prairie communities is variation in soil moisture. The local soil moisture regime is determined by slope, aspect, proximity to the water table, and soil texture. On a regional scale, variation in species

composition is primarily caused by climatic variation (i.e., the westward decline in precipitation and northward decline in temperature in Minnesota).

Upland Prairies occur on a range of landforms in the prairie zone, from nearly flat glacial lakeplains to steep morainic slopes. In the deciduous forest-woodland zone, prairies occur on droughty, level outwash areas and steep south- and west-facing slopes. The pre-European settlement distribution of prairie was related to the interaction of local fire frequency with growth rates of woody species: where conditions were favorable for rapid growth, more frequent fires were necessary to maintain prairie over savanna, woodland, or forest. Fragmentation of Upland Prairie since European settlement has reduced fire frequency throughout the prairie and deciduous forest-woodland zones, and most prairie remnants have more brush and trees than were present in the past.

Dry Prairie is a dry to dry-mesic herbaceous community dominated by grasses and sedges. It occurs throughout the prairie zone and sporadically in the deciduous forest-woodland zone. Dry Prairie has considerable variation in species composition, reflecting interactions among geography (namely climate), soils, and topography. In general, Dry Prairies have a greater component of Great Plains species than Mesic Prairies, especially in prairies in the western part of Minnesota. Big bluestem (*Andropogon gerardii*) is always present in the community and usually important, but it does not achieve the dominance it typically has in Mesic Prairie. Indiangrass (*Sorghastrum nutans*) is more limited in occurrence, generally appearing only where conditions approach mesic. Mid-height and short grasses and sedges are usually dominant in Dry Prairie. Among the more common are porcupine grass (*Stipa spartea*), little bluestem (*Schizachyrium scoparium*), side-oats grama (*Bouteloua curtipendula*), prairie June-grass (*Koeleria macrantha*), and sun-loving sedge (*Carex heliophila*).

Forb variation within the community is more pronounced. Some widespread, characteristic species are dotted blazing star (*Liatris punctata*), pasque flower (*Pulsatilla nuttalliana*), prairie golden-aster (*Heterotheca villosa*), stiff sunflower (*Helianthus rigidus*), silky aster (*Aster sericeus*), green milkweed (*Asclepias viridiflora*), stiff goldenrod (*Solidago rigida*), gray goldenrod (*Solidago nemoralis*), Missouri goldenrod (*Solidago missouriensis*), and narrow-leaved puccoon (*Lithospermum incisum*). Dry Prairies share many forb species with Mesic Prairies, including rough blazing star (*Liatris aspera*), buffalo-bean (*Astragalus crassicarpus*), tooth-leaved evening primrose (*Calylophus serrulatus*), silverleaf scurfpea (*Psoralea argophylla*), thimbleweed (*Anemone cylindrica*), Louisiana sagewort (*Artemisia ludoviciana*), prairie larkspur (*Delphinium virescens*), heartleaved alexanders (*Zizia aptera*), purple prairie-clover (*Petalostemon purpureum*), hoary puccoon (*Lithospermum canescens*), prairie smoke (*Geum triflorum*), and wood lily (*Lilium philadelphicum*).

Three sub-shrubs--leadplant (*Amorpha canescens*), prairie rose (*Rosa arkansana*), and wolfberry (*Symphoricarpos occidentalis*)--typical in Mesic Prairies are also generally present in Dry Prairie. Soil-encrusting lichens and the fern-ally rock-spikemoss (*Selaginella rupestris*) are often common in Dry Prairie. Brush, and sometimes trees, may be present in hollows and draws. Bur oak (*Quercus macrocarpa*), chokecherry (*Prunus virginiana*), wild plum (*Prunus americana*), and smooth sumac (*Rhus glabra*) are the most widespread woody species. Other woody species more limited in distribution in the community are northern pin oak (*Quercus ellipsoidalis*), black oak (*Quercus velutina*), and hazel (*Corylus americana*).

Dry Prairies are maintained by fire but require less frequent fires than mesic and wet prairies because the droughty conditions within Dry Prairies slow or prevent the growth of woody species. Dry Prairie occurs on a variety of landforms, including sand dune blankets of mid-Holocene origin, glacial lake beach ridges, outwash deposits, ice-contact features (kames,

eskers), morainic hills, erosional slopes in glacial drift, and bedrock-cored bluffs. Soils range from nearly pure sand with little profile development, to mollisols, although the latter have a much thinner organic-rich surface horizon than the soils of Mesic Prairie. All overlie deep glacial drift except for those of the bedrock-cored bluffs, which are formed in a thin layer of loess or residuum. Soils are well drained to excessively drained. Depending upon the degree of slope, the slope aspect, and the soil composition, Dry Prairie intergrades with Mesic Prairie.

61211 Dry prairie barrens subtype

See description of 61210 Dry Prairie

Mn DNR Natural Heritage description: The Barrens Subtype, which occurs primarily on old dune blankets, is perhaps most distinctive, and additional plot data may support recognizing it as a separate community type. The Barrens Subtype occurs on dry to dry-mesic sands on outwash plains, old dune blankets, and alluvial deposits along rivers and streams. It is present in the northwest, central, and southeastern parts of the prairie zone, and also in the deciduous forest-woodland zone. The low nutrient levels, low levels of organic matter, and poor water-retaining capacity of the deep sands presumably are the major determinants of the species composition and structure of the subtype. The vegetation is generally sparser than in other Dry Prairie subtypes (often with less than 50% cover), but is fairly rich floristically. The major graminoid species in the subtype include all of the common graminoids listed above for Dry Prairies in general, excluding side-oats grama. Other graminoids characteristic of the Barrens Subtype are sand dropseed (*Sporobolus cryptandrus*), sand reedgrass (*Calamovilfa longifolia*), hairy grama (*Bouteloua hirsuta*), blue grama (*Bouteloua gracilis*), and several sedges, notably *Carex foenea* and *Cyperus schweinitzii*.

Among the more distinctive forbs that occur in this subtype are prairie sagewort (*Artemisia frigida*), plantain-leaved pussytoes (*Antennaria plantaginifolia*), large-flowered beard-tongue (*Penstemon grandiflorus*), hairy puccoon (*Lithospermum caroliniense*) (in the southeast and central parts of the state), and silky prairie-clover (*Petalostemum villosum*). Prairie willow (*Salix humilis*) is generally a common low shrub in this subtype. Several plant species characteristic of the Barrens Subtype (for example, false heather (*Hudsonia tomentosa*)) are restricted to local disturbances such as active blowouts or slipfaces.

The Barrens Subtype often occurs as inclusions in areas of Dry Oak Savanna or Oak Woodland. Whether to classify an area as Dry Prairie Barrens Subtype or as part of a savanna community depends upon the size of the prairie opening, or often upon the degree to which fragmentation has isolated small remnants. The Barrens Subtype grades into Mesic Prairie or even into Wet Prairie in low areas or where sand grades into richer soils.

The Barrens Subtype is present in the Northwest, the Central, and the Southeast Sections of Dry Prairie. In the Northwest Section, the subtype occurs on dune blankets such as the Agassiz Dunes and Skull Lake Dunes. In the Central Section, occurrences are on outwash along the Mississippi River and on the Anoka Sand Plain. In the Southeast Section, the subtype is present on dunes on terraces along the Mississippi River (Weaver Dunes) and on sandy alluvial fans at Whitewater Wildlife Management Area and Rushford Sand Barrens SNA.

61212 Dry prairie bedrock bluff subtype

See description of 61210 Dry Prairie

Mn DNR Natural Heritage description: The Bedrock Bluff Subtype occurs on bluffs along the Mississippi River and many of its tributaries in southeastern Minnesota, and to a very limited extent along the St. Croix River. The community is best developed on very steep south- and west-facing slopes; goat prairie, the popular name of the community, indicates the steepness of these slopes. The major graminoid species in the Bedrock Bluff Subtype are those generally common graminoids to all dry prairies (see above). Other common graminoid species are prairie dropseed (*Sporobolus heterolepis*), plains muhly (*Muhlenbergia cuspidata*), hairy grama (*Bouteloua hirsuta*), Leiberg's panic grass (*Panicum leibergii*), and long-leaved panic grass (*Panicum perlongum*). Some of the more common distinctive forbs are plains paintbrush (*Castilleja sessiliflora*), aromatic aster (*Aster oblongifolius*), sky-blue aster (*Aster oolentangiensis*), cylindric blazing-star (*Liatris cylindracea*), false boneset (*Kuhnia eupatoroides*), birdfoot coreopsis (*Coreopsis palmata*), and flowering spurge (*Euphorbia corollata*).

Soils of the Bedrock-Bluff Subtype are thin and formed in loess or residuum on steep erosional bedrock slopes. The underlying bedrock is dolomite and sandstone. Cobble to boulder sized rock rubble is abundant, and bedrock outcrops are common. Soils are excessively drained to well drained. Occurrences of this community are usually small openings surrounded by woodland or forest, although there are some large bluffs that are completely covered by prairie.

The frequency and intensity of moisture stress on the steepest south- or west-facing slopes (summer soil temperatures often exceed 40 degrees C) greatly impede invasion of Bedrock Bluff Prairies by woody vegetation, but complete suppression of fire does result in eventual succession from prairie to savanna or dry woodland.

61213 Dry prairie sand-gravel subtype

See description of 61210 Dry Prairie

Mn DNR Natural Heritage description: The Sand-Gravel Subtype occurs on gently to steeply sloping sites throughout the prairie zone, with scattered occurrences in the deciduous forest-woodland zone. In addition to the widespread graminoids listed above in the general description of Dry Prairies, important species in the Sand-Gravel Subtype include needle grass (*Stipa comata*), plains muhly (*Muhlenbergia cuspidata*), prairie dropseed (*Sporobolus heterolepis*), Wilcox's panic grass (*Panicum wilcoxianum*), blue grama (*Bouteloua gracilis*), hairy grama (*Bouteloua hirsuta*), and sand reedgrass (*Calamovilfa longifolia*). Some distinctive forb species, in addition to those present in all Dry Prairie subtypes, are prairie sagewort (*Artemisia frigida*), plantain-leaved pussytoes (*Antennaria plantaginifolia*), purple coneflower (*Echinacea angustifolia*) (except in the southeast), skeleton-weed (*Lygodesmia juncea*), small white beard-tongue *(Penstemon albidus*), plains paintbrush (*Castilleja sessiliflora*), prairie cinquefoil (*Potentilla pensylvanica*), and the milk-vetch (*Astragalus adsurgens*).

The Sand-Gravel Subtype of Dry Prairie occurs on the former shorelines of Glacial Lake Agassiz, on outwash deposits, and on ice-contact features such as kames and eskers. Occurrences are typically small, corresponding to the local extent of these landforms. Soils are mollisols ("prairie" soils), but the organic-rich surface horizon is thinner than in Mesic Prairie, and fine to coarse gravel constitutes a significant fraction of the solum. Soil texture is most commonly sandy-skeletal, often with abundant larger stones as well as gravel. These soils are excessively drained or somewhat excessively drained.

This subtype grades into the Barrens Subtype on outwash deposits, or even into the dry-mesic phase of Mesic Prairie. Distinguishing between the Sand-Gravel Subtype when it is present on steeply sloping collapsed outwash or ice-contact deposits and the Hill Subtype may be especially difficult. The Sand-Gravel Subtype occurs in the Southeast, Southwest, Central, and Northwest Sections of Dry Prairie.

61214 Dry prairie hill subtype

See description of 61210 Dry Prairie

Mn DNR Natural Heritage description: The Hill Subtype occurs on steep terrain throughout the prairie zone as far north as Polk County, and sporadically in the deciduous forest-woodland zone. Depending upon slope position, angle, and aspect, as well as soil type, conditions vary from dry to mesic, although drier conditions predominate. Of the Dry Prairie Subtypes, the Hill Subtype has the greatest overlap in species composition with Mesic Prairie and is richest in species. The major graminoids include those listed above for all Dry Prairies, plus prairie dropseed (*Sporobolus heterolepis*); Indian grass (*Sorgastrum nutans*) and big bluestem (*Andropogon gerardii*) are more important in the Hill Subtype than in other Dry Prairie subtypes. Less abundant but characteristic graminoids include Wilcox's panic grass (*Panicum wilcoxianum*) and plains muhly (*Muhlenbergia cuspidata*). Typical forbs other than those common to all Dry Prairie subtypes include purple coneflower (*Echinacea angustifolia*), aromatic aster (*Aster oblongifolius*), plains paintbrush (*Castilleja sessiliflora*), small white beard-tongue (*Penstemon albidus*), locoweed (*Oxytropis lambertii*), and the milk-vetch (*Astragalus adsurgens*).

The Hill Subtype occurs on erosional features in glacial till (e.g., valley side slopes), but also on steep slopes in disintegration moraine. Soils are mollisols but with shallower organic-rich surface horizons than in Mesic Prairie. Soil texture ranges from clay loam to sandy loam; cobbles and boulders are often common and gravelly inclusions may also be present. Soils are excessively drained to well drained. Floristically, the boundary between the Hill Subtype of Dry Prairie and the dry-mesic phase of Mesic Prairie is particularly indistinct. They are best separated by topography. This subtype also grades into the hillier forms of the Sand-Gravel Subtype of Dry Prairie, as noted above. Heavily grazed occurrences of the Hill Subtype are often difficult to distinguish floristically from the Sand-Gravel Subtype. The Hill Subtype is present in the Southeast, Southwest, Central, and Northwest Sections of Dry Prairie.

61220 Medium-tall altered/non-native dominated grassland +

Key-based definition: This upland grassland is generally <1m tall, with <10% tree cover and <50% shrub cover, and is dominated by non-native species, such as brome, Kentucky bluegrass, reed canary grass, and spotted knapweed.

Temporarily flooded grassland

61300 Temporarily flooded grassland. Surface water present for brief periods during growing season, but water table usually lies well below soil surface. Often characterizes flood-plain wetlands.

61310 Wet prairie

Key-based definition: A prairie species dominated grassland growing on temporarily flooded soils with <30% tree cover and <50% shrub cover (<30% in northwestern Minnesota).

Mn DNR Natural Heritage description: Wet prairie occurs mainly in the southern and western parts of the prairie zone, with scattered occurrences in the deciduous forest-woodland zone. Typically, Wet Prairie is dominated by grasses, but sedges are also important in the community. The major cover-forming grasses in wet prairies in eastern Minnesota are prairie cordgrass (*Spartina pectinata*) and blue-joint (*Calamagrostis canadensis*). Prairie cordgrass and blue-joint are also present in Wet Prairies in western Minnesota, but the major cover-forming grasses in the west are bog reed-grass (*Calamagrostis inexpansa*), big bluestem (*Andropogon gerardii*), and the low grass, mat muhly (*Muhlenbergia richardsonis*). Other common grasses in the community are switchgrass (*Panicum virgatum*), wheatgrass (*Agropyron trachycaulum*), fowl meadow grass (*Poa palustris*), and sweet grass (*Hierocloe odorata*). The introduced grass redtop (*Agrostis stolonifera*) is often present on disturbed sites. Common Wet Prairie sedges are *Carex lanuginosa*, *C. sartwellii*, *C. tetanica*, and, in the west, *C. praegracilis*. Stiff rush (*Juncus balticus*) is frequently present.

Forbs are abundant in Wet Prairies, but on the whole fewer forb species occur in Wet Prairie than in Mesic Prairie. Common widespread Wet Prairie forb species are panicled aster (*Aster lanceolatus*), New England aster (*A. novae-angliae*), meadow ragwort (*Senecio pseudaureus*), giant goldenrod (*Solidago gigantea*), Riddell's goldenrod (*S. riddellii*), giant sunflower (*Helianthus giganteus*), sawtooth sunflower (*H. grosseserratus*), sneezeweed (*Helenium autumnale*), gay-feather (*Liatris pycnostachya*), blazing-star (*L. ligulistylis*), grass-leaved goldenrod (*Euthamia graminifolia*), Indian hemp (*Apocynum sibiricum*), golden alexanders (*Zizia aurea*), closed gentian (*Gentiana andrewsii*), yellow star-grass (*Hypoxis hirsuta*), marsh vetchling (*Lathyrus palustris*), tall meadow rue (*Thalictrum dasycarpum*), prairie loosestrife (*Lysimachia quadriflora*), Virginia mountain-mint (*Pycnanthemum virginianum*), swamp lousewort (*Pedicularis lanceolata*), and northern bog violet (*Viola neprophylla*). Small willows (pussy willow and other willow species) and meadowsweet are common in the community; willow and aspen trees are also sometimes present, growing either singly or scattered in small clumps along wetland margins.

Wet Prairie is a fire-dependent community, with shrub and tree cover increasing in the community in the absence of fire (though regular haying will also prevent increased shrub and tree cover in the community.) Wet Prairie occurs in low areas (such as depressions and drainageways) where the water table remains within the plant rooting zone for several weeks during the growing season, but where inundation occurs only infrequently and briefly. In some Wet Prairies groundwater seepage causes soils to be very moist or wet. Wet Prairie is especially common on broad, poorly drained flats in the Glacial Lake Agassiz Interbeach Area, where there are many areas of artesian seepage. In the deciduous forest-woodland zone, Wet Prairie exists on broad, nearly level river terraces or in shallow depressions on outwash.

The soils within the community are mainly mollisols (aquolls). They range in texture from silty clays to fine sands and are somewhat poorly drained to very poorly drained. Impermeable subsurface layers impede soil drainage on some sites, and a thin layer of muck may be present at the ground surface on Wet Prairies in seepage areas. Most soils are calcareous. Salt concentrations (sulfates of calcium and magnesium) high enough to influence the species composition of the community are present in the soils of Wet Prairies along the western edge of Minnesota, primarily in the Agassiz Lacustrine Plain.

On drier sites Wet Prairie often grades into wet-mesic stands of Mesic Prairie; on wet sites it often grades into Wet Meadow. Mesic Prairie, Wet Prairie, and Wet Meadow do not have well-defined floristic boundaries, and sometimes are difficult to separate from one-another in the field when they occur together. Shrub cover increases in Wet Prairie northward, and in the northern part of the community's range Wet Prairie often grades into Wet Brush-Prairie. Wet Prairie in southeastern Minnesota is distinctive from that elsewhere in the state, containing several species with restricted distribution. Floristic diversity is low in Wet Prairies in western Minnesota, but distinctive species assemblages occur there in association with saline sites.

61311 Wet prairie saline subtype

See description of 61310 Wet prairie

NVCS description of a more broadly defined community (CEGL002255): This inland saltgrass wet meadow is found in the northeastern and north-central Great Plains and tallgrass prairie regions of the United States and adjacent Canada, ranging from Minnesota and the Dakotas to Manitoba. Stands occur on terraces, floodplains, swales and other low sites where drainage is poor. The soils are moderately to strongly saline, fine-textured, and moderately deep to deep. The water table is often high and salt encrustations may be present on the surface. This community has low species diversity and is dominated by salt-tolerant graminoids. Total vegetation cover is sparse to moderate and bareground is common. The dominant species are *Distichlis spicata* and *Hordeum jubatum*. Other common species include *Muhlenbergia asperifolia, Muhlenbergi richardsonis, Puccinellia nuttalliana, Sporobolus asper, Suaeda calceoliformis,* and *Spartina gracilis. Pascopyrum smithii* and *Bouteloua gracilis* can be common on relatively dry inclusions within this community and *Elymus lanceolatus* may be found on the upland border. Common forbs include *Ambrosia coronopifolia, Aster ericoides, Chenopodium leptophyllum, Grindelia squarrosa, Melilotus officinalis, Plantago elongata, Plantago patagonica*, and *Salicornia rubra*.

61320 Wet meadow - temporarily flooded soils

See description of 61420 Wet meadow

Key-based definition: A wetland on temporarily flooded soils with <30% tree cover and <50% shrub cover and NOT dominated by prairie species or non-native species.

61330 Temporarily flooded altered/non-native dominated grassland +

Key-based definition: This community, with <30% tree cover and <50% shrub cover and dominated by non-native species (especially reed canary grass), is subject to occasional floodplain inundations or is flooded frequently enough that the vegetation includes at least 50% cover by hydrophytic species.

61340 Cattail marsh - temporarily flooded

See description of 61610 Cattail marsh

Key-based definition: A wetland on temporarily flooded soils with <30% tree cover and <50% shrub cover and dominated by cattails.

Saturated graminoid vegetation

61400 Saturated graminoid vegetation. Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season.

61410 Wet prairie - saturated soils.

See description of 61310 Wet prairie

Key-based definition: A prairie species dominated grassland growing on saturated soils with <30% tree cover and <50% shrub cover (<30% in northwestern Minnesota).

61411 Wet prairie saline subtype - saturated soils

See description of 61311 Wet prairie saline subtype

61412 Wet prairie seepage subtype - saturated soils

See description of 61310 Wet prairie

Mn DNR Natural Heritage description: Occurrences of the Seepage Subtype almost always have significant shrub cover (especially by bog birch). Further data collection and analysis may reveal that these seepage occurrences are actually Wet Brush Prairie rather than Wet Prairie. Revision of the existing sections and recognition of additional subtypes on the basis of soil properties is possible, following collection and analysis of plot data.

61420 Wet meadow[+]

Key-based definition: A wetland on saturated soils where peat is <0.5m deep and the leaves of most grasses and sedges (such as *Calamagrostis canadensis*, *Carex lacustris*, and *C. stricta*, NOT prairie species) are >3mm wide. There is <50% cover by tall shrubs, no sphagnum moss, and no groundwater discharge.

Mn DNR Natural Heritage description: Wet Meadow is present throughout Minnesota. The groundlayer of the community is composed of dense, closed stands of predominately wide-leaved sedges (e.g., *Carex lacustris*, *C. stricta*, *C. aquatilis C. rostrata*, *C. haydenii*) or grasses (e.g., *Calamagrostis canadensis*, *C. inexpansa*). On saturated soils *C. stricta* is more common, while on seasonally flooded soils *C. lacustris* is more common. Forb cover and diversity usually are high. Forbs such as spotted joe-pye weed (*Eupatorium maculatum*), common mint (*Mentha arvensis*), turtlehead (*Chelone glabra*), and swamp milkweed (*Asclepias incarnata*) are conspicuous. Shrub cover in Wet Meadows ranges from 0 to 70% and is composed of Bebb's willows and pussy willows. Mosses are rare or absent.

Wet Meadow occurs on wet mineral soil, muck, or shallow peat (<0.5 m). Standing water (generally stagnant) is present in the spring and after heavy rains, but the water table is

generally below the soil surface for most of the growing season. The drawdown of the water table as the growing season progresses enables the oxidation of dead organic matter that has accumulated on the ground surface from previous years. This process makes available nutrients for some of the nutrient-demanding species present in the community. Occurrences of Wet Meadow along stream courses or adjacent to lakes often have fairly constant water levels relative to Wet Meadows in depressions or basins. On these sites siltation may be important in maintaining high nutrient levels.

Wet Meadow tends to succeed to Shrub Swamp communities in the absence of fire. Water-table lowering caused by drought or by ditching promotes succession of Wet Meadow to Shrub Swamps. Wet Meadows on organic soils, like other communities that occur on organic soils, recover very slowly, if at all, once altered by artificial flooding or draining.

There is one subtype, a Shrub Subtype.

61430 Cattail marsh -saturated soils

See description of 61610 Cattail marsh

Key-based definition: A wetland on saturated soils where cattails comprise >50% of the vegetation, but even when they form a monotypic canopy there is still fairly high plant diversity.

61440 Calcareous seepage fen

Key-based definition: A wetland on saturated soils where peat is >0.5m deep and the leaves of most grasses and sedges are <3mm wide. There is calcareous groundwater seepage, <50% cover by shrubs (including dwarf-shrubs), and no sphagnum moss.

Mn DNR Natural Heritage description: Calcareous Seepage Fen is an open sedge and rush community that occurs throughout Minnesota. The groundlayer is usually dominated by wiregrass sedge (*Carex lasiocarpa*), *Carex sterilis*, beaked-sedge (*Rhynchospora capillacea*), spike-rush (*Eleocharis rostellata*), and *Scirpus cespitosus*. Marsh muhly (*Muhlenbergia glomerata*), grass of Parnassus (*Parnassia glauca*) and Kalm's lobelia (*Lobelia kalmii*) are often present in Calcareous Seepage Fens (as well as in Rich Fens). Shrubs, including bog birch, sage-leaved willow, and shrubby cinquefoil, are common in the community. Mosses range in cover from abundant to scarce.

Calcareous Seepage Fens occur on shallow or deep peaty soils in areas of calcareous groundwater discharge. The surface water is usually circumneutral (pH 6.8 - 8.0) with high concentrations of dissolved salts ($[Ca^{2+}]$ = 10-100 mg/l) that often form a visible marl precipitate. The discharge water is low in oxygen (anoxic), which is believed to be important in inhibiting dense vegetation growth, thereby promoting the occurrence of several rare heliophytic vascular and bryophyte plant species in the community.

61441 Calcareous seepage fen boreal subtype

See description of 61440 Calcareous seepage fen

Mn DNR Natural Heritage description: The Boreal Subtype occurs in the Conifer-Hardwood Forest Zone and contains species characteristic of high-boreal peatlands, including bog-rosemary

(*Andromeda glaucophylla*), small cranberry (*Vaccinium oxycoccos*), and pitcher plant (*Sarracenia purpurea*). The Boreal Subtype has no recognized geographic sections.

61442 Calcareous seepage fen prairie subtype

See description of 61440 Calcareous seepage fen

Mn DNR Natural Heritage description: The Prairie Subtype (which occurs in both the prairie and deciduous forest-woodland zones) contains many characteristically prairie species, including big bluestem (*Andropogon gerardi*), yellow stargrass (*Hypoxis hirsuta*), Virginia mountain-mint (*Pycnanthemum virginianum*), starry false Solomon's-seal (*Smilacina stellata*), and golden alexanders (*Zizia aurea*). The Prairie Subtype also commonly contains patches of emergent aquatic species such as broad-leaved cattail (*Typha latifolia*), hard-stemmed bulrush (*Scirpus acutus*), *Scirpus americanus*), and common reed grass (*Phragmites australis*). The Prairie Subtype is divided into three geographic sections, a Southeast Section, a Southwest Section, and a Northwest Section.

61450 Poor fen

Mn DNR Natural Heritage description: Poor Fen is most common in the conifer-hardwood forest zone, with scattered occurrences in the deciduous forest-woodland zone. The ground cover of the community is dominated by wiregrass sedge (*Carex lasiocarpa*) or few-seeded sedge (*C. oligosperma*). Mud sedge (*C. limosa*), creeping sedge (*C. chordorrhiza*), beaked-sedge (*Rhynchospora alba*), tufted club-rush (*Scirpus cespitosus*), scheuchzeria (*Scheuchzeria palustris*), and ericaceous shrubs are present in most Poor Fens as associates of the dominant sedges. Poor Fens have at least 50% cover by sphagnum mosses, and up to 70% cover by shrubs and small trees, most commonly bog birches and stunted tamaracks.

Poor Fen occurs on deep peat (>1.0m) that receives minimal nutrient-rich run-off from surrounding uplands. In Minnesota's large patterned peatlands, Poor Fen often is present on sites with water infiltration from adjacent raised bogs. Less frequently, Poor Fen occurs in the interiors of small basins that are relatively isolated from run-off. The surface water of Poor Fen is slightly acidic (pH 4.1 - 5.9) and nutrient poor ($[Ca^{2+}]$ <13 mg/l). Poor Fen is transitional between Rich Fen and Open Bog and commonly grades into these communities on the landscape.

There are four subtypes of Poor Fen, a Sedge Subtype, a Shrub Subtype, a Scrub Tamarack Subtype, and a Patterned Subtype.

61451 Poor fen sedge subtype

See description of 61450 Poor fen

Key-based definition: A saturated wetland on peat >0.5m deep where grasses and sedges, such as *Carex lasiocarpa*, and *C. chordorrhiza*, are mostly <3mm wide and there is <50% cover by shrubs, including dwarf-shrubs. The community does not occur on the floating mat at the edge of a shallow lake and lacks the complex patterned topography of strings and flarks. The following species are NOT common: *Carex livida, C. buxbaumii, Pedicularis lanceolata, Eleocharis compressa, Muhlenbergia glomerata,* and *Lobelia kalmii*.

NVCS description of a more narrowly defined community (CEGL002265): This graminoid poor fen community is found in the Great Lakes region of the United States and Canada, as well as elsewhere in central Canada, ranging from Ontario to Manitoba, south to Iowa, and east to Illinois. Stands are found in peatlands with low exposure to mineral-rich groundwater, including basin fens, shores above the level of seasonal flooding and larger peatlands. Water hydrology is saturated, and surface water is slightly acidic and nutrient poor. The vegetation is dominated by graminoids, with up to 25 percent shrub cover, and scattered trees. The dominant graminoid is *Carex lasiocarpa*, and typical associates include *Carex chordorrhiza, Carex limosa, Carex oligosperma, Rhynchospora alba, Scirpus cespitosus*, and *Scheuchzeria palustris*. Forbs include *Arethusa bulbosa, Aster borealis, Calopogon tuberosus, Pogonia ophioglossoides, Sarracenia purpurea, Solidago uliginosa*. The low-shrub layer contains *Andromeda polifolia, Betula pumila, Chamaedaphne calyculata, Larix laricina, Salix discolor, Salix pedicellaris*, and *Vaccinium oxycoccos*. The moss layer is virtually continuous, and is dominated by *Sphagnum capillifolium, Sphagnum fuscum*, and *Sphagnum magellanicum*. Diagnostic features include the dominance of graminoids, particularly *Carex lasiocarpa*, the almost continuous layer of *Sphagnum* peat, and few minerotrophic indicators.

61452 Poor fen patterned fen subtype

See description of 61450 Poor fen

Key-based definition: A saturated wetland on peat >0.5m deep where grasses and sedges, such as *Carex lasiocarpa*, and *C. chordorrhiza*, are mostly <3mm wide. The community does not occur on the floating mat at the edge of a shallow lake and the following species are NOT common: *Carex livida, C. buxbaumii, Pedicularis lanceolata, Eleocharis compressa, Muhlenbergia glomerata,* and *Lobelia kalmii*. The fen has complex patterned topography with strings (hummocks usually dominated by shrubs such as bog birch and leatherleaf) and flarks (flat hollows) with a sphagnum lawn and *Carex oligosperma, Equisetum fluviatile, Menyanthes trifoliata*, and *Scheuchzeria palustris*.

NVCS description of an equivalent community (CEGL002502): This patterned poor fen represents a complex of strings and flarks in peatlands in the boreal regions of the Great Lakes and central Canada, ranging from Michigan to Minnesota, and northward into parts of Central Canada, from Quebec to Manitoba, and possibly elsewhere. Microtopography is high to intermediate hummocks (strings) with hollows or flats (flarks) comprised of a *Sphagnum* lawn. Substrate is a fibric peat. These peatlands are exposed to low levels of mineral-rich groundwater, and are typically found in the margins of larger peatlands. The hollows generally contain a lawn of *Sphagnum spp*. (including *Sphagnum angustifolium*) and *Carex oligosperma, Equisetum fluviatile, Menyanthes trifoliata*, and *Scheuchzeria palustris. Carex chordorrhiza* can also be present. The strings (or hummocks) are shrub dominated and contain *Betula pumila, Chamaedaphne calyculata*, and *Andromeda polifolia*. Scattered short stems (<2 m) of *Picea mariana* and *Larix laricina* cover less than 10% of the area. The herbaceous layer on the hummocks contains *Carex oligosperma, Carex limosa, Drosera rotundifolia, Maianthemum trifolium*, and *Sarracenia purpurea*. Mosses include *Sphagnum angustifolium, Sphagnum fuscum*, and *Sphagnum magellanicum*. Patterning is diagnostic of the type as is the presence of

minerotrophic indicators, such as *Betula pumila*. This type is somewhat wet, and *Carex oligosperma* is more common than *Carex lasiocarpa*.

61460 Rich fen

Mn DNR Natural Heritage description: Rich Fen occurs in the conifer-hardwood forest and deciduous forest-woodland zones. The groundlayer is dominated by wiregrass sedge (*Carex lasiocarpa*), brown sedge (*Carex buxbaumii*), livid sedge (*Carex livida*), *Calamagrostis neglecta*, or bog reed-grass (*Calamagrostis inexpansa*). Although generally open communities, Rich Fens may have up to 70% cover of woody shrubs, especially bog birches, sage-leaved willows, and shrubby cinquefoils. Mosses range from scarce to abundant in the community. Where mosses are abundant, the dominant species are species other than *Sphagnum* spp.

Surface waters within the community are slightly acidic to circumneutral (pH 5.8 - 7.8) with moderate nutrient levels ($[Ca^{2+}]$ = 10-32 mg/l). Rich Fen grades into Poor Fen but is distinguishable from Poor Fen by its higher species diversity and by the more frequent occurrence and greater abundance of minerotrophic indicator species, including livid sedge (*Carex livida*), brown sedge (*C. buxbaumii*), swamp lousewort (*Pedicularis lanceolata*), spike-rush (*Eleocharis compressa*), marsh muhly (*Muhlenbergia glomerata*), and Kalm's lobelia (*Lobelia kalmii*).

There are two geographic sections of Rich Fen, a Transition Section and a Boreal Section. In the Boreal Section, Rich Fen usually occurs on deep peat and contains characteristically northern species such as bog-rosemary (*Andromeda glaucophylla*) and other ericaceous shrubs, the bulrush *Scirpus hudsonianus*, and pitcher-plant (*Sarracenia purpurea*). In the Transition Section Rich Fen may be present on relatively shallow peat, or on very shallow, highly decomposed, low-buoyancy peat, or even on wet mineral soil. Floristically, Rich Fen in the Transition Section differs from Rich Fen in the Boreal Section mainly by containing prairie species, such as grass-leaved goldenrod (*Euthamia graminifolia*), Sartwell's sedge (*Carex sartwellii*), and wooly sedge (*C. lanuginosa*).

61461 Rich fen sedge subtype

See description of 61460 Rich fen

Key-based definition: A saturated wetland on peat >0.5m deep where grasses and sedges, such as *Carex lasiocarpa*, and *C. chordorrhiza*, are mostly <3mm wide and there is <50% cover by shrubs, including dwarf-shrubs. The community does not occur on the floating mat at the edge of a shallow lake and lacks the complex patterned topography of strings and flarks. There is no discharge of calcareous groundwater, and the following species are often common: *Carex livida, C. buxbaumii, Pedicularis lanceolata, Eleocharis compressa, Muhlenbergia glomerata,* and *Lobelia kalmii*.

61462 Rich fen floating-mat subtype - saturated soils

See description of 61460 Rich fen

Key-based definition: A saturated wetland on peat >0.5m deep where grasses and sedges, such as *Carex lasiocarpa*, and *C. chordorrhiza*, are mostly <3mm wide. The community lacks the

complex patterned topography of strings and flarks, and there is no discharge of calcareous groundwater. The community occurs on the floating mat at the edge of a shallow lake, and the following species are often common: *Carex livida, C. buxbaumii, Pedicularis lanceolata, Eleocharis compressa, Muhlenbergia glomerata,* and *Lobelia kalmii*.

61463 Rich fen patterned fen subtype

See description of 61460 Rich fen

Key-based definition: A saturated wetland on peat >0.5m deep where grasses and sedges, such as *Carex lasiocarpa*, and *C. chordorrhiza*, are mostly <3mm wide. The community does not occur on the floating mat at the edge of a shallow lake and there is no discharge of calcareous groundwater. The following species are often common: *Carex livida, C. buxbaumii, Pedicularis lanceolata, Eleocharis compressa, Muhlenbergia glomerata,* and *Lobelia kalmii*. The fen has complex patterned topography with strings (hummocks usually dominated by shrubs such as bog birch and leatherleaf) and flarks (flat hollows) with a sphagnum lawn and *Carex oligosperma, Equisetum fluviatile, Menyanthes trifoliata*, and *Scheuchzeria palustris.*

NVCS description of an equivalent community (CEGL005117): This patterned rich fen community is found in peatlands in the Upper Great Lakes region of the United States and Canada, and in the northeastern United States and central Canada, ranging from Minnesota to Michigan, and into central Canada, from Manitoba to Quebec. Stands are typically found in water tracks of large peatlands, perpendicular to the water flow, where strings (hummocks) and flarks (hollows) form. Shrubs and stunted trees dominate the physiognomy. This scrub layer contains *Betula pumila, Chamaedaphne calyculata, Larix laricina, Ledum groenlandicum, Pentaphylloides floribunda, Rhamnus alnifolia, Salix pedicellaris*, and *Thuja occidentalis*. The dwarf-shrub layer contains *Andromeda polifolia, Juniperus horizontalis, Lonicera villosa*, and *Vaccinium oxycoccos*. The herb-rich layer contains graminoids such as *Carex interior, Carex lasiocarpa, Carex limosa, Carex livida, Muhlenbergia glomerata, Scirpus cespitosus*, and *Eriophorum alpinum (= Scirpus hudsonianus)*. Common forbs include *Equisetum fluviatile, Galium labradoricum, Maianthemum trifolium, Menyanthes trifoliata, Sarracenia purpurea, Solidago uliginosa, Tofieldia glutinosa*, and *Triglochin maritimum*. Occasionally, locally abundant species include *Carex exilis*, and *Cladium mariscoides*. The moss layer contains brown mosses, such as *Campylium stellatum, Limprichtia revolvens (= Drepanocladus revolvens), Scorpidium scorpioides* (eastern part of the range), and *Tomentypnum nitens*, with patches of *Sphagnum spp*. Submergent aquatics, such as *Utricularia intermedia* and *Utricularia minor* may be found in the flarks.

61470 Open bog

See description of 51110 Open sphagnum bog

61471 Open sphagnum bog schlenke subtype

See description of 51110 Open sphagnum bog

Key-based definition: A sphagnum-covered bog where *Carex lasiocarpa* and *C. chordorrhiza* and also shade tolerant species are all rare in the ground layer, shrubs (including dwarf-shrubs) cover <50%, and pool formations have developed near bog crests. *Rhynchospora alba* and *Utricularia cornuta* are present, and hollows contain *Sphagnum cuspidatum*.

MnDNR Natural Heritage description: The Schlenke Subtype is rare. It occurs only in three raised bogs in Minnesota in which pool formations have developed near the bog crests. The Schlenke Subtype is characterized by maritime bog species such as scheucherzia *(Scheucherzia palustris*), beaked-sedge (*Rhynchospora alba*), and horned bladderwort (*Utricularia cornuta*), and hollows containing *Sphagnum cuspidatum*.

61472 Graminoid bog

See description of 51110 Open sphagnum bog

Key-based definition: A sphagnum-covered bog where *Carex lasiocarpa*, and *C. chordorrhiza* and also shade tolerant species are all rare in the ground layer, and shrubs (including dwarf-shrubs) cover <50%. Pool formations have NOT developed near bog crests. *Rhynchospora alba* and *Utricularia cornuta* are NOT present, and hollows do NOT contain *Sphagnum cuspidatum*.

NVCS description: This open sedge/sphagnum bog type is found widely in the boreal/sub-boreal regions of the Great Lakes, and more widely in Canada.. It ranges from Minnesota to possibly Maine, and northward in Canada from Quebec to Manitoba and possibly elsewhere. Stands occur in drainageways at margins of raised bogs in large peatland complexes, or occasionally on shores, but isolated from groundwater influence. The substrate is a saturated, fibric peat. The vegetation is either dominated by sedges, especially *Carex oligosperma*, or by *Sphagnum spp*. (sphagnum lawns). Shrub cover is less than 25%, and tree cover is less than 10%. Microtopography in more northern stands is high hummocks and weakly developed hollows, but some stands can be flat. The groundcover is a continuous layer of *Sphagnum spp*., including *Sphagnum angustifolium, Sphagnum fuscum* and *Sphagnum magellanicum*,. Graminoid-dominated examples contain *Carex oligosperma* and *Carex pauciflora*, as well as *Eriophorum vaginatum* and *Eriophorum virginicum*. Herbs include *Sarracenia purpurea* and *Scheuchzeria palustris*. Scattered low shrubs may occur, such as *Andromeda polifolia, Chamaedaphne calyculata, Kalmia polifolia, Ledum groenlandicum*and *Vaccinium oxycoccos*. Minerotrophic indicators may be present at low cover when rooted in minerotrophic peat beneath the mat, such as *Betula pumila, Carex aquatilis* and *Carex stricta*.

61480 Saturated altered/non-native dominated graminoid vegetation +

Key-based definition: A wetland on saturated soils with <30% tree cover and <50% shrub cover that is dominated by non-native species, especially reed canary grass. This type also includes monotypic cattail stands when few (or no) other plant species are present.

Seasonally flooded emergent vegetation

61500 Seasonally flooded emergent vegetation. Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is very variable, extending from saturated to a water table well below the ground surface. Includes Cowardin's Seasonal, Seasonal-Saturated, and Seasonal-Well Drained modifiers.

61510 Cattail marsh - seasonally flooded +

See description of 61610 Cattail marsh

Key-based definition: A wetland on seasonally flooded soils with <30% tree cover and <50% shrub cover and dominated by cattails, but even when they form a monotypic canopy there is still fairly high plant diversity.

61520 Mixed emergent marsh - seasonally flooded

See description of 61620 Mixed emergent marsh

Key-based definition: A wetland on seasonally flooded soils with <30% tree cover and <50% shrub cover that is NOT dominated by cattails, non-native species, or native graminoids <1m tall.

61530 Seasonally flooded altered/non-native dominated emergent vegetation +

Key-based definition: A wetland on seasonally flooded soils with <30% tree cover and <50% shrub cover that is dominated by non-native species, especially reed canary grass or purple loosestrife. This type also includes monotypic cattail stands when few (or no) other plant species are present.

61540 Wet meadow - seasonally flooded

Key-based definition: A wetland on seasonally flooded soils with <30% tree cover and <50% shrub cover that is NOT dominated by cattails, non-native species, or native graminoids >1m tall.

Semipermanently flooded emergent vegetation

61600 Semipermanently flooded emergent vegetation. Surface water persists throughout the growing season in most years. Land surface is normally saturated when water level drops below soil surface. Includes Cowardin's Intermittently Exposed and Semipermanently Flooded modifiers.

61610 Cattail marsh [+]

Key-based definition: A wetland on semipermanently flooded soils with <30% tree cover and <50% shrub cover and dominated by cattails, but even when they form a monotypic canopy there is still fairly high plant diversity.

Mn DNR Natural Heritage description: Cattail Marsh is an emergent marsh dominated by cattails (including *Typha angustifolia*, *T. latifolia*, and their hybrids). It occurs most commonly along lake margins and in shallow basins, although it is sometimes also present in river backwaters. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots do not contact the bottom but instead the plants grow suspended in a buoyant peaty mat. Associated species vary widely, but some of the most common ones are sedges of the genus *Carex* (*C. aquatilis*, *C. rostrata*, and *C. lanuginosa*), bulrushes (*Scirpus americanus*, *S. acutus*, and *S. heterochaetus*), and broad-leaved herbs such as northern marsh fern (*Thelypteris palustris*), swamp milkweed (*Asclepias incarnata*), jewel-weed (*Impatiens capensis*), broad-leaved arrowhead (*Sagittaria latifolia*), mad-dog skullcap (*Scutellaria lateriflora*), marsh skullcap (*Scutellaria galericulata*), and blue vervain (*Verbena hastata*).

61620 Mixed emergent marsh[+]

Key-based definition: A wetland on semipermanently flooded soils with <30% tree cover and <50% shrub cover that is NOT dominated by cattails or non-native species.

Mn DNR Natural Heritage description: Mixed emergent marsh is dominated by wetland species other than cattails. Bulrushes are the most common dominants, especially hard-stemmed bulrush (*Scirpus acutus*), river bulrush (*Scirpus fluviatilis*), softstem bulrush (*Scirpus validis*), *Scirpus americanus*, and *Scirpus heterochaetus*. Common reed grass (*Phragmites australis*), spike rushes (*Eleocharis* spp.), and (in some river backwaters) prairie cordgrass (*Spartina pectinata*) are less common dominants. In general, Mixed Emergent Marsh tends to occur on harder pond, lake, or river bottoms than Cattail Marsh and is less likely to contain the forbs that grow on the floating peat mats present in many cattail marshes. Broad-leaved arrowhead (*Sagittaria latifolia*) and aquatic macrophytes are the most common non-graminoid associates. Many Mixed Emergent Marsh species are sensitive to fertilizer run-off and other artificial disturbances, and disturbed Mixed Emergent Marshes (especially in the Prairie Zone) tend to convert to Cattail Marshes or become strongly dominated by reed canary grass (*Phalaris arundinacea*) or common reed grass (*Phragmites australis*), species that increase in abundance with disturbance.

Mixed Emergent Marsh is a broad community type, encompassing all marshes dominated by species other than cattails. Therefore, subtyping or recognition of new marsh types is likely following more thorough inventories of these marshes. New divisions most likely will be made according to dominant species or basin types (e.g., lacustrine versus riverine), or both. There are two geographic sections, a Forest Section and a Prairie Section. The dominant species in the Prairie Section tend to have a Great Plains distribution while those in the Forest Section tend to have a Great Lakes distribution.

61630 Semipermanently flooded altered/non-native dominated vegetation

Key-based definition: A wetland on semipermanently flooded soils with <30% tree cover and <50% shrub cover that is dominated by non-native species, such as purple loosestrife. This type also includes monotypic cattail stands when few (or no) other plant species are present.

61640 Wet meadow – semipermanently flooded

See description of 61420 Wet meadow

Key-based definition: A wetland on semipermanently flooded soils with <50% shrub cover that is not dominated by cattails, non-native species, or native graminoids >1m tall. The leaves of most grasses and sedges are >3mm wide. Dominant species often include *Calamagrostis canadensis* and *Carex lacustris*.

61641 Wet Meadow, floating mat subtype

See description of 61420 Wet meadow

Key-based definition: A floating wetland in a semipermanently flooded basin that is not dominated by cattails, non-native species, or native graminoids >1m tall. The leaves of most grasses and sedges are >3mm wide, but some narrow-leaved species are also present.

61650 Rich fen, floating mat subtype – semipermanently flooded

Key-based definition: A floating wetland in a semipermanently flooded basin that is not dominated by cattails or non-native species or native graminoids >1m tall. The leaves of most grasses and sedges are <3mm wide.

See description of 61460 Rich fen

Intermittently exposed emergent vegetation

61700 Intermittently exposed emergent vegetation. Surface water is present throughout the year except in years of extreme drought.

61710 Cattail marsh - intermittently exposed

See description of 61610 Cattail marsh

Key-based definition: A wetland on intermittently exposed soils with <30% tree cover and <50% shrub cover and dominated by cattails, but even when they form a monotypic canopy there is still fairly high plant diversity.

61720 Mixed emergent marsh - intermittently exposed

See description of 61620 Mixed emergent marsh

Key-based definition: A wetland on intermittently exposed soils with <30% tree cover and <50% shrub cover that is NOT dominated by cattails or non-native species.

61730 Intermittently exposed altered/non-native dominated vegetation

Key-based definition: A wetland on intermittently exposed soils with <30% tree cover and <50% shrub cover that is dominated by non-native species, such as purple loosestrife. This type also includes monotypic cattail stands when few (or no) other plant species are present.

61740 Rich fen floating-mat subtype intermittently exposed

See description of 61460 Rich fen

Key-based definition: A floating wetland in an intermittently exposed basin that is not dominated by cattails or non-native species.

Permanently flooded emergent vegetation

61800 Permanently flooded emergent vegetation. Water covers the land surface at all times of the year in all years.

61810 Cattail marsh - permanently flooded

See description of 61610 Cattail marsh

Key-based definition: A wetland on permanently flooded soils with <30% tree cover and <50% shrub cover and dominated by cattails, but even when they form a monotypic canopy there is still fairly high plant diversity.

61820 Mixed emergent marsh - permanently flooded

See description of 61620 Mixed emergent marsh

Key-based definition: A wetland on permanently flooded soils with <30% tree cover and <50% shrub cover that is NOT dominated by cattails or non-native species.

61830 Permanently flooded altered/non-native dominated vegetation

Key-based definition: A wetland on permanently flooded soils with <30% tree cover and <50% shrub cover that is dominated by non-native species, such as purple loosestrife. This type also includes monotypic cattail stands when few (or no) other plant species are present.

61840 Rich fen floating-mat subtype permanently flooded

See description of 61460 Rich fen

Key-based definition: A floating wetland in a permanently flooded basin that is not dominated by cattails or non-native species.

Grassland with sparse tree layer

62000 Grassland with sparse tree layer Upland vegetation with 10-70% cover by trees, where >30% of non-tree cover is herbaceous

Tall grassland with sparse deciduous trees

62100 Tall grassland with sparse deciduous trees Upland vegetation with 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous

62110 Aspen openings

Key-based definition: Upland vegetation in northwestern Minnesota with 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous (prairie-dominated) and where aspens or balsam poplars comprise >50% of the tree cover.

Mn DNR Natural Heritage description: Aspen Openings are fine-grained mosaics of aspen groves and prairie or brush-prairie. They occur in the northern part of the deciduous forest-woodland zone. The dominant trees are quaking aspens, which frequently are mixed with balsam poplars; bur oaks are sometimes present on drier sites. The aspen and balsam poplar groves consist predominantly of young trees that originated from scattered mature trees by root suckering following fire. The bur oaks are usually small, spindly, and overtopped by the aspens and poplars, but larger well-formed trees are not uncommon.

Aspen openings exist on sites ranging from wet to mesic. The understory composition in the tree groves and prairie openings varies with this range in moisture. Understory vegetation within the tree groves is often similar to that of Aspen Woodland. However, in young

occurrences that have recently invaded prairie, prairie herbs and shrubs dominate the understory vegetation.

Aspen Openings develop on nearly level to gently undulating topography. On low sites, aspen groves occur in the better-drained areas and wet prairie occurs in the open areas between groves. On more mesic sites, especially southward, aspen groves often have developed in wet-mesic to wet depressions, with mesic prairie present in better-drained areas between the groves. Historically, Aspen Openings existed where fire was frequent or intense enough to prevent complete succession to woodland. In the prolonged absence of fire, Aspen Openings succeed to Aspen Woodland, with only the wettest areas (e.g., Wet Meadow and Marsh areas) remaining open. Drought stress is also important in maintaining Aspen Openings, and often interacts with fire. Most modern examples of Aspen Openings probably represent succession from Brush Prairie (where quaking aspen and balsam poplar were present but rarely reached tree size) following fire suppression, or from the invasion of other prairie types by aspen following fire suppression. It is not known whether Aspen Openings can be maintained as a stable type or whether occurrences are always transitory.

Aspen Openings is a scale-dependent community, as it is a composite of prairie communities and Aspen Woodland. Because of this, the placement of boundaries between Aspen Openings and Aspen Woodland or between Aspen Openings and Brush-Prairie communities is usually subjective.

62111 Aspen openings sand-gravel subtype

See description of 62110 Aspen openings

Mn DNR Natural Heritage description: There is one recognized subtype of Aspen Openings, the Sand-Gravel Subtype. The Sand-Gravel Subtype is a dry-mesic to mesic savanna present in areas of undulating outwash with coarse-textured gravelly soils (gravel fraction >10%). The herbaceous vegetation in openings between aspen groves is similar to that of the Sand-Gravel Subtype of Upland Prairie.

62120 Dry oak savanna

Key-based definition: Upland vegetation with 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous (prairie-dominated) and where oaks comprise >30% of the tree cover. The soil is composed of sand or gravel (sometimes with a thin organic surface layer), or any texture on steep slopes.

Mn DNR Natural Heritage description: This dry to dry-mesic community is most common in the deciduous forest-woodland zone, but also occurs sporadically throughout the prairie zone. The principal trees are bur oaks and northern pin oaks, but black oaks are also common in the southeast. Northwards, quaking aspens become more frequent in the community. The stature and spacing of trees is somewhat variable, reflecting differences in soils, topography, and climate, factors that strongly affect local droughtiness and fire frequency. Small, gnarly, open-grown trees are most common, although in moister spots, or in heavier soils, larger trees are sometimes more common. Tree spacing ranges from sparsely and evenly distributed to strongly

clumped in moderately dense patches. Shrub cover is variable as well. The species composition of the shrub layer depends somewhat upon soil characteristics. Oak grubs and chokecherries are common on all soil types. On sandier soils, prairie willows (*Salix humilis*), New Jersey tea (*Ceanothus americanus*), American hazelnuts (*Corylus americana*), sand cherries (*Prunus pumila*), and juneberries (*Amelanchier* spp.) are usually present. Wolfberries (*Symphoricarpos occidentalis*) are commoner on heavier soils.

Dry Oak Savanna occurs on the same kinds of landforms as Dry Prairie, except for bedrock bluffs. Correspondingly, substrates range from excessively-drained to well-drained, sand to loam soils. The presence of savanna rather than prairie indicates a lower fire frequency or intensity (or both) than in prairie. Dry Oak Savanna requires less frequent fire than Mesic Savanna for maintenance. However, in the complete absence of fire woodland will eventually replace Dry Oak Savanna. Grazing and browsing animals may also have had a role in the maintenance of Dry Oak Savanna. Because Dry Oak Savanna occurs on sites that are not as suitable for cultivation as Mesic Savanna sites, and because succession in the absence of fire is not as rapid, more examples remain of Dry Oak Savanna than of Mesic Oak Savanna.

62121 Dry oak savanna hill subtype

See description of 62120 Dry oak savanna

Mn DNR Natural Heritage description: This subtype occurs on the same kinds of sites as the Hill Subtype of Dry Prairie. Occurrences are concentrated along the ecotone between the prairie and deciduous forest-woodland zones, and tend to be small. Bur oak and northern pin oak are the major oak species; aspen becomes important northwards. The most common shrubs are chokecherries, wolfberries, and smooth sumacs. Leadplant is always present. The density of the shrub layer is highly variable. The herbaceous vegetation of open areas between trees is essentially the same as that of the Hill Subtype of Dry Prairie. This subtype succeeds to woodland almost as rapidly as Mesic Oak Savanna except on the steepest, droughtiest slopes. Therefore, few examples remain. Most surviving examples have a history of fairly heavy grazing.

The Hill Subtype occurs in the Southwest, Southeast, and Central Sections of Dry Oak Savanna.

62122 Dry oak savanna barrens subtype

See description of 62120 Dry oak savanna

Mn DNR Natural Heritage description: This subtype occurs on the same kinds of sand deposits as the Barrens Subtype of Dry Prairie. On dune blankets it tends to be favored over prairie in areas of sharper relief. Bur oaks are generally the prevalent trees; northern pin oaks are also common in the Central Section, and black oaks are common in the Southeast Section. In the Northwest and Central Sections quaking aspens are common in moister spots (this may represent post-settlement invasion). Trees range in spacing from sparse and evenly spaced to strongly clumped. The shrub layer is usually sparse; the most common species are oaks (in the form of grubs), chokecherry, American hazel, smooth sumac, and prairie willow. Creeping juniper

(*Juniperus horizontalis*) is common in the northwest, and bush juniper (*Juniperus communis*) and New Jersey tea (*Ceanothus americanus*) are usually present in the Central and Southeast Sections. The herbaceous vegetation present in open areas is similar to that of the Barrens Subtype of Dry Prairie.

This subtype grades into the Sand-Gravel Subtype of Dry Oak Savanna. The Barrens Subtype occurs in the Southeast, Central, and Northwest Sections of the community.

62123 Dry oak savanna sand-gravel subtype

See description of 62120 Dry oak savanna

Mn DNR Natural Heritage description: This subtype of Dry Oak Savanna occurs on the same kinds of sites as the Sand-Gravel Subtype of Dry Prairie. Such sites are more likely to be savanna than prairie in the far northwest and within the deciduous forest-woodland zone. Occurrences tend to be small. The oak species composition has the same geographic pattern as in the Barrens Subtype of Dry Oak Savanna, and again quaking aspen becomes important northwards. The shrub species are essentially the same as in the Barrens Subtype, but the shrub layer is generally denser. American hazels, chokecherries, and Juneberries (*Amelanchier* spp.) predominate. Wolfberries are frequent. The herbaceous vegetation is similar to that of the Sand-Gravel Subtype of Dry Prairie. The Sand-Gravel Subtype of Dry Oak Savanna succeeds to woodland more rapidly than the Barrens Subtype.

As noted above, examples of this subtype on outwash material may be difficult to distinguish floristically from the Barrens Subtype. The Sand-Gravel Subtype occurs in the Southeast, Central, and Northwest Sections of Dry Oak Savanna.

62130 Mesic oak savanna

Key-based definition: Upland vegetation with 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous (prairie-dominated) and where oaks comprise >30% of the tree cover, but NOT on steep slopes or on sand- or gravel-dominated soil.

Mn DNR Natural Heritage description: Mesic Oak Savanna is very rare in Minnesota. Historically, it occurred in the prairie and deciduous forest-woodland zones. The characteristic trees were bur oaks and to a lesser extent northern pin oaks. Northward, quaking aspens were probably common in moister parts of Mesic Oak Savannas. The stature and spacing of the oaks in the community probably varied considerably, primarily with differences in fire history, which were themselves related to differences in soils, landforms, and climate. Grubs and small, gnarly, open-grown trees were probably most common. The distribution of trees ranged from evenly spaced to strongly clumped. Shrub cover, likewise, was probably quite variable. The shrub layer included chokecherries (*Prunus virginiana*), low juneberries (*Amelanchier humilis*), gray-bark dogwoods (*Cornus foemina*), wolfberries (*Symphoricarpos occidentalis*), and on lighter soils, prairie willows (*Salix humilis*), New Jersey tea (*Ceanothus americanus*), and American hazelnuts (*Corylus americana*). Leadplant (*Amorpha canescens*) was always present. The herbaceous vegetation was dominated by species typical of Mesic Prairie, but herbs typical

of Oak Woodland and Oak Forest were probably present as well, especially beneath tree or shrub canopies.

Mesic Oak Savanna occurred on dry-mesic to mesic, gently undulating to moderately sloping sites. These sites were on glacial till or outwash, with soil texture ranging from clay loam to sandy loam. Mesic Oak Savanna generally occurred on sites where fire was frequent enough to prevent trees and shrubs from forming closed canopies, thereby permitting heliophilous prairie herbs to dominate the groundlayer. However, fire frequencies were lower than in prairies on similar topography and soils. Native grazing and browsing animals may also have helped maintain the open character of Mesic Oak Savanna. Out in the prairie zone, Mesic Oak Savanna occurred where either topographic features or wetlands, lakes, or streams created local fire "shadows" (areas of reduced fire frequency). Occurrences here were usually small. Closer to the deciduous forest-woodland zone and within it, where landscape character reduced fire frequency on a larger scale, Mesic Oak Savanna often covered larger areas. With settlement and the suppression of prairie fires, savannas in the deciduous forest-woodland zone that escaped clearing and cultivation quickly succeeded to woodland unless heavily and continuously grazed. No good quality examples are known.

62140 Grassland with sparse deciduous trees - altered/non-native dominated vegetation +

Key-based definition: This upland vegetation has 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous and dominated by non-native species. The ground layer is often dominated by brome or Kentucky bluegrass. Common shrubs include sumac and Tartarian honeysuckle. Almost any tree species can be found, but elms, cottonwoods, green ashes, boxelders, and bur oaks are common.

Grassland with sparse conifer or mixed deciduous/coniferous trees

62200 Grassland with sparse conifer or mixed deciduous/coniferous trees - Presettlement savannas on level outwash sands flanking the Mississippi River north of the Twin Cities and on mesic sites in the Anoka Sand Plain may have constituted a Sand Subtype, corresponding to the hypothetical Sand Subtype of Mesic Prairie.

62210 Jack pine barrens

Key-based definition: Upland vegetation with 10-70% cover by trees (of which >25% is conifer), where >30% of non-tree cover is herbaceous (prairie-dominated) and where jack pines comprise >50% of the tree cover.

Mn DNR Natural Heritage description: Trees predominantly jack pine; habitat typically dry sandy soils; openings have groundlayer composed of species characteristic of prairies. Jack Pine Barrens occur on extremely droughty, nutrient-poor dune fields along the border between the conifer-hardwood and deciduous forest-woodland zones in central Minnesota. The tree canopy is patchy and most often is composed purely of jack pines, although occasionally scattered red pines may be present. The deciduous tree species that occur in the community--primarily pin oak and bur oak--are usually present as fire-stunted subcanopy grubs and only rarely grow into

the canopy. Jack Pine Barrens have a sparse tall-shrub layer, composed mostly of American hazelnuts, juneberries, and downy arrowwoods. The groundlayer is sparse, mainly because of the droughty, infertile soils on which the community occurs, and consists of a mixture of sand prairie species and common herbs of dry woodlands.

Jack Pine Barrens is a fire-maintained community. An analysis of fire scars on jack pines in a stand near Brainerd suggests that fires historically occurred in the community every ten years or less. Many of these jack pines have multiple fire scars on their trunks, indicating that most fires are low-intensity ground fires. This type of fire regime is very likely the result of the sparsely vegetated groundlayer in the community, which rarely contains enough biomass to fuel hot crown fires. Thus, it appears that Jack Pine Barrens are maintained by frequent, low-intensity ground fires. Occasionally, however, fires may kill some of the trees in the community, contributing to the formation of the patchy canopy characteristic of savannas. The fires also repeatedly burn back the oak shoots, maintaining the oaks in the community as grubs. The ground fires also may contribute to the open nature of the understory, by preventing the development of a dense shrub layer. At the same time, the droughty, infertile sites on which the community occurs probably slow or prevent the development of a dense shrub layer even in the absence of fire. In the past, grazing by native herbivores may also have been important in maintaining the open structure of the community.

Structurally, Jack Pine Barrens are somewhat similar to Jack Pine Woodland. However, Jack Pine Woodland occurs on comparatively rich prairie soils on outwash, lacks a sand prairie understory, and has a dense shrub understory. There are no recognized subtypes or sections of Jack Pine Barrens.

62220 Grassland with sparse conifer or mixed deciduous/coniferous trees - altered/non-native dominated vegetation

Key-based definition: This upland vegetation has 10-70% cover by trees (of which >25% is conifer), where >30% of non-tree cover is herbaceous and dominated by non-native species. The ground layer is often dominated by brome or Kentucky bluegrass. Common shrubs include sumac, prickly ash, and Tartarian honeysuckle. Tree species generally include red cedars and a mix of other species.

Temporarily flooded grassland with sparse deciduous trees

62300 Temporarily flooded grassland with sparse deciduous trees - Temporarily flooded vegetation with 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous

62310 Altered/non-native grassland with sparse deciduous trees - temporarily flooded^{+}

Key-based definition: This temporarily flooded vegetation has 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous and dominated by non-native species. The ground layer is often dominated by reed canary grass. Common tree species include elms, cottonwoods, ashes, boxelders, and willows.

Saturated grassland with sparse deciduous trees

62400 Saturated grassland with sparse deciduous trees - Saturated flooded vegetation with 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous

62410 Altered/non-native grassland with sparse deciduous trees - saturated soils

Key-based definition: This saturated flooded vegetation has 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous and dominated by non-native species. The ground layer is often dominated by reed canary grass. Common tree species include elms, cottonwoods, green ashes, boxelders, and willows.

Seasonally flooded grassland with sparse deciduous trees

62500 Seasonally flooded grassland with sparse deciduous trees - Seasonally flooded vegetation with 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous

62510 Altered/non-native grassland with sparse deciduous trees - seasonally flooded

Key-based definition: This seasonally flooded vegetation has 10-70% cover by trees (of which <25% is conifer), where >30% of non-tree cover is herbaceous and dominated by non-native species. The ground layer is often dominated by reed canary grass. The most common tree species are ashes and willows.

Perennial Forb vegetation

63000 Perennial Forb vegetation - Perennial forbs (including ferns and biennials) generally contributing to greater than 50% of total herbaceous canopy cover.

Upland forb vegetation

63100 Upland forb vegetation

63110 Talus Slope Algific Subtype

Key-based definition: Talus slope with >25% vegetative cover, but with <10% tree cover and <50% shrub cover. It grows at the base of a north-facing dolostone talus slope and is dominated by the species listed below.

Mn DNR Natural Heritage description: The Algific Subtype occurs only on the Paleozoic Plateau in southeastern Minnesota, at the bases of steep, north-facing dolomite talus slopes. Continuous cold air drainage from fissures and ice caves in the talus creates a cool, moist

microclimate in which summer temperatures rarely exceed 16°C. These talus slopes may be small (one square meter), or narrow linear complexes up to 1.5 km long. Disjunct populations of several northern species are present in Algific Talus Slope communities, including miterwort (*Mitella nuda*), Canada mayflower (*Maianthemum canadense*), bunchberry (*Cornus canadensis*), smaller enchanter's nightshade (*Circaea alpina*), tall lungwort (*Mertensia paniculata*), moschatel (*Adoxa moschatellina*), alder-leaved buckthorn, balsam fir, and American yew. The rare boreal disjunct golden saxifrage (*Chrysosplenium iowense*), and several snail species occur in Minnesota only in this community. The more stable upper talus slopes are forested, usually containing northern species such as balsam fir, American yew, and yellow birch. Algific talus slopes are often associated with Maderate Cliffs (81121).

Saturated forb vegetation

63200 Saturated forb vegetation. Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season.

63210 Seepage meadow

Key-based definition: A wetland on saturated soils where peat is <0.5m deep and the leaves of most grasses and sedges (such as *Calamagrostis canadensis*, *Carex lacustris*, and *C. stricta*, NOT prairie species) are >3mm wide. There is <50% cover by tall shrubs and no sphagnum moss. Groundwater is discharged from springs, often forming rivulets.

Mn DNR Natural Heritage description: Seepage Meadow probably occurs throughout Minnesota, but is best documented in the St. Croix valley. Skunk cabbage (*Symplocarpus foetidus*) and angelica (*Angelica atropurpurea*) are the dominant plants and are indicative of the community. Graminoid cover is generally low; broad-leaved sedges (*Carex lacustris*, *C. stricta*, *C. stipata*, and *C. comosa*) are the most common graminoid species. Northern marsh fern (*Thelypteris palustris*) and jewel-weed (*Impatiens capensis*) are common cover-forming species. Three rare species--bog bluegrass (*Poa paludigena*), water-pennywort (*Hydrocotyle americana*), and false mermaid (*Floerkea proserpinacoides*)--appear to be endemic to Seepage Meadow communities or to small inclusions of Seepage Meadow in swamp forests.

Seepage Meadows develop around spring heads and in broader areas of groundwater discharge, most commonly in deep glacial meltwater-cut river valleys, at the bases of slopes separating stream terraces. The upwelling groundwater is cold and flows year-round. Peat is present in some seepage areas, sometimes in layers greater than one meter thick. Other seepage areas have little organic material, with the groundwater welling up through carbonate encrusted gravel.

There are no recognized subtypes or sections of Seepage Meadow. Most occurrences of Seepage Meadow are small and are classified as inclusions within seepage subtypes of Tamarack Swamp or Hardwood Swamp communities.

Hydromorphic rooted vegetation

64000 Hydromorphic rooted vegetation. Non-emergent graminoids, or forbs structurally supported by water and rooted in substrate**.**

Standing water hydromorphic rooted vegetation

64100 Standing water hydromorphic rooted vegetation

64110 Water lily

Key-based definition: Standing water with >25% cover by rooted species that either float or are submerged, most of which are water lilies.

64111 Water Lily Open Marsh

NVCS description: This rooted aquatic or open marsh community occupies shallow water depressions, oxbow ponds, backwater sloughs of river floodplains, slow moving streams, ponds, and small lakes throughout the central and eastern United States, extending from Maine to Ontario and Minnesota, south to Oklahoma and east to Georgia.. It is dominated by rooted, floating-leaved aquatic species, with both submergent and emergent aquatics also present. *Nuphar lutea ssp. advena* and *Nymphaea odorata* are dominants. Other species present may include *Brasenia schreberi*, various *Potamogeton spp., Polygonum amphibium*, and *Polygonum coccineum*. Submerged aquatics that are more common in the southern part of the range include *Cabomba caroliniana, Ceratophyllum demersum*, and *Heteranthera dubia*.

64112 Boreal Water Lily Aquatic Wetland

NVCS description: This water lily aquatic community type is found in the boreal regions of central Canada, and may occur in the United States. Stands occur on the margins of lakes, or in ponds and slow-moving rivers. The vegetation is dominated by rooted aquatics, with at least 25% cover. Dominants include *Nymphaea tetragona, Nuphar lutea ssp. pumila* and *Nuphar lutea ssp. variegata*.

64113 Northern Water Lily Aquatic Wetland

NVCS description: This water lily aquatic wetland type occurs throughout the upper midwestern region of the United States and adjacent Canada. Stands occur in open, slow-moving water on lakes and streams, often less than 0.5 m deep. The substrate is variable, from muck to sedimentary peat. Emergent vegetation cover is less than 25% and floating-leaved aquatics cover at least 25% of the surface. Typical dominants vary from stand to stand, but include *Nymphaea odorata, Nuphar lutea ssp. pumila*, and *Nuphar lutea ssp. variegata*. Other dominants may include *Brasenia schreberi* and *Potamogeton amplifolius*. A variety of emergent species can occur with this type.

64120 Midwest Pondweed Submerged Aquatic Wetland

Key-based definition: Standing water with >25% cover by rooted species that either float or are submerged, most of which are NOT water lilies.

NVCS description: This broadly defined submerged aquatic or open marsh type is found throughout the midwestern region of the United States and adjacent Canada. Based on information in the northern parts of the Midwest, several vegetation subgroups can be recognized that may be separate associations. Subgroup A is a shallow (<50 cm), sparsely vegetated, open water marsh found on sand, or organic and mineral material trapped in rocky bottoms. Stands are often exposed to wave action and found in oligotrophic lakes. Dominant plants often have basal rosettes that are resistant to wave action. Typical species include *Elatine minima, Eriocaulon aquaticum, Gratiola aurea, Isoetes echinospora, Isoetes macrospora, Juncus pelocarpus*, and *Lobelia dortmanna*. Subgroup B is a shallow (<50 cm) open water marsh with emergent cover <25 percent and floating-leaved aquatics >25 percent. Substrate is a mineral soil (often sand), boulders, or a mixture of sedimentary peat and fine mineral soil. Stands can be exposed to waves or are in stream channels. Stands may often be dominated by a single species. Typical dominants include *Eleocharis acicularis, Myriophyllum spp., Potamogeton amplifolius, Potamogeton gramineus, Potamogeton praelongus, Potamogeton robbinsii, Sparganium fluctuans*, and *Utricularia vulgaris*. Subgroup C includes open water marsh with emergent cover <25 percent and floating leaved aquatics >25 percent. Substrate is sedimentary peat and stands are often found in sheltered bays of lakes and streams which do not have high wave energy. Stands may often be dominated by a single species. Typical dominants include *Ceratophyllum demersum, Lemna spp. Myriophyllum sibiricum, Myriophyllum verticillatum, Potamogeton natans, Potamogeton pectinatus, Potamogeton richardsonii, Potamogeton zosteriformis, Ranunculus aquatilis, Utricularia vulgaris*, and *Vallisneria americana*.

Annual grasslands or forb vegetation

65000 Annual grasslands or forb vegetation - The vegetation is dominated by annual species (those that grow for only one year, such as those on bare mud left when the water level drops)

Seasonally flooded annual forb vegetation

65100 Seasonally flooded annual forb vegetation. Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is very variable, extending from saturated to a water table well below the ground surface. Includes Cowardin's Seasonal, Seasonal-Saturated, and Seasonal-Well Drained modifiers.

65110 Slender Glasswort Saline Meadow

Key-based definition: Vegetation with >25% cover on an exposed mudflat, most of which is slender glasswort.

NVCS description: This community is associated with highly alkali wetlands or semipermanent alkali lakes in the northern Great Plains and Great Basin of the United States and adjacent Canada. It often borders intermittent open water or is found on the exposed mud of alkali flats. *Salicornia rubra* may make up to 100 percent of the vegetation within these areas. Other species which may be found associated with *Salicornia rubra* include *Puccinellia airoides, Distichlis spicata, Hordeum jubatum, Triglochin maritimum, Chenopodium rubrum*, and *Suaeda erecta*.

Mn DNR Natural Heritage description of a more broadly defined community: There is one recognized subtype of Mud Flat, a Saline Subtype. It has several plant species tolerant of high concentrations of dissolved salts. Red glasswort (*Salicornia rubra*), Nuttall's alkali grass (*Puccinellia nuttalliana*), and *Scirpus paludosis* are particularly characteristic. The Saline Subtype occurs only in extreme western Minnesota.

Nonvascular

70000 Nonvascular. Non vascular cover (bryophytes, non-crustose lichens, and algae) dominant, generally forming at least 25% cover. Nonvascular cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and herb cover, respectively. Crustose lichen dominated areas should be placed in the Sparse Vegetation class (80000).

Lichen vegetation

71000 Lichen vegetation. Lichens (foliose or fruticose) generally dominate the nonvascular cover.

Lichen vegetation with sparse tree layer

71100 Lichen vegetation with sparse tree layer. Areas with lichen vegetation dominant, generally forming at least 25% of the vegetative cover, with trees and shrubs generally less than 25% of the vegetative cover.

71110 Northern Conifer scrubland

Key-based definition: Upland vegetation with 10-70% cover by trees, of which >50% is conifer, where >30% of non-tree cover consists of lichens and mosses.

Mn DNR Natural Heritage description: Northern Conifer Scrubland occurs on bald rock ridges on the Canadian Shield in the conifer-hardwood forest zone. The tree canopy is usually dominated by closed-cone jack pines, however white spruces and balsam firs sometimes dominate the community along the north shore of Lake Superior. Black spruces are present in occurrences of the community in Lake and Cook counties.

The conifer trees in the canopy grow scattered among shorter northern red oaks and clumps of Bebb's willow. Areas without trees contain either a drought resistant, low-shrub layer of bush honeysuckles, juneberries, beaked hazels, and blueberries, or primary rock outcrop communities composed of mosses, lichens, and vascular species such as wintergreen (*Gaultheria procumbens*), pale corydalis (*Corydalis sempervirens*), bristly sarsaparilla (*Aralia hispida*), and three-toothed cinquefoil (*Potentilla tridentata*).

Northern Conifer Scrubland is an early successional community that originates following severe fires in coniferous forests on rocky sites. These fires remove all the duff and moss or lichen cover from the ground surface, exposing bare rock and patches of bare soil (where soil has accumulated in depressions and crevices in the rock). The bare soil patches are recolonized by conifer species (particularly the fire-adapted jack pine), setting the pattern for the patchy tree canopy characteristic of the community.

There are no recognized subtypes or sections of Northern Conifer Scrubland. Northern Conifer Scrubland grades into the Jack Pine-Oak Subtype of Jack Pine Forest. Similar communities (called lichen woodlands) with scattered spruces and jack pines have been described at the northern edge of the Boreal Forest in Canada.

Sparse Vegetation

80000 Sparse Vegetation. Describes vegetation with low total plant cover; abiotic substrate features are dominant; vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources (total vegetation cover is typically less than 25% and greater than 0%); areas with high cover of crustose lichen and no other vegetation are included here.

Consolidated Rock

81000 Consolidated Rock (cliffs, bedrock, etc.). Vegetation characterized by herbs, shrubs, trees, and/or nonvascular plants growing in fissures of rocks or walls, or growing adnate on these surfaces.

Cliffs with Sparse Vegetation

81100 Cliffs with Sparse Vegetation. Any high, very steep to perpendicular, or overhanging face of a rock outcrop with sparse vascular vegetation (e.g., bromeliads in neotropics). May have sparse to dense crustose lichens, sparse bryoids or foliose or fruticose lichens.

81110 Open Cliff

81111 Great Lakes Shore Basalt/Diabase Cliff

Key-based definition: A cliff with <25% vegetative cover on Lake Superior primarily composed of basalt or diabase, and without continuous groundwater seepage.

NVCS description: This basalt/diabase cliff community is found along the Great Lakes shorelines and inland areas in the sub-boreal regions of the Great Lakes in the United States and central Canada, including Michigan, Minnesota, and Ontario. Stands occur on vertical or near-vertical, south- to west-facing aspects of bedrock. Moisture is derived from precipitation, with severe wave action possible for cliffs along the Great Lakes shoreline. Mosses, lichens, ferns, and liverworts may be found, with occasional graminoids in crevices or shelves that trap soil. In Minnesota, arctic-alpine disjunct plant species (e.g. *Arenaria macrophylla, Draba norvegica*) and more temperate plant species may be found.

Cliffs along the Great Lakes shore are exposed to severe wave action, preventing establishment of vegetation.

81112 Northern (Laurentian) Igneous/Metamorphic Dry Cliff

Key-based definition: A cliff with <25% vegetative cover NOT on Lake Superior, NOT primarily composed of sandstone, limestone, or dolostone, and without continuous groundwater seepage.

NVCS description: This northern igneous dry cliff community is found in the northern Great Lakes region of the United States and Canada. Stands occur inland from the Great Lakes Shoreline, and do include basalt/diabase cliffs. Other igneous or metamorphic rock types may also be included. These dry cliffs may have <25% total plant cover, excluding crustose lichens (Minnesota NHP 1993). Further characterization of this type is needed.

81113 Midwest Dry Limestone/Dolostone Cliff

Key-based definition: A cliff with <25% vegetative cover NOT on Lake Superior, primarily composed of limestone or dolostone, and without continuous groundwater seepage.

NVCS description: This limestone/dolostone cliff community type is found throughout the midwestern United States and adjacent Canada, from Ohio and Ontario, west to Minnesota, south to Kansas, and possibly Arkansas, and east to Indiana. Stands occur as steep to vertical rock exposures of limestone bedrock. Aspect is variable, but stands are best developed on south- and west-facing slopes. Vegetation is restricted to shelves, cracks and crevices in the rock, generally averaging less than 20 percent, and typically consisting of vines and ferns. In the Ozarks and Interior Plateau region, ferns include *Cheilanthes feei, Argyrochosma dealbata (= Notholaena dealbata), Pellaea atropurpurea*, and *Pellaea glabella*. Herbaceous forbs and graminoids include *Aquilegia canadensis, Houstonia nigricans, Mentzelia oligosperma, Muhlenbergia cuspidata, Sedum pulchellum*, and *Solidago drummondii*. Lichens include *Dermatocarpon lachneum, Lecanora muralis* and *Psora russellii*. In Ohio, stands contain the ferns *Pellaea atropurpurea*, and *Pellaea glabella*, and the forbs *Aquilegia canadensis, Arabis laevigata, Heuchera americana, Hydrangea arborescens*, and *Sedum ternatum*. Scattered woody plants across the range include *Celastrus scandens, Juniperus virginiana, Parthenocissus quinquefolia, Physocarpus opulifolius, Quercus prinus* (southward), and *Toxicodendron radicans (= Rhus radicans)*, and farther north, *Taxus canadensis, Thuja occidentalis*, and *Tsuga canadensis*.

Natural disturbances include drought stress, wind and storm damage, and disturbances from cliff-dwelling animals, particularly in the crevices, ledges and rock shelters (Nelson 1985).

81114 Midwest Sandstone Dry Cliff

Key-based definition: A cliff with <25% vegetative cover primarily composed of sandstone, NOT on Lake Superior, and without continuous groundwater seepage, often on south- or west-facing slopes. *Aralia nudicaulis, Asarum canadense, Mitella diphylla, Cystopteris bulbifera*, or *C. fragilis* are NOT common.

NVCS description: This dry sandstone cliff community is found throughout the central and upper Midwestern United States and adjacent Canada, ranging from Ohio and Ontario west to Minnesota, south to Kansas, and east to Indiana. Stands occur as steep to vertical rock exposures of sandstone bedrock. Aspect is variable, but stands are best developed on south- and west-facing slopes. Vegetation is restricted to shelves, cracks and crevices in the rock, generally averaging less than 20 percent. Mosses and lichens are common, including crustose lichens. In the Ozarks and Interior Low Plateau, scattered occurrences of woody species, such as *Juniperus virginiana,*

Quercus stellata, Vaccinium arboreum, and *Vaccinium pallidum (= Vaccinium vacillans)*, are found; farther east in Ohio, woody species include *Tsuga canadensis, Betula lutea, Kalmia latifolia*, and *Hydrangea arborescens*. In the Ozarks and Interior Low Plateau, the herbaceous layer contains the ferns *Asplenium bradleyi, Asplenium pinnatifidum, Cheilanthes lanosa, Dennstaedtia punctilobula*, and *Dryopteris marginalis*. In the Allegheny region of Ohio, the sandstone cliffs contain the forbs *Agrostis perennans, Aquilegia canadensis, Mitchella repens*, and *Viola blanda*, and the ferns *Asplenium montanum, Asplenium pinnatifidum, Asplenium rhizophyllum, Asplenium trichomanes, Cystopteris fragilis, Dennstaedtia punctilobula, Dryopteris intermedia, Dryopteris marginalis, Polypodium virginianum*, and the rare *Asplenium bradleyi* (some of these species in Ohio may be more common in moist sandstone cliffs). In Minnesota and Wisconsin the dry cliffs include forbs, such as *Aquilegia canadensis, Campanula rotundifolia, Solidago hispida, Solidago sciaphila* (Driftless area endemic)*, Toxicodendron radicans, Selaginella rupestris, Silene antirrhina*, and *Tradescantia ohioensis*, and the ferns *Asplenium trichomanes, Pellaea atropurpurea, Pellaea glabella*, *Polypodium vulgare,* and *Woodsia spp*. The nonvascular layer in Missouri includes the mosses *Brothera leana, Polytrichum spp*., and *Rhodobryum roseum*, and the lichens, *Acarospora chlorophana, Cladonia mateocyatha, Cladonia strepsilis*, and *Dermatocarpon miniatum*.

Natural disturbances include drought stress, wind and storm damage, and disturbances from cliff-dwelling animals, particularly in the crevices, ledges and rock shelters (Nelson 1985).

81115 Midwest Sandstone Moist Cliff

Key-based definition: A cliff with <25% vegetative cover primarily composed of sandstone, NOT on Lake Superior, and without continuous groundwater seepage. *Aralia nudicaulis, Asarum canadense, Mitella diphylla, Cystopteris bulbifera*, or *C. fragilis* are common, often on north- or east-facing slopes.

NVCS description: This moist sandstone cliff community is found throughout the central and upper midwestern United States and adjacent Canada, from Ohio and Ontario west to Minnesota, south to Kansas and east to Indiana. Stands occur as steep to vertical rock exposures of sandstone bedrock. Aspect is variable, but stands are best developed on north- and east-facing slopes, or under sandstone overhangs. Vegetation is restricted to shelves, cracks and crevices in the rock, generally averaging less than 20 percent, and often dominated by forbs and ferns, with mats of mosses and lichens. In the Ozarks and Interior Low Plateau, the herbaceous layer contains the forbs *Dicentra canadensis, Dodecatheon frenchii, Heuchera parviflora, Hypericum walteri, Mitchella repens, Mitella diphylla*, among others, and the ferns *Athyrium filix-femina, Cystopteris bulbifera, Osmunda cinnamomea, Osmunda regalis*, and *Trichomanes boschianum*. In the Allegheny region of Ohio, the sandstone cliffs include the forbs *Agrostis perennans, Aquilegia canadensis, Mitchella repens*, and *Viola blanda*, and the ferns *Asplenium montanum, Asplenium pinnatifidum, Asplenium rhizophyllum, Asplenium trichomanes, Cystopteris fragilis, Dennstaedtia punctilobula, Dryopteris intermedia, Dryopteris marginalis, Polypodium virginianum*, and the rare *Asplenium bradleyi*. In Minnesota and Wisconsin the moist cliffs include forbs, such as *Aralia nudicaulis, Asarum canadense* and *Mitella diphylla*, and the ferns *Cystopteris bulbifera* and *Cystopteris fragilis*. The nonvascular layer is poorly described. Seepage areas in Minnesota include *Sullivantia renifolia* (also found in Missouri) and *Cryptogramma stelleri*.

Natural disturbances include wind and storm damage, activity by cliff-dwelling animals in the crevices, ledges and rock shelters, and the build up and collapse of ice (Nelson 1985).

81116 Great Lakes Shoreline Granite/Metamorphic Cliff

Key-based definition: A cliff with <25% vegetative cover on Lake Superior, NOT primarily composed of basalt or diabase, and without continuous groundwater seepage.

NVCS description: This granite/metamorphic cliff community type is found along the Great Lakes shoreline of the United States and Canada, possibly in Minnesota, Michigan, and Ontario. Stands occur along the lake shore and are exposed to wind, wave, and ice action. Bedrock is composed of granite or metamorphic rock. The vegetation is very sparse. Further information describing this type is needed.

81120 Wet Cliff

81121 Maderate Cliff

Key-based definition: A cliff with <25% vegetative cover and continuous groundwater seepage, primarily composed of dolostone, with cool air seeping from fissures, even in summer.

NVCS description: This moist maderate cliff community type is found in the Driftless area of the upper midwestern United States, particularly in southeast Minnesota and northeast Iowa. Stands occur on vertical or near vertical dolomite bedrock exposures, with a northern to northeastern aspect. Maderate Cliffs can be up to 60 m in height, and may extend up to 0.6 km in length. Generally, the dissected (eroded) fissure and sink system essential in maintaining cold air flow is small; fissures extend only 0.06 km or so into the rock, and the surface feeder sinks are usually cryptic. The yearly temperatures range only between about -10 and +10 degrees Celsius. Humidity is fairly high, generally 80 percent at ground surface. The overall effect is to make the sites cooler than normal in summer and warmer than normal in winter. The vegetation on the cliffs is sparse, but typically herbaceous and shrub species include *Cystopteris bulbifera, Pentaphylloides floribunda, Zigadenus elegans, Cornus canadensis, Galium triflorum, Campanula rotundifolia, Aquilegia canadensis, Solidago sciaphila, Physocarpus opulifolius*, and *Arabis lyrata*. Tree and shrub species in close proximity to maderate cliffs (at the base or overhanging the top) characteristically include *Pinus strobus, Abies balsamea, Betula lutea, Betula papyrifera, Taxus canadensis, Acer saccharum* and *Tilia americana*. Ferns, mosses and liverworts have been poorly characterized. Both maderate cliffs and the closely-related algific talus slopes share some relict species that arrived shortly after the glaciers moved further north and the climate gradually ameliorated; both, however, contain their own unique suite of relict species. Among the relict and disjunct plants, *Sedum integrifolium ssp. leedyi* and *Draba arabisans* occur in the Paleozoic Plateau region only on the maderate cliffs. Several relict land snails are restricted to or occur on maderate cliffs, including two species within the proposed genera *Novisuccinea , Catinella gelida* and several *Vertigo spp*.

81122 Midwest Sedimentary Dripping Cliff

Key-based definition: A cliff with <25% vegetative cover and continuous groundwater seepage that does not fit the description of Maderate Cliff.

NVCS description: This sedimentary dripping cliff community is found primarily in the Great Lakes states and adjacent Ontario, with some occurrences in the Interior Low Plateau. Stands are moist, vertical to near vertical cliffs that have a continuous groundwater seepage over the rock surface. Species present include the ferns *Cystopteris bulbifera* and *Cystopteris fragilis*, as well as numerous mosses. Herbs present could include *Asarum canadense*, and *Mitella diphylla*. Additional species that thrive on the seepage areas include *Cryptogramma stelleri, Dodecatheon amethystinum, Poa wolfii* and *Sullivantia renifolia*.

81130 Rock Outcrop / Butte Sparse Vegetation Alliance

81131 Northern (Laurentian) Granite/Metamorphic Rock Outcrop

Key-based definition: Bedrock (not vertical, or if vertical <3m high) with <25% vegetative cover NOT on shore of river or lake, occurring in the northern conifer-hardwood zone.

NVCS description: This granite/metamorphic rock outcrop community type is found on the Canadian Shield in the northern Great Lakes region of the United States and elsewhere in Canada. Stands are typically comprised of granite or metamorphic rock, as well as basalt. They occur on relatively level or rounded areas of exposed bedrock. Soil development is minimal, and pH is typically acid. The vegetation is typically sparse. Occurrences are typically a mosaic of exposed bedrock with patches of low vegetation dominated by fruticose lichens and mosses. Lichen species include *Cladonia rangiferina* and *Cladonia mitis*. Mosses include *Dicranum spp., Pleurozium schreberi*, and *Polytrichum spp*. Scattered shrub species include *Amelanchier spp., Diervilla lonicera*, and *Vaccinium angustifolium*. The sparse herbaceous layer includes *Aralia hispidus, Corydalis sempervirens*, and *Sibbaldiopsis tridentata (= Potentilla tridentata)*.

Fire appears to be important in maintaining this community. In the absence of fire, these rock outcrops are invaded by trees from surrounding forest types, especially *Pinus banksiana* and (in more southern examples) *Quercus rubra* (Minnesota NHP 1993)

81132 Midwest Quartzite - Granite Rock Outcrop

Key-based definition: Bedrock (not vertical, or if vertical <3m high) with <25% vegetative cover NOT on shore of river or lake and NOT occurring in the northern conifer-hardwood zone.

NVCS description: This quartzite-granite rock outcrop community type is found on rocky, relatively level or hilly regions in the upper midwestern United States, particularly in southwestern Minnesota, eastern South Dakota, and the Baraboo Hills of Wisconsin. The vegetation is sparse, with little soil development, and extreme temperature fluctuations. The outcrops are composed primarily of Sioux quartzite, granite and gneiss. This community, in Minnesota and South Dakota contains a sparse vegetation layer, with scattered succulents and many annuals. Vegetation growing in the patchy soils include *Opuntia fragilis*', *Opuntia macrorhiza, Escobaria vivipara (= Coryphantha vivipara)*, and *Lomatium orientale*, as well as *Selaginella rupestris, Talinum parviflorum, Woodsia ilvensis*, and a variety of spring and

summer blooming annuals. In the Baraboo Hills, *Opuntia humifusa (= Opuntia compressa), Schizachyrium scoparium*, and *Bouteloua curtipendula* are typical.

This community type is found in southwestern Minnesota (especially the Minnesota River Valley between New Ulm and Ortonville and in Cottonwood, Pipestone, and Rock counties), eastern South Dakota (especially east and west of Sioux Falls, and, at least historically, around Millbank) and in the Baraboo Hills of Wisconsin.

Level Bedrock (pavement) with Sparse Vegetation

81200 Level Bedrock (pavement) with Sparse Vegetation. A relatively flat surface of consolidated material, generally exposed bedrock. May have sparse to dense crustose lichens, sparse bryoids, or foliose or fruticose lichens.

81210 Open Pavement Sparse Vegetation Alliance

81211 Inland Lake Igneous/Metamorphic Bedrock Shore

Key-based definition: Bedrock (not vertical, or if vertical <3m high) with <25% vegetative cover, NOT on the shore of Lake Superior, and NOT composed of sandstone on the shore of a river.

NVCS description: This igneous/metamorphic inland bedrock lakeshore community type is found on small lakes on the Canadian shield in the Upper Great Lakes region of the United States and Canada, including Minnesota, Wisconsin, Manitoba and Ontario, and perhaps more widely in Canada. Stands are exposed bedrock along lakeshores. Substrate may be either granite/metamorphic or basalt/conglomerate. Vegetation is sparse, but little information is available to further characterize this type.

A sufficiently sized lake with substantial wave action is needed to create a sparse, rocky vegetation zone along the lakeshore.

81212 Great Lakes Basalt (Conglomerate) Bedrock Lakeshore

Key-based definition: Bedrock (not vertical, or if vertical <3m high) with <25% vegetative cover on the shore of Lake Superior, NOT primarily composed of sandstone, limestone, or dolostone.

NVCS description: This basalt bedrock lakeshore is found along the Lake Superior shoreline of both the United States and Canada, ranging from Michigan to Minnesota and Ontario. The bedrock consists of basalts, volcanic conglomerates, and localized rhyolites. Volcanic conglomerate shores may be more species rich than basalt shores due to the presence of cracks or small cavities in the former. Wave action and ice scour action are strongest near the shore, producing a wave-washed zone almost devoid of vegetation, except for scattered patches of mosses and lichens, and pockets of herbaceous species around bedrock pools. With increasing distance above the lake, herbaceous and nonvascular plant cover increases, though still very patchy, with lichens predominating, particularly on high, dry rocks. Herbaceous species include

Achillea millefolium, Campanula rotundifolia, Fragaria virginiana, Sibbaldiopsis tridentata (= Potentilla tridentata), and *Solidago simplex*. Perched meadows, dominated by tufted graminoids, are found at the edge of seasonal pools. The most common meadow species are *Calamagrostis canadensis, Carex buxbaumii, Carex castanea, Danthonia spicata, Deschampsia cespitosa, Scirpus cespitosus*, and *Trisetum spicatum*, as well as *Pinguicula vulgaris*. Lichens, mosses, and liverworts are prominent. Scattered, often stunted, woody trees and shrubs are found throughout, including *Abies balsamea, Amelanchier spp., Juniperus communis, Picea glauca, Populus tremuloides, Rubus pubescens, Shepherdia canadensis, Thuja occidentalis*, and *Vaccinium angustifolium*.

Wave action and ice scour action are the primary disturbances affecting the vegetation. Near the lakeshore a wave-washed zone is almost devoid of vegetation. A gradient of increasing vegetation occurs further above the lakeshore (Albert et al. 1995).

81213 Great Lakes Limestone-Dolostone Bedrock Lakeshore

Key-based definition: Bedrock (not vertical, or if vertical <3m high) with <25% vegetative cover on the shore of Lake Superior, primarily composed of limestone or dolostone.

NVCS description: This community occurs along Great Lakes shores in the United States and Canada, ranging from Michigan and Wisconsin to Ontario, and possibly to Minnesota and Ohio where broad, flat, horizontally-bedded limestone or dolostone are exposed along or near the shoreline. Limestone cobble may be present. These lakeshores are characterized by a zonal gradation of plant communities, changing in response to distance from the lake. The width of the zone varies with fluctuations in the Great Lakes water level. The splash/scrape zone, which averages 10 m in width, is very sparsely vegetated, with small pools of standing water. Plant species are typically found in protected bedrock cracks. Typical species in this zone include *Juncus balticus, Argentina anserina (= Potentilla anserina)*, and *Populus balsamifera*. The vegetated zone occurs more inland as soil accumulates in and adjacent to bedrock cracks. Vegetation is still patchy. Common species include *Calamintha arkansana, Deschampsia cespitosa, Pentaphylloides floribunda, Panicum lindheimeri*, and species from the previous zone. A variety of mosses, including *Campylium stellatum*, are common throughout this zone. Further inland, sand accumulations or cobble ridges on the bedrock surface provide a suitable substrate for the establishment of woody and herbaceous plants. Scattered trees and shrubs are common, including *Abies balsamea, Picea glauca, Populus balsamifera*, and *Thuja occidentalis*.

Wind, waves, and ice action disturb the various zones in this community.

81214 Great Lakes Sandstone Bedrock Shore

Key-based definition: Bedrock (not vertical, or if vertical <3m high) with <25% vegetative cover on the shore of Lake Superior, primarily composed of sandstone.

NVCS description: This sparsely vegetated sandstone bedrock rocky shore community is found in the United States and Canada on the Michigan, Wisconsin (Apostle Islands only), and Ontario shores of Lake Superior, and possibly in Minnesota. They occur as small inclusions within areas of the larger sandstone cliff communities. Narrow areas of pavement occur at less than a meter

above the lake levels and are generally moist. Mosses, liverworts, and scattered vascular plants may be found. Vascular plants on the pavement are concentrated in cracks in the rock, whereas mosses and liverworts are found where seepages flow across the rock. Some of the more common vascular plants include *Achillea millefolium, Epilobium angustifolium, Betula papyrifera, Campanula rotundifolia, Cystopteris fragilis, Deschampsia cespitosa, Thelypteris phegopteris, Alnus incana, Equisetum arvense*, and *Euthamia graminifolia*. Less common, and more restricted to cracks in the pavement, are *Sibbaldiopsis tridentata (= Potentilla tridentata), Lobelia kalmii, Senecio indecorus, Senecio pauperculus, Physocarpus opulifolius, Primula mistassinica, Trisetum spicatum*, and *Rubus pubescens*.

81215 River Ledge Sandstone Pavement

Key-based definition: Bedrock (not vertical, or if vertical <3m high) with <25% vegetative cover composed of sandstone on the shore of a river.

NVCS description: This sandstone bedrock river shore community type is found in the upper Great Lakes region of the United States and Canada, and perhaps elsewhere, ranging from Michigan, Wisconsin, and Minnesota to Ontario and Manitoba. Stands are found on rivers where scouring by ice or flooding creates a sparsely vegetated zone along the river. Substrate is sandstone. The vegetation of this type has not yet been characterized.

Boulder, Gravel, Cobble, or Talus

82000 Boulder, Gravel, Cobble, or Talus. Vegetation generally characterized by herbs, and occasionally shrubs and trees on gravel or cobble substrates. Lichens are also common.

Lowland or Submontane Talus / Scree Slopes

82100 Lowland or Submontane Talus / Scree Slopes. A sloping accumulation of coarse rock fragments at the base of a cliff.

82110 Lowland Talus Sparse Vegetation Alliance

82111 Northern Granite/Metamorphic Talus

Key-based definition: Talus slope with <25% vegetative cover NOT primarily composed of sandstone, limestone, dolostone, basalt, or diabase.

NVCS description: This granite/metamorphic talus type is found in the northern parts of the Great Lakes region in both the United States and Canada, ranging from Minnesota and Ontario east to Wisconsin and Michigan. Stands occur as unconsolidated rocks at the base of steep slopes or cliffs. Soils are absent. The parent material is either granite or metamorphic, and rock fragments are often angular and large. The vegetation on these talus slopes varies from very sparse to pockets of shrubs and trees. Species composition needs to be described.

82112 Midwest Limestone - Dolostone Talus

Key-based definition: Talus slope with <25% vegetative cover primarily composed of limestone or dolostone.

NVCS description: This limestone-dolostone talus community is found throughout the central/upper midwestern United States, including the Ozark region, and adjacent Canada, extending from Ontario west to Minnesota, south to Arkansas, and east to possibly Illinois. Stands occur at the bases of steep cliffs along larger streams or rivers, or strongly dissected valleys. Aspect is variable, and moisture could be moist or dry. Soils are generally absent. Parent material could be limestone or dolostone with a mixture of rock fragments and large boulders. The vegetation is generally sparse but may vary depending on degree of slope, exposure (open vs. shaded), and rock type. The composition of the type may be heavily influenced by adjacent forested stands. In Missouri, characteristic species include the ferns *Adiantum pedatum, Athyrium pycnocarpon, Asplenium rhizophyllum (= Camptosorus rhizophyllus)*, and *Cystopteris bulbifera*. Other herbaceous species include *Aralia nudicaulis, Impatiens capensis, Pilea pumila, Polymnia canadensis*, and *Physalis missouriensis*. Scattered woody plants include *Hydrangea arborescens* and *Staphylea trifolia*. In Ontario open talus stands contain *Adiantum pedatum, Eupatorium rugosum, Geranium robertianum, Impatiens capensis, Poa pratensis*, and *Toxicodendron radicans*.

Cliff weathering causes rock debris to fall and accumulate at the base of the cliff.

82113 Northern Sandstone Talus

Key-based definition: Talus slope with <25% vegetative cover primarily composed of sandstone.

NVCS description: This sandstone talus community is found in the upper Great Lakes region of the United States and Canada, ranging from Ontario into Minnesota, though it may also occur further south into the Midwest. Aspect is variable, and moisture could be moist or dry. Soils are generally absent. Parent material is sandstone. The vegetation is generally sparse, but may vary depending on degree of slope, exposure (open vs. shaded) and rock type. The composition of the type may be heavily influenced by adjacent forested stands. Vegetation of this type has not been characterized.

82114 Northern Basalt/Diabase Open Talus

Key-based definition: Talus slope with <25% vegetative cover primarily composed of basalt or diabase.

NVCS description: This open basalt/diabase talus type occurs in the northern parts of the midwestern United States and into Canada, ranging from Wisconsin and Ontario to possibly Minnesota and Michigan. The type is in need of further characterization.

Cobble / Gravel Beaches and Shores

82200 Cobble / Gravel Beaches and Shores

82210 Cobble / Gravel Shore Sparse Vegetation Alliance

82211 Great Lakes Basalt/Diabase Cobble-gravel Lakeshore

Key-based definition: Cobble or gravel shore with <25% vegetative cover along Lake Superior primarily composed of basalt or diabase.

NVCS description: The basalt cobble-gravel Great Lakes shore type is commonly found in the northern Great Lakes region of the United States and Canada, ranging from Michigan to Minnesota and Ontario. Stands occur between volcanic bedrock exposures comprised of both basalt and Copper Harbor conglomerates. Size of the gravel and cobble vary from less than 2 cm to over 20 cm. Size range varies depending on the wave energy acting on the shoreline and the nature of the bedrock being eroded. These steep shores are typically devoid of vegetation. At Isle Royale NP, this cobble-gravel lakeshore is a sparsely vegetated community on cobble or gravel beaches. This community occurs as a mosaic of sparse grassland with over 25% cover, and sparsely vegetated areas with less than 25% cover. The most abundant herbs are grasses, mostly *Elymus trachycaulus* (average 29% cover); other characteristic herbs are *Lathyrus palustris* and *Oenothera biennis*; characteristic shrubs are *Rubus idaeus, Cornus sericea*, and *Alnus viridis* (each with < 5% cover). The shrub zone is dominated by low shrubs, which vary from 20 to 60% cover. The most abundant shrubs are *Rosa acicularis, Rubus idaeus, Diervilla lonicera, Physocarpus opulifolius, Ribes oxyacanthoides, Alnus incana*, and *Sorbus decora*. There may be scattered trees (0 to 5% cover) including *Picea glauca, Abies balsamea, Thuja occidentalis*, and *Betula papyrifera*. Cover of herbs varies from 10 to 40%; the most common herbs are *Lathyrus palustris, Oenothera biennis, Cornus canadensis, Calamagrostis canadensis*, and *Equisetum hyemale.*, *Carex atratiformis, Polygonum viviparum*, and *Trisetum spicatum* have been reported at the inner margin of the island's cobble lakeshore, near the tree edge. Elsewhere, in Minnesota, *Lathyrus japonicus* is characteristic.

These are exposed shores that are regularly disturbed by wave action and winter ice movements from the lake. Most of the shore has little or no vegetation, probably due to regular disturbance by waves washing the shore. The high beach ridge is formed by the most severe storm waves, so the disturbance is irregular and infrequent (C. Reschke pers. comm. 1999).

82212 Riverine Igneous/Metamorphic Cobble-gravel Shore

Key-based definition: Cobble or gravel shore with <25% vegetative cover along a river or stream.

NVCS description: This igneous/metamorphic cobble-gravel bedrock river shore community type is found in the upper Great Lakes region of the United States and Canada, and perhaps elsewhere, ranging from Minnesota to Michigan and north into central Canada, from Saskatchewan east to Quebec. Stands are found on rivers where scouring by ice or flooding creates a sparsely vegetated zone along the river. Substrate is cobble-gravel, and may be

composed of either basalt/diabase or granite/metamorphic rocks. The vegetation of this type has not yet been characterized.

Scouring by ice or flooding is common.

82213 Great Lakes Non-alkaline Cobble/Gravel Shore

Key-based definition: Cobble or gravel shore with <25% vegetative cover along Lake Superior and NOT primarily composed of basalt or diabase.

NVCS description: This non-alkaline cobble/gravel Great Lakes shore type is found along the shores of northern Great Lakes in the United States and Canada, ranging from Michigan and Wisconsin, north to Ontario and possibly Minnesota. Substrates currently identified include a combination of siltstones, shales, and sandstones. Sites identified in Michigan are almost completely covered by a gravel and cobble beach and support no vegetation. The exposures are subject to too much wave action to support a distinctive plant community. Rangewide description is still needed.

These rock exposures are subject to much wave action that prevents the development of a distinctive plant community (Albert et al. 1995).

82214 Inland Lake Igneous/Metamorphic Cobble-gravel Shore

Key-based definition: Cobble or gravel shore with <25% vegetative cover along a lake other than Lake Superior.

NVCS description: This cobble-gravel lakeshore community type is possibly found on small lakes on the Canadian shield in the Upper Great Lakes region of the United States and Canada, and perhaps more widely in Canada, ranging from Michigan and Minnesota to Ontario and probably more widely across central Canada. Stands are exposed bedrock along lakeshores. Cobble-gravel substrate may be either granite/metamorphic or basalt/conglomerate. Vegetation is sparse, but little information is available to further characterize this type.

A sufficiently sized lake with substantial wave action is needed to create a sparse, rocky vegetation zone along the lakeshore.

Unconsolidated Material

83000 Unconsolidated Material (soil, sand, and ash). Vegetation generally characterized by isolated herbs or occasionally shrubs.

Sand Flats

83100 Sand Flats. Including storm-washed beaches.

83110 Inland Strand Beach

83111 Inland Freshwater Strand Beach

Key-based definition: Sandy beach with <25% vegetative cover along the shore of an inland lake where the lower beach zone has submergent and floating-leaved aquatics tolerant of stranding.

NVCS description: This freshwater inland lake beach occurs locally throughout the upper midwestern and northeastern United States and adjacent Canada, ranging from Minnesota and Saskatchewan southeastward to Indiana and northeastward to Vermont and Ontario. Stands may be most common on sandy outwash plains, where lakes are large enough to be affected by wave action or annual fluctuations in water level. Stands are found in the lower beach zone. The lower beach zone has submergent and floating-leaved aquatics tolerant of stranding. Species composition of this type needs to be described.

Wave action and annual fluctuations in water level disturb these sandy beaches.

Temporarily Flooded Sand Flats

83200 Temporarily Flooded Sand Flats. Sand flats where the surface water is present for brief periods during growing season, but water table usually lies well below soil surface. Often characterizes floodplain wetlands. Equivalent to Cowardin's Temporary modifier.

83210 Sand Flats Temporarily Flooded Sparse Vegetation Alliance

83211 Lacustrine Sand Flats - Bars

Key-based definition: Sandy beach with <25% vegetative cover along the shore of an inland lake where the lower beach zone does NOT have submergent or floating-leaved aquatics tolerant of stranding.

NVCS description: This freshwater inland lake beach occurs throughout the upper midwestern United States and adjacent Canada. Stands may be most common on sandy outwash plains, where lakes are large enough to be affected by wave action or annual fluctuations in water level. Stands are found in the upper beach zone. The upper beach zone has both perennial graminoids tolerant of inundation and erosion and annual species. Species composition of this type needs to be described.

83212 Riverine Sand Flats - Bars

Key-based definition: Sandy beach with <25% vegetative cover NOT along the shore of a lake.

NVCS description: This community is found from the western Great Plains to the eastern parts of the midwestern United States and Canada, ranging from Indiana northwest to Saskatchewan, and south to Kansas. It is a sparsely vegetated community that occurs along river shorelines, islands, pointbars, and flats. These sandbars form when receding floodwaters deposit sand and lesser amounts of clay, silt, and cobbles in the stream bed. Soils are often undeveloped due to the

ephemeral nature of the stands. Drainage depends on depth above the water level. Herbaceous species shared in Missouri and Nebraska include *Cyperus spp. (Cyperus erythrorhizos, Cyperus odoratus, Cyperus squarrosus), Eragrostis hypnoides, Eragrostis trichodes, Leptochloa fascicularis, Polygonum spp*. (including *Polygonum lapathifolium), Rorippa sinuata, Sporobolus cryptandrus*, and *Xanthium strumarium*.

This community can be very short-lived. For example, in Nebraska, it rarely persists for more than a single season before it is either destroyed by flooding or succeeds to other communities such as *Salix exigua* communities (Steinauer and Rolfsmeier 1997).

Seasonally / Temporarily Flooded Mud Flats

83300 Seasonally / Temporarily Flooded Mud Flats. Mud flats where surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is very variable, extending from saturated to a water table well below the ground surface. Surface water could also be present for brief periods during growing season. Often characterizes flood-plain wetlands. Equivalent to Cowardin's Seasonal, Seasonal-Saturated, Seasonal-Well Drained, and Temporary modifiers.

83310 Non-tidal Mud Flat Seasonally / Temporarily Flooded Sparse Vegetation Alliance

83311 Lake Mud Flats

Key-based definition: Mud flat with <25% vegetative cover NOT along a river and NOT dominated by plant species tolerant of high concentrations of dissolved salts, such as *Salicornia rubra*, *Puccinellia nuttalliana*, and *Scirpus paludosis* (*maritimus*).

NVCS description: The lake mudflat community type is found throughout the upper midwestern region of the United States and adjacent Canada . It ranges from Minnesota and Manitoba east to Michigan and Ontario, and south to Indiana. Stands occur in shallow basins or lake margins that flood in the spring and draw down later in the season, exposing wet, muddy sediments on which plant species subsequently grow. Great Lakes shore mudflats are placed here as well. Substrate includes silt and clay mixed with marl or sedimentary peats comprised of plant and animal residues precipitated from standing water. Rooted aquatics may grow during the flood stages, leaving organic debris on the surface during drawdowns. The composition and structure of the vegetation is influenced by the flooding regime. In general, the vegetation is composed of dryland forms of aquatic plants and seedlings originating from seeds dormant in the sediment or washed in from other communities. These aquatics include *Heteranthera spp., Nuphar spp., Nymphaea spp., Polygonum amphibium*, and *Potamogeton spp*. As the vegetation matures over the summer and early fall, graminoids or forbs may dominate, including species of *Cyperus spp., Juncus spp., Polygonum spp*., and *Scirpus spp*.

83312 River Mud Flats

Key-based definition: Mud flat with <25% vegetative cover along a river.

NVCS description: The river mudflat community type is found throughout the upper and central midwestern region of the United States and adjacent Canada, and probably more widely. Currently, it ranges from Minnesota and Manitoba east to Michigan and Ontario, and south to Illinois and Indiana. Stands occur in riverine areas that flood in the spring, but dry out later in the season, exposing wet, muddy sediments on which plant species subsequently grow. Substrate includes silt and clay. The composition and structure of the vegetation is influenced by the flooding regime. Vegetation of this type has not been characterized. Stands in south-central Illinois and east-central Missouri contain the characteristic, and rare, *Boltonia decurrens*.

Spring floods and subsequent drawdown cause the exposure of mud flats.

83313 Saline Spring Mud Flats

Key-based definition: Mud flat NOT along a river, where vegetation (<25% cover) is dominated by species tolerant of high concentrations of dissolved salts, such as *Salicornia rubra*, *Puccinellia nuttalliana*, and *Scirpus paludosis* (*maritimus*).

NVCS description: This saline spring mud flat community type occurs in the northern tallgrass region of the United States and Canada, ranging from Minnesota into Manitoba. These mudflats are found in shallow basins that flood in the spring and draw down later in the season, exposing the wet sediments on which the plants grow. High concentrations of salts that were dissolved in the water accumulate on the surface. Submerged aquatic plants may be present during the flooding stage, leaving an organic debris on the surface. The vegetation is generally sparse. Plant species tolerant of high concentrations of dissolved salts dominate the stands. *Puccinellia nuttalliana, Salicornia rubra* and *Scirpus maritimus* are particularly characteristic.

Water

90000 Water This Formation Class cover type is to be used for open water. Open water may include large mats of floating algae or non-rooted vascular vegetation. Emergent vegetation generally contributes less than 5% total cover. Where emergent vegetation found in rivers, intermittent streams, lakes and wetlands is greater than 4%, they are to be classified under other Formation Class cover types. Definitions contained herein are based on those for Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, et. al.).

River

91000 River (riverine) Riverine systems classified under this subclass include all open water contained within a channel. A channel is an open conduit either naturally or artificially created which contains moving water, or which forms a connecting link between two bodies of standing water (Cowardin). Riverine systems may contain upland islands or palustrine wetlands in the channel. If these areas are larger than one acre they are not to be included in this classification and should be classified individually under other Natural/Semi-Natural classes.

Slow moving linear open water habitat

91100 Slow moving linear open water habitat+

Key-based definition: Open water with <25% vegetative cover in an undammed channel where the gradient is low, the water velocity is slow, dissolved oxygen concentration is low, and the substrate is NOT comprised mostly of rock, cobble, or gravel with occasional patches of sand.

The Cowardin classification system calls this a lower perennial riverine system. The gradient is low and water velocity is slow. The substrate consists mainly of mud and sand. Oxygen deficits may sometimes occur, the fauna is composed mostly of species that reach their maximum abundance in still water, and true planktonic organisms are common. The gradient is lower than that of the Upper Perennial System and the floodplain is well developed.

Fast moving linear open water habitat

91200 Fast moving linear open water habitat

Key-based definition: Open water with <25% vegetative cover in a channel where the gradient is high, the water velocity is fast, dissolved oxygen concentration is near saturation, and the substrate is comprised mostly of rock, cobble, or gravel with occasional patches of sand. (Little floodplain is present.)

The Cowardin classification system calls this an upper perennial riverine system. The gradient is high and the velocity of water is fast. The substrate consists of rock, cobbles, or gravel with occasional patches of sand. The natural dissolved oxygen concentration is normally near saturation. The fauna is characteristic of running water, and there are few or no planktonic

forms. The gradient is high compared with that of the Lower Perennial Subsystem, and there is very little floodplain development.

Lake

92000 Lake (lacustrine) Lacustrine systems classified under this subclass include all open water situated in a topographic depression or a dammed river channel and the total area exceeds 20 acres. Smaller areas may also be included if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 6.6 feet (2 meters) at low water. Lacustrine systems may contain upland islands or vegetated palustrine wetlands. If these areas are larger than one acre they are not to be included in this classification and should be classified individually under other Natural/Semi-Natural classes.

Limnetic Open Water

92100 Limnetic Open Water +

Key-based definition: Open water with <25% vegetative cover NOT in a channel (or in a channel where flow is not visible due to damming). The water covers >8 hectares (20 acres) OR water depth is >2 meters (6.6 feet) in the deepest part of the basin at times of low water.

Semipermanently flooded littoral aquatic bed

92200 Semipermanently flooded littoral aquatic bed. Surface water persists throughout the growing season in most years. Land surface is normally saturated when water level drops below soil surface. Includes Cowardin's Intermittently Exposed and Semipermanently Flooded modifiers.

92210 Floating algae - semipermanently flooded littoral aquatic bed

Key-based definition: Semipermanently flooded open water with >25% vegetative cover (mostly floating algae) in a basin (or in a channel where flow is not visible due to damming) >8 hectares (20 acres) where water depth is <2 meters (6.6 feet) at times of low water.

92220 Floating vascular vegetation - semipermanently flooded littoral aquatic bed

Key-based definition: Semipermanently flooded open water with >25% vegetative cover (mostly non-rooted vascular) in a basin (or in a channel where flow is not visible due to damming) >8 hectares (20 acres) where water depth is <2 meters (6.6 feet) at times of low water.

Intermittently exposed littoral aquatic bed

92300 Intermittently exposed littoral aquatic bed. Surface water is present throughout the year except in years of extreme drought.

92310 Floating algae - Intermittently exposed littoral aquatic bed

Key-based definition: Intermittently exposed open water with >25% vegetative cover (mostly floating algae) in a basin (or in a channel where flow is not visible due to damming) >8 hectares (20 acres) where water depth is <2 meters (6.6 feet) at times of low water.

92320 Floating vascular vegetation - Intermittently exposed littoral aquatic bed

Key-based definition: Intermittently exposed open water with >25% vegetative cover (mostly non-rooted vascular) in a basin (or in a channel where flow is not visible due to damming) >8 hectares (20 acres) where water depth is <2 meters (6.6 feet) at times of low water.

Permanently flooded littoral aquatic bed

92400 Permanently flooded littoral aquatic bed. Water covers the land surface at all times of the year in all years. Equivalent to Cowardin's 'permanently flooded.'

92410 Floating algae - Permanently flooded littoral aquatic bed

Key-based definition: Permanently flooded open water with >25% vegetative cover (mostly floating algae) in a basin (or in a channel where flow is not visible due to damming) >8 hectares (20 acres) where water depth is <2 meters (6.6 feet) at times of low water.

92420 Floating vascular vegetation - Permanently flooded littoral aquatic bed

Key-based definition: Permanently flooded open water with >25% vegetative cover (mostly non-rooted vascular) in a basin (or in a channel where flow is not visible due to damming) >8 hectares (20 acres) where water depth is <2 meters (6.6 feet) at times of low water.

Littoral Open water

92500 Littoral Open water[+]

Key-based definition: Open water >8 hectares (20 acres) with <25% vegetative cover NOT in a channel (or in a channel where flow is not visible due to damming), where water depth is <2 meters (6.6 feet) at times of low water.

Cowardin defines these wetland habitats as extending from the shoreward boundary of the system to a depth of 6.6 feet (2 meters) below low water or to the maximum extent of non-persistent emergents, if these grow at depths greater than 6.6 feet.

Wetland-Open Water (palustrine)

93000 Wetland-Open Water (palustrine) - Palustrine systems classified under this subclass include wetlands lacking vegetation and the following three characteristics; 1) areas less than 20 acres, 2) active wave-formed or bedrock shoreline features lacking, and 3) water depth in the deepest part of the basin is less than 6.6 feet at low water. Palustrine systems may be adjacent to, or contain upland islands, vegetated palustrine wetlands, riverine systems, or lacustrine

systems. If these areas are larger than one acre they are not to be included in this classification and should be classified individually under other Natural/Semi-Natural classes.

Intermittently exposed aquatic bed

93100 Intermittently exposed aquatic bed. Surface water is present throughout the year except in years of extreme drought.

93110 Floating algae - Intermittently exposed aquatic bed

Key-based definition: Intermittently exposed open water with >25% vegetative cover (mostly floating algae) in a basin (or in a channel where flow is not visible due to damming) <8 hectares (20 acres) where water depth is <2 meters (6.6 feet) at times of low water.

93120 Floating vascular vegetation - Intermittently exposed aquatic bed

Key-based definition: Intermittently exposed open water with >25% vegetative cover (mostly non-rooted vascular) in a basin (or in a channel where flow is not visible due to damming) <8 hectares (20 acres) where water depth is <2 meters (6.6 feet) at times of low water.

Permanently flooded aquatic bed

93200 Permanently flooded aquatic bed. Water covers the land surface at all times of the year in all years. Equivalent to Cowardin's 'permanently flooded.'

93210 Floating algae

Key-based definition: Permanently flooded open water with >25% vegetative cover (mostly floating algae) in a basin (or in a channel where flow is not visible due to damming) <8 hectares (20 acres) where water depth is <2 meters (6.6 feet) at times of low water.

93220 Floating vascular vegetation

Key-based definition: Permanently flooded open water with >25% vegetative cover (mostly non-rooted vascular) in a basin (or in a channel where flow is not visible due to damming) <8 hectares (20 acres) where water depth is <2 meters (6.6 feet) at times of low water.

Palustrine Open water

93300 Palustrine Open water [+]

Key-based definition: Open water with <25% vegetative cover NOT in a channel (or in a channel where flow is not visible due to damming). The water covers <8 hectares (20 acres) AND water depth is <2 meters (6.6 feet) in the deepest part of the basin at times of low water.

Modifier Codes

Modifiers are to be used to further define a site and are considered equal in weight to the initial MLCCS code. In cases where a site has been field checked, appropriate modifiers should be applied. Polygon attribute tables will accommodate modifiers from each grouping of modifier codes. Definitions for many of the modifiers are included, however most modifiers are self explanatory. Field inspections should be conducted when applying modifier codes. Modifiers can be applied while doing the initial air photo interpretation, though caution should be used in making modifier decisions only on air photo interpretation. With practice and experience, a person may be able to gain confidence to apply modifiers from air photo interpretation only.

0XX Modifiers for Percent Imperviousness

The 000-100 codes are for percent impervious. All 101 codes may be used. Example, if an area is calculated to be 37% impervious, then the correct modifier code would be 037. Average imperviousness may be estimated using the following averages developed by lot size for the SCS TR-55 Model (Urban Hydrology for Small Watersheds).

000 - 0% impervious
012 - 12% impervious (2 acre lot)
020 - 20% impervious (1 acre lot)
025 - 25% impervious (2 acre lot)
030 - 30% impervious (1/3 acre lot)
038 - 38% impervious (1/4 acre lot)
065 - 65% impervious (1/8 acre lot)
072 - 72% impervious (Large buildings)
085 - 85% impervious (large buildings or pavement)
096 - 96% impervious
100 - 100% impervious

2XX Modifiers to identify Land Use

In the metro area land use data is usually readily available and will not be required to be collected for land cover information. In areas where this information is not available, the MLCCS may incorporate land use nomenclature. However, MLCCS polygons will have been delineated by land cover, and thus a specific polygon may require several applicable land use modifiers.

210 - Residential
211 - Low Density Residential (one dwelling unit per acre)
212 - Medium Density Residential (two to five dwelling units per acre)
213 - High Density Residential (greater than five dwelling units per acre)

220 - Commercial / Industrial
221 - Commercial
222 - Industrial
223 - City Center
224 - Institutional
225 - Corporate Park

226 - Recreational
227 - Utility
228 - Brownfield
229 - Other

230 - Transportation (Roads & Railroads)
231 - Roads
232 - Railroads
233 - Parking Lot
234 - Runway
235 - Marina / Barge Tie-ups
236 - Other

240 Open space use
241 - Parks (picnic grounds, ball fields, playgrounds)
242 - Golf Course
243 - Big Lawn
244 - Public Garden
245 - Cemetery
246 - Greenways
247 - Trail corridor
248 - Natural area / preserve

250 - Pavement
251 - Unimproved (Dirt)
252 - Gravel
253 - Bituminous
254 - Concrete
255 - Porous Pavement
256 - Brick / Cobblestone
257 - Other

260 - Farm buildings
261 - Farmstead
262 - Feeding Operation

270 - Agricultural field methods
271 - Straight row
272 - Crop residue
273 - Contoured
274 - Terraced
275 - Pasture
276 - Hayfield

3XX Modifiers to further define vegetation community

30X - Modifiers that reflect current vegetation management of a site

301 - Planted community

302 - Managed for wildlife

31X - Natural community with active vegetation management

310 - undefined vegetation management

311 - burned

312 - mowed

313 - chemical application

314 - brush cutting

315 - tree thinning

32X - Modifiers that reflect types of disturbances observed

321 - Natural community disturbed by wind

322 - Natural community disturbed by flood

323 - Natural community disturbed by fire

324 - Natural community disturbed by disease

325 - Recently clear-cut

326 - Natural community disturbed by non-native plants

327 - Natural community disturbed by major cultural activity

328 - Natural community disturbed by unknown factors

329 - Monocultural vegetation

33X - NOT USED ANYMORE

Old modifiers that reflected natural quality of a polygon

331 - High quality natural community

High quality examples of natural communities include a large portion of the species typical of the community (see the community descriptions section). Few weedy plants are present. (Weedy species can be native or non-native and are typical of disturbed areas. In forests weedy species include boxelder, buckthorn, prickly ash, and garlic mustard; in prairies they include red cedar, sumac, brome grass, and Kentucky blue-grass.) Most natural processes are occurring, including disturbances such as fire or flooding, if appropriate. There is little or no evidence of human disturbances, such as logging or livestock grazing.

332 - Medium quality natural community

Medium quality examples of natural communities lack many of the species typical of the community. Weedy species may be abundant, but they are not dominant over the typical native species. (In communities with multiple layers of vegetation, weedy species are not dominant in any layer.) Natural processes may have changed and there may be evidence of human disturbance, but the nature of the community has not been altered beyond recognition.

333 - Low Quality

In low quality examples of natural communities weedy species are dominant in any or all layers of vegetation. Natural processes are highly altered and there are extensive human

disturbances. The community may not resemble any naturally-occurring community (i.e. one described by DNR Natural Heritage or NVCS).

340 - Native species present in a non-native dominated polygon.

34X - Modifiers for natural community quality ranking.
The natural plant community sites can be given a natural quality ranking, based on the DNR's Natural Heritage's Element Occurrence Ranking Guidelines* (EOR). See "Natural Community Modifiers" for a discussion of the Element Occurrence Ranking Guidelines. Refer to the EOR Guidelines to evaluate the specific natural communities. Non-native, altered and disturbed communities should only be given a non-native ranking (NN or NA). Valid codes and general definitions modifier m_34X are:

A = highest quality natural community, no disturbances and natural processes intact. Site must be visited entirely or partially to accurately assess its natural quality at this level (fld_level = 3 or 4).

B = good quality natural community. Has its natural processes intact, but shows signs of past human impacts. Low levels of exotics. Site must be visited entirely or partially to accurately assess its natural quality at this level (fld_level = 3 or 4).

C = moderate condition natural community with obvious past disturbance but is still clearly recognizable as a native community. Not dominated by weedy species in any layer. Minimally, the site must be visited from the edge to accurately assess its natural quality at this level (fld_level = 2, 3 or 4).

D = poor condition of a natural community. Includes some natives, but is dominated by non-natives and/or is widely disturbed and altered. Herbaceous communities may be assessed with this ranking from a distance (fld_level = 1) if large masses of invasive species are present and the entire community is visible.

NA = Native species present in an altered / non-native plant community. This NA ranking can only be used if the site is field checked from the edge or to a greater degree (fld_level 2, 3, or 4), thus confirming the presence of native species within a non-native community.

NN = Altered / non-native plant community. These semi-natural communities do not qualify for natural quality ranking. Using NN signifies the site has been field checked and confirms it is a semi-natural community.

* http://files.dnr.state.mn.us/ecological_services/nhnrp/eoranks2001.pdfp/eoranks2001.pdf

4XX Modifiers that reflect invasive species or vegetative encroachment.

These are to be used to identify non-native plants observed in significant numbers for all natural or semi-natural areas. The polygon attribute table allows for selecting all species that apply. The amount of invasive species present can be tracked using the following codes in its corresponding polygon attribute field:

0 = unknown, or if field checked, plants not observed
1 = observed, unknown quantity
2 = 1 to 5% coverage
3 = 6 to 25% coverage
4 = 26 to 50% coverage
5 = 51 to 75% coverage
6 = 76 to 100% coverage

400 - Overgrown prairie/savanna
401 - Overgrown woodland
402 - Purple loosestrife
403 - Eurasian watermilfoil
404 - Curly-leaf pondweed
405 - Flowering rush
406 - Narrow-leaf cattail
407 - Crown vetch
408 – Common and glossy buckthorn
409 - Leafy spurge
410 - Tartarian honey suckle
411 - Garlic mustard
412 - Reed canary grass
413 - Smooth brome
414 - Spotted knapweed
415 - Exotic thistle
416 - Siberian elm
417 - Phragmites
418 - Grecian foxglove
419 - Amur maple
420 - Black locust
421 - Absinthe sage (*Artemisia absinthium*)
499 - Other

5XX Tree Species

500 - Coniferous trees
501 - Pines
502 - White Pine
503 - Red Pine
504 - Scotch Pine
505 - Ponderosa Pine
506 - Jack Pine
507 - Spruces

508 - White Spruce
509 - Black Spruce
510 - Norway Spruce
511 - Colorado Spruce
512 - Cedars
513 - White Cedar
514 - Red cedar
515 - Tamarack
516 - Pine / Spruce mix
517 - White Pine / Red cedar mix
518 - Deciduous Trees
519 - Planted Maples
520 - Sugar Maple
521 - Norway Maple
522 - Silver Maple
523 - Boxelder
524 - Oaks
525 - White Oak
526 - Red Oak
527 - Burr Oak
528 - Swamp White Oak
529 - Northern Pin Oak
530 - Ashes
531 - Green Ash
532 - White Ash
533 - Poplars
534 - Cottonwood
535 - Aspen
536 - Bigtooth Aspen
537 - Maple / Oak mix
538 - Maple / Ash mix
539 - Northern Hardwoods
540 - Mixed early successional hardwoods
541 - Mixed Coniferous - Deciduous Trees
542 - White Pine / Sugar Maple
543 - Pine / Spruce / Oak / Maple
544 - Pine / Oak
545 - Walnut
546 - Willow

6XX Forestry modifiers

60X - Forest Dynamics.

The following terminology was developed by John Kotar at the University of Wisconsin-Madison through a cooperative agreement with the USDA Forest Service, Northeastern Area State and Private Forestry.

601 - Stand initiation.
This follows major disturbances, such as catastrophic wind, fire or clear cutting. The open space becomes filled with individuals that arrive by seed (e.g., paper birch, yellow poplar, aspen, cherry), stump sprouts (e.g., oak after fire) and root sprouts (e.g., aspen after clear cutting), or that were present as advance regeneration (e.g., sugar maple or other shade-tolerant species after a tornado or logging removes the canopy). This stage ends when the canopy becomes continuous and trees begin competing with each other for light and canopy space.

602 - Stem exclusion.
During this stage, the canopy is dense enough to prevent new saplings from growing into the canopy - there is no space available for new canopy trees. The canopy continues to have only one dominant cohort, with a relatively smooth upper canopy surface. Competition among trees is intense and density-dependent self-thinning is the major cause of mortality. Crowns are small enough so that when one tree dies, the other trees are able to fill the vacated space in the canopy by expanding their crowns. The duration of this stage varies with species and geographic region. For example, in the Lake States and the Northeast, this situation continues for 75-150 years in northern hardwoods and red or white pine stands, but may last only 20 to 40 years in some aspen and jack pine stands.

603 - Understory reinitiation
At this point, a stand undergoes demographic transition from one cohort to more than one cohort. There may be a wave of high mortality as many trees reach old age at the same time. The crowns of the trees are now large enough so that when one dies, the surrounding trees cannot fill the gap. As a result, a new cohort of trees has space to enter the canopy. The diameter distribution becomes a compound of the two cohorts - an old unimodal peak in larger size classes and a new peak in the small size classes. If the stand was originally composed of a pioneer species (e.g., paper birch, aspen or yellow poplar), shade-tolerant trees such as sugar maple or beech may begin entering the canopy. If there are more gaps in the canopy and more light on the forest floor, some of the mid-tolerant trees, such as white ash, red maple, yellow birch and white pine, also may enter the canopy. Mortality undergoes a transition from mostly density-dependent self-thinning to mostly density independent mechanisms, such as senescence, windthrow (due to weakened wood caused by heartrot) or disease. The stand begins to take on "old growth" characteristics, with large rotten logs on the forest floor, many tree sizes and an uneven canopy surface.

604 - Old, multi-aged community
At this point, demographic transition is complete; the forest has many age classes and size classes of trees in the canopy. There may be few or no remnants left from the original cohort. Mortality is continuous at a relatively low level, with death occurring mainly in individuals or small groups of trees.

61X Percent tree canopy cover
610 - No tree cover
611 - 1% to 10% tree cover

612 - 11% to 20% tree cover
613 - 21% to 40% tree cover
614 - 41% to 60% tree cover
615 - 61% to 80% tree cover
616 - 81% to 100% tree cover

62X Cover size. Average diameter of trees
621 - not applicable to stand
622 - 0 to 0.9' Diameter Breast Height (DBH)
623 - 1 to 2.9' DBH
624 - 3 to 4.9' DBH
625 - 5 to 8.9' DBH
626 - 9 to 14.9' DBH
627 - 15 to 19.9' DBH
628 - 20 to 24.9' DBH
629 - 25+= DBH

7XX Water modifiers

71X - Water regime (NWI modifiers)
710 - Temporarily Flooded (A)
711 - Saturated (B)
712 - Seasonally Flooded (C)
713 - Semipermanently Flooded (F)
714 - Intermittently Exposed (G)
715 - Permanently Flooded (H)
716 - Artificially Flooded (K)

72X - Built features
720 - Beaver Pond (b)
721 - Partially Drained/Ditched (d)
722 - Farmed (f)
723 - Diked/Impounded (h)
724 - Artificial Substrate (r)
725 - Spoil (s)
726 - Excavated (x)

73X - Wetland features
730 - wetland(s) present
731 - water feature used for stormwater management
732 - water feature used for wildlife management
733 - reservoir
734 - livestock watering hole

74X - Stream features
740 - stream(s) present
741 - ditch present

75X - Spring feature

750 - groundwater seepage/springs present

Tables of MLCCS Codes

An integral part of the MLCCS is the use of modifier codes. Modifier codes are to be used to further define a site and are considered equal in weight to the initial MLCCS code. In cases where a site has been field checked, appropriate modifiers should be applied. See page B-26 for the modifier codes.

NOTE: The NVCS Evergreen classification has been changed to coniferous, thus moving tamarack forests from the NVCS deciduous classification to a coniferous classification

Artificial surfaces and associated areas

C_NUM	DESCRIPTION	C_ALPHA
10000	Artificial surfaces and associated areas	1.
11000	Artificial surfaces with trees as the dominant vegetation cover (25% to 96% vegetation cover)	1.tt.
11100	Artificial surfaces with coniferous trees	1.tt.CC.
11110	4% to 10% impervious cover with coniferous trees	1.tt.CC.i10.
11111	Jack pine (forest or woodland) with 4-10% impervious cover	1.tt.CC.i10.cJP.
11112	White/red pine (forest) with 4-10% impervious cover	1.tt.CC.i10.cWF.
11113	Spruce-fir (forest) with 4-10% impervious cover	1.tt.CC.i10.cSF.
11114	Eastern red cedar (woodland) with 4-10% impervious cover	1.tt.CC.i10.cRC.
11115	Northern conifer (woodland) with 4-10% impervious cover	1.tt.CC.i10.cNW.
11116	Planted red pine with 4-10% impervious cover	1.tt.CC.i10.cPR.
11117	Planted white pine with 4-10% impervious cover	1.tt.CC.i10.cPW.
11118	Planted spruce/fir with 4-10% impervious cover	1.tt.CC.i10.cPS.
11119	Other planted conifers with 4-10% impervious cover	1.tt.CC.i10.cPC.
11120	11% to 25% impervious cover with coniferous trees	1.tt.CC.i25.
11121	Jack pine (forest or woodland) with 11- 25% impervious cover	1.tt.CC.i25.cJP.
11122	White/red pine (forest) with 11- 25% impervious cover	1.tt.CC.i25.cWF.
11123	Spruce-fir (forest) with 11- 25% impervious cover	1.tt.CC.i25.cSF.
11124	Eastern red cedar (woodland) with 11- 25% impervious cover	1.tt.CC.i25.cRC.
11125	Northern conifer (woodland) with 11- 25% impervious cover	1.tt.CC.i25.cNW.
11126	Planted red pine with 11- 25% impervious cover	1.tt.CC.i25.cPR.
11127	Planted white pine with 11- 25% impervious cover	1.tt.CC.i25.cPW.
11128	Planted spruce/fir with 11- 25% impervious cover	1.tt.CC.i25.cPS.
11129	Other planted conifers with 11- 25% impervious cover	1.tt.CC.i25.cPC.
11130	26% to 50% impervious cover with coniferous trees	1.tt.CC.i50.
11131	Jack pine (forest or woodland) with 26-50% impervious cover	1.tt.CC.i50.cJP.
11132	White/red pine (forest) with 26-50% impervious cover	1.tt.CC.i50.cWF.
11133	Spruce-fir (forest) with 26-50% impervious cover	1.tt.CC.i50.cSF.
11134	Eastern red cedar (woodland) with 26-50% impervious cover	1.tt.CC.i50.cRC.
11135	Northern conifer (woodland) with 26-50% impervious cover	1.tt.CC.i50.cNW.
11136	Planted red pine with 26-50% impervious cover	1.tt.CC.i50.cPR.
11137	Planted white pine with 26-50% impervious cover	1.tt.CC.i50.cPW.

11138	Planted spruce/fir with 26-50% impervious cover	1.tt.CC.i50.cPS.
11139	Other planted conifers with 26-50% impervious cover	1.tt.CC.i50.cPC.
11140	51% to 75% impervious cover with coniferous trees	1.tt.CC.i75.
11141	Jack pine (forest or woodland) with 51-75% impervious cover	1.tt.CC.i75.cJP.
11142	White/red pine (forest) with 51-75% impervious cover	1.tt.CC.i75.cWF.
11143	Spruce-fir (forest) with 51-75% impervious cover	1.tt.CC.i75.cSF.
11144	Eastern red cedar (woodland) with 51-75% impervious cover	1.tt.CC.i75.cRC.
11145	Northern conifer (woodland) with 51-75% impervious cover	1.tt.CC.i75.cNW.
11146	Planted red pine with 51-75% impervious cover	1.tt.CC.i75.cPR.
11147	Planted white pine with 51-75% impervious cover	1.tt.CC.i75.cPW.
11148	Planted spruce/fir with 51-75% impervious cover	1.tt.CC.i75.cPS.
11149	Other planted conifers with 51-75% impervious cover	1.tt.CC.i75.cPC.
11200	Artificial surfaces with deciduous tree cover	1.tt.CD.
11210	4% to 10% impervious cover with deciduous trees	1.tt.CD.i10.
11211	Oak (forest or woodland) with 4-10% impervious cover	1.tt.CD.i10.cOA.
11212	Northern hardwood (forest) with 4-10% impervious cover	1.tt.CD.i10.cNH.
11213	Maple-basswood (forest) with 4-10% impervious cover	1.tt.CD.i10.cMB.
11214	Boxelder-green ash (forest) with 4-10% impervious cover	1.tt.CD.i10.cBG.
11215	Aspen-birch (forest) with 4-10% impervious cover	1.tt.CD.i10.cAB.
11216	Aspen (forest, woodland) with 4-10% impervious cover	1.tt.CD.i10.cAF.
11217	Planted ash with 4-10% impervious cover	1.tt.CD.i10.cPA.
11218	Planted oak with 4-10% impervious cover	1.tt.CD.i10.cPO.
11219	Other deciduous trees with 4-10% impervious cover	1.tt.CD.i10.cPD.
11220	11% to 25% impervious cover with deciduous trees	1.tt.CD.i25.
11221	Oak (forest or woodland) with 11- 25% impervious cover	1.tt.CD.i25.cOA.
11222	Northern hardwood (forest) with 11- 25% impervious cover	1.tt.CD.i25.cNH.
11223	Maple-basswood (forest) with 11- 25% impervious cover	1.tt.CD.i25.cMB.
11224	Boxelder-green ash (forest) with 11- 25% impervious cover	1.tt.CD.i25.cBG.
11225	Aspen-birch (forest) with 11- 25% impervious cover	1.tt.CD.i25.cAB.
11226	Aspen (forest, woodland) with 11- 25% impervious cover	1.tt.CD.i25.cAF.
11227	Planted ash with 11- 25% impervious cover	1.tt.CD.i25.cPA.
11228	Planted oak with 11- 25% impervious cover	1.tt.CD.i25.cPO.
11229	Other deciduous trees with 11- 25% impervious cover	1.tt.CD.i25.cPD.
11230	26% to 50% impervious cover with deciduous trees	1.tt.CD.i50.
11231	Oak (forest or woodland) with 26-50% impervious cover	1.tt.CD.i50.cOA.
11232	Northern hardwood (forest) with 26-50% impervious cover	1.tt.CD.i50.cNH.
11233	Maple-basswood (forest) with 26-50% impervious cover	1.tt.CD.i50.cMB.
11234	Boxelder-green ash (forest) with 26-50% impervious cover	1.tt.CD.i50.cBG.
11235	Aspen-birch (forest) with 26-50% impervious cover	1.tt.CD.i50.cAB.
11236	Aspen (forest, woodland) with 26-50% impervious cover	1.tt.CD.i50.cAF.
11237	Planted ash with 26-50% impervious cover	1.tt.CD.i50.cPA.
11238	Planted oak with 26-50% impervious cover	1.tt.CD.i50.cPO.
11239	Other deciduous trees with 26-50% impervious cover	1.tt.CD.i50.cPD.
11240	51% to 75% impervious cover with deciduous trees	1.tt.CD.i75.
11241	Oak (forest or woodland) with 51-75% impervious cover	1.tt.CD.i75.cOA.
11242	Northern hardwood (forest) with 51-75% impervious cover	1.tt.CD.i75.cNH.
11243	Maple-basswood (forest) with 51-75% impervious cover	1.tt.CD.i75.cMB.
11244	Boxelder-green ash (forest) with 51-75% impervious cover	1.tt.CD.i75.cBG.

11245	Aspen-birch (forest) with 51-75% impervious cover	1.tt.CD.i75.cAB.
11246	Aspen (forest, woodland) with 51-75% impervious cover	1.tt.CD.i75.cAF.
11247	Planted ash with 51-75% impervious cover	1.tt.CD.i75.cPA.
11248	Planted oak with 51-75% impervious cover	1.tt.CD.i75.cPO.
11249	Other deciduous trees with 51-75% impervious cover	1.tt.CD.i75.cPD.
11300	Artificial surfaces with mixed coniferous and deciduous tree cover	1.tt.CM.
11310	4% to 10% impervious cover with mixed coniferous/deciduous trees	1.tt.CM.i10.
11311	Mixed pine-hardwood (forest) with 4-10% impervious cover	1.tt.CM.i10.cMF.
11312	White pine-hardwood (forest) with 4-10% impervious cover	1.tt.CM.i10.cWH.
11313	Northern hardwood-conifer (forest) with 4-10% impervious cover	1.tt.CM.i10.cNF.
11314	Planted mixed coniferous/deciduous trees with 4-10% impervious cover	1.tt.CM.i10.cPM.
11320	11% to 25% impervious cover with mixed coniferous/deciduous trees	1.tt.CM.i25.
11321	Mixed pine-hardwood (forest) with 11-25% impervious cover	1.tt.CM.i25.cMF.
11322	White pine-hardwood (forest) with 11-25% impervious cover	1.tt.CM.i25.cWH.
11323	Northern hardwood-conifer (forest) with 11-25% impervious cover	1.tt.CM.i25.cNF.
11324	Planted mixed coniferous/deciduous trees with 11-25% impervious cover	1.tt.CM.i25.cPM.
11330	26% to 50% impervious cover with mixed coniferous/deciduous trees	1.tt.CM.i50.
11331	Mixed pine-hardwood (forest) with 26-50% impervious cover	1.tt.CM.i50.cMF.
11332	White pine-hardwood (forest) with 26-50% impervious cover	1.tt.CM.i50.cWH.
11333	Northern hardwood-conifer (forest) with 26-50% impervious cover	1.tt.CM.i50.cNF.
11334	Planted mixed coniferous/deciduous trees with 26-50% impervious cover	1.tt.CM.i50.cPM.
11340	51% to 75% impervious cover with mixed coniferous/deciduous trees	1.tt.CM.i75.
11341	Mixed pine-hardwood (forest) with 51-75% impervious cover	1.tt.CM.i75.cMF.
11342	White pine-hardwood (forest) with 51-75% impervious cover	1.tt.CM.i75.cWH.
11343	Northern hardwood-conifer (forest) with 51-75% impervious cover	1.tt.CM.i75.cNF.
11344	Planted mixed coniferous/deciduous trees with 51-75% impervious cover	1.tt.CM.i75.cPM.
12000	Artificial surfaces with coniferous and/or deciduous shrub dominant vegetation (25% to 96% vegetation cover)	1.ss.
12100	Artificial surfaces with coniferous and/or deciduous shrubs	1.ss.CS.
12110	4% to 10% impervious cover with coniferous and/or deciduous shrubs	1.ss.CS.i10.
12111	Short grasses with planted coniferous and/or deciduous shrubs, 4-10% impervious cover	1.ss.CS.i10.cGS.
12112	Long grasses with planted coniferous and/or deciduous shrubs, 4-10% impervious cover	1.ss.CS.i10.cGL.
12113	Other coniferous and/or deciduous shrubs with 4-10% impervious cover	1.ss.CS.i10.cOB.
12120	11% to 25% impervious cover with coniferous and/or deciduous shrubs	1.ss.CS.i25.
12121	Short grasses with planted coniferous and/or deciduous shrubs, 11-25% impervious cover	1.ss.CS.i25.cGS.
12122	Long grasses with planted coniferous and/or deciduous shrubs, 11-25% impervious cover	1.ss.CS.i25.cGL.
12123	Other coniferous and/or deciduous shrubs, 11-25% impervious cover	1.ss.CS.i25.cOB.
12130	26% to 50% impervious cover with coniferous and/or deciduous shrubs	1.ss.CS.i50.
12131	Short grasses with planted coniferous and/or deciduous shrubs, 26-50% impervious cover	1.ss.CS.i50.cGS.
12132	Long grasses with planted coniferous and/or deciduous shrubs, 26-50% impervious cover	1.ss.CS.i50.cGL.

12133	Other coniferous and/or deciduous shrubs, 26-50% impervious cover	1.ss.CS.i50.cOB.
12140	51% to 75% impervious cover with coniferous and/or deciduous shrubs	1.ss.CS.i75.
12141	Short grasses with planted coniferous and/or deciduous shrubs, 51-75% impervious cover	1.ss.CS.i75.cGS.
12142	Long grasses with planted coniferous and/or deciduous shrubs, 51-75% impervious cover	1.ss.CS.i75.cGL.
12143	Other coniferous and/or deciduous shrubs, 51-75% impervious cover	1.ss.CS.i75.cOB.
12200	Artificial surfaces with coniferous and/or deciduous shrubs with sparse trees	1.ss.CE.
12210	4% to 10% impervious cover with coniferous and/or deciduous shrubs and sparse trees	1.ss.CE.i10.
12211	Oak woodland brushland with 4-10% impervious cover	1.ss.CE.i10.cOW.
12212	Other coniferous and/or deciduous shrubs and trees with 4-10% impervious cover	1.ss.CE.i10.cOR.
12220	11% to 25% impervious cover with coniferous and/or deciduous shrubs and sparse trees	1.ss.CE.i25.
12221	Oak woodland brushland with11-25% impervious cover	1.ss.CE.i25.cOW.
12222	Other coniferous and/or deciduous shrubs and trees with11-25% impervious cover	1.ss.CE.i25.cOR.
12230	26% to 50% impervious cover with coniferous and/or deciduous shrubs and sparse trees	1.ss.CE.i50.
12231	Oak woodland brushland with 26-50% impervious cover	1.ss.CE.i50.cOW.
12232	Other coniferous and/or deciduous shrubs and trees with 26-50% impervious cover	1.ss.CE.i50.cOR.
12240	51% to 75% impervious cover with coniferous and/or deciduous shrubs and sparse trees	1.ss.CE.i75.
12241	Oak Woodland brushland with 51-75% impervious cover	1.ss.CE.i75.cOW.
12242	Other coniferous and/or deciduous shrubs and trees with 51-75% impervious cover	1.ss.CE.i75.cOR.
13000	Artificial surfaces with herbaceous dominant vegetation (25% to 96% vegetation cover)	1.hh.
13100	Artificial surfaces with perennial grasses with sparse trees	1.hh.CT.
13110	4% to 10% impervious cover with perennial grasses and sparse trees	1.hh.CT.i10.
13111	Jack pine barrens with 4-10% impervious cover	1.hh.CT.i10.cJB.
13112	Oak savanna with 4-10% impervious cover	1.hh.CT.i10.cOS.
13113	Aspen openings with 4-10% impervious cover	1.hh.CT.i10.cAO.
13114	Short grasses and mixed trees with 4-10% impervious cover	1.hh.CT.i10.cGS.
13115	Long grasses and mixed trees with 4-10% impervious cover	1.hh.CT.i10.cGL.
13120	11% to 25% impervious cover with perennial grasses and sparse trees	1.hh.CT.i25.
13121	Jack pine barrens with 11-25% impervious cover	1.hh.CT.i25.cJB.
13122	Oak savanna with 11-25% impervious cover	1.hh.CT.i25.cOS.
13123	Aspen openings with 11-25% impervious cover	1.hh.CT.i25.cAO.
13124	Short grasses and mixed trees with 11-25% impervious cover	1.hh.CT.i25.cGS.
13125	Long grasses and mixed trees with 11-25% impervious cover	1.hh.CT.i25.cGL.
13130	26% to 50% impervious cover with perennial grasses and sparse trees	1.hh.CT.i50.
13131	Jack pine barrens with 26-50% impervious cover	1.hh.CT.i50.cJB.
13132	Oak savanna with 26-50% impervious cover	1.hh.CT.i50.cOS.
13133	Aspen openings with 26-50% impervious cover	1.hh.CT.i50.cAO.
13134	Short grasses and mixed trees with 26-50% impervious cover	1.hh.CT.i50.cGS.
13135	Long grasses and mixed trees with 26-50% impervious cover	1.hh.CT.i50.cGL.
13140	51% to 75% impervious cover with perennial grasses and sparse trees	1.hh.CT.i75.

13141	Jack pine barrens with 51-75% impervious cover	1.hh.CT.i75.cJB.
13142	Oak savanna with 51-75% impervious cover	1.hh.CT.i75.cOS.
13143	Aspen openings with 51-75% impervious cover	1.hh.CT.i75.cAO.
13144	Short grasses and mixed trees with 51-75% impervious cover	1.hh.CT.i75.cGS.
13145	Long grasses and mixed trees with 51-75% impervious cover	1.hh.CT.i75.cGL.
13200	Artificial surfaces with perennial grasses	1.hh.CG.
13210	4% to 10% impervious cover with perennial grasses	1.hh.CG.i10.
13211	Short grasses with 4-10% impervious cover	1.hh.CG.i10.cGS.
13212	Non-native dominated long grasses with 4-10% impervious cover	1.hh.CG.i10.cGL.
13213	Mesic prairie with 4-10% impervious cover	1.hh.CG.i10.cMP.
13214	Dry prairie with 4-10% impervious cover	1.hh.CG.i10.cDP.
13220	11% to 25% impervious cover with perennial grasses	1.hh.CG.i25.
13221	Short grasses with 11-25% impervious cover	1.hh.CG.i25.cGS.
13222	Non-native dominated long grasses with 11-25% impervious cover	1.hh.CG.i25.cGL.
13223	Mesic prairie with 11-25% impervious cover	1.hh.CG.i25.cMP.
13224	Dry prairie with 11-25% impervious cover	1.hh.CG.i25.cDP.
13230	26% to 50% impervious cover with perennial grasses	1.hh.CG.i50.
13231	Short grasses with 26-50% impervious cover	1.hh.CG.i50.cGS.
13232	Non-native dominated long grasses with 26-50% impervious cover	1.hh.CG.i50.cGL.
13233	Mesic prairie with 26-50% impervious cover	1.hh.CG.i50.cMP.
13234	Dry prairie with 26-50% impervious cover	1.hh.CG.i50.cDP.
13240	51% to 75% impervious cover with perennial grasses	1.hh.CG.i75.
13241	Short grasses with 51-75% impervious cover	1.hh.CG.i75.cGS.
13242	Non-native dominated long grasses with 51-75% impervious cover	1.hh.CG.i75.cGL.
13243	Mesic prairie with 51-75% impervious cover	1.hh.CG.i75.cMP.
13244	Dry prairie with 51-75% impervious cover	1.hh.CG.i75.cDP.
13300	Artificial surfaces with cultivated herbaceous vegetation (Gardens)	1.hh.CN.
13310	4% to 10% impervious cover with cultivated herbaceous vegetation	1.hh.CN.i10.
13311	Vegetables with 4-10% impervious cover	1.hh.CN.i10.cVG.
13312	Forbs (flowers) with 4-10% impervious cover	1.hh.CN.i10.cFB.
13320	11% to 25% impervious cover with cultivated herbaceous vegetation	1.hh.CN.i25.
13321	Vegetables with 11-25% impervious cover	1.hh.CN.i25.cVG.
13322	Forbs (flowers) with 11-25% impervious cover	1.hh.CN.i25.cFB.
13330	26% to 50% impervious cover with cultivated herbaceous vegetation	1.hh.CN.i50.
13331	Vegetables with 26-50% impervious cover	1.hh.CN.i50.cVG.
13332	Forbs (flowers) with 26-50% impervious cover	1.hh.CN.i50.cFB.
13340	51% to 75% impervious cover with cultivated herbaceous vegetation	1.hh.CN.i75.
13341	Vegetables with 51-75% impervious cover	1.hh.CN.i75.cVG.
13342	Forbs (flowers)with 51-75% impervious cover	1.hh.CN.i75.cFB.
14000	Artificial surfaces with less than 25% vegetation cover	1.mv.
14100	Buildings and/or pavement	1.mv.BP.
14110	76% to 90% impervious cover	1.mv.BP.i90.
14111	Buildings with 76-90% impervious cover	1.mv.BP.i90.cBD.
14112	Pavement with 76-90% impervious cover	1.mv.BP.i90.cPV.
14113	Buildings and pavement with 76-90% impervious cover	1.mv.BP.i90.cBP.
14120	91% to 100% impervious cover	1.mv.BP.i99.
14121	Buildings with 91-100% impervious cover	1.mv.BP.i99.cBD.
14122	Pavement with 91-100% impervious cover	1.mv.BP.i99.cPV.

14123	Buildings and pavement with 91-100% impervious cover	1.mv.BP.i99.cBP.
14200	Exposed earth	1.mv.EE.
14210	0% to 10% impervious cover-exposed earth	1.mv.EE.e10.
14211	Mines with 0-10% impervious cover	1.mv.EE.e10.cMN.
14212	Sand and gravel pits with 0-10% impervious cover	1.mv.EE.e10.cSG.
14213	Landfill with 0-10% impervious cover	1.mv.EE.e10.cLF.
14214	Other exposed/transitional land with 0-10% impervious cover	1.mv.EE.e10.cOE.
14220	11% to 25% impervious cover-exposed earth	1.mv.EE.e25.
14221	Mines with 11-25% impervious cover	1.mv.EE.e25.cMN.
14222	Sand and gravel pits with 11-25% impervious cover	1.mv.EE.e25.cSG.
14223	Landfill with 11-25% impervious cover	1.mv.EE.e25.cLF.
14224	Other exposed/transitional land with 11-25% impervious cover	1.mv.EE.e25.cOE.
14230	26% to 50% impervious cover-exposed earth	1.mv.EE.e50.
14231	Mines with 26-50% impervious cover	1.mv.EE.e50.cMN.
14232	Sand and gravel pits with 26-50% impervious cover	1.mv.EE.e50.cSG.
14233	Landfill with 26-50% impervious cover	1.mv.EE.e50.cLF.
14234	Other exposed/transitional land with 26-50% impervious cover.	1.mv.EE.e50.cOE.

Planted or Cultivated Vegetation

20000	Planted or Cultivated Vegetation (greater than 96% vegetation cover)	2.
21000	Planted, maintained or cultivated tree vegetation	2.tt.
21100	Planted, maintained or cultivated coniferous trees	2.tt.CC.
21110	Upland soils with planted, maintained, or cultivated coniferous trees	2.tt.CC.pUS.
21111	Spruce/fir trees on upland soils	2.tt.CC.pUS.cPS.
21112	White pine trees on upland soils	2.tt.CC.pUS.cPW.
21113	Red pine trees on upland soils	2.tt.CC.pUS.cPR.
21114	Coniferous trees on upland soils	2.tt.CC.pUS.cPC.
21200	Planted, maintained or cultivated deciduous trees	2.tt.CD.
21210	Upland soils with planted, maintained or cultivated deciduous trees	2.tt.CD.pUS.
21211	Fruit trees (apple, cherry, plum, etc) on upland soils	2.tt.CD.pUS.cPF.
21212	Walnut trees on upland soils	2.tt.CD.pUS.cPT.
21213	Deciduous trees on upland soils	2.tt.CD.pUS.cPD.
21300	Planted, maintained or cultivated mixed coniferous and deciduous trees	2.tt.CM.
21310	Upland soils with planted, maintained or cultivated mixed coniferous/deciduous trees	2.tt.CM.pUS.
21320	Hydric soils with planted, maintained or cultivated mixed coniferous/deciduous trees	2.tt.CM.pHS.
22000	Planted, maintained or cultivated shrub and/or vine vegetation	2.sv.
22100	Planted, maintained or cultivated coniferous shrubs	2.sv.CB.
22110	Upland soils with planted, maintained or cultivated coniferous shrubs	2.sv.CB.pUS.
22120	Hydric soils with planted, maintained or cultivated coniferous shrubs	2.sv.CB.pHS.
22200	Planted, maintained or cultivated deciduous shrub/vine vegetation	2.sv.CO.
22210	Upland soils with planted, maintained or cultivated deciduous shrub/vine vegetation	2.sv.CO.pUS.
22211	Blackberry	2.sv.CO.pUS.cBB.
22212	Blueberry	2.sv.CO.pUS.cBL.
22213	Grape	2.sv.CO.pUS.cGP.
22214	Raspberry-black	2.sv.CO.pUS.cRB.
22215	Raspberry-red	2.sv.CO.pUS.cRR.
22216	Other shrub/vine vegetation	2.sv.CO.pUS.cOX.
22220	Artificially flooded or saturated soils	2.sv.CO.pFL.
22221	Cranberry	2.sv.CO.pFL.cCB.
22300	Planted, maintained or cultivated mixed coniferous-deciduous shrub/vine vegetation	2.sv.CS.
22310	Upland soils with planted, maintained or cultivated mixed coniferous-deciduous shrub/vine	2.sv.CS.pUS.
22320	Hydric soils with planted, maintained or cultivated mixed coniferous-deciduous shrub/vine	2.sv.CS.pHS.
23000	Planted or maintained herbaceous vegetation	2.ph.
23100	Planted or maintained grasses with sparse tree cover	2.ph.CT.
23110	Upland soils with planted or maintained grasses and sparse tree cover	2.ph.CT.pUS.
23111	Short grasses with sparse tree cover on upland soils	2.ph.CT.pUS.cGS.
23112	Long grasses with sparse tree cover on upland soils	2.ph.CT.pUS.cGL.
23120	Hydric soils with planted or maintained grasses and sparse tree cover	2.ph.CT.pHS.
23121	Short grasses with sparse tree cover on hydric soils	2.ph.CT.pHS.cGS.
23122	Long grasses with sparse tree cover on hydric soils	2.ph.CT.pHS.cGL.

23200	Planted or maintained grasses	2.ph.CG.
23210	Upland soils with planted or maintained grasses	2.ph.CG.pUS.
23211	Short grasses on upland soils	2.ph.CG.pUS.cGS.
23212	Long grasses on upland soils	2.ph.CG.pUS.cGL.
23220	Hydric soils with planted or maintained grasses	2.ph.CG.pHS.
23221	Short grasses on hydric soils	2.ph.CG.pHS.cGS.
23222	Long grasses on hydric soils	2.ph.CG.pHS.cGL.
23300	Planted or maintained grasses and forbs	2.ph.CF.
23310	Upland soils with planted or maintained grasses and forbs	2.ph.CF.pUS.
23311	Short grasses and forbs on upland soils	2.ph.CF.pUS.cGS.
23312	Long grasses and forbs on upland soils	2.ph.CF.pUS.cGL.
23320	Hydric soils with planted grasses and forbs	2.ph.CF.pHS.
23321	Short grasses and forbs on hydric soils	2.ph.CF.pHS.cGS.
23322	Long grasses and forbs on hydric soils	2.ph.CF.pHS.cGL.
24000	Cultivated herbaceous vegetation	2.ch.
24100	Row cropland	2.ch.RC.
24110	Upland soils - cropland	2.ch.RC.pUS.
24111	Beans (all types except soybeans)	2.ch.RC.pUS.cBN.
24112	Corn	2.ch.RC.pUS.cCO.
24113	Sorghum	2.ch.RC.pUS.cSG.
24114	Soybeans	2.ch.RC.pUS.cSB.
24115	Sugar beets	2.ch.RC.pUS.cST.
24116	Potato	2.ch.RC.pUS.cPP.
24117	Pumpkins	2.ch.RC.pUS.cPK.
24118	Sunflowers	2.ch.RC.pUS.cSF.
24119	Other vegetable and truck crops	2.ch.RC.pUS.cOV.
24120	Hydric soils - row cropland	2.ch.RC.pHS.
24121	Beans (all types except soybeans) on hydric soils	2.ch.RC.pHS.cBN.
24122	Corn on hydric soils	2.ch.RC.pHS.cCO.
24123	Sorghum on hydric soils	2.ch.RC.pHS.cSG.
24124	Soybeans on hydric soils	2.ch.RC.pHS.cSB.
24125	Sugar beets on hydric soils	2.ch.RC.pHS.cST.
24126	Potato on hydric soils	2.ch.RC.pHS.cPP.
24127	Pumpkins on hydric soils	2.ch.RC.pHS.cPK.
24128	Sunflowers on hydric soils	2.ch.RC.pHS.cSF.
24129	Other vegetable and truck crops on hydric soils	2.ch.RC.pHS.cOV.
24200	Close grown or solid seeded cropland	2.ch.GN.
24210	Upland soils - close grown cropland	2.ch.GN.pUS.
24211	Wheat	2.ch.GN.pUS.cWT.
24212	Oats	2.ch.GN.pUS.cOT.
24213	Barley	2.ch.GN.pUS.cBA.
24214	Sod	2.ch.GN.pUS.cSD.
24215	Not planted	2.ch.GN.pUS.cNP.
24216	Fallow	2.ch.GN.pUS.cFW.
24217	Hayfield	2.ch.GN.pUS.cHF.
24218	All other close grown cropland on upland soils	2.ch.GN.pUS.cOC.
24220	Hydric soils - close grown cropland	2.ch.GN.pHS.
24221	Wheat on hydric soils	2.ch.GN.pHS.cWT.

24222	Oats on hydric soils	2.ch.GN.pHS.cOT.
24223	Rice on hydric soils	2.ch.GN.pHS.cRI.
24224	Barley on hydric soils	2.ch.GN.pHS.cBA.
24225	Sod on hydric soils	2.ch.GN.pHS.cSD.
24226	Not planted on hydric soils	2.ch.GN.pHS.cNP.
24227	Fallow hydric soils	2.ch.GN.pHS.cFW.
24228	Hayfield on hydric soils	2.ch.GN.pHS.cHF.
24229	All other close grown cropland on hydric soils	2.ch.GN.pHS.cOC.
24230	Artificially flooded or saturated soils - close grown cropland	2.ch.GN.pFL.
24231	Rice	2.ch.GN.pFL.cRI.

Forest

30000	Forests	3.
31000	Coniferous forest	3.ce.
31100	Upland coniferous forest	3.ce.UP.
31110	Black spruce-feathermoss forest	3.ce.UP.nBL.
31120	Jack pine forest	3.ce.UP.nJP.
31121	Jack pine forest jack pine-fir subtype	3.ce.UP.nJP.nJF.
31122	Jack pine forest hazel subtype	3.ce.UP.nJP.nJH.
31123	Jack pine forest jack pine-oak subtype	3.ce.UP.nJP.nJO.
31124	Jack pine forest jack pine-black spruce subtype	3.ce.UP.nJP.nJS.
31125	Jack pine forest blueberry subtype	3.ce.UP.nJP.nJY.
31130	Red pine forest	3.ce.UP.nRP.
31140	White pine forest	3.ce.UP.nWF.
31150	Upland white cedar forest	3.ce.UP.nUW.
31151	Upland white cedar forest wet-mesic subtype	3.ce.UP.nUW.nUE.
31152	Upland white cedar forest mesic subtype	3.ce.UP.nUW.nUM.
31160	Spruce-fir forest	3.ce.UP.nSF.
31161	Spruce-fir forest white spruce-balsam fir subtype	3.ce.UP.nSF.nSB.
31162	Spruce-fir forest fir-birch subtype	3.ce.UP.nSF.nSI.
31200	Saturated coniferous forest	3.ce.WB.
31210	Tamarack swamp	3.ce.WB.nTS.
31211	Tamarack swamp seepage subtype	3.ce.WB.nTS.nTE.
31212	Tamarack swamp minerotrophic subtype	3.ce.WB.nTS.nTM.
31213	Tamarack swamp sphagnum subtype	3.ce.WB.nTS.nTP.
31220	White cedar swamp	3.ce.WB.nWC.
31221	White cedar swamp seepage subtype	3.ce.WB.nWC.nWT.
31230	Black spruce swamp	3.ce.WB.nBS.
31240	Black spruce bog	3.ce.WB.nBB.
31241	Black spruce bog intermediate subtype	3.ce.WB.nBB.nBI.
31242	Black spruce bog raised subtype	3.ce.WB.nBB.nBR.
32000	Deciduous forest	3.de.
32100	Upland deciduous forest	3.de.UP.
32110	Oak forest	3.de.UP.nOA.
32111	Oak forest red maple subtype	3.de.UP.nOA.nOL.
32112	Oak forest mesic subtype	3.de.UP.nOA.nOM.
32113	Oak forest dry subtype	3.de.UP.nOA.nOD.
32120	Northern hardwood forest	3.de.UP.nNH.
32130	Paper birch forest	3.de.UP.nPB.
32131	Paper birch forest northern hardwoods subtype	3.de.UP.nPB.nPN.
32132	Paper birch forest spruce-fir subtype	3.de.UP.nPB.nPS.
32140	Aspen-birch forest	3.de.UP.nAB.
32141	Aspen-birch forest northern hardwoods subtype	3.de.UP.nAB.nAN.
32142	Aspen-birch forest spruce-fir subtype	3.de.UP.nAB.nAU.
32150	Maple-basswood forest	3.de.UP.nMB.
32160	Aspen forest	3.de.UP.nAF.
32170	Altered/non-native deciduous forest	3.de.UP.nAT.

32200	Temporarily flooded deciduous forest	3.de.WA.
32210	Floodplain forest	3.de.WA.nFF.
32211	Floodplain forest silver maple subtype	3.de.WA.nFF.nFM.
32212	Floodplain forest swamp white oak subtype	3.de.WA.nFF.nFO.
32220	Lowland hardwood forest	3.de.WA.nLH.
32230	Aspen forest - temporarily flooded	3.de.WA.nAF.
32240	Altered/non-native temporarily flooded deciduous forest	3.de.WA.nAT.
32300	Saturated deciduous forest	3.de.WB.
32310	Black ash swamp	3.de.WB.nBA.
32311	Black ash swamp seepage subtype	3.de.WB.nBA.nBE.
32320	Mixed hardwood swamp	3.de.WB.nMH.
32321	Mixed hardwood swamp seepage subtype	3.de.WB.nMH.nMS.
32330	Aspen forest - saturated soils	3.de.WB.nAF.
32340	Altered/non-native saturated soils deciduous forest	3.de.WB.nAT.
32400	Seasonally flooded deciduous forest	3.de.WC.
32410	Black ash swamp - seasonally flooded	3.de.WC.nBA.
32420	Mixed hardwood swamp - seasonally flooded	3.de.WC.nMH.
32430	Altered/non-native seasonally flooded deciduous forest	3.de.WC.nAT.
33000	Mixed coniferous-deciduous forest	3.cd.
33100	Upland mixed coniferous-deciduous forest	3.cd.UP.
33110	Mixed pine-hardwood forest	3.cd.UP.nMF.
33120	Boreal hardwood-conifer forest	3.cd.UP.nBF.
33130	Northern hardwood-conifer forest	3.cd.UP.nNF.
33131	Northern hardwood-conifer forest yellow birch-white cedar subtype	3.cd.UP.nNF.nNY.
33140	White pine-hardwood forest	3.cd.UP.nWH.
33141	White pine-hardwood forest dry subtype	3.cd.UP.nWH.nWD.
33142	White pine-hardwood forest mesic subtype	3.cd.UP.nWH.nWE.

Woodland

40000	Woodland	4.
41000	Coniferous woodland	4.ce.
41100	Upland coniferous woodland	4.ce.UP.
41110	Jack pine woodland	4.ce.UP.nJW.
41120	Northern conifer woodland	4.ce.UP.nNW.
41130	Eastern Red Cedar woodland	4.ce.UP.nRC.
42000	Deciduous woodland	4.de.
42100	Upland deciduous woodland	4.de.UP.
42110	Aspen woodland	4.de.UP.nAW.
42120	Oak woodland-brushland	4.de.UP.nOW.
42130	Altered/non-native deciduous woodland	4.de.UP.nAT.
42200	Temporarily flooded deciduous woodland	4.de.WA.
42210	Altered/non-native deciduous woodland - temporarily flooded	4.de.WA.nAT.
42300	Saturated deciduous woodland	4.de.WB.
42310	Altered/non-native deciduous woodland - saturated	4.de.WB.nAT.
42400	Seasonally flooded deciduous woodland	4.de.WC.
42410	Altered/non-native deciduous woodland - seasonally flooded	4.de.WC.nAT.
43000	Mixed coniferous-deciduous woodland	4.cd.
43100	Upland mixed coniferous-deciduous woodland	4.cd.UP.
43110	Altered/non-native mixed woodland	4.cd.UP.nAT.

Shrubland

50000	Shrubland	5.
51000	Coniferous / evergreen shrubland	5.ce.
51100	Saturated needle-leaved or microphyllous evergreen	5.ce.WB.
51110	Open sphagnum bog	5.ce.WB.nOB.
51111	Open sphagnum bog intermediate subtype	5.ce.WB.nOB.nOI.
51112	Open sphagnum bog raised subtype	5.ce.WB.nOB.nOR.
51120	Scrub tamarack poor fen	5.ce.WB.nPT.
52000	Deciduous shrubland	5.de.
52100	Upland deciduous shrubland	5.de.UP.
52110	Mesic brush-prairie	5.de.UP.nMR.
52111	Mesic brush-prairie sand-gravel subtype	5.de.UP.nMR.nMG.
52120	Native dominated disturbed upland shrubland	5.de.UP.nNT.
52130	Altered/non-native dominated upland shrubland	5.de.UP.nAT.
52200	Temporarily flooded deciduous woodland	5.de.WA.
52210	Native dominated temporarily flooded shrubland	5.de.WA.nNT.
52220	Non-native dominated temporarily flooded shrubland	5.de.WA.nAT.
52230	Bog birch, spiraea temporarily flooded shrubland	5.de.WA.nBH.
52300	Saturated deciduous shrubland	5.de.WB.
52310	Shrub fen	5.de.WB.nSN.
52311	Poor fen shrub subtype	5.de.WB.nSN.nRH.
52312	Rich fen shrub subtype	5.de.WB.nSN.nPH.
52320	Wet brush-prairie	5.de.WB.nWB.
52321	Wet brush-prairie seepage subtype	5.de.WB.nWB.nWG.
52330	Altered/non-native dominated saturated shrubland	5.de.WB.nAT.
52340	Shrub swamp seepage subtype	5.de.WB.nSS.
52350	Alder swamp - saturated soils	5.de.WB.nAS.
52360	Willow swamp - saturated soils	5.de.WB.nWI.
52370	Wet meadow shrub subtype - saturated soils	5.de.WB.nWR.
52380	Bog birch, spiraea shrubland - saturated soils	5.de.WB.nBH.
52400	Seasonally flooded deciduous shrubland	5.de.WC.
52410	Alder swamp	5.de.WC.nAS.
52420	Wet meadow shrub subtype	5.de.WC.nWR.
52430	Willow swamp	5.de.WC.nWI.
52440	Altered/non-native dominated seasonally flooded shrubland	5.de.WC.nAT.
52450	Bog birch, spiraea shrubland - seasonally flooded	5.de.WC.nBH.
52500	Semipermanently flooded deciduous shrubland	5.de.WF.
52510	Wet meadow shrub - semipermanently flooded	5.de.WF.nWR.
52520	Willow swamp - semipermanently flooded	5.de.WF.nWI.
52530	Bog birch, spiraea shrubland - semipermanently flooded	5.de.WF.nBH.
52540	Altered/non-native dominated semipermanently flooded shrubland	5.de.WF.AT.

Herbaceous

60000	Herbaceous	6.
61000	Grassland or emergent vegetation	6.ge.
61100	Tall grassland	6.ge.TG.
61110	Mesic prairie	6.ge.TG.nMP.
61111	Mesic prairie carbonate bedrock subtype	6.ge.TG.nMP.nMA.
61112	Mesic prairie crystalline bedrock subtype	6.ge.TG.nMP.nMY.
61120	Tall grass altered/non-native dominated grassland	6.ge.TG.nAT.
61200	Medium-tall grassland	6.ge.MG.
61210	Dry Prairie	6.ge.MG.nDP.
61211	Dry Prairie barrens subtype	6.ge.MG.nDP.nDA.
61212	Dry Prairie bedrock bluff subtype	6.ge.MG.nDP.nDB.
61213	Dry Prairie sand-gravel subtype	6.ge.MG.nDP.nDG.
61214	Dry Prairie hill subtype	6.ge.MG.nDP.nDH.
61220	Medium-tall grass altered/non-native dominated grassland	6.ge.MG.nAT.
61300	Temporarily flooded graminoid vegetation	6.ge.WA.
61310	Wet prairie	6.ge.WA.nWP.
61311	Wet prairie saline subtype	6.ge.WA.nWP.nWA.
61320	Wet meadow - temporarily flooded soils	6.ge.WA.nWM.
61330	Temporarily flooded altered/non-native dominated grassland	6.ge.WA.nAT.
61340	Cattail marsh - temporarily flooded	6.ge.WA.nCM.
61400	Saturated graminoid vegetation	6.ge.WB.
61410	Wet prairie - saturated soils	6.ge.WB.nWP.
61411	Wet prairie saline subtype - saturated soils	6.ge.WB.nWP.nWA.
61412	Wet prairie seepage subtype - saturated soils	6.ge.WB.nWP.nWS.
61420	Wet meadow	6.ge.WB.nWM.
61430	Cattail marsh - saturated soils	6.ge.WB.nCM.
61440	Calcareous seepage fen	6.ge.WB.nCF.
61441	Calcareous seepage fen boreal subtype	6.ge.WB.nCF.nCB.
61442	Calcareous seepage fen prairie subtype	6.ge.WB.nCF.nCP.
61450	Poor fen	6.ge.WB.nPF.
61451	Poor fen sedge subtype	6.ge.WB.nPF.nPD.
61452	Poor fen patterned fen subtype	6.ge.WB.nPF.nPA.
61460	Rich fen	6.ge.WB.nRF.
61461	Rich fen sedge subtype	6.ge.WB.nRF.nRD.
61462	Rich fen floating-mat subtype - saturated soils	6.ge.WB.nRF.nRM.
61463	Rich fen patterned fen subtype	6.ge.WB.nRF.nRT.
61470	Open bog	6.ge.WB.nOB.
61471	Open sphagnum bog schlenke subtype	6.ge.WB.nOB.nOS.
61472	Graminoid bog	6.ge.WB.nOB.nGB.
61480	Saturated altered/non-native dominated graminoid vegetation	6.ge.WB.nAT.
61500	Seasonally flooded emergent vegetation	6.ge.WC.
61510	Cattail marsh - seasonally flooded	6.ge.WC.nCM.
61520	Mixed emergent marsh - seasonally flooded	6.ge.WC.nME.
61530	Seasonally flooded altered/non-native dominated emergent vegetation	6.ge.WC.nAT.
61540	Wet meadow - seasonally flooded	6.ge.WC.nWM.

61600	Semipermanently flooded emergent vegetation	6.ge.WF.
61610	Cattail marsh - semipermanently flooded	6.ge.WF.nCM.
61620	Mixed emergent marsh	6.ge.WF.nME.
61630	Semipermanently flooded altered/non-native dominated vegetation	6.ge.WF.nAT.
61640	Wet meadow - semipermanently flooded	6.ge.WF.nWM.
61641	Wet meadow floating mat subtype	6.ge.WF.nWM.nFV.
61650	Rich fen floating-mat subtype - semipermanently flooded	6.ge.WF.nRM.
61700	Intermittently exposed emergent vegetation	6.ge.WG.
61710	Cattail marsh - intermittently exposed	6.ge.WG.nCM.
61720	Mixed emergent marsh - intermittently exposed	6.ge.WG.nME.
61730	Intermittently exposed altered/non-native dominated vegetation	6.ge.WG.nAT.
61740	Rich fen floating-mat subtype - intermittently exposed	6.ge.WG.nRM.
61800	Permanently flooded emergent vegetation	6.ge.WH.
61810	Cattail marsh - permanently flooded	6.ge.WH.nCM.
61820	Mixed emergent marsh - permanently flooded	6.ge.WH.nME.
61830	Permanently flooded altered/non-native dominated vegetation	6.ge.WH.nAT.
61840	Rich fen floating-mat subtype - permanently flooded	6.ge.WH.nRM.
62000	Grassland with sparse tree layer	6.gt.
62100	Grassland with sparse deciduous trees	6.gt.GD.
62110	Aspen openings	6.gt.GD.nAO.
62111	Aspen openings sand gravel subtype	6.gt.GD.nAO.nAG.
62120	Dry oak savanna	6.gt.GD.nDO.
62121	Dry oak savanna hill subtype	6.gt.GD.nDO.nDI.
62122	Dry oak savanna barrens subtype	6.gt.GD.nDO.nDN.
62123	Dry oak savanna sand-gravel subtype	6.gt.GD.nDO.nDR.
62130	Mesic oak savanna	6.gt.GD.nMO.
62140	Grassland with sparse deciduous trees - altered/non-native dominated vegetation	6.gt.GD.nAT.
62200	Grassland with sparse conifer or mixed deciduous/coniferous trees	6.gt.GC.
62210	Jack pine barrens	6.gt.GC.nJB.
62220	Grassland with sparse conifer or mixed deciduous/coniferous trees - altered/non-native dominated	6.gt.GC.nAT.
62300	Temporarily flooded grassland with sparse deciduous trees	6.gt.WA.
62310	Altered/non-native grassland with sparse deciduous trees - temporarily flooded	6.gt.WA.nAT.
62400	Saturated grassland with sparse deciduous trees	6.gt.WB.
62410	Altered/non-native grassland with sparse deciduous trees - saturated soils	6.gt.WB.nAT.
62500	Seasonally flooded grassland with sparse deciduous trees	6.gt.WC.
62510	Altered/non-native grassland with sparse deciduous trees - seasonally flooded	6.gt.WC.nAT.
63000	Perennial forb vegetation	6.pf.
63100	Upland forb vegetation	6.pf.UP.
63110	Talus slope algific subtype	6.pf.UP.nTL.
63200	Saturated forb vegetation	6.pf.WB.
63210	Seepage meadow	6.pf.WB.nSM.
64000	Hydromorphic rooted vegetation	6.hr.
64100	Standing water hydromorphic rooted vegetation	6.hr.SW.
64110	Water lily	6.hr.SW.nWL.

64111	Water lily open marsh	6.hr.SW.nWL.nLC.
64112	Boreal water lily aquatic wetland	6.hr.SW.nWL.nLL.
64113	Northern water lily aquatic wetland	6.hr.SW.nWL.nLN.
64120	Midwest pondweed submerged aquatic wetland	6.hr.SW.nPW.
65000	Annual grasslands or forb vegetation	6.ag.
65100	Seasonally flooded annual forb vegetation	6.ag.WC.
65110	Slender glasswort saline meadow	6.ag.WC.nSG.

Nonvascular vegetation

70000	Nonvascular vegetation	7.
71000	Lichen vegetation	7.li.
71100	Lichen vegetation with sparse tree layer	7.li.LT.
71110	Northern conifer scrubland	7.li.LT.nNS.

Sparse vegetation

80000	Sparse vegetation	8.
81000	Consolidated rock (cliffs, bedrock, etc.)	8.cr.
81100	Cliffs with sparse vegetation	8.cr.CL.
81110	Open cliff	8.cr.CL.nOC.
81111	Great Lakes shore basalt/diabase cliff	8.cr.CL.nOC.nBD.
81112	Northern (Laurentian) igneous/metamorphic dry cliff	8.cr.CL.nOC.nIG.
81113	Midwest dry limestone/dolostone cliff	8.cr.CL.nOC.nLD.
81114	Midwest sandstone dry cliff	8.cr.CL.nOC.nDC.
81115	Midwest sandstone moist cliff	8.cr.CL.nOC.nMC.
81116	Great Lakes shoreline granite/metamorphic cliff	8.cr.CL.nOC.nGR.
81120	Wet cliff	8.cr.CL.nTC.
81121	Maderate cliff	8.cr.CL.nTC.nMM.
81122	Midwest sedimentary dripping cliff	8.cr.CL.nTC.nSD.
81130	Rock outcrop / butte	8.cr.CL.nRO.
81131	Northern (Laurentian) granite/metamorphic rock outcrop	8.cr.CL.nRO.nGG.
81132	Midwest quartzite - granite rock outcrop	8.cr.CL.nRO.nQG.
81200	Level bedrock with sparse vegetation	8.cr.LB.
81210	Open level bedrock	8.cr.LB.nLB.
81211	Inland lake igneous/metamorphic bedrock shore	8.cr.LB.nLB.nLE.
81212	Great Lakes basalt (conglomerate) bedrock lakeshore	8.cr.LB.nLB.nBC.
81213	Great Lakes limestone-dolostone bedrock lakeshore	8.cr.LB.nLB.nTB.
81214	Great Lakes sandstone bedrock shore	8.cr.LB.nLB.nSL.
81215	River ledge sandstone pavement	8.cr.LB.nLB.nRE.
82000	Boulder, gravel, cobble, or talus	8.bg.
82100	Lowland or submontane talus / scree slopes	8.bg.TS.
82110	Lowland talus	8.bg.TS.nTA.
82111	Northern granite/metamorphic talus	8.bg.TS.nTA.nTG.
82112	Midwest limestone - dolostone talus	8.bg.TS.nTA.nTD.
82113	Northern sandstone talus	8.bg.TS.nTA.nTN.
82114	Northern basalt/diabase open talus	8.bg.TS.nTA.nTF.
82200	Cobble / gravel beaches and shores	8.bg.BS.
82210	Cobble / gravel shore	8.bg.BS.nCG.
82211	Great Lakes basalt/diabase cobble-gravel lakeshore	8.bg.BS.nCG.nLG.
82212	Riverine igneous/metamorphic cobble-gravel shore	8.bg.BS.nCG.nRG.
82213	Great Lakes non-alkaline cobble/gravel shore	8.bg.BS.nCG.nGC.
82214	Inland lake igneous/metamorphic cobble-gravel shore	8.bg.BS.nCG.nIM.
83000	Unconsolidated material (soil, sand, and ash)	8.um.
83100	Sand flats	8.um.SF.
83110	Inland strand beach	8.um.SF.nIS.
83111	Inland freshwater strand beach	8.um.SF.nIS.nLS.
83200	Temporarily flooded sand flats	8.um.AS.
83210	Sand flats temporarily flooded	8.um.AS.nST.
83211	Lacustrine sand flats - bars	8.um.AS.nST.nFB.
83212	Riverine sand flats - bars	8.um.AS.nST.nRS.
83300	Seasonally / temporarily flooded mud flats	8.um.MF.

83310	Non-tidal mud flat seasonally / temporarily flooded	8.um.MF.nMU.
83311	Lake mud flats	8.um.MF.nMU.nLM.
83312	River mud flats	8.um.MF.nMU.nRU.
83313	Saline spring mud flats	8.um.MF.nMU.nMN.

Water

90000	Water	9.
91000	River (riverine)	9.ri.
91100	Slow moving linear open water habitat	9.ri.S.
91200	Fast moving linear open water habitat	9.ri.FR.
92000	Lake (lacustrine)	9.la.
92100	Limnetic open water	9.la.LC.
92200	Semipermanently flooded littoral aquatic bed	9.la.WF.
92210	Floating algae - semipermanently flooded littoral aquatic bed	9.la.WF.nFA.
92220	Floating vascular vegetation - semipermanently flooded littoral aquatic bed	9.la.WF.nFV.
92300	Intermittently exposed littoral aquatic bed	9.la.WG.
92310	Floating algae - intermittently exposed littoral aquatic bed	9.la.WG.nFA.
92320	Floating vascular vegetation - intermittently exposed littoral aquatic bed	9.la.WG.nFV.
92400	Permanently flooded littoral aquatic bed	9.la.WH.
92410	Floating algae - permanently flooded littoral aquatic bed	9.la.WH.nFA.
92420	Floating vascular vegetation - permanently flooded littoral aquatic bed	9.la.WH.nFV.
92500	Littoral open water	9.la.LL.
93000	Wetland-open water (palustrine)	9.ww.
93100	Intermittently exposed aquatic bed	9.ww.WG.
93110	Floating algae - intermittently exposed aquatic bed	9.ww.WG.nFA.
93120	Floating vascular vegetation - intermittently exposed aquatic bed	9.ww.WG.nFV.
93200	Permanently flooded aquatic bed	9.ww.WH.
93210	Floating algae	9.ww.WH.nFA.
93220	Floating vascular vegetation	9.ww.WH.nFV.
93300	Palustrine open water	9.ww.OW.

Definitions of the alphanumeric characters

LEVEL 1

1. Artificial Surfaces
2. Cultivated or Planted
3. Forests
4. Woodland
5. Shrubland
6. Herbaceous
7. Nonvascular
8. Sparse Vegetation
9. Water

LEVEL 2

Level 2 - Cultural

ch. Cultivated Herbaceous
hh. Herbaceous
mv. Minimal Vegetation
ph. Planted Herbaceous
ss. Shrubs
sv. Shrubs and Vines
tt. Trees

Level 2 - Natural

ag. Annual Grasslands or Forb Vegetation
bg. Boulder, Gravel, Cobble, or Talus
cd. Mixed Coniferous and Deciduous
ce. Coniferous / Evergreen
cr. Consolidated Rock
de. Deciduous
ge. Grassland or Emergent Vegetation
gt. Grassland with Sparse Trees
hr. Hydromorphic Rooted Vegetation
la. Lake
li. Lichen
pf. Perennial Forb Vegetation
ri. River (Riverine)
um. Unconsolidated Material
ww. Wetland / Open Water

LEVEL 3

Level 3 - Cultural

BP. Buildings or Pavement
CB. Cultural Coniferous Shrubs
CC. Cultural Conifers
CD. Cultural Deciduous
CE. Cultural Shrubs with Trees
CF. Cultural Grasses and Forbs
CG. Cultural Grasses
CM. Cultural Mixed Coniferous/Deciduous
CN. Cultural Gardens
CO. Cultural Deciduous Shrubs

CS. Cultural Mixed Shrubs
CT. Cultural Grasses with Trees
EE. Exposed Earth
GN. Close Grown Cropland
RC. Row Cropland

Level 3 - Natural, Plant Physiognomics
GC. Grassland with Sparse Coniferous Trees
GD. Grassland with Sparse Deciduous Trees
LT. Lichen Vegetation with Sparse Trees
MG. Medium-tall Grass
TG. Tall Grass

Level 3 - Natural, Geomorphology and Hydrology
AS. Temporarily Flooded Sand Flats
BS. Cobble / Gravel Beaches and Shores
CL. Cliffs
FR. Fast River
LB. Level Bedrock
LC. Limnetic
LL. Littoral
MF. Seasonally / Temporarily Flooded Mud Flats
OW. Palustrine Open Water
SF. Sand Flats
SR. Slow River
SW. Standing Water
TS. Lowland Talus / Scree
UP. Upland

Level 3 - Cowardin Hydrology
WA. Temporarily flooded
WB. Saturated
WC. Seasonally flooded
WF. Semi-permanently flooded
WG. Intermittently exposed
WH. Permanently flooded

LEVEL 4

Level 4 - Cultural, Artificial Surfaces
i10. 4% to 10% Impervious Cover
i25. 11% to 25% Impervious Cover
i50. 26% to 50% Impervious Cover
i75. 51% to 75% Impervious Cover
i90. 76% to 90% Impervious Cover
i99. 91% to 100% Impervious Cover

Level 4 - Cultural, Exposed Earth
e10. 0% to 10% Impervious Cover-Exposed Earth
e25. 11% to 25% Impervious Cover-Exposed Earth
e50. 26% to 50% Impervious Cover-Exposed Earth

Level 4 - Cultural, Soil Hydrology
pFL. Artificially flooded

pHS. Hydric Soils
pUS. Upland Soils

LEVEL 4 & 5

Level 4 & 5 - Cultural Communities

cAB. Aspen-birch
cAF. Aspen
cAO. Aspen Openings
cBA. Barley
cBB. Blackberry
cBD. Buildings
cBG. Boxelder-green ash
cBL. Blueberry
cBN. Beans
cBP. Buildings and Pavement
cCB. Cranberry
cCO. Corn
cDP. Dry Prairie
cFB. Forbs
cFW. Fallow
cGL. Long Grass
cGP. Grape
cGS. Short Grass
cHF. Hayfield
cJB. Jack Pine Barrens
cJP. Jack Pine
cLF. Landfill
cMB. Maple-basswood
cMF. Mixed Pine Hardwood
cMN. Mines
cMP. Mesic Prairie
cNF. Northern Hardwood Conifer
cNH. Northern Hardwood
cNP. Not Planted
cNW. Northern Conifers
cOA. Oak Forest
cOB. Other Shrubs
cOC. Other Close Grown crops
cOE. Other Exposed
cOR. Other Shrubs with Trees
cOS. Oak Savanna
cOT. Oats
cOV. Other Vegetables
cOW. Oak woodland
cOX. Other Shrub / Vines
cPA. Planted Ash
cPC. Planted Conifers

cPD. Planted Deciduous
cPF. Fruit Trees
cPK. Pumpkins
cPL. Planted Landscape
cPM. Planted Mixed Conifer - Deciduous
cPO. Planted Oak
cPP. Potato
cPR. Planted Red Pine
cPS. Planted Spruce
cPT. Walnut trees
cPV. Pavement
cPW. Planted White Pine
cRB. Raspberry - black
cRC. Red Cedar
cRI. Rice
cRR. Raspberry - red
cSB. Soybeans
cSD. Sod
cSF. Spruce Fir
cSG. Sand and Gravel
cST. Sugar Beets
cVG. Vegetables
cWF. White Pine
cWH. White Pine Hardwood
cWT. Wheat

Level 4 & 5 - Natural Communities

nAB. Aspen-birch Forest
nAC. Open Great Lakes Alkaline Cliff
nAF. Aspen Forest
nAG. Aspen Openings Sand-gravel Subtype
nAN. Aspen-birch Forest Northern Hardwoods Subtype
nAO. Aspen Openings
nAS. Alder Swamp
nAT. Altered/non-native
nAU. Aspen-birch Forest Spruce-fir Subtype
nAW. Aspen Woodland
nBA. Black Ash Swamp
nBB. Black Spruce Bog
nBC. Great Lakes Basalt (Conglomerate) Bedrock Lake Shore
nBD. Basalt / Diabase Great Lakes Cliff Sparse Vegetation
nBE. Black Ash Swamp Seepage Subtype
nBF. Boreal Hardwood-conifer Forest
nBG. Boxelder - Green Ash Disturbed Native Forest
nBH. Birch bog - spiraea shrubland
nBI. Black Spruce Bog Intermediate Subtype
nBL. Black Spruce-feathermoss Forest
nBR. Black Spruce Bog Raised Subtype

nBS. Black Spruce Swamp
nCB. Calcareous Seepage Fen Boreal Subtype
nCF. Calcareous Seepage Fen
nCG. Cobble / Gravel Shore
nCM. Cattail Marsh
nCP. Calcareous Seepage Fen Prairie Subtype
nDA. Dry Prairie Barrens Subtype
nDB. Dry Prairie Bedrock Bluff Subtype
nDC. Sandstone Dry Cliff
nDG. Dry Prairie Sand-gravel Subtype
nDH. Dry Prairie Hill Subtype
nDI. Dry Oak Savanna Hill Subtype
nDN. Dry Oak Savanna Barrens Subtype
nDO. Dry Oak Savanna
nDP. Dry Prairie
nDR. Dry Oak Savanna Sand-gravel Subtype
nDT. Disturbed Natural Community
nFA. Floating Algae
nFB. Lacustrine Sand Flats - Bars
nFF. Floodplain Forest
nFM. Floodplain Forest Silver Maple Subtype
nFO. Floodplain Forest Swamp White Oak Subtype
nFV. Floating Vascular Vegetation
nGB. Graminoid Bog
nGC. Non-alkaline Cobble - Gravel Lakes Shore
nGG. Granite / Metamorphic Rock Outcrop
nGR. Granite / Metamorphic Great Lakes Cliff
nIG. Northern (Laurentian) Igneous/Metamorphic Dry Cliff
nIM. Inland Lake Igneous/Metamorphic Cobble-gravel Shore
nIS. Inland Strand Beach
nJB. Jack Pine Barrens
nJF. Jack Pine Forest Jack Pine-fir Subtype
nJH. Jack Pine Forest Hazel Subtype
nJO. Jack Pine Forest Jack Pine-oak Subtype
nJP. Jack Pine Forest
nJS. Jack Pine Forest Jack Pine-black Spruce Subtype
nJW. Jack Pine Woodland
nJY. Jack Pine Forest Blueberry Subtype
nLB. Open Level Bedrock
nLC. Central Water Lily Aquatic Wetland
nLD. Limestone / Dolostone Midwest Dry Cliff
nLE. Lake Beach Bedrock Subtype
nLG. Gravel - Cobble Lake Shore
nLH. Lowland Hardwood Forest
nLL. Boreal Water Lily Aquatic Wetland
nLM. Lake Beach Mud Subtype
nLN. Northern Water Lily Aquatic Wetland
nLS. Lake Beach Sand Subtype

nMA. Mesic Prairie Carbonate Bedrock Subtype
nMB. Maple-basswood Forest
nMC. Sandstone Moist Cliff
nME. Mixed Emergent Marsh
nMF. Mixed Pine-hardwood Forest
nMG. Mesic Brush Prairie Sand-gravel Subtype
nMH. Mixed Hardwood Swamp
nMM. Moist Cliff Maderate Subtype
nMN. Mud Flat Saline Subtype
nMO. Mesic Oak Savanna
nMP. Mesic Prairie
nMR. Mesic Brush Prairie
nMS. Mixed Hardwood Swamp Seepage Subtype
nMU. Mud Flat
nMY. Mesic Prairie Crystalline Bedrock Subtype
nNF. Northern Hardwood-conifer Forest
nNH. Northern Hardwood Forest
nNS. Northern Conifer Scrubland
nNT. Native Dominant
nNW. Northern Conifer Woodland
nNY. Northern Hardwood-conifer Forest, yellow birch-white cedar
nOA. Oak Forest
nOB. Open Sphagnum Bog
nOS. Open Sphagnum Bog Schlenke Subtype
nOW. Oak Woodland-brushland
nPA. Poor Fen Patterned Subtype
nPB. Paper Birch Forest
nPD. Poor Fen Sedge Subtype
nPF. Poor Fen
nPH. Poor Fen Shrub Subtype
nPN. Paper Birch Forest Northern Hardwoods Subtype
nPS. Paper Birch Forest Spruce-fir Subtype
nPT. Poor Fen Scrub Tamarack Subtype
nPW. Midwest Pondweed Submerged Aquatic Wetland
nQG. Quartzite - Granite Rock Outcrop
nRC. Red Cedar Woodland
nRD. Rich Fen Sedge Subtype
nRE. Sandstone Bedrock River Shore
nRF. Rich Fen
nRG. Cobble - Gravel River Shore
nRH. Rich Fen Shrub Subtype
nRM. Rich Fen Floating-mat Subtype
nRO. Rock Outcrop
nRP. Red Pine Forest
nRS. River Beach Sand Subtype
nRT. Rich Fen, Patterned Subtype
nRU. River Mud Flats
nRW. Red Saltwort

nSB. Spruce-fir Forest White Spruce-balsam Fir Subtype
nSC. Sandstone Cliff Great Lakes
nSD. Sedimentary Dripping Bluff - Cliff
nSF. Spruce-fir Forest
nSG. Slender Glasswort Saline Meadow
nSI. Spruce-fir Forest Fir-birch Subtype
nSL. Sandstone Bedrock Great Lakes Shore
nSM. Seepage Meadow
nSN. Shrub Fen
nSS. Shrub Swamp Seepage Subtype
nST. Sand Flats Temporarily Flooded
nTA. Talus Slope
nTB . Great Lakes Limestone Bedrock Lake Shore
nTC. Wet Cliff
nTD. Limestone - Dolomite Talus
nTE. Tamarack Swamp Seepage Subtype
nTF. Basalt/Diabase Open Talus
nTG. Granite / Metamorhic Talus Northern
nTL. Talus Slope Algific Subtype
nTM. Tamarack Swamp Minerotrophic Subtype
nTN. Sandstone Talus Northern
nTP. Tamarack Swamp Sphagnum Subtype
nTS. Tamarack Swamp
nUD. Upland White Cedar Woodland Cliff
nUE. Upland White Cedar Forest Wet-mesic Subtype
nUM. Upland White Cedar Forest Mesic Subtype
nUW. Upland White Cedar Forest
nWA. Wet Prairie Saline Subtype
nWB. Wet Brush Prairie
nWC. White Cedar Swamp
nWD. White Pine-hardwood Forest Dry Subtype
nWE. White Pine-hardwood Forest Mesic Subtype
nWF. White Pine Forest
nWG. Wet Brush Prairie Seepage Subtype
nWH. White Pine-hardwood Forest
nWI. Willow Swamp
nWL. Water Lilly
nWM. Wet Meadow
nWP. Wet Prairie
nWR. Wet Meadow Shrub Subtype
nWS. Wet Prairie Seepage Subtype
nWT. White Cedar Swamp Seepage Subtype

Glossary

Aquatic Bed - Aquatic Bed includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Water regimes include irregularly exposed, regularly flooded, permanently flooded, intermittently exposed, semipermanently flooded, and seasonally flooded. Aquatic Beds represent a diverse group of plant communities that requires surface water for optimum growth and reproduction. They are best developed in relatively permanent water or under conditions of repeated flooding. The plants are either attached to the substrate or float freely in the water above the bottom or on the surface. (Cowardin, et. al.)

Artificial cover - Nonvegetative cover either made or modified by human activity and prohibiting or restricting plant growth and water penetration. (Road and roof surfaces, paved and stone surface parking areas, sidewalks and driveways are included.) [NRI-92]

Artificial surfaces and associated areas - Areas which contain artificial cover which is the result of human activities such as construction (e.g. buildings, pavement), extraction sites (e.g. open mines, quarries, pits) and waste disposal sites. This class is determined by the presence of manmade impervious surface.

Artificially Flooded - The amount and duration of flooding is controlled by means of pumps or siphons in combination with dikes or dams. The vegetation growing on these areas cannot be considered a reliable indicator of water regime. Examples of artificially flooded wetlands are some agricultural lands managed under a rice-soybean rotation, and wildlife management areas where forests, crops, or pioneer plants may be flooded or dewatered to attract wetland wildlife. Neither wetlands within or resulting from leakage from man-made impoundments, nor irrigated pasture lands supplied by diversion ditches or artesian wells, are included under this modifier.

Close grown cropland - Crops that are generally drill-seeded or broadcast, such as wheat, oats, and barley. (NRI).

Conifer (tree) - a needle-leaved tree with cones (i.e., a gymnosperm). (DNRNH) Note: The MLCCS changed NVCS's Evergreen classification to coniferous, thus moving tamarack and tamarack forests from the NVCS deciduous classification to a coniferous classification.

Cover - the proportion of the ground covered by projecting the plant canopy or artificial surfaces vertically downward onto the ground. This would be the proportion of the ground surface shaded by plants if the sun were directly overhead. (DNRNH)

Cowardin system - A classification system of wetlands and deep water habitats of the United States, officially adopted by the U.S. Fish and Wildlife Service (FWS) used to develop wetland data bases. The system was developed by Lewis M. Cowardin of the U.S. Fish and Wildlife Service and others. The five major systems are recognized in the NRI: Estuarine, Lacustrine, Marine, Palustrine, and Riverine. (USFWS)

Cropland - Areas used for the production of adapted crops for harvest. Two categories of cropland are recognized: row cropland, and close grown cropland. (NRI)

Cultivated - Describes vegetation planted by humans and/or treated with annual management; usually dominated by plants not indigenous to the area (NVCS). This vegetation is usually planted with the intent on harvest, often on an annual basis. Regular modification of cover is expected.

Cultural Cover - Areas where the natural vegetation has been removed or modified and replaced by different types of cover resulting from anthropic activities. This cover is artificial and requires human activities to be maintained over the long term. In between the human activities, the surface can be temporarily without vegetative cover. Its seasonal phenological appearance can be regularly modified by humans (e.g. irrigation). All vegetation that is planted, maintained or cultivated with the intent to harvest is included in this class (e.g. wheat fields, orchards. Restorations or re-planting of natural communities are not considered in this category because although planted, they are intended to mimic natural cover. This class is determined by vegetation, cover, time factor, soil condition and artificiality of cover. (Di Gregorio and Jansen).

Deciduous - Describes a woody plant that seasonally loses all of its leaves and becomes temporarily bare-stemmed. (NVCS). Note: The MLCCS changed NVCS's Evergreen classification to coniferous, thus moving tamarack and tamarack forests from the NVCS deciduous classification to a coniferous classification.

Diked - Created or modified by a man-made barrier or dike designed to obstruct the inflow of water. (Cowardin, et al.)

DNRNH - see Natural Heritage

Dominant - A plant species that shapes the character of a community by virtue of its great size, dense shade, allelochemic properties, or effects on soils. Dominant species generally influence the presence, growth, and distribution of other plant species in the community. (DNRNH)

Dwarf-shrub - Low-growing shrub life form usually under 0.5 m or 1.5 feet tall (never exceeding 1 meter or 3 feet tall) at maturity. (NVCS)

Dwarf-shrubland - Vegetation dominated by low-growing shrubs, usually under 0.5 m or 1.5 feet tall, with individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees and tall shrubs generally less than 25% cover); dwarf-shrub cover may be less than 25% where it exceeds tree, shrub, herb, and nonvascular cover, respectively. (NVCS)

Emergent - A plant capable of surviving indefinitely with its root system and lower stem submerged and its aerial shoots above water (e.g., cattails). (DNRNH)

Excavated - Lies within a basin or channel excavated by humans. (Cowardin, et al.)

Fallow - Cropland which has been left idle, either tilled or untilled, during the whole or greater

portion of the growing season. (SCSA)

Farmed - The soil surface has been mechanically or physically altered for production of crops, but hydrophytes will become reestablished if farming is discontinued. (Cowardin, et al.)

Floating plant - A non-anchored plant that floats freely in the water or on the surface; e.g., water hyacinth (Eichhornia crassipes) or common duckweed (Lemna minor). (Cowardin et. al.)

Floodplain - A flat terrace along a stream or river, created by erosion and deposition of sediment during flood cycles. Signs of active flooding include debris caught in trees growing on the floodplain or ice scars at the bases of the trees. (DNRNH)

Forb - A broad-leaved herbaceous plant. (NVCS)

Forest - Trees with their crowns overlapping (generally forming 60 - 100% cover). Forests are defined primarily by the dominant species present, not by the current height of the cover. For example, if the area is composed by young elms and ashes that are only 15 feet tall, it would be classified as a forest or woodland depending on the density of the tree species. If the area is composed of willows and dogwoods also 15 feet tall, it would be classified as shrubland. (NVCS)

Gleyed soil - A poorly drained soil with gray coloring or mottling caused by the reduction of iron and other elements that occurs under poor drainage conditions. (DNRNH)

Graminoid - A plant with linear "grass-like" leaves that typically branch vertically from the stem. Graminoids are members of the Gramineae, Cyperaceae, Juncaceae, Iridaceae, Typhaceae, Sparginiaceae, and other families. (DNRNH)

Grassland - Vegetation dominated by perennial graminoid plants. (NVCS)

Hayfield - Land managed for the production of forage crops that are machine harvested. These crops may be grasses, legumes, or a combination. (NRI)

Herb - A vascular plant without significant woody tissue above or at the ground; an annual, biennial, or perennial plant lacking significant thickening by secondary woody growth, with perennating buds borne at or below the ground surface (hemicryophytes, geophytes, helophytes, and therophytes). (NVCS)

Herbaceous - A plant without a persistent above-ground woody stem (e.g. graminoids, forbs, and ferns). (DNRNH)

Herbaceous Vegetation - Vegetation in which herbs (graminoids, forbs, and ferns) dominate (generally forming at least 25% cover, trees, shrubs, and dwarf-shrubs generally with less than 25% cover). Herb cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and nonvascular cover, respectively. (NVCS)

Hydric soil - Soil that is wet long enough to periodically produce anaerobic conditions, thereby influencing the growth of plants. (Cowardin, et al.)

Hydrophyte - A plant able to grow in water or on wet soils that are periodically saturated and deficient in oxygen. (DNRNH)

Impervious cover - The sum of roof, pavement and other impermeable surfaces.

Impounded - Created or modified by a barrier or dam which purposefully or unintentionally obstructs the outflow of water. Both man-made dams and beaver dams are included. (Cowardin, et al.)

Intermittently Exposed - Surface water is present throughout the year except in years of extreme drought. (Cowardin, et al)

Intermittently Flooded - The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. Weeks, months, or even years may intervene between periods of inundation. The dominant plant communities under this regime may change as soil moisture conditions change. Some areas exhibiting this regime do not fall within our definition of wetland because they do not have hydric soils or support hydrophytes. (Cowardin, et al.)

Lake (Lacustrine) - Wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) trees, shrubs, persistent emergents, emergent mosses or lichens are less than 30% of the coverage; and (3) total area exceeds 8 ha (20 acres). Similar wetland and deepwater habitats totaling less than 8 ha are also included in the Lacustrine System if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 2 m (6.6 feet) at low water. (Cowardin, et al.)

Lichen - An organism generally recognized as a single plant that consists of a fungus and an alga or cyanobacterium living in symbiotic association. (NVCS)

Long grasses - Mixed grass species such as those typically found along roadsides (Bromegrass, Fescue, ryegrass, vetch, alfalfa, Bluestem, Grama, oats, wheat, etc). Species may be native and/or non-native. Forbs may also be present. Mowing may occur, though infrequently.

Mesic habitat - A habitat with average soil moisture, where soil moisture is not limiting to plant growth during the growing season, and soils are not saturated except following rain or spring snowmelt. (DNRNH)

Minerotrophic - A wetland receiving nutrients from groundwater as well as from rainwater, or a wetland with peat and surface water nutrient content considerably higher than that of rainwater. (DNRNH)

Mottled soil - A soil with spots or blotches of a color different from the base color of the soil. Mottling results from cycles of anaerobic and aerobic conditions caused by cycles of soil saturation and drying. (DNRNH)

Native Species - Species that grew in Minnesota prior to European settlement. (Reed canary grass (*Phalaris arundinacea*) is not considered native even though it probably grew in Minnesota before settlement because its genetics have likely been altered by the import of exotic strains, and it has become an aggressive invader of wetlands.)

Natural Heritage (DNRNH) - Minnesota Department of Natural Resources Natural Heritage Program. The Natural Heritage program published *Minnesota's Native Vegetation: A Key to Native Communities*. This publication has been used throughout the MLCCS to describe natural vegetation.

Natural and Semi-Natural Communities - Natural communities are defined as areas where the vegetative cover is in balance with the biotic and abiotic forces of its biotope. The natural communities in the MLCCS have been described by the Natural Heritage Program of the Minnesota Department of Natural Resources or the National Vegetation Classification System. Semi-natural vegetation is defined as vegetation not planted by humans but influenced by human actions, either deliberate or inadvertent. Semi-natural vegetation may result from livestock grazing, logging, or the abandonment of previously cultivated areas where vegetation is regenerating. Thus, semi-natural vegetation is a result of human influences but is not artificial and does not require human activities to be maintained over the long term. Natural and Semi-Natural Communities include planted areas that successfully mimic the dominant features of natural communities. This class is determined by vegetation, cover, time factor, soil condition and natural cover. (NVCS, DNRNH, Di Gregorio and Jansen)

Non-heritage type - Plant Community types not defined by Minnesota's Native Vegetation: *A Key to Natural Communities* , published by the DNR Natural Heritage Program, 1993.

Non-Native Species - Species brought to Minnesota intentionally or accidentally by humans since European settlement. (Reed canary grass (*Phalaris arundinacea*) is considered non-native even though it probably grew in Minnesota before settlement because its genetics have likely been altered by the import of exotic strains, and it has become an aggressive invader of wetlands.)

Nonvascular vegetation - Nonvascular cover (bryophytes, non-crustose lichens, and algae) dominant (generally forming at least 25% cover). Nonvascular cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and herb cover, respectively. (NVCS)

Nonvascular plant - A plant without specialized water or fluid conductive tissue (xylem and phloem); includes bryophytes, non-crustose lichens, and algae. (NVCS)

NRI - National Resources Inventory. The NRI is conducted by the USDA Natural Resources Conservation Service (NRCS)

NWI - National Wetlands Inventory

NVCS - US National Vegetation Classification System documents of the *International Classification of Ecological Communities: Terrestrial Vegetation of the Great Plains and Great Lakes*. Compiled by The Nature Conservancy and edited by Don Faber-Langendoen and Kristin Snow, April 2000.

Open Water - This major cover type is to be used for areas with greater than 96% open water, floating algae and/or non-rooted vascular vegetation. Emergent or rooted floating vegetation in rivers, intermittent streams, lakes and wetlands are to be classified under the Herbaceous Vegetation cover type.

Partially drained/ditched - The water level has been artificially lowered, but the area is still classified as wetland because soil moisture is sufficient to support hydrophytes. Drained areas are not considered wetland if they can no longer support hydrophytes. (Cowardin, et al.)

Pasture - Land managed primarily for the production of introduced or native forage plants for livestock grazing. Pasture may consist of a single species in a pure stand, a grass mixture, or a grass-legume mixture. Management usually consists of cultural treatments, such as fertilizer, weed control, reseeding, or renovation, and control of grazing. (NRCS)

Pavement - Artificially covered surface for thoroughfare. Surfaces may include concrete, asphalt, gravel, or brick materials.

Peat soil - Unconsolidated soil consisting largely of undecomposed (fibric peat), slightly decomposed (hemic peat), or mostly decomposed (sapric peat or muck) organic matter accumulated under conditions of excessive moisture. (DNRNH)

Perennial - Plant species with a life-cycle that characteristically lasts more than two growing seasons and persists for several years. (NVCS)

Permanently Flooded - Water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes. (Cowardin, et al.)

Planted (maintained) - Natural vegetation has been removed or modified and replaced with different types of vegetative cover resulting from anthropic activities. This vegetation is artificial and requires human activities to be maintained over the long term. Nurseries, tree stands (tree farms or windbreaks), crops, ballfields, roadsides, and yards are included in this group. Successful restorations or re-planting of natural communities are not considered as planted because although planted, they are intended to mimic natural cover.

Pre-development vegetation - Native vegetation found in natural and semi-natural communities.

River (Riverine) - Wetlands and deepwater habitats contained within a channel, with the exception of: wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. A channel is "an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of

standing water" (Langbein and Iseri 1960:5). Water is usually, but not always, flowing in the Riverine System. Upland islands or Palustrine wetlands may occur in the channel, but they are not included in the Riverine System. (Cowardin, et al.)

Row cropland - Row crops such as corn and soybeans. (NRCS)

Saturated - The substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present. (Cowardin, et al.)

Seasonally Flooded - Surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface. (Cowardin, et al)

Semipermanently Flooded - Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface. (Cowardin, et al)

Short Grasses - Planted grass species typical of 'turf' (bluegrass, fescue, etc). Species composition is typical of regular and frequent mowing.

Shrub - A perennial woody species with a life form that is usually less than 4 to 5 meters or 13 to 16 feet in height at maturity and under optimal growing conditions. Typically, plants have several stems arising from or near the ground, but this term includes short tuft-tree and woody vine species; length of vine may exceed 5 meters; shrub species growth form may be taller than 5 meters or single-stemmed under certain environmental conditions.(NVCS)

Shrubland - Shrubs and dwarf-shrubs with individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees generally less than 25% cover). Shrub cover may be less than 25% where it exceeds tree, herb, and nonvascular cover, respectively. Vegetation dominated by woody vines is generally treated in this class. (NVCS)

Sparse vegetation - Describes vegetation with low total plant cover; abiotic substrate features are dominant; vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources. Total vegetation cover is typically less than 25% and greater than 0%. (NVCS)

Substrate - The soil or other medium on which a community occurs.

Talus - A sloping accumulation of coarse rock fragments at the base of a cliff. (NVCS)

Temporarily Flooded - Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season. Plants that grow both in uplands and wetlands are characteristic of the temporarily flooded regime. (Cowardin, et al.)

Tree - Perennial, woody species life form with a single stem (trunk), normally greater than 4 to 5 meters or 13 to 16 feet in height at maturity and under optimal growing conditions. Under

certain environmental conditions, some tree species may develop a multi-stemmed or short growth form (less than 4 meters or 13 feet in height). (NVCS)

Understory - The vegetation occurring below the canopy in a plant community. (DNRNH)

Upland Soils - Areas not flooded, or saturated by groundwater, for more than a few days during a normal year. Soils are predominantly mineral and without hydric characteristics (i.e., gleying or mottling).

USNVC - U.S. National Vegetation Classification System for natural community identification developed by The Nature Conservancy and used by some federal agencies. The acronym NVCS is more commonly used.

Vascular plant - Plant with water and fluid conductive tissue (xylem and phloem); includes seed plants, ferns, and fern allies. (NVCS)

Woodland - Open stands of trees with crowns not usually touching (generally forming 25 - 60% cover). Canopy tree cover may be less than 25% in cases where it exceeds shrub, dwarf-shrub, herb, and nonvascular cover, respectively. (NVCS)

Appendix 1: Development History of the MLCCS

The MLCCS is the result of several collaborations to develop an approach for the identification and classification of land cover along the Mississippi River in the metro region.

Cooperative Ecological Inventory of the Saint Paul Mississippi River Valley. In 1998 Greening The Great River Park (now Great River Greening) produced a pilot project which compiled all existing and available land use and land cover data in a GIS format. This data was divided into five major categories: Biological, Geological, Land Use, Pollution and Water Resources.

Mississippi National River and Recreation Area. In 1995, the federal government approved the Comprehensive Management Plan for the Mississippi National River and Recreation Area (MNRRA). The MNRRA corridor (which is identical to the Mississippi River Critical Area) is a 72-mile stretch of the Mississippi River through the Metro area. The management plan outlined goals to (1) protect, preserve and enhance nationally significant resources in the Mississippi River Corridor through the Twin Cites metropolitan area; (2) coordinate government programs in the corridor; and (3) provide a management framework to assist the State of Minnesota and its units of local government in the development and implementation of its integrated resource management programs.

Pine Bend River Bluffs Greenways Grant. In 1998, the Friends of the Mississippi River and Dakota SWCD received a grant from the DNR Metro Greenways Initiative to conduct an ecological inventory of the Pine Bend Bluff area of Dakota County along the Mississippi River. A hierarchical classification system was developed using the Minnesota's Native Vegetation: A Key to Natural Communities, version 1.5 developed by the DNR Natural Heritage Program and traditional land use terminology developed by the USGS (Anderson et al.). This initial system had eight major classifications, including Urban and Agriculture. Digitization and coding began in the fall of 1998.

In January of 1999, the Natural Resource Inventory Steering Committee was created to determine the needs and use of an ecological inventory for the entire MNRRA Corridor. The Committee determined that the available data as provided by the *Cooperative Ecological Inventory of the Saint Paul Mississippi River Valley* did not fulfill their various needs. The committee decided to expand the Pine Bend Bluffs Classification system and use it throughout the MNRRA Corridor.

In the spring of 1999, the Pine Bend Classification system was compared to other classification systems in use around the state and country. It was found that the US Federal Geographic Data Committee (FGDC) had endorsed a new system for the classification of vegetation. This system, called the United States National Vegetation Classification System (NVCS), had also been adopted by the US Department of Interior as the standard for classification of vegetation on federal lands and on projects funded by the federal government. With this finding, a complete review of the Pine Bend Classification system began.

In the late spring of 1999, the Steering Committee decided to change the Pine Bend Classification system into a hybrid of the NVCS and the DNR publication Minnesota's Native

Vegetation: A Key to Natural Communities, version 1.5. The hybrid system for classification of natural and semi-natural system would meet the federal requirement of using the NVCS, and preserve the terminology that has been in use for years here in Minnesota. Also, departing from traditional remote sensing land use/cover terminology developed by the USGS Anderson et al. in the mid-70's, the steering committee sought to rid the new system of any land use terminology. This resulted in a completely new system for classification of lands traditionally labeled as residential, urban, industrial, park, etc. The newly developed system recognizes the amount of artificial surfaces in areas where naturally occurring vegetation no longer exists, while at the same time recognizing the amount and type of vegetative cover. This new system took on the name Metro Land Cover Classification System (MLCCS).

Recognizing that the use of a pure land cover data set would be useful for others outside the scope of the original MNRRA project, the MLCCS was again compared to other classification systems used locally and statewide. With statewide applicability, the system name was changed to the Minnesota Land Cover Classification System (MLCCS).

The MLCCS has been reviewed by dozens of scientists and potential users representing a cross-section of federal, state, county and local organizations. Currently, the system is being applied to an inventory of the Mississippi River Corridor and the Minnesota River Corridor in the Twin Cities. Effort is also underway to create crosswalk tables between the MLCCS and other systems used in Minnesota (National Wetlands Inventory, National Resources Inventory, etc.). The Metro Greenways program has begun encouraging its use by local units of government for developing Greenway plans. MetroGIS conducted a peer review of the system, and endorsed it as a "best practice" classification system for GIS land cover inventory projects. The MLCCS is comprehensive and systematic, is applicable at any scale and is suitable for monitoring and mapping purposes of any identified land cover found in Minnesota.

Appendix 2: Existing Classification Systems

A. The USGS Anderson model and how it is currently applied
   1. USGS Land Cover Characteristic Program from EROS
      http://edcwww.cr.usgs.gov/programs/lccp/
   2. 1990 Land Use/Land Cover map produced compiled by the DNR
      http://lucy.lmic.state.mn.us/metadata/luse8.html
      http://www.datafinder.org/metadata/dnr0012.htm
   3. National Gap Analysis Program (GAP)
      http://www.gap.uidaho.edu/gap/
      a. Upper Midwest GAP
         http://www.umesc.usgs.gov/umgaphome.html
         ftp://ftp.umesc.usgs.gov/pub/media_archives/documents/project_status_reports/1999/psr99_04.pdf
      c. Wisconsin GAP - WISCLAND
         http://www.dnr.state.wi.us/org/at/et/geo/data/wlc.htm
      b. MnDNR satellite data - the origins of GAP
         http://www.ra.dnr.state.mn.us/imageview/
   4. Manitoba Natural Resources, Remote Sensing Lab, Land Use / Land Cover
      http://www.gov.mb.ca/natres/lid/remote_sensing/
   5. U of M Duluth Natural Resource Inventory
      http://www.nrri.umn.edu/cwe/glpf/glpf.html
      http://oden.nrri.umn.edu/lsgis/databases.htm
      http://oden.nrri.umn.edu/lsgis/landuse.htm

B. Plant community and ecologically based systems
   1. MnDNR CBS/Heritage
   2. The Nature Conservancy/National Vegetation Classification Standard and the Federal Geographic Data Committee (FGDC)
      http://biology.usgs.gov/npsveg/classification.html
      http://www.nbs.gov/fgdc.veg/standards/vegstd.htm#6.2
   3. Upper Midwest Environmental Sciences Center
      http://www.umesc.usgs.gov/umesc_spatial/available_data/ltrmp_lcu_legend.html
      http://www.umesc.usgs.gov/umesc_spatial/available_data/1989lcu_landsat.html
   4. MnDNR Cooperative Stand Assessment
      http://www.ra.dnr.state.mn.us/forestview/
      http://www.dnr.state.mn.us/forestry/forresas.html
   5. National Wetlands Inventory
      http://www.nwi.fws.gov
   6. Food and Agriculture Organization (FAO) of the United Nations
      http://www.fao.org/sd/eidirect/eire0019.htm

C. Cultural based systems

1. MetCouncil's Generalized Land Use
   http://www.datafinder.org/metadata/metc0009.htm
2. National Resource Inventory, U.S. Dept. of Ag.
   http://www.ftw.nrcs.usda.gov/nri_data.html
   http://www.ftw.nrcs.usda.gov/pdf/gis_898.pdf
3. Parcel data managed by individual counties

Appendix 3: Natural Community and Plant References

VASCULAR PLANT IDENTIFICATION

Barnes, B. and Wagner, W. 1981. **Michigan trees: a guide to the trees of Michigan and the Great Lakes region**. University of Michigan, Ann Arbor.
Includes line drawings, habitat information, key characters, and keys to genera and species. Most Minnesota trees included.

Baumgardt, J.P. 1982. **How to identify flowering plant families: a practical guide for horticulturists and plant lovers.** Timber Press, Portland, Oregon.
Contains introduction, a key to some plant families, floral diagrams, pronunciation, photographs of representative plants, and drawings and text for each family, with a listing of the more common genera.

Borman, S., Korth, R., and Temte, J. 1999. **Through the looking glass: a field guide to aquatic plants**. University of Wisconsin, Stevens Point.
Contains descriptions, habitat information, and over 200 illustrations of North American aquatic plants, organized by habitat category, including emergent plants, free-floating plants, floating-leaved plants, and submersed plants.

Cobb, B. 1963. **A field guide to the ferns**. Peterson Field Guide Series. Houghton Mifflin Co., Boston.
Covers an area from Wisconsin eastward, but many Minnesota species included. Includes keys, line drawings, and species descriptions.

Courtenay, B. and J. H. Zimmerman. 1972. **Wildflowers and weeds**. Van Nostrand Reinhold Co., New York.
Small color photographs of many herbaceous species. Modified keys. Quite comprehensive. Covers the Great Lakes region of the U.S. and Canada. Out of print, but sometimes available through used bookstores.

Eggers, S.D., and D.M. Reed. 1987. **Wetland plants and plant communities of Minnesota and Wisconsin**. U.S. Army Corps of Engineers, St. Paul. Order through http://www.mvp.asace.army.mil/docs/bookorderform.txt
Color photographs and descriptions of selected wetland plants.

Fink, D.F. 1994. **A guide to aquatic plants.** Ecological Services Section, Minnesota Department of Natural Resources, St. Paul, Minnesota.
An illustrated guide to common aquatic plants in Minnesota. Includes discussion of state regulations and factors that influence aquatic plant abundance.

Gleason, H.A., and A Cronquist, 1991. **Manual of Vascular Plants of Northeastern United States and Adjacent Canada**. Second Edition. New York Botanical Garden. Bronx, New York

Holmgren, Noel H., 1998. **The Illustrated Companion to Gleason and Cronquist's Manual. Illustrations of Vascular Plants of Northeastern United States and Adjacent Canada.** New York Botanical Garden. Bronx, New York

Looman, J. 1982. **Prairie grasses**. Publication 1413. Agriculture Canada. Canada Communication Group-Publishing, Ottawa.
107 grass species identified and described by vegetative characters and illustrated (whole plant) with line drawings. Primarily rangeland species, but some forest and wetland species included.

Mohlenbrock, R.H., and J.W. Thieret. 1987. **Trees: a quick reference guide to trees of North America**. Macmillan Publishing Company, New York.
Popular key. Includes color plates, distribution maps, and brief species descriptions for about one third of the most common native species found north of Mexico.

Moyle, J.B. and E.W. Moyle. 1977. **Northland wildflowers**. University of Minnesota Press, Minneapolis.
Photographs of some of the more common Minnesota flowering plants.

Newcomb, L. 1977. **Newcomb's wildflower guide**. Little, Brown, and Co., Boston.
Includes many line drawings and a few colored drawings. Covers eastern North America from central Minnesota eastward. Used by MNDNR Forestry in plant identification training courses.

Peterson, R.T., and M. McKenny. 1968. **A field guide to wildflowers of northeastern and northcentral North America**. Houghton Mifflin Company, Boston.
Popular key to many species of flowering plants. Illustrated with colored plates. Plants grouped by flower color.

Petrides, G.A. 1972. **A field guide to trees and shrubs**. Houghton Mifflin Company, Boston.
In the Peterson Field Guide series. Includes species descriptions and some line drawings.

Severin, B. C. 1980. **A key to the woody plants of Minnesota.** St. Mary's Press, Winona, Minnesota.
Key based on vegetative structures. Line drawings of leaves. Includes cultivated as well as native plants.

Symonds, G.W.D. 1958. **The tree identification** book. William Morrow and Co., New York.
Uses photographs to identify trees. Includes photographs of leaves, twigs, bark, fruit. Covers species from Maine to North Dakota and Texas to Florida.

Symonds, G.W.D. 1963. **The shrub identification book**. William Morrow and Co., New York.
Uses photographs to identify shrubs. Includes many but not all shrub species found in MN. Especially useful when only part of a plant (e.g., leaves, buds) is available.

Van Bruggen, T. 1976. **Wildflowers of the northern plains and Black Hills**. Bulletin No. 3. Badlands Natural History Association, Interior, South Dakota.

Color photographs and species descriptions of many prairie (mostly) plants. Grouped by flower color.

Technical Keys and Manuals

Regional

Case, F.W., Jr. 1987. **Orchids of the Western Great Lakes region**. Second edition. Bulletin 48. Cranbrook Institute of Science.
Keys, photographs, distribution maps, and extensive species descriptions for Great Lakes orchid species. First edition 1964.

Crow, G. and Hellquist, C.B. 2000. **Aquatic and wetland plants of northeastern North America. Volumes 1 & 2**. University of Wisconsin Press, Madison.

Two volume set with updated keys to 1,139 plant species, with illustrations of most taxa, habitat information, geographic ranges, and synonomy, and glossaries of botanical and habitat terms. Fassett, N.C. 1951. **Grasses of Wisconsin.** Univ. of Wisconsin Press, Madison. Includes 58 page section of illustrations and a glossary.

Fassett, N.C. 1957. **A manual of aquatic plants**. University of Wisconsin Press, Madison.
Technical keys to aquatic plants found from Minnesota south to Missouri and east to the east coast. Includes line drawings of many plants.

Fassett, N.C. 1976. **Spring flora of Wisconsin**. University of Wisconsin Press, Madison.
Key to Wisconsin plants blooming before 15 June. Some illustrations.

Fernald, M.L. 1950. **Gray's manual of botany**. 8th edition. American Book Company, New York.
Classic technical key and plant descriptions for ferns and flowering plants found in central and northeastern United States and adjacent Canada. Includes pronunciation guides and a few line drawings.

Flora of North America Editorial Committee. 1993. **Flora of North America north of Mexico**. Vol. 2: Pteridophytes and Gymnosperms. Oxford University Press, New York.
Technical key, species descriptions, and distribution maps to ferns, conifers, and related plants. Volume 1 relates the history of the Flora of North America project. Ten volumes are planned.

Gleason, H.A., and A. Cronquist. 1991. **Manual of vascular plants of northeastern United States and adjacent Canada**. Second edition. New York Botanical Garden, New York.
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Appendix 4: References

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Appendix 5: Sampling Techniques

Accuracy assessment techniques from the U.S. Fish & Wildlife Service and National Park Service.

Stratified Random Sampling Technique - sampling grid within each vegetation type. Used to verify individual communities.

Gradient-Oriented Sampling or Gradsect - used for landscape scale projects. Transect is placed across the strongest environmental gradients, not randomly placed.

Random field sites should still be used to locate the actual plot you're sampling. "You don't want your biases against prickly, wet, difficult plots to present any more statistical difficulties than absolutely necessary." U.S. Fish & Wildlife vegetation mapping guidelines.

Project Area	Sampling Approach
< 100 km2 (< 40 square miles, ~ one township)	Representative polygons across entire area, chosen by stratified random sampling. Suggest 10 plots per vegetation type, each in separate polygon. Fewer plots necessary where variation is low. Focus efforts on unknown areas.
100 - 2,500 km2 (40 - 1,000 square miles)	Gradsects strategy, where biophysical habitats are chosen and mapped, along with known veg type boundaries, then sample areas representing at least 15% of total mapped area for each biophysical unit are chosen along efficient sampling route across major environmental gradients. One or more plots per vegetation type, each in a randomly chosen separate polygon, with at least one plot per biophysical habitat unit; emphasis on unknown or poorly described veg units.

Plot sizes

Class	Community size	Dimensions (in meters)
Forest	100 - 1,000 m2	10x10 - 20x50
Woodland	100 - 1,000 m2	10x10 - 20x50
Shrubland	25 - 400 m2	5x5 - 20x20
Herbaceous	25 - 400 m2	5x5 - 20x20
Nonvascular	1 - 25 m2	1x1 - 5x5

Field Check Form

MLCCS field assessment

Township/Range_____Section_____ Quad Name_____
DNR Quad Code_____
Location of polygon within 1:3000 DOQ_____
_____

Classification given to polygon by aerial photo interpretation_____
New Polygon created during field check? YES / NO Location of New Polygon_____

Date of Visit_____Name(s) of Visitor(s)_____
Polygon (1) viewed from a distance (approximate distance_____), (2) viewed from edge, (3) visited partially, (4) visited entirely

RATIONALE for Levels 1-3 classification:

RATIONALE for Level 4 classification:

RATIONALE for Level 5 classification:

Classification of Polygon after Site Visit_____

Dominant Species in Each Layer of Vegetation

Tree Layer Shrub Layer

_____
_____
_____
_____
_____

Ground Layer

_____
_____
_____
_____
_____

Use back of page for additional notes (soil type, disturbances, invasive species, rare species)