

# **Landscape Ecosystems of the University of Michigan Biological Station<sup>1</sup>**

**Douglas R. Pearsall, Burton V. Barnes, Gregory P. Zogg,  
Marc Lapin, and Richard M. Ring**

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<sup>1</sup>Copies of the maps that accompany this document are available for use at the University of Michigan Biological Station, Pellston, Michigan. Copies of the maps and this document also reside at the campus office of the Biological Station in Ann Arbor, Michigan, and with Burton V. Barnes at the School of Natural Resources and Environment, Ann Arbor, Michigan.

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*An Introduction To:***Landscape Ecosystems of the  
University of Michigan Biological Station**by **Burton V. Barnes and Douglas R. Pearsall\*****Introduction and Conceptual Approach**

The aim of our research is to provide an understanding of the three-dimensional (air-earth-organism) units of the landscape of the University of Michigan Biological Station (UMBS) that we call landscape ecosystem types, or simply ecosystems. Ecosystems are distinguished at multiple hierarchical scales. At UMBS, we have distinguished and mapped landscape ecosystems at three scales, termed Major Landforms (or Physiographic Systems: hundreds to thousands of hectares), Minor Landforms (or simply Landforms; ca. 500 to less than 100 ha), and Landscape Ecosystem Types at the finest scale (<0.1 to tens of hectares). Of these three levels, we have focused in particular on the spatial location and composition (physiography, soil, hydrology, vegetation) of the local landscape ecosystem types. Future research on the functioning of these ecosystems together with inventories of their plant and animal life will add significantly to the landscape ecology research that we have initiated.

A major reason for this research is to provide the conceptual basis and baseline data for understanding ecosystem change. Although it is popular to speak of *climate* change, entire ecosystems change; some components change faster than others. Sooner or later, ecosystem change manifests itself in functional and compositional changes in real landscapes. Therefore, a major objective of our research is to provide baseline maps, data, and permanent sample plots to monitor these perceived changes in site-specific ecosystems of UMBS. Monitoring of these landscape ecosystems over the next 150-200 years will confirm or reject predictions now being made and reveal the sequence of changes in each site-specific ecosystem type or group of ecosystem types.

In the last 150 years, massive human disturbances of logging and burning have caused major changes to UMBS ecosystems (Kilburn 1957). These remarkable changes, although virtually undocumented as to their extent and severity, are primarily manifest in the drastic difference we perceive in tree species now dominating many UMBS ecosystems compared to that in presettlement time (200-500 years ago, before European settlement). To understand future changes we must also understand the kind and severity of changes in the recent past in addition to the kinds and patterns of landscape ecosystems and their geology, physiography, soil, and vegetation. Our research has produced several maps to provide an ecological framework for understanding past, present, and future change.

- map of major landforms,
- map of major and minor landforms,
- map of the local landscape ecosystem types (see discussion on pp. 27-28), and

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- map of the present-day cover types, based on aerial photographs taken in 1987.

Instructions and documentation accompanying these maps in this text are as follows: (1) classifications and descriptions of landforms are in Part 2, (2) classifications of the ecosystem types and ecosystem groups are in Part 3, (3) descriptions of all ecosystem types are given in Appendix A, (4) the classification and descriptions of cover types are given in Part 5. In addition, the ecological species groups are listed and described in Part 4.

In identifying, classifying, describing, and mapping the landscape ecosystem types it was necessary to understand the geology and physiography of the area. Thus we have prepared maps of both the major and minor landforms of UMBS, a brief description of the glacial history of the area, and a synopsis of each of the landforms. In understanding the spatial structure and functioning of ecosystems and ecosystem change, the understanding of the physiography (physical geography) of an area is extremely important. Therefore, the local ecosystem types are specifically identified as to their location within these landforms.

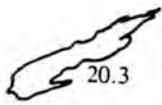
### Landscape Ecosystems

Landscape ecosystems are geographic or terrain segments of Earth space -- units that may be identified and separated out from the landscape continua in which they occur. They are the structural-functional units of nature. The definition by Rowe (1961) emphasized their layered and volumetric nature:

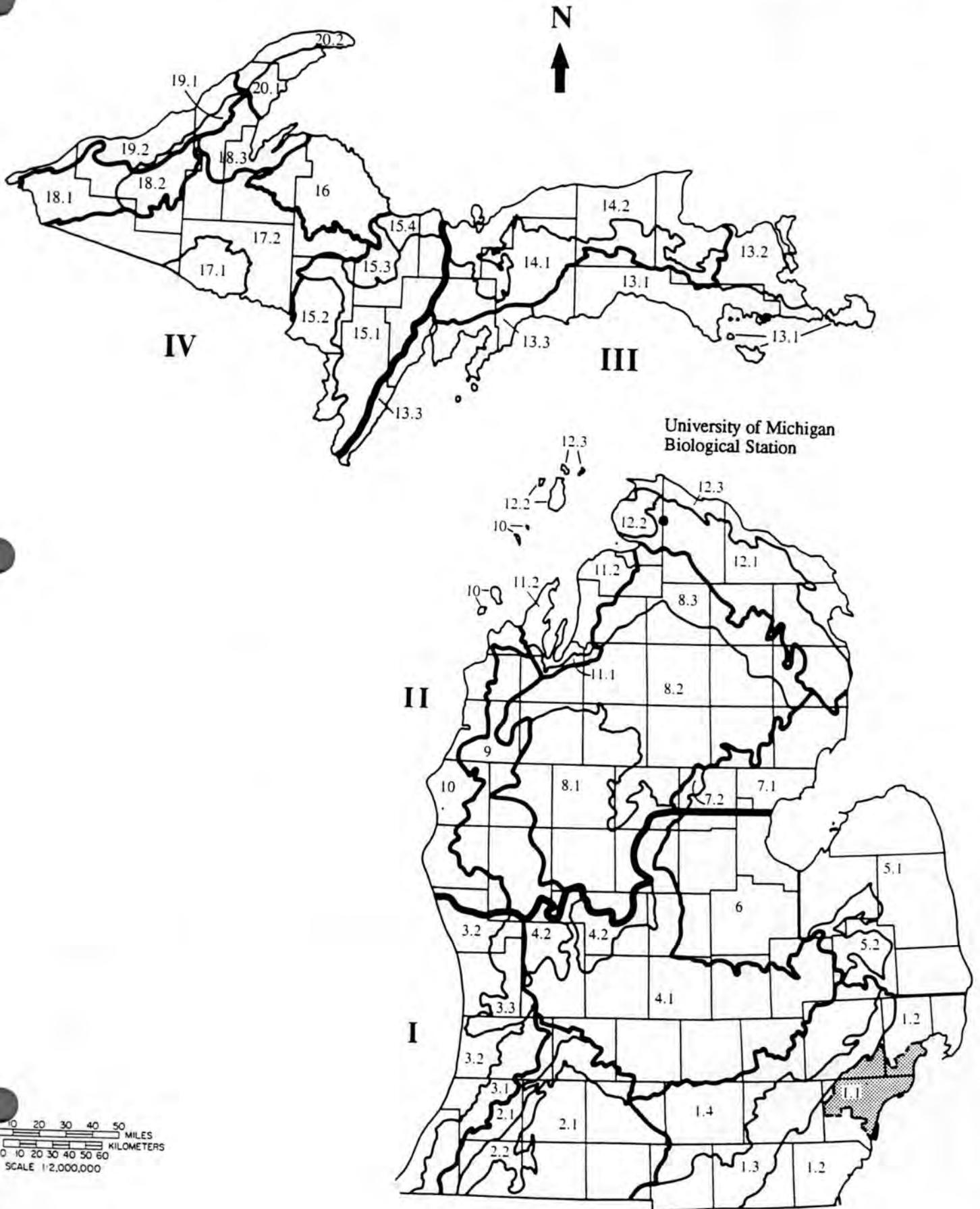
**Any single perceptible ecosystem is a topographic unit, a volume of land and air plus organic contents extended areally over a particular part of the earth's surface for a certain time.**

They are not simply organisms plus environment (Rowe and Barnes 1994). Organisms do not stand on their own; they evolve and exist in the context of ecological systems that confer those properties called life. Plants are inseparable from their encompassing environment, and change in plant composition is a result of changes in the immediate environment—due to physical and biotic factors in their physiographic context. Thus it is critical to have a detailed understanding of physiography – specific landform, slope position and percent, microclimate, parent material, and soil properties of the physical environment where plants live, as well as species composition and coverage.

The local landscape ecosystem types of UMBS are one level of a hierarchy of landscape ecosystems. The largest ecosystem that we can directly know is the Ecosphere. It can be segmented, according to purpose, into three-dimensional chunks of the Earth's surface. The landscape is therefore perceived as ecosystems large and small, nested within one another in a hierarchy of spatial sizes (Rowe and Sheard 1981). An example of the subdivision of a large regional area is that of the State of Michigan by Albert et al. (1986). Figure 1 illustrates the division of the state into regional landscape ecosystems of three hierarchical levels: **Region, District, and Subdistrict**. As seen in Figure 1, UMBS is located in the Onaway Subdistrict (12.1) of the Presque Isle District (12) along the boundary of Cheboygan and Emmet Counties. The averages for climatic variables of the Presque Isle District such as: growing season length, growing season heat sum, precipitation, potential evapotranspiration, and extreme minimum temperature are given in Albert et al. (1986).



**Figure 1 Regional Landscape Ecosystems of Michigan**



We have classified the landscape ecosystems below the Onaway Subdistrict level on the basis of broad physiography systems, here termed **Major Landforms**. For the UMBS area these are **Outwash Plain**, **Ice-Contact Terrain**, and **Moraine** (see Item 2, page 22). Within this Major Landform category, we distinguish and map three hierarchical levels of **Minor Landforms** (see Item 2, p. 22 and Item 3, p. 23). The local landscape ecosystem types are grouped by specific physiographic and soil factors within this hierarchy of major and minor landforms (see Part 3, Item 1 - classification of landscape ecosystem types of UMBS, pp. 30-38). Depending on the nature of the research question one can study ecosystems (and their components) at any one of a number of hierarchical levels. For example, for **Outwash Plain** ecosystem types there are seven hierarchical levels (i.e., groups of ecosystems; see p. 30 of the Classification of Landscape Ecosystem Types). One could study one or more of these groups of ecosystems, as well as any one ecosystem type itself.

### Approach Used in Distinguishing Landscape Ecosystems

The approach we use in distinguishing and mapping landscape ecosystems is modified from the multi-factor and multi-scale method applied for over 45 years in the southwestern German state of Baden-Württemberg (Barnes 1964, 1984, 1993). Fundamentally, the goal is to identify, classify, describe, and map the basic units of nature. The initial research in developing and testing the approach was done in old-growth forests of Upper Michigan -- the Cyrus H. McCormick Experimental Forest (Barnes et al. 1982, Pregitzer and Barnes 1984) and the Sylvania Recreation Area (Spies and Barnes 1985a). Both of these landscapes were dominated by old-growth hemlock-northern hardwood forests. The approach has been used and tested in various other landscapes in Michigan including 19,000 km<sup>2</sup> of disturbed oak forests in southern Michigan (Archambault et al. 1990), in the Smoky Mountains, and in China.

At the local scale, landscape ecosystems form a spatial pattern over the landscape. Some ecosystems are encountered in relatively neat packages, such as a bog (Gleason's bog for example) bounded by upland on all sides. More typically we carve them out of the landscape continuum by the use of appropriate criteria. Although this subjectivity may be a stumbling block for some to the acceptance of landscape ecosystems, it need not be (Rowe 1961). Soils are a good analogy; they are an accepted object of scientific study although their boundaries are fixed only by definition.

In undisturbed areas in northern Michigan, one can readily identify and distinguish, as different local landscape ecosystem types, sandy beach ridges supporting jack pine and a nearby peat bog of black spruce. These types differ not only in their plants and animals, but equally important in the form of the land (rolling upland vs. depression), atmosphere (hot vs. cold), and soil parent material (sand vs. peat). These two parts of landscape ecosystems, the physical site and its biotic cover, are ever interacting and affecting one another. Each such ecosystem type not only has *structure* (the arrangement of its parts -- air layers, soil layers, vegetative layers) but also complex interactions between its atmospheric, physiographic, soil, and biotic components that we term its functioning.

Landscape ecosystems are generally considered to be made up of two parts: first, the geographic place or site, together with the physical ecosystem components of that place -- physiography, climate, and

soil. Terms such as site unit, site type, land type, geosystem, or forest site are often used to identify these spatial land units. The second part is the biological cover (vegetation and animals) of a given land unit; this has been termed the biotic community, vegetation type, or cover type. Ideally, we would like to use both the physical factors and the biota, especially the vegetation that is fixed in place, to distinguish and map the ecosystem types. However, this can only be done in pristine areas where late-successional tree species form the overstory cover. In some old-growth forests in the Upper Peninsula of Michigan we were able to identify and map landscape ecosystem types using the late-successional overstory tree composition and structure, the undisturbed ground-cover flora, and the many physical site characteristics of landform and soil. In highly disturbed forests, the characteristic tree communities of the overstory that were present in the presettlement forest may be lacking. The currently existing vegetation is typically of quite a different composition. Furthermore, the disturbed overstory may cover the sites of two or more ecosystem types so it can be very confusing and often provides little help in confirming the landform and soil factors of different ecosystems. Mapping just the existing overstory vegetation would not give the resolution of the different underlying sites. Such is the case at UMBS where the overstory of at least 60% of the area consists of either bigtooth or tembling aspen -- not the pines, hemlock, beech, sugar maple, and basswood of the presettlement forest overstory. Thus to distinguish the ecosystem types we must distinguish and map the sites (the site units or site types) of the landscape ecosystems by using primarily physiographic and soil characteristics. We also can use many of the ground-cover species of herbs and shrubs because they have not been so highly disturbed or eliminated as have the overstory tree communities. For each mapping unit we *infer* the presettlement tree species that would have occupied a given site based upon (1) our ecological understanding of physiography, soil, and ground-cover vegetation and (2) a generalized map of the presettlement vegetation of UMBS lands. The term we use for the mapping units is *landscape ecosystem type* -- rather than site types or site units. Such types, *regardless of present vegetation*, have the same or similar physical properties and potential vegetation. In summary, in ecosystem classification and mapping, the common focus is on place, on geographic area, on site: the stage where each unique complex of climate-biota-soil-landform carries on its dynamic and ever-changing performance, directed and invigorated by solar energy.

Landscape ecosystems change constantly in time. Most obvious are the relatively short-term plant changes (traditionally known as succession), especially of the overstory, that are due to disturbance regimes of fire and windthrow (uprooting of trees) and changes in macro- and microclimate, soil, and their own effects on ecosystem factors. At a given place on the earth's surface different ecosystems have occurred there as a result of the changing interactions of the relatively stable physiography and the more labile components of biota, climate, and soil. Thus we consider landscape ecosystems at both spatial and temporal scales. And for substantial periods of time, 300+ years, we can provide useful maps and descriptions of the landscape ecosystems centered around the site -- the physiographic features (specific landforms, their parent materials and other characters of slope and aspect) of a location-specific site.

**Distinguishing and Mapping Ecosystems.** How are local landscape ecosystem types differentiated, classified, and mapped using the multi-factor method? No single, rigid method is appropriate because of the enormous ecological diversity of different landscapes. However, an approach using many factors is more generally applicable than one using a single factor. Our job is to sort out the landscape mosaic, differentiating the ecosystems, and in disturbed areas the *sites* of landscape ecosystems (Rowe 1991). The methods we use have been published and copies are available in the UMBS Library: McCormick Experimental Forest (Barnes et al. 1982, Pregitzer and Barnes 1984); Sylvania Recreation Area (Spies and Barnes 1985a, 1985b); oak ecosystems of southeastern Michigan (Archambault et al. 1989, 1990); Huron Mountains (Simpson et al. 1990). The most comprehensive description of this approach and its results for a large landscape is found in Simpson et al. (1990).

At UMBS, landscape ecosystem research was initiated by Dr. Barnes and Master's student Marc Lapin in 1988. Marc worked during the field seasons of 1988 and 1989. He developed the first approximation of the map of landforms and developed a classification and map of upland landscape ecosystem groups (Lapin 1990). He also studied the alpha and beta diversity of ground-cover species for six different ecosystem types. His Master's thesis (Lapin 1990) and the paper resulting therefrom (Lapin and Barnes 1995) are available in the UMBS library. Graduate students Douglas Pearsall, Greg Zogg, Rich Ring, and Nancy Walker, together with research assistants Joann Constantinides, Lance Cablk, Alex Davis, Steve Signell, John Syring, Dan Kashian, Tom Hulleberg, and Todd Williams continued the research to distinguish and map the landscape ecosystem types. Specific methods to develop the classification and maps of ecosystem types and cover types are presented in the documentation of these materials.

**Ecological Species Groups.** In all our landscape ecosystem research, ground-cover species (herbs, shrubs, vines) are of particular importance because many of them exhibit a relatively narrow range of response to environmental factors (moisture, nutrient, and light conditions) compared to that of tree species. Furthermore, at UMBS they are of critical importance because the tree species of the overstory and understory are often of little indicator value because of great human-caused disturbances to UMBS ecosystems. Thus we have adopted the German approach of using groups of ground-cover species, *ecological species groups*, to help distinguish and map landscape ecosystem types. Through detailed observations throughout UMBS lands we have grouped together species that appear to have similar requirements as to moisture, nutrients, and other factors. In Part 4, the concept of ecological species groups is discussed, and the set of ecological species groups is given together with a brief description of the indicator value of each group. Landscape ecosystem types are characterized by the absence or presence of these groups and by the abundance of the species of various groups that are present. Papers describing this approach and giving examples of the use of ecological species groups include Barnes et al. (1982), Pregitzer and Barnes (1982), Spies and Barnes (1985b), and Archambault et al. (1989).

### Diversity of Landscape Ecosystems of UMBS

Because of its geographic position and glacial history, UMBS land exhibits some of the most diverse landforms and ecosystems in northern lower Michigan. A climatically extreme outwash plain, the most extreme in the State (Pellston Plain), lies adjacent to non-extreme moraine and outwash terrain. Several kinds of ice-contact and moraine features occur on UMBS lands. Many different kinds of wetland ecosystems are associated with the outwash, ice-contact, and moraine landforms. Greg Zogg made a detailed study of wetland ecosystems, and his Master's Thesis (Zogg 1993) and paper resulting from his work (Zogg and Barnes 1995) are available in the UMBS library. Aquatic waterscape ecosystems of Douglas and Burt Lakes, the Maple and Little Carp Rivers, and Van Creek dominate the landscape where they occur and influence adjacent terrestrial landscape ecosystems. Some of the most severely deforested and "abused" lands of the northern hemisphere (ecosystem types 36 and 37) occur at UMBS. In contrast, the best example of old-growth hemlock-northern hardwood forest in northern lower Michigan is found at Colonial Point. Glacial history and the resulting physiographic diversity are responsible for the great diversity of the landscape ecosystem types. Douglas Pearsall's comprehensive study of ecosystem diversity and ground-cover diversity of UMBS (Pearsall 1995) is available in the UMBS library.

Plant community types or cover types, based on dominant species, traditionally have been used as a convenient way to describe the vegetation of a region (biome) or a local area (plant association or community). Such types are defined quite generally, and relatively few community types are identified for a given area. For example, Küchler (1964) only mapped 116 potential natural vegetation types for the entire conterminous area of the United States. The traditional community type approach typically underestimates the diversity of communities and the landscape ecosystems of which they are a part. By use of such terms as "northern hardwoods," "mixed hardwood," "pine-oak," "mixed mesophytic," "beech-maple" or "sugar maple" one is led to believe that communities occur broadly over the landscape and are relatively homogeneous in composition. Although still somewhat oversimplified, we have identified 67 different cover types for just the 4,000 hectares of UMBS land. When one examines the landscape ecosystems in detail we find enormous complexity. For example, in the western Upper Peninsula of Michigan we identified 15 different kinds of landscape ecosystems dominated by sugar maple (i.e., the "sugar maple" cover type) in three areas occupying less than 18,000 ha. At UMBS we have identified and mapped 125 landscape ecosystems. This great ecosystem diversity is the basis for studying biodiversity, the diversity of plants and animals.

Each of the ecosystem types is undergoing changes in vegetation, as well as in soil, microclimate, and the cycling of water and nutrients. Multiple factors affect changes of each ecosystem, including the complex history of logging and post-logging fires. Determining vegetational change in the future for different ecosystems due to changing climate requires detailed research. The landscape ecosystem approach provides the geographic framework and the emphasis on physical factors, as well as vegetation, to establish hypotheses for testing. By this approach we are therefore well prepared to undertake the detailed studies necessary to monitor ecosystem changes and determine why they are occurring.

**Potential Uses of the Materials Available (Classifications, Maps, Descriptions)**

The materials provide baseline information and maps for many different uses and research projects by UMBS faculty and students, as well as for monitoring, over time, changes in landscape ecosystems and cover types of UMBS. Some of the specific uses include:

1. Basis for inventories of plants and animals of UMBS by (a) landform, (b) cover type, and (c) ecosystem type.
2. Basis for monitoring ecosystem changes, i.e., changes in plant and animal occurrence, coverage, reproduction, and diversity together with that of their immediate, encompassing environment (landform, soil, adjacent ecosystems and water bodies, etc.). In particular, one can monitor changes in dominant tree cover and ground-cover flora in different ecosystem types. Over 250 permanent plots have been established. Selected samples thereof representing different ecosystem types could be periodically remeasured to assess changes in occurrence and coverage of plant species and changes in soil factors.
3. Basis for establishing a network of climatic stations to monitor climate in relation to elevation, landform, vegetative cover, etc.
4. Basis for comparative studies of the functioning of landscape ecosystems -- the dynamics of carbon allocation and biomass production and water and nutrient cycling, i.e., ecosystem physiology.
5. Basis for establishing new permanent sample plots or gradients to test specific hypotheses regarding change of specific organisms (plants, birds, insects, invertebrates) in particular ecosystems or group of ecosystems.
6. Basis for monitoring changes in forest disturbances (fire, windstorm, water table change, insect and disease occurrence) that influence succession and biotic diversity in natural systems.
7. Basis for modeling changes in different ecosystems, especially the ground-cover flora and the overstory cover.
8. Basis for developing a map of ground-cover types associated with the cover types which are predominantly dominant tree overstory types. Ground-cover species may be more sensitive to climatic change than the overstory species.
9. Basis for physiological studies of ground-cover flora and their sexual and asexual reproductive ability related to climatic change.
10. Basis for landscape-scale experiments (prescribed burning, experimental cuttings, land clearing, fencing, fertilization, etc.).
11. Basis for studying effects of adjacent ecosystems on one another in exchange of propagules, water, organic matter, and nutrients.
12. The cover type classification and map provides a basis for developing and refining remote sensing techniques for mapping cover types at a fine scale of resolution.

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# **Geological History and Guide To The Classifications and Maps of The Landforms of UMBS**

by Douglas R. Pearsall, Gregory P. Zogg, Marc Lapin and Burton V. Barnes

## **Introduction**

### **Contents Of Part 2**

Following the discussion of physiography and a synopsis of geological history of UMBS, three items are presented:

**Item 1: Descriptions of the Landforms of UMBS;** a brief geological history of the specific major and minor landforms.

**Item 2: Major Landforms of UMBS** (accompanies the map with the same title); a classification of the specific landforms at the broadest scale.

**Item 3: Major and Minor Landforms of UMBS** (accompanies map of same title); a classification of the major landforms and the smaller landforms that can be identified within them.

### **What Is Physiography And Why Is It So Important?**

Physiography is an abbreviation for physical geography, which is defined as the surface features of an area. Physiography includes the specific surface features themselves, the landforms, and the geologic parent material beneath the surface. Thus defined, the physiography of any area provides a fundamental understanding of the ecological systems of regions (regional landscape ecosystems of Michigan; Albert et al. 1986) or of a local area such as UMBS (local landscape ecosystem types). An ecosystem is a topographic unit, a volume of land and air plus organic contents extended areally over a particular part of the earth's surface (Rowe 1961). The plants and animals that excite our interest are but one part of such an interacting system. Specific landforms (with their characteristic shape and parent material) are significant in controlling the spatial occurrence of ecosystems and the plant composition and dynamics of each ecosystem. At local and regional scales, landforms control the climatic regime; they modify the intensity and quality of solar energy received as well as precipitation reception, retention, and movement. They also, in part, control soil development. Physiography is the most stable of all ecosystem components and is indispensable in mapping ecosystems from aerial photographs. Therefore it is extremely useful in distinguishing landscape ecosystems and thereby understanding plant composition and dynamics (Zogg and Barnes 1995). By modifying the fluxes of moisture and radiation, specific landforms regulate the key factors affecting plant survival, growth, and change over time (succession). The physiographic features of UMBS were determined by the glacial events of the last 14,000 years, and a brief summary of these events is described below.

## Geological History of UMBS

The landscapes of northern Lower Michigan were shaped by the events of the late Wisconsinan glaciation. The University of Michigan Biological Station (UMBS) covers approximately 4,000 ha (10,000 acres) of terrain in Cheboygan and Emmet counties. The landforms and parent materials of UMBS result from the final two glacial episodes of the Wisconsinan glaciation – the Port Huron and Greatlakean substages – and the fluctuating water levels of the Great lakes. The physiography of the landscape is a mosaic of glacial outwash plains, ice-contact features, moraines, and lakeplains. A tabular summary, developed by Lapin (1990), of important glacial events and their estimated dates of their occurrence or duration is presented in Table 1.

The Port Huron glaciation was the most significant ice advance in the region, reaching a maximum at 12,600 years ago and virtually obliterating all previous signs of glacial activity. This glaciation covered most of the northern lower peninsula with a thick sheet of ice that built several interlobate moraines throughout the northern counties and a large end moraine that stretches east to west from Alcona County through Otsego County to Leelanau County (Melhorn 1954). One of the interlobate moraines is conspicuous in the landscape of the station. It is visible as a high ridge running north to south on the Cheboygan-Emmet county line, west of Douglas and Burt Lakes. The highest elevation (277 m) on the property is on this moraine. Another likely Port Huron feature, Colonial Point, is a broad, gently sloping till upland.

The Port Huron ice retreated only as far north as northern Cheboygan County before the ice readvanced for the final time in the Pleistocene (Farrand et al. 1969). This last advance, the Greatlakean (maximum at 11,700 years ago), positioned a thin, weak ice sheet over the region; the glacier's advance was impeded to the south by the Port Huron end moraine. No moraines were constructed by Greatlakean ice, but the glacier left its signature by reworking deposits of previous advances (Murray 1953). The Greatlakean advance came from the northwest and moved southeasterly; the features of northern lower Michigan indicate this direction by a strong orientation of drumlins and reworked moraines. The interlobate moraine along the county line, referred to above, and the extensive drumlinized ground moraine northeast of Douglas Lake are two examples of its action. The Greatlakean ice churned up the Port Huron till and apparently mixed in additional sand and till. At lower elevations on the interlobate moraine the light red Port Huron till appears to have been overlain by dark red Greatlakean till.

This final glacier stagnated and ablated *in situ* over Cheboygan and Emmet counties. Large ice blocks were irregularly deposited throughout the northern and northwestern counties. Many of the inland lakes are located where ice blocks once stood. Burt and Douglas Lakes exemplify these large kettle lakes.

As the Greatlakean ice melted, relatively flat, sandy outwash plains formed. One outwash channel flowed in a southeasterly direction in the present Van Creek channel, over and around the interlobate moraine and between the ice blocks that resulted in the Burt and Douglas Lakes basins (Spurr and Zumberge 1956). High outwash plains were built-up adjacent to the ice blocks and the reworked moraine. These high-level outwash deposits are the principal physiographic feature between Burt and Douglas

Table 1. A chronology of Late-Wisconsinan and Holocene geological events at the University of Michigan Biological Station (UMBS), Pellston, Michigan, modified from Lapin (1990).

YEARS B.P.*	GLACIAL STAGE	LAKE MICHIGAN BASIN	LAKE HURON BASIN	EVENTS AT UMBS
2,000		LAKE MICHIGAN 176 m (577 ft)	LAKE HURON 176 m (577 ft)	
3,000				
5,000		NIPPISSING GREAT LAKES 185 m (605 ft) maximum 4,700 B.P.	NIPPISSING GREAT LAKES 185 m (605 ft) maximum 4,700 B.P.	Beach ridges and dunes constructed at Hogsback road; levelling of terraces and cutting of cliffs at Colonial Point
6,000				Building of dunes on the Pellston Plain
9,000		LAKE CHIPPEWA 70 m (230 ft)	LAKE STANLEY 55 m (180 ft)	
10,000				Opening of North Bay outlet, lake levels drop
11,000		MAIN LAKE ALGONQUIN 185 m (605 ft)	MAIN LAKE ALGONQUIN 185 m (605 ft)	Shoreline erosion; Lake Algonquin levelling terraces, cutting cliffs, and constructing beaches
	Lower Peninsula Ice Free			Riggsville and Pellston Islands part of Northern Lower Michigan archipelago
11,500				
	GREATLAKEAN SUBSTAGE maximum 11,700 ybp	LAKE CHICAGO CALUMET 189/185 m (620/605 ft)	LAKE ALGONQUIN 185 m (605 ft)	Onaway readvance, streamlining Port Huron features, drumlin building
12,000	TWO CREEKS INTERSTADE	TWOCREEKAN LOW LEVEL <180 m (580 ft)	TWOCREEKAN LOW LEVEL <180 m (580 ft)	Pellston Plain as outwash plain
		LAKE CHICAGO GLENWOOD II 195/189 m (640/620 ft)	EARLY ALGONQUIN 185 m (605 ft)	
	PORT HURON SUBSTAGE maximum 12,600 ybp			Construction of outer and inner Port Huron moraines
13,000	MACKINAW INTERSTADE			Ice retreat to Straits of Mackinac area
14,000	PORT BRUCE SUBSTAGE	LAKE CHICAGO GLENWOOD II 195 m (640 ft)	LAKE ARKONA 216-212 m (710-695 ft)	Ice covers all of Northern Lower Michigan

\*Years before present; note uneven time scale

Lakes. To the north and northeast of Douglas Lake lies a broad rolling plain of drumlinized ground moraine, some of which on the southern edge is overlain with outwash. Only a small section of this feature is within station boundaries. Later, the main outwash channel through Van Creek was rerouted almost due south through the Maple River channel, west of the interlobate moraine.

Subsequent to the melting of the Greatlakean ice, the lakes of the Michigan and Huron basins stabilized at the highest level recorded. **Lake Algonquin** existed at 185 m above sea level at UMBS for a period of roughly 1,000 years (11,000 - 10,000 years ago), long enough to erode steep sandy cliffs along its shoreline and form terraces (due to isostatic rebound the Algonquin shoreline is presently at 225 m). High pieces of land protruded above the water level and formed an archipelago. Along the margins of these high lands we now see the terraces and steep eroded cliffs of the Lake Algonquin shoreline. Terraces are prominent at Grapevine Point and all along the shores of the "Fishtail" Bays of Douglas Lake. Steep cliffs formed along the western edge of the interlobate moraine and along the southern boundaries of the high level outwash flats.

The interlobate moraine and adjacent outwash plains south of Douglas Lake were above the level of Lake Algonquin and constituted "Pellston Island." The drumlinized ground moraine and adjacent outwash deposits east and northeast of Douglas Lake formed "Riggsville Island." Other large islands in Lake Algonquin were formed by morainal deposits near Levering and Brutus, north of UMBS (Spurr and Zumberge 1956). The basins of Douglas and Burt Lakes, as well as the very gently sloping land north of Burt Lake, were beneath the waters of Lake Algonquin.

Between the interlobate moraine on station property and the broad extensive Emmet moraine in central and western Emmet County, lies a sandy, low, flat outwash plain, the Pellston Plain. The sands of the original outwash events were probably shifted and moved by repeated wave and current action of Lake Algonquin to form a very level plain. This low-lying sandy plain is climatically extreme. Bounded by the two elevated moraines to the east and west, the Pellston Plain functions as a giant cold air sink, trapping air that flows down off the high landforms. Often the coldest temperatures recorded in the state are reported from the weather station at the Pellston airport. In the summer, higher temperatures are recorded in the droughty, fire-prone plain than the surrounding areas.

Lake Algonquin existed for about 1,000 years before new outlets eroded and enabled the lake to drain to the lowest recorded level, **Lake Chippewa** in the Michigan basin (Hough 1963). A long, north-south string of sand dunes that were formed during this period is found on the eastern part of the Pellston Plain. The lake waters rose again about 6,000 years ago to form **Lake Nipissing** in the Lake Michigan basin. Lake Nipissing existed at its maximum level (presently 190 m at UMBS) between 4,700 and 4,000 years ago; the eastern portion of Hogsback Road follows the crest of dunes formed along Lake Nipissing's shore (Spurr and Zumberge 1956). The Lake Nipissing shoreline is very apparent, in the form of a steep wave-cut bluff, on the eastern side of Colonial Point.

Lake Nipissing was succeeded by **Lake Algoma**, and then by the present **Lake Michigan**. Lakes Michigan and Huron have existed at current levels for some 2,500 years.

The landscapes of northern lower Michigan have been dynamic for at least the past 14,000 years. The present landforms have resulted from the final two glacial advances and several successive lacustrine events. Situated between two large kettle lakes, UMBS property is composed of sandy lake bed, reworked interlobate moraine, drumlinized ground moraine, ice-contact terrain, and high-level outwash plains. This mosaic of landforms is the basis of the diverse ecosystems of UMBS.

### **Methods Used In Determining Landforms**

The landforms of UMBS were identified based upon the research of Lapin (1990) and a review of the literature (Leverett and Taylor 1915, Spurr and Zumberge 1956, Farrand et al. 1969, Farrand and Eschman 1974, Burgis 1977, and Papp 1986). Additional field reconnaissance and sampling were undertaken during the 1991 field season. Over 60 transects were run and aspect (the position a slope faces), slope percent, microtopography, and soils (to a depth of 1.5 to 3 m) were documented.

### **Landform Descriptions and Classifications**

Descriptions of the specific landforms are presented in the next section identified as Item 1, The classifications of Major Landforms (Item 2) and Major and Minor Landforms (Item 3) follow the descriptions. These classifications are also shown as the legend of the reflective maps.

The landforms are presented in a hierarchy. The highest level of the hierarchy, the major or basal landforms: **Outwash Plain, Ice-contact Terrain, and Moraine**, occur throughout the Onaway Subdistrict (12.1) of the Presque Isle District of Northern Lower Michigan (Albert et al. 1986) in which UMBS is located. The minor landforms are shown at lower levels of the hierarchy within the major landforms. The landscape ecosystem types described in Part 3 and shown on the map of ecosystem types are localized volumetric segments of these landforms.

## ITEM 1

### Descriptions of the Landforms of UMBS<sup>1</sup>

#### OUTWASH PLAIN (A/-).

CLIMATICALLY EXTREME, LOW-LEVEL OUTWASH CHANNEL (Pellston Plain) (A1/A) -- The Pellston Plain is a low-lying, level outwash plain about 8 km (5 miles) from east to west and 16 km (10 miles) from north to south. It is bounded on the east and west by morainic features of Port Huron age and is a sink for cold air draining from the higher landforms located to the east and west of it. The broad plain also is subject to dramatic diurnal temperature variation, up to 64 degrees in summer.

OUTWASH PLAINS (-/A1) --The Pellston Plain was presumably an expansive outwash plain during the Two Creeks Interstade (11,900 years ago). During the Greatlakean substage (11,700 years ago) the Pellston Plain became an embayment of glacial Lake Algonquin into which outwash poured and filled irregularities in the topography. Thus the Pellston Plain became a relatively level surface.

RIVERINE FEATURES (-/A2) --Among the few features on the Pellston Plain is the Maple River, a sinuous first-order stream draining Douglas Lake into the Burt Lake basin. The Maple River has captured the central portion of an outwash channel that operated in late Greatlakean time (11,600 years ago). Van Creek occupies the northwestern segment of the same channel and is currently a shallow creek bed characterized by a marked seasonal flow of slow-moving water. Riverine features including terraces, streamside wetlands, and abandoned oxbows can be found along both streams. The width of the original channel can be seen clearly on aerial photographs and topographic maps.

CHIPPEWA-AGE DUNAL COMPLEX (-/A3) -- A string of sand dunes is located on the eastern rim of the central outwash channel now occupied by the Maple River. They were probably constructed during the very dry Lake Chippewa period (9,000 - 7,500 years ago) when lake levels lowered more than 100 m, exposing the sandy plain. Prevailing westerly winds picked up medium and fine sand particles, depositing them at the point of deceleration: the eastern rim of the channel.

GLACIAL LAKE BEACH FEATURES (-/A4) -- Gravelly, calcareous features can be found at the elevation of the Lake Algonquin (11,000 - 10,000 years ago) shoreline (225 m), but are most prevalent at the north end of the Interlobate Moraine. Wave action removed fine particles and left a lag deposit of linear beaches.

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<sup>1</sup> The letters in parentheses following the name of each landform corresponds with those on the maps of **Major Landforms of UMBS**, and **Major and Minor Landforms of UMBS**, respectively. A hyphen before the slash indicates that the landform is not identified on the major landform map; a hyphen after the slash indicates that the landform is not identified on the major and minor landform map.

CLIMATICALLY MODERATE, HIGH-LEVEL OUTWASH PLAIN (A2/B) -- Outwash features to the east of the Interlobate Moraine are not subject to the extremes of climate that exist on the Pellston Plain.

OUTWASH PLAIN NOT COVERED BY GLACIAL LAKES (A21/B1) -- Four sandy outwash surfaces -- two broad and two relatively small -- lie to the south and east of Douglas Lake. These landforms were constructed from Greatlakean (11,800 - 11,500 years ago) outwash. The rapidly ablating Greatlakean glacier left many huge ice blocks strewn over the land. As these chunks of glacier melted, outwash plains and ice-contact deposits formed around and adjacent to the blocks. During Lake Algonquin time these high-level deposits formed the archipelago. The short, wave-cut cliffs along the edges of these outwash islands demarcate the Lake Algonquin shoreline.

GLACIAL LAKE ALGONQUIN BASIN (A22/B2) -- Land that was submerged in Glacial Lake Algonquin (11,000 - 10,000 years ago) may or may not have been significantly altered by lake activity. The gently sloping lake floor probably retains much of its original character as an outwash plain, whereas other areas may have been entirely altered by the lake (e.g., shoreline features) or subsequent events (e.g., the Little Carp River Gorge).

GLACIAL LAKE FLOOR (-/B21)-- Lake Algonquin is believed to have receded very rapidly. As the lake level dropped (10,000 years ago), sandy lacustrine material was deposited in recessional strands along the lake margin and formed the prominent sandy slopes between the high-level outwash deposits and Reese's Swamp.

GLACIAL LAKE SHORELINE FEATURES (-/B22)-- These features include beaches and dunes at or associated with the Lake Algonquin shoreline (225 m, 11,000 - 10,000 years ago), and large dunes at the Lake Nipissing shoreline (190 m, 6,000 - 4000 years ago) that spill into the Algonquin basin. At several points along the Lake Algonquin lakeshore, large spits or beach ridges were formed by the prevalent wave action. These features are characteristically composed of coarse sands, pebbles, and cobbles near their point of origin and grade into medium sand at their terminus. Of these beaches, the one that crosses Riggsville Road at the center of the section line between sections 32 and 5 is also partly covered by a complex arrangement of dunes. Some of these appear to be parabolic and some appear longitudinal, parallel to the direction of prevailing wind. The winds that created these complex dunes probably were not only shoreline winds but were influenced by westerly winds carrying sand down off the interlobate moraine.

Glacial Lake Nipissing spawned large shoreline dunes in many places, and the bay of Lake Nipissing that is now in the Burt Lake basin has some fine examples. The eastern portion of Hogsback Road is built along the crest of the largest of these dunes.

LITTLE CARP RIVER GORGE (A24/B23)-- The Little Carp River is a groundwater seep draining out of Douglas Lake into Burt Lake. Over the last 4,000 years the seepage has eroded the base of the high-level outwash deposits below which it lies, leading to the collapse of the sidewalls and subsequent down-cutting erosion.

MELTWATER CHANNELS (-/B24) -- There are two of these features. One is a distinctive northwest-southeast trending channel located near the northeast portion of the Port Huron moraine in the high-level outwash deposits, The other is a near mirror image, though somewhat smaller, on the east side of the lake floor cutting between the two smaller outwash islands. They apparently drained small, slowly melting ice blocks during and after Algonquin time (1100 - 10,000 years ago) into what would become the Nipissing basin.

ICE-MEDIATED, SHALLOW, PONDED DEPRESSIONS (A25/B25) -- A large depression is located on the northeast side of the interlobate moraine (Sections 30 and 31; T37N, R3W). It was associated with the northwest-southeast-oriented outwash channel that funneled large amounts of melt-water sediments between the moraine to the south and the ice block to the north, located approximately where Douglas lake is today. This feature is interpreted as being the result of: (1) a buried or partially buried ice block located against the moraine, (2) the water and outwash drift that was moving over and around it, and (3) a fresh-water lagoon connected to glacial Lake Algonquin. The ice melted over a long period of time and interaction with the outwash materials and lake waters formed slack-water ponds and a fine-grain microtopography of flats, ridges, and depressions. Clay-textured materials were evidently eroded from the adjacent moraine and deposited in thick layers in shallow depressions. Adjacent flats and ridges of coarser soils form a complex and confusing pattern of fine-scale landforms. This land mosaic has produced a rich array of local ecosystem types -- one of the most diverse areas for its size on the entire property. This feature is not characteristic of the broad and well-sorted substrate conditions typical of the major outwash plain landform. However, it lacks the hilly topography and the semi-sorted or slumped parent materials of typical ice-disintegration (kettle-kame) landforms such as found west of North Fishtail Bay of Douglas Lake (see below). Thus we have not classified it as ice-contact terrain. Nevertheless, the importance of melting ice adjacent to the interlobate moraine differentiates this group of ecosystems markedly from those of the typically flat outwash plains.

The distinct meltwater channel leading southeast from this depression connected it with Lake Algonquin, at least during periods of high lake levels. Slack-water deposits could have formed during this time. Another but smaller ponded depression occurs just north of Riggsville Road in the SE 1/4 of Section 27, T37N, R3W.

**ICE- AND LAKE-MARGIN SHORES AND TERRACES (A26/--)** -- The area immediately surrounding Douglas lake is characterized by steep, Lake Algonquin-cut slopes and level to moderately sloping terraces formed by ice-margin outwash currents and lake shore activity. A large ice block was situated where Douglas Lake is located today. As the ice melted back, ice-margin streams of different velocities and lake shore currents shaped today's topography of high and low terraces. Although these ice- and lake-margin features are not classical ice-disintegration terrain, the dynamics of the melting ice block greatly affected the diversity of the water-laid drift that was deposited. Thus this minor landform (including both shores and low terraces and high terraces) is much more diverse in local ecosystem types than typical outwash plains. Like the ice-mediated ponded depressions, melting ice and streams in contact with ice greatly influenced the resulting landforms and the structure and function of the landscape ecosystems occurring thereon.

**ICE- AND LAKE-MARGIN SHORES AND LOW TERRACES (--/B26).** Lake shores and low terraces owe their existence to stream action adjacent to the last stages of the melting ice block (see above) and particularly to shoreline activity of Douglas Lake and Burt Lake. They occur within three meters of the current lake level. Along-shore currents have created spits that enlarge and close off ponds on their landward side; the ponds eventually fill in with peat and become acidic, forested wetlands. Some of the most extensive of these diverse areas can be found at Sedge Point and Pine Point.

**ICE-MARGIN HIGH TERRACES (--/B27).** High terraces typically formed where kames or high-level outwash plain formations were very near to the large stagnant ice blocks of Douglas-Lake and Burt Lake basins. Near the end of the Greatlakean period (11,900 - 11,500 years ago) torrential ice-margin streams, running along the ice blocks apparently created the gravely and cobbly terraces along and at the tip of Grapevine Point and the North Fishtail Bay kame. Later, Lake Algonquin (11,000 - 10,000 years ago) currents modified these and probably formed the gently sloping high terraces on the east side of Douglas Lake. Due to this stream action adjacent to extant ice, local topography is diverse. The combination of diverse form and parent materials resulted in the diverse ecosystem types that occupy this relatively small area around the lakes. Although undoubtedly water-laid and well sorted (outwash landform), the influence of ice in the formulation process has resulted in local diversity of ecosystems much greater than that of the typical broad and flat outwash plains of the Biological Station.

**GLACIAL LAKE NIPISSING BASIN (A23/B3)** -- The Nipissing Great Lakes (6,000 - 4,000 years ago) receded much more slowly than Lake Algonquin. The lake floor features produced by Lake Nipissing were thus much more level than those of the Lake Algonquin period. Reese's swamp is the largest remnant of Nipissing lake plain on UMBS property. The soils in Reese's swamp are predominantly composed of coarse nearshore Nipissing lacustrine deposits (sand) over finer offshore Algonquin deposits (clays). Recessional strands occur at somewhat regular intervals from north to south across the gentle slope, and

create a pattern of wetlands and narrow upland ridges. Features associated with the Little Carp River are also evident. Nipissing-age lakeshore terraces and wave-cut bluffs are prominent features on Colonial Point.

### ICE-CONTACT TERRAIN (B/-)

**KETTLE-KAME LANDFORMS (-/C)** -- There are numerous features formed during Greatlakean time (11,900 - 11,500 years ago) that are associated with wasting ice-blocks. A high kame was built adjacent to the ice residing in the North Fishtail Bay of Douglas Lake. The parent material of the kame (and its sister on the west side of Munro Lake, to the north) differs significantly from the deep sands of the outwash deposits. A calcareous, gravelly substrate characterizes the kames. Gates Bog (Sections 21 and 22 T37N, R3W) is in the center of a large kettle located just northwest of the North Fishtail kame, and one large kettle hole (Sections 28 and 29 T37N, R3W) is associated with the high-level outwash south of Douglas Lake.

### MORaine (C/-)

**INTERLOBATE MORaine (C1/D)** -- The highest elevation (277 m) and greatest topographic relief on UMBS property is found on a morainic feature of Port Huron age (12,600 years ago). The diverse nature of the parent material -- deep sand, banded sand (sand with sporadic bands of pedogenic and depositional origin), light-textured till, and heavy-textured till -- suggests a complex history. Red, sandy, (typically sandy clay loam) Port Huron till is found at or near the surface around most of the feature at an elevation of approximately 225 m. Greatlakean ice (11,700 years ago) overrode the Port Huron deposit and as it wasted considerable sand was deposited thereon; ice-contact material was probably deposited as well. Thus a deep overburden of Greatlakean sandy outwash covers much of the Port Huron till, although till is exposed at the surface at several high-elevation spots. This landform has the most complex mosaic of soils of any on UMBS property. During the time of Lake Algonquin (11,000 - 10,000 years ago), the moraine was the westernmost part of an archipelago of islands on UMBS land. The steep west and south slopes display the impressive Algonquin wave-cut cliffs.

**DRUMLINIZED MORaine (C2/E)** -- A broad expanse of drumlinized Port Huron ground moraine lies northeast of Douglas Lake. However, only a small portion of it lies within UMBS property (Section 22, T37N, R3W). The red, sandy Port Huron (12,600 years ago) till was sculpted into elongate, elliptical, drumlin-like ridges by the overriding Greatlakean ice (11,700 years ago). A strong northwest-southeast orientation to the corrugated landscape is evident. Parts of this feature are topped with sandy outwash, whereas other areas reveal the sandy loam till at the surface. During Lake Algonquin time (11,000 - 10,000 years ago) the drumlinized moraine constituted the eastern and northern portion of the archipelago of islands. Currently most of the landform is used for agriculture.

COLONIAL POINT (C3/F) -- Colonial Point is a broad, level to gently sloping feature of complex origin. Till, most likely of Port Huron age (12,600 years ago), is mostly buried by one to two meters of sandy outwash or heavy Lake Algonquin (11,000 - 10,000 years ago) deposits of clay and silt. A gravel bar, possibly from an early stage of Lake Algonquin (11,500 years ago), forms a small ridge along the highest axis of the Colonial Point peninsula.

## ITEM 2

### Major Landforms of the University of Michigan Biological Station<sup>2</sup> (For use with the map of the same title)

The classification presented below shows the **Major Landforms** (Outwash Plain, Ice-Contact Terrain, and Moraine) and two hierarchical levels of the **Minor Landforms** for Outwash Plain and one level for Moraine.

#### A OUTWASH PLAIN

A1 Climatically Extreme Low-level Outwash Plain (Pellston Plain) (1-35, 108)

A2 Climatically Moderate, High-level Outwash Plain

A21 Outwash Plain Not Covered By Glacial Lakes (37-38, 40-41, 43-46, 49-52)

A22 Glacial Lake Algonquin Basin (36, 39, 42, 47-48, 53-58, 74-78, 81-103, 105-108)

A23 Glacial Lake Nippising Basin (53-56, 67-70, 74, 79-80, 87-88, 99-100, 103)

A24 Little Carp River Gorge (65-66, 70-73)

A25 Ice-mediated, Shallow, Poned Depressions (81-85)

A26 Ice- and Lake-Margin Shores and Terraces (86-103)

#### B ICE-CONTACT TERRAIN (104-108)

#### C MORaine

C1 Interlobate Moraine (59-64, 74, 109, 113-114, 116, 118)

C2 Drumlinized Moraine (109, 113, 119)

C3 Colonial Point (110-112, 115, 117-118, 120-125)

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<sup>2</sup>Numbers in parentheses refer to **Landscape Ecosystem Types of UMBS** (Part 3, Item 1).

### ITEM 3

## Major and Minor Landforms of the University of Michigan Biological Station<sup>3</sup> (For use with the map of the same title)

#### OUTWASH PLAIN

##### A CLIMATICALLY EXTREME, LOW-LEVEL OUTWASH CHANNEL (Pellston Plain)

- A1 OUTWASH PLAINS (1-27)
- A2 RIVERINE FEATURES (28-33)
- A3 CHIPPEWA-AGE DUNAL COMPLEX (34)
- A4 GLACIAL LAKE BEACH FEATURES (35)

##### B CLIMATICALLY MODERATE, HIGH-LEVEL OUTWASH PLAIN

- B1 OUTWASH PLAIN NOT COVERED BY GLACIAL LAKES (37-38, 40-41, 43-46, 49-52, 59-64)
- B2 GLACIAL LAKE ALGONQUIN BASIN
  - B21 Glacial Lake Floor (36, 39, 42, 47-48, 53-58)
  - B22 Glacial Lake Shoreline Features (74-78)
  - B23 Little Carp River Gorge (65-66, 70-73)
  - B24 Meltwater Channels (36, 39, 42)
  - B25 Ice-mediated, Shallow, Poneded Depressions (81-85)
  - B26 Ice- and Lake-Margin Shores and Low Terraces (86-95)
  - B27 Ice-Margin High Terraces (96-103)
- B3 GLACIAL LAKE NIPISSING BASIN (53-56, 67-70, 74, 79-80, 92-93, 104-105, 108)

#### ICE-CONTACT TERRAIN

##### C KETTLE-KAME LANDFORMS (81-85)

#### MORaine

- D INTERLOBATE MORaine (59-64, 74, 109, 113-114, 116, 118)
- E DRUMLINIZED MORaine (109, 113, 119)
- F COLONIAL POINT (110-112, 115, 117-118, 120-125)

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<sup>3</sup>Numbers in parentheses refer to Landscape Ecosystem Types of UMBS (Part 3, Item 1).

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## Guide to Using the Classifications and Map of Landscape Ecosystem Types of UMBS

by Douglas R. Pearsall and Burton V. Barnes

### Getting Started

People using the classification and map of the local landscape ecosystem types are urged to read the *Introduction to Landscape Ecosystems of UMBS* (Part 1) in which we explain the ecosystem approach and describe the various products resulting from this research. These products include the two maps of UMBS landforms, the map of local landscape ecosystem types, the cover type map, and all the documentation that goes with each. People are also urged to read the *Geologic History and Guide to the Classifications and Maps of the Landforms of UMBS* so they have the physiographic basis for understanding the complex kinds and patterns of local ecosystem types found on UMBS land.

### Classifications of Ecosystem Types

Presented below is a guide to the landscape ecosystem type classifications and map. There are two classifications of the landscape ecosystem types that are shown on the map.

1. The first classification and brief description of the ecosystem types (Part 3, Item 1; 9 pages) is organized by the ecological and functional similarity of the ecosystems. Similar ecosystems are grouped together **regardless of where they occur (on which landform) on the area**. This classification lists ecosystems (types in hierarchical groups) that would support similar plant and animal species and respond similarly to experimental treatment.

2. The second classification (no description of types provided) lists the ecosystem types (Part 3, Item 2; 2 pages) by the landforms where they occur in the field, **regardless of differences in their physiography, soil, vegetation, or functioning from other ecosystems occurring on that landform**. This classification differs from #1 above in that all the kinds of local ecosystem types occurring in a particular landform are grouped together. For example, the large moraine landform located along the county line north and south of Robinson Road includes dry, nutrient poor ecosystem types similar to those on the high-level outwash plain as well as mesic and fertile ecosystems having less than 3 m of outwash over glacial till. Because this major morainal landform is a geographic feature in the landscape all its ecosystems are grouped together in this classification.

### Classification of Ecosystem Groups

For many purposes, people will want to study and use **groups of similar ecosystems** rather than the local ecosystem types themselves. What are groups of ecosystems? Ecosystem groups are the collection of ecosystem types that have one or more similar properties (e.g., calcareous ecosystems of the Pellston Plain (types 11-19); shores and active beaches of Douglas and Burt lakes (types 86-89), etc.). Ecosystem types in a given group would be those listed under each hierarchy of the ecosystem type classification

(classification #1 described above). Thus for classification 1 there are as many ecosystem groups as there are hierarchical levels of the classification.

The third classification of this part (titled: Landscape Ecosystem Groups of UMBS; Part 3, Item 3; 2 pages) identifies the hierarchy of ecosystem groups for ecosystem type classification #1 described above.

### **Introduction To Using The Ecosystem Type Classification And Map**

Landscape ecosystems are volumetric pieces of the earth's surface that have characteristic and recognizable climate, physiography, soil, and biota. They can be conceived as existing in a nested hierarchy of spatial sizes, the largest being the earth, or ecosphere, and the smallest mapped at UMBS being local landscape ecosystem types such as a kettle-hole bog dominated by leatherleaf or a lakeshore terrace supporting red pine and low sweet blueberry. The ecosystem concept imparts major importance to their geographic, geologic, and climatic factors as well as the biotic components. Global geological and climatic patterns control the broad distribution of soil types and organisms, and local physiographic features (landforms; e.g., kames, moraines, and dunes) modify local climate (including temperature and wind) and drainage. Thus the local occurrence of soils and organisms (especially plants) corresponds with specific landforms and their attributes such as parent material, slope aspect, slope percent, and slope position. Areas that are relatively similar in these physiographic characteristics are found to have similar soil and biota. A given glacial landform is typically relatively homogeneous with respect to topography and parent material, and thus forms the basis for an ecosystem group, within which local ecosystem types are nested (Rowe and Sheard 1981, Host et al. 1987, 1988).

The landscape ecosystem research team at UMBS has been engaged in the process of identifying, describing, classifying, and mapping the landscape ecosystems of UMBS since 1988. The classification and map of landscape ecosystem types presented here are the results of six field seasons of research, the first two carried out by Marc Lapin in 1988 and 1989, and the latter four by a team of researchers from 1991-1994. These products provide a framework for further research; the ecosystem map, in particular, is a set of hypotheses that can be tested at any of the hierarchical levels of the classification.

The local physiography of the UMBS landscape modifies regional climate, and the microclimatic differences influence ecosystem development. For example, the broad, flat, plain on the western third of the property, known as the Pellston Plain, is climatically distinct from the rest of the property. Cold air drainage from the higher moraine to the west and the moraine-outwash complex to the east creates a broad frost-pocket, where diurnal temperatures can vary as much as 64°F (36°C) in summer (Barnes 1959). This climatic difference may account for differences in vegetation on areas with otherwise similar parent material and soil.

The major landforms (Outwash Plain, Ice-contact Terrain, and Moraine) form the first level of the hierarchy of ecosystem groups and types. Within each landform, slope or soil parameters characterize subsequently lower levels. As typical of a glaciated landscape, however, the major landforms are quite complex, and ecosystems that are essentially the same with regard to physiography, soils, and vegetation may occur on different major landforms. This complexity is most evident on the large interlobate moraine;

the glacial till of the moraine has been mostly covered by outwash. Where that outwash is greater than 3 m in depth, the influence of the till on moisture and nutrient availability is considered insignificant, and the ecosystems are considered to be of outwash origin, not morainal. Ecosystem types 59-64 comprise the outwash ecosystems that occur on moraine landforms.

### **Methods Used In Distinguishing And Mapping Ecosystem Types**

Starting with an analysis of USGS 7.5 minute quadrangle maps and aerial photos (both black and white infra-red 1:16,300 and color infra-red 1:24,000), major landforms and ecosystems were identified. Through reconnaissance and sampling of transects and formal plots, tentative ecosystem groups and types were identified. Lapin (1990), working alone for two field seasons, mapped and described UMBS landforms and ecosystem groups, providing a significant starting point for the research that followed. The preliminary ecosystem types were determined in 1991 and 1992 and field checked through an iterative process of reconnaissance, transect and plot sampling. By walking across potential landscape boundaries and recording changes in physiography, soil, and vegetation, the research team gained both familiarity with the ecosystems and practice in distinguishing their boundaries. Hypothesized ecosystem groups and types were further tested by sampling rectangular plots (15 x 30 m). Physiographic variables measured at each sample plot included slope position, aspect, and percent. Slope percent was measured along the aspect and along the north and south axes of the plot. Convexity/concavity was assessed, and distance to nearest surface water was determined from topographic maps. Landform (e.g., outwash plain) was determined through assessment of physiographic parameters.

Thickness and pH of soil organic horizons were measured at three locations within the plot. A soil pit 1-2 m in depth was dug in a randomly determined location within the plot, and the observable horizons were described in terms of depth (range and average), pH, texture, color, structure, consistency, and percent pebbles and cobbles (United States Department of Agriculture 1975). One sample (1-2 pints) was collected for each mineral horizon described. In addition, an auger was used to briefly describe soil below the pit (to 4-5 m) and determine depth to water table.

Vegetation was sampled in three strata: overstory, understory, and groundcover. DBH (diameter breast height; 1.4 m) and species of all overstory stems (DBH > 9 cm) within the plot was determined. Understory stems were identified to species and assigned to one of three DBH classes (1.5 - 4.0, 4.1 - 6.6, and 6.7 - 9.0 cm). The plot was divided into three 5 x 30 m subplots, and groundcover (DBH < 1.5 cm) was sampled in the center subplot only. All groundcover species present were noted and each assigned to one of 12 cover classes (Simpson et al. 1990). Coverage was determined by counting the number (or fraction) of sample frames covered by each species (one sample frame represents 0.1% of subplot area). Ecological species groups were developed as in Spies and Barnes (1985b). Through reconnaissance and sampling researchers gained familiarity with groups of groundcover shrubs and herbs that co-occur in patterns related to abiotic factors. Initial groups that reflect ecological extremes were developed, and with additional observations and review, intermediate groups were identified and refined. See Part 4 on Ecological Species Groups.

Mapping of local ecosystem types was accomplished through a field procedure similar to that detailed by Spooner (1984) and Hix (1983) and is described in Pearsall (1995). To locate ecosystem boundaries in the field and transfer them accurately to a 1:16,300 enlargement of a USGS map, a 5-chain interval mapping grid, composed of main lines at 10-chain intervals and side lines, was completed. Each main line was begun from a predetermined starting point and at a known azimuth; horizontal distance was measured with a 2-chain (132 ft., 40.22 m) steel tape. From the starting point, a side line (wing) was paced out 5 chains at an azimuth  $90^\circ$  from the main line, then 5 chains at an azimuth parallel to the main line, then back towards the main line to intersect at 5 chains from the starting point. From that intersection, a wing on the opposite side of the main line was completed, and the process repeated until the end of the central line was reached. Ecosystem boundaries (as interpreted from changes in physiography, drainage, and/or coverage of ecological species groups), roads, trails, and other landmarks were recorded onto field mapping sheets when encountered. The ecosystem teams hiked over 750 km in mapping ecosystem types and determining their boundaries by multiple site and vegetative factors.

Ecosystem boundaries were compiled from field mapping sheets onto mylar overlays and digitized from those into Arc/Info (ESRI 1992), a Geographic Information System (GIS). Enlargements of USGS 7.5' maps for the Indianville, Pellston, and Burt Lake quadrangles were used for the base maps of roads, section lines, shorelines, and streams. ARCPLOT (an Arc/Info module) was used to create four maps of landscape ecosystem types, one at the 1:16,308 scale depicting UMBS land exclusive of Colonial Point, two maps covering the western and eastern parts of the same UMBS area at a 1:10,000 scale, and one of the Colonial Point area at 1:10,000. These larger scale maps show the boundaries of small ecosystem types better than the smaller scale map of the entire UMBS tract. The digital maps of ecosystem types, as well as those of major landforms, major and minor landforms, and the cover types, are available at the School of Natural Resources and Environment (contact Burton V. Barnes, 2532 Dana; 313/764-1407). They are also available in CMAP (another GIS) form by contacting Bob Vande Kopple at UMBS.

### **Interpreting The Description Of Ecosystem Types**

A brief description of each landscape ecosystem type is given in Classification #1 (Part 3, Item 1). It consistently gives important attributes of each type. Typically, the sequence is the drainage class, a general soil characteristic, the characteristic physiographic position, and finally the vegetation (presettlement overstory type and characteristic ecological species group). The detailed descriptions of each ecosystem type appear in Appendix A: Descriptions of the Landscape Ecosystem Types of the University of Michigan Biological Station.

### **Landscape Ecosystem Types As Hypotheses For Testing**

The landscape ecosystem types we have identified, classified, described, and mapped are our best approximation of the basic units of nature. We recognize that this version is not the **final** approximation; the classification (Part 3, Item 1) and map provide types that are hypotheses for testing. The ecosystem types are "carved out" of the continuum of the landscape using their key attributes simultaneously. This

process is deductive and based on ecological theory and experience. We use observable differences in local physiography, soil factors and drainage, vegetation, forest history, and our understanding of their interrelationships to distinguish the types. It is a process that should give respectable results.

Because UMBS ecosystems are highly disturbed, ground-cover species groups were the most important vegetative indicator used in distinguishing and mapping ecosystem types. Although we have distinguished and mapped ecosystem types to a relatively fine level of resolution, even finer differences were observed but not mapped. In some cases, types showing subtle differences of a given component were combined where they might have been split into two types. Work could still be done to refine boundaries and improve the resolution of the classification and map. Use of the classification and map by students and faculty will assist greatly in the refinement and changes that are appropriate.

## ITEM 1

## Landscape Ecosystem Types of the University of Biological Station

DRP, BVB, NAW, RMR 7/4/95

### OUTWASH PLAIN

- **CLIMATICALLY EXTREME, LOW-LEVEL  
OUTWASH CHANNEL (PELLSTON PLAIN)**
- • **Outwash plains reworked by glacial lakes**
- • • **Uplands**
- • • • **Deep outwash**
- • • • • **Non-calcareous**
- • • • • • **Non-banded deep sand**
  - 1 Excessively drained medium sand, outwash plain in the Pellston Plain; white pine - red pine - hemlock - red oak/*Cladina*
  - 2 Somewhat excessively drained medium to fine sand; outwash plain in the Pellston Plain; white pine - red pine - hemlock - red oak/*Gaultheria*
  - 3 Well drained medium sand; raised features in outwash plain in the Pellston Plain; hemlock - beech/*Maianthemum*
  - 4 Well drained to moderately well drained medium sand; outwash plain in the Pellston Plain; white pine - red pine - hemlock/*Maianthemum*
  - 5 Somewhat poorly drained to well drained medium sand; outwash plain in the Pellston Plain; white spruce - balsam fir/*Clintonia*
  - 6 Somewhat poorly drained medium sand; outwash plain in Pellston Plain; white spruce - balsam fir/*Rhamnus*
- • • • • • • **Banded soil**
  - 7 Somewhat excessively drained to well drained, banded, medium sand; outwash plain in Pellston Plain; white pine - red pine - hemlock - red oak/*Gaultheria*
  - 8 Somewhat excessively drained to well drained, banded, medium sand; outwash plain within 1000 m of Douglas Lake; white pine - red pine - hemlock - red oak/*Gaultheria*
  - 9 Moderately well drained to somewhat poorly drained, banded, medium sand; outwash plain within 1000 m of Douglas Lake; red maple - elm/*Clintonia*
  - 10 Moderately well drained to somewhat poorly drained, banded, medium sand, outwash plain in Pellston Plain; white pine - hemlock - red maple/*Clintonia*

• • • • • **Calcareous**

• • • • • **Non-banded deep sand**

- 11 Somewhat excessively drained medium sand, calcareous in C horizon; outwash plain in Pellston Plain; white pine - red pine - hemlock - red oak/*Oryzopsis*
- 12 Well drained medium sand, calcareous in C horizon; outwash plain in Pellston Plain; hemlock - northern hardwood/*Osmorhiza*
- 13 Somewhat excessively drained medium sand, calcareous in C horizon; raised features in outwash plain in Pellston Plain; hemlock - northern hardwood/*Polygonatum*
- 14 Well drained medium sand, calcareous in C horizon; raised features in outwash plain in Pellston Plain; hemlock - northern hardwood/*Aralia*
- 15 Well drained to moderately well drained medium sand, calcareous below 175 cm; outwash plain in Pellston Plain; white pine - red pine - hemlock - red oak/*Polygala*
- 16 Somewhat poorly drained to well drained medium sand, calcareous in C horizon; outwash plain in Pellston Plain; white spruce - balsam fir/*Prunella*

• • • • • **Banded soil**

- 17 Somewhat excessively drained to well drained, banded, medium sand; calcareous in C horizon below 200 cm; outwash plain in Pellston Plain; white pine - red pine - hemlock - red oak/*Aralia*
- 18 Well drained to moderately well drained, banded, medium sand, calcareous in C horizon; outwash plain in Pellston Plain; hemlock - northern hardwood/*Toxicodendron*
- 19 Moderately well drained to somewhat poorly drained, banded, medium sand, calcareous in C horizon; outwash plain in Pellston Plain; hemlock - northern hardwood/*Osmorhiza*

• • • • • **Shallow outwash over till**

• • • • • **Non-calcareous**

- 20 Well drained to moderately well drained medium sand over clay loam; outwash plain over moraine in Pellston Plain; hemlock - northern hardwood/*Clintonia*

• • • • • **Calcareous**

- 21 Moderately well drained to somewhat poorly drained medium sand over clay loam; outwash plain over moraine in Pellston Plain; hemlock - northern hardwood/*Osmorhiza*
- 22 Somewhat poorly drained, medium sand over clay loam; outwash plain over moraine in Pellston Plain; hemlock - northern hardwood/*Arisaema*

• • • **Wetlands**

- 23(Z)<sup>1</sup> Outwash-lake plain shrub willow swamp in Pellston Plain; willow/*Onoclea*
- 24(Z) Outwash-lake plain shrub alder swamp in Pellston Plain; alder/*Onoclea*
- 25(Z) Outwash-lake plain hardwood swamp in Pellston Plain; American elm - red maple - black ash/*Onoclea*
- 26 Outwash-lake plain conifer swamp in Pellston Plain; northern white-cedar - white spruce - balsam fir/*Coptis*
- 27 Outwash-lake plain foot-slope hardwood swamp in Pellston Plain; American elm - red maple - black ash/*Arisaema*

<sup>1</sup>Refers to types described in Gregory Zogg's Master's thesis (Zogg 1993).

- • **Riverine features**

- • • **Uplands**

28 Moderately well drained medium sand, calcareous in C horizon; alluvial terrace in Pellston Plain; American elm - balsam poplar-red ash/*Toxicodendron*

- • • **Wetlands**

29(Z) Outwash-lake plain hardwood intermittent stream channel swamp in Pellston Plain; black ash - elm/*Onoclea*

30(Z) Outwash-lake plain herbaceous intermittent stream channel marsh in Pellston Plain; sweet gale - meadowsweet/*Typha*

31(Z) Outwash-lake plain herbaceous streamside marsh in Pellston Plain; sweet gale - meadowsweet/*Typha*

32(Z) Outwash-lake plain shrub alder streamside swamp in Pellston Plain; alder/*Onoclea*

33 Riverine oxbow hardwood swamp in Pellston Plain; American elm - balsam poplar - red ash/*Onoclea*

- • **Dunes**

34 Somewhat excessively drained medium sand; dunes on outwash plain in Pellston Plain; white pine - red pine - hemlock - red oak/*Gaultheria*

- • **Glacial lake beach features**

35 Well drained medium sand over sandy loam; glacial lake beach over moraine in Pellston Plain; hemlock - northern hardwood/*Polygonatum*

- **Climatically Moderate, High-level Outwash Plains**

- • **Outwash plains and associated slopes**

- • • **Uplands**

- • • • **Level to moderately sloping (<15%)**

- • • • • **Non-calcareous substrate (calcareous material below 250 cm)**

- • • • • • **Non-banded, deep sand**

36 Excessively drained medium sand; high-level outwash-lake plain; white pine - red pine - hemlock - red oak/*Gaultheria*

37 Excessively drained medium sand; high-level outwash plain; white pine - red pine - hemlock - red oak/*Gaultheria*

38 Somewhat excessively drained medium sand; high-level outwash plain within 0.5 km of Douglas Lake and the interlobate moraine; white pine - red pine - hemlock - red oak/*Aralia*

- • • • • • **Banded soil**

39 Somewhat excessively drained, banded, medium sand; high-level outwash-lake plain; white pine - red pine - hemlock - red oak/*Maianthemum*

40 Somewhat excessively drained to well drained, banded, medium sand; high-level outwash plain; hemlock - northern hardwood/*Aralia*

41 Well drained, banded, medium sand; high-level outwash plain within 0.9 km of the drumlinized moraine; hemlock - northern hardwood/*Ostrya*

42 Well drained, banded, medium sand; high-level outwash-lake plain; hemlock - northern hardwood/*Aralia*

- • • • • • **Calcareous above 250 cm**

- • • • • • • **Non-banded deep sand**

43 Excessively drained medium sand, calcareous in C horizon below 200 cm; high-level outwash plain within 0.5 km of Douglas Lake and the interlobate moraine; hemlock - northern hardwood/*Oryzopsis*

44 Excessively drained to somewhat excessively drained medium sand, calcareous horizon; high-level outwash plain; hemlock - northern hardwood/*Oryzopsis*

45 Somewhat excessively drained medium sand, calcareous in C horizon; high-level outwash plain within 0.4 km of Douglas Lake; hemlock - northern hardwood/*Ostrya*

46 Well drained medium sand, calcareous in C horizon; high-level outwash plain within 0.4 km of Douglas Lake; hemlock - northern hardwood/*Osmorhiza*

- • • • • • • **Banded soil**

47 Somewhat excessively drained, banded, medium sand, calcareous below 200 cm; high-level outwash-lake plain; white pine - red pine - hemlock - red oak/*Oryzopsis*

48 Well drained, banded, loamy sand over sandy loam, calcareous in lower C horizons; high-level outwash-lake plain; hemlock - northern hardwood/*Aralia*

- • • • **Steeply sloping (>15%)**

- • • • • **Non-lake-affected**

49 Somewhat excessively drained medium sand; west-facing, strongly to steeply sloping high-level outwash; white pine - red pine - hemlock - red oak/*Maianthemum*

50 Somewhat excessively drained medium sand; north- and east-facing, strongly to steeply sloping high-level outwash; white pine - red pine - hemlock - red oak/*Aralia*

- • • • • **Lake-affected**

51 Somewhat excessively drained medium sand, calcareous in C horizon; west- and south-facing, lake-affected, strongly to steeply sloping high-level outwash; hemlock - northern hardwood/*Aralia*

52 Somewhat excessively drained medium sand, calcareous in C horizon; north- and east-facing, lake-affected, strongly to steeply sloping high-level outwash; hemlock - northern hardwood/*Polygonatum*

- • • **Wetlands**

53(Z) Outwash-lake plain hardwood swamp; red maple - black ash/*Ilex*

54(Z) Outwash-lake plain hardwood-conifer swamp; black ash - northern white-cedar - balsam fir/*Arisaema*

55(Z) Outwash-lake plain conifer-hardwood swamp; northern white-cedar - white spruce - balsam fir - black ash/*Coptis*

56(Z) Outwash-lake plain northern white-cedar swamp; northern white-cedar/*Coptis*

57 Outwash-lake plain shrub willow swamp; northern white-cedar - white spruce - balsam fir/sedge

58 Outwash-lake plain herbaceous wetland; alder - willow/*Onoclea*

- • **Deep outwash on moraine landforms**

- • • **Level to moderately sloping (<15%)**

59 Somewhat excessively drained to excessively drained, banded, medium sand; high-level outwash plain on moraine landforms; white pine - red pine - hemlock - red oak/*Maianthemum*

60 Well drained to somewhat excessively drained, banded, medium sand; high-level outwash plain on moraine landforms; hemlock - northern hardwood/*Aralia*

- • • **Steeply sloping (>15%)**

- • • • **West and south aspects**

61 Somewhat excessively drained medium sand; west-facing, strongly to steeply sloping high-level outwash on moraine landforms; white pine - red pine - hemlock - red oak/*Maianthemum*

62 Well drained fine sandy loam; south-facing, strongly to steeply sloping high-level outwash on moraine landforms; hemlock - northern hardwood/*Polygonatum*

- • • • **North and east aspects**

- 63 Somewhat excessively drained medium sand; north-facing, strongly to steeply sloping high-level outwash on moraine landforms; red oak - white pine - hemlock/*Aralia*
- 64 Well drained fine sandy loam; north-facing, strongly to steeply sloping outwash on moraine landforms; hemlock - northern hardwood/*Polygonatum*

- • **Little Carp River gorge and riverine ecosystems**

- • • **Uplands**

- 65 Somewhat excessively drained medium sand; steeply sloping high-level outwash in the Little Carp River gorge; white pine - red pine - hemlock - red oak/*Maianthemum*
- 66 Well drained medium and coarse sand; rolling colluvial deposits in the Little Carp River gorge; hemlock - northern hardwood/*Polygala*
- 67 Well drained to somewhat poorly drained medium sand; alluvial ridge along the Little Carp River; hemlock - northern hardwood/*Clintonia*
- 68 Well drained to moderately well drained silt loam; Nipissing-age delta; hemlock - northern hardwood/*Polygonatum*
- 69 Well drained to moderately well drained medium to fine sand; post-Nipissing-age delta; hemlock/*Maianthemum*

- • • **Wetlands**

- 70(Z) Outwash-lake plain conifer streamside swamp; northern white cedar - white spruce - balsam fir/*Coptis*
- 71(Z) Outwash-lake plain streamside conifer-hardwood swamp; hemlock - northern white-cedar - black ash/*Clintonia*
- 72(Z) Outwash-lake plain streamside shrub alder swamp; alder/*Ilex*
- 73 Colluvium conifer-hardwood seep wetland in the Little Carp River gorge; hemlock - northern hardwood/*coptis*

- • **Dunes**

- 74 Excessively drained to somewhat excessively drained medium sand to fine sand; dunes on high-level outwash-lake plain; white pine - red pine - hemlock - red oak/*Gaultheria*

- • **Glacial lake beach features**

- • • **Glacial Lake Algonquin basin**

- 75 Somewhat excessively drained medium sand; glacial lake beaches; white pine - red pine - hemlock - oak/*Maianthemum*
- 76 Somewhat excessively drained medium sand, calcareous in C horizon; glacial lake beaches; white pine - red pine - red oak - red oak or hemlock - northern hardwood/*Oryzopsis*
- 77 Somewhat excessively drained medium sand, calcareous in C horizon; glacial lake beaches; hemlock - northern hardwood/*Polygonatum*
- 78 Moderately well drained, banded, medium sand, calcareous in C horizon; glacial lake beaches; hemlock - northern hardwood/*Polygonatum*

- • • **Glacial Lake Nipissing basin**

- 79 Well drained to moderately well drained medium sand; glacial lake beaches; white pine - white spruce - balsam fir/*Maianthemum*
- 80 Well drained medium sand, calcareous in C horizon; glacial lake gravel bars and beaches at Colonial Point; hemlock - northern hardwood/*Caulophyllum*

- • **Ice-mediated, shallow ponded depressions**

- • • **Uplands**

- 81 Somewhat excessively drained medium sand; ice-contact ridges in shallow ponded depressions; hemlock - northern hardwood/*Maianthemum*
- 82 Well drained to moderately well drained loamy fine sand to sandy loam; shallow ponded depressions; hemlock - northern hardwood/*Polygonatum*
- 83 Moderately well drained to somewhat poorly drained medium sand; wetland margins in high-level outwash plains and ice-contact terrain; white - hemlock - red maple/*Clintonia*
- 84 Moderately well drained to somewhat poorly drained medium fine sand to sandy loam, calcareous in C horizon; wetland margins in shallow ponded depressions; American elm - red maple - black/*Osmorhiza*

- • • **Wetlands**

- 85 Ice-contact ponded depression hardwood swamp; American elm - red maple - black ash/*Onoclea*

- • **Ice- and lake-margin shores and terraces**

- • • **Shores; active beaches of Douglas and Burt Lakes**

- • • • **Uplands**

- 86 Well drained medium sand, calcareous in C horizon; beach terrace; white pine/grasses
- 87 Somewhat poorly drained medium sand or gravel and cobbles; beaches; red maple - willow/*Typha*

- • • • **Wetlands**

- 88(Z) Lake shore herbaceous emergent wetland; rushes/*Typha*
- 89 Ice-margin herbaceous beach pool wetland; willow - alder/*Typha*

- • • **Low terraces (terraces created by shoreline dynamics in modern lakes)**

- • • • **Uplands**

- 90 Moderately well drained to well drained medium sand; low lake terraces; white pine - red pine/*Clintonia*
- 91 Moderately well drained to well drained medium sand; low lake terraces; white pine - hemlock - red maple/*Aralia*
- 92 Moderately well drained to well drained medium sand; low lake terraces on Pell's Island; white pine - hemlock - red maple/*Polygala*
- 93 Moderately well drained to well drained medium sand, calcareous in C horizon; low lake terraces; hemlock - northern hardwood/*Osmorhiza*

- • • • **Wetlands**

94(Z15) Ice-margin closed beach pool red maple swamp; red maple/*Ilex*

95 Ice-margin open beach pool hardwood swamp; American elm - red maple/*Onoclea*

- • • **High terraces** (terraces created by ice block-margin meltwater currents and shoreline wave action of glacial lakes Algonquin or Nipissing)

- • • • **Uplands**

- • • • • **Non-calcareous**

96 Excessively drained medium sand; high ice-margin terraces; white pine - red pine - hemlock - red oak/*Gaultheria*

97 Somewhat excessively drained medium sand to fine sand; high ice-margin terraces; white pine - red pine - hemlock - red oak/*Aralia*

- • • • • **Calcareous**

98 Somewhat excessively drained loamy medium sand, calcareous in C horizon; high ice-margin terraces; hemlock - northern hardwood/*Aralia*

99 Somewhat excessively drained medium sand, calcareous in C horizon; high ice-margin terraces; hemlock - northern hardwood/*Ostrya*

100 Well drained medium sand over sandy loam, calcareous in C horizon; high ice-margin terraces; hemlock - northern hardwood/*Caulophyllum*

101 Well drained loamy medium sand, calcareous in C horizon; high ice-margin terraces; hemlock - northern hardwood/*Osmorhiza*

102 Well drained fine sand; high ice-margin terraces; hemlock - northern hardwood/*Polygonatum*

- • • • **Wetlands**

103 Ice-margin-lake terrace hardwood swamp; black ash - basswood/*Arisaema*

## ICE-CONTACT TERRAIN

- **Kettle-kame landforms**

- • **Uplands**

104 Somewhat excessively drained medium sand, calcareous in C horizon; kames; hemlock - northern hardwood/*Osmorhiza*

105 Somewhat excessively drained medium sand, calcareous in C horizon; kamic island; hemlock - northern hardwood/*Osmorhiza*

106 Somewhat excessively drained to well drained medium sand; calcareous in C horizon; ice-block depression; hemlock - northern hardwood/*Polygonatum*

107 Well drained to moderately well drained, gleyed, medium sand; ice-block depression; white pine - red pine - hemlock - red oak/*Gaultheria*

- • **Wetlands**

108(Z14) Ice-contact kettle-hole leatherleaf bog; leatherleaf/*Chamaedaphne*

## MORAINE

### • Outwash over till

#### • • Uplands

- 109 Somewhat excessively drained medium sand over sandy loam, calcareous in 2C horizons; gently sloping moraines; hemlock - northern hardwood/*Polygala*
- 110 Somewhat excessively drained to well drained medium sand over sandy loam, calcareous in 2C horizons; very gently sloping moraine at Colonial Point; hemlock - northern hardwood/*Polygonatum*
- 111 Well drained loamy sand over sandy loam, calcareous in 2C horizon; gently sloping moraine at Colonial Point; hemlock - northern hardwood/*Polygonatum*
- 112 Well drained sandy loam, calcareous in 2C horizon; very gently sloping moraine at Colonial Point; hemlock - northern hardwood/*Osmorhiza*
- 113 Well drained loamy sand over sandy loam, calcareous in 2C horizon; gently sloping moraines; hemlock - northern hardwood/*Polygonatum*
- 114 Well drained sandy clay loam; level to moderately sloping moraines; northern hardwood - hemlock/*Osmorhiza*
- 115 Moderately well drained loamy sand over sandy loam; very gently sloping moraine at Colonial Point; hemlock - northern hardwood/*Polygonatum* (ferns in pits)
- 116 Moderately well drained to somewhat poorly drained loamy sand to medium sand over sandy loam, calcareous in 2C horizon; gently sloping moraines; hemlock - northern hardwood/*Osmorhiza*
- 117 Moderately well drained to somewhat poorly drained loamy sand over sandy loam; level moraine at Colonial Point; hemlock - northern hardwood/*Aralia*, *Arisaema*

#### • • Wetlands

- 118(Z) Morainal mid-slope channel hardwood wetland; white ash - basswood/*Osmorhiza*
- 119(Z) Morainal lower-slope channel conifer-hardwood wetland; northern white-cedar - black ash/*Arisaema*

### • Lacustrine deposits over till

#### • • Uplands

- 120 Well drained medium sand and silt over sandy loam; gently sloping lacustrine deposits over moraine at Colonial Point; hemlock - northern hardwood/*Polygonatum*
- 121 Well drained sandy loam over clay; gently sloping lacustrine deposits over moraine at Colonial Point; hemlock - northern hardwood/*Osmorhiza*
- 122 Well drained to moderately well drained loamy sand over silty clay, calcareous in 2C horizon; very gently sloping lacustrine deposits over moraine at Colonial Point; hemlock - northern hardwood/*Caulophyllum*
- 123 Somewhat poorly drained medium sand over clay; level wetland margins in lacustrine deposits on moraine at Colonial Point; hemlock - northern hardwood/*Arisaema*

#### • • Wetlands

- 124 Moraine-lake plain upper slope hardwood swamp; American elm - black ash/*Arisaema*, *Caulophyllum*
- 125 Moraine plain mid-slope depression hardwood swamp; black ash - red maple/*Onoclea*

## ITEM 2

### Landscape Ecosystem Types of UMBS, By Landform

#### OUTWASH PLAIN

##### A CLIMATICALLY EXTREME, LOW-LEVEL OUTWASH CHANNEL (Pellston Plain)

###### A1 OUTWASH PLAINS

A11 Uplands (1-22)

A12 Wetlands (23-27)

###### A2 RIVERINE FEATURES

A21 Uplands (28)

A22 Wetlands (29-33)

###### A3 CHIPPEWA-AGE DUNAL COMPLEX (34)

###### A4. GLACIAL LAKE BEACH FEATURES (35)

##### B CLIMATICALLY MODERATE, HIGH-LEVEL OUTWASH PLAIN

###### B1 OUTWASH PLAIN NOT COVERED BY GLACIAL LAKES AND NOT ON MORaine LANDFORMS (37-38, 40-41, 43-46, 49-52)

###### B2 OUTWASH PLAIN COVERED BY GLACIAL LAKES

###### B21 Glacial Lake Algonquin Basin

###### B211 Glacial Lake Floor

B2111 Uplands (36, 39, 42, 47-48)

B2112 Wetlands (53-58)

###### B212 Glacial Lake Beach Features (75-78)

###### B213 Algonquin-Age Dunal Complex (74)

###### B214 Nipissing-Age Dunal Complex (74)

###### B215 Little Carp River Gorge

B2151 Uplands (65-66)

B2152 Wetlands (70-73)

###### B216 Meltwater Channel (36, 39, 42)

###### B217 Ice-mediated, Shallow, Pondered Depressions

B2171 Uplands (42, 47, 48, 81-84)

B2172 Wetlands (85)

**B218 Ice- and Lake-Margin Shores and Terraces**

**B2181 Shores**

B21811 Uplands (86-87)

B21812 Wetlands (88-89)

**B2182 Low Terraces**

B21821 Uplands (90-93)

B21822 Wetlands (94-95)

**B2183 High Terraces**

B21831 Uplands (96-102)

B21832 Wetlands (103)

**B22 Glacial Lake Nipissing Basin**

**B221 Uplands**

B2211 Alluvial/Deltaic land forms (67-69)

B2212 Recessional Beach Ridges (79-80)

**B222 Wetlands (53-56)**

**B3 OUTWASH ON MORaine LANDFORMS**

B31 Level to Moderately Sloping (59-60)

B32 Strongly to Steeply Sloping (61-64)

**ICE-CONTACT TERRAIN**

**C KETTLE-KAME LANDFORMS**

C1 UPLANDS (104-107)

C2 WETLANDS (108)

**MORaine**

**D INTERLOBATE MORaine**

D1 UPLANDS (109, 113-114, 116)

D2 WETLANDS (118)

**E DRUMLINIZED MORaine**

E1 UPLANDS (109, 113)

E2 WETLANDS (119)

**F COLONIAL POINT**

**F1 OUTWASH OVER TILL**

H11 Uplands (110-112, 115, 117)

H12 Wetlands (118, 119)

**F2 LACUSTRINE DEPOSITS OVER TILL**

F21 Uplands (120-123)

F22 Wetlands (124-125)

### ITEM 3

## Landscape Ecosystem Groups of UMBS<sup>2</sup>

### OUTWASH PLAIN

#### CLIMATICALLY EXTREME, LOW-LEVEL OUTWASH CHANNEL (Pellston Plain)

##### OUTWASH PLAINS

###### Uplands

###### Deep outwash

###### Non-calcareous

Non-banded (1-6)

Banded (7-10)

###### Calcareous

Non-banded (11-16)

Banded (17-19)

###### Shallow outwash over till

Non-calcareous (20)

Calcareous (21-22)

Wetlands (23-27)

##### RIVERINE FEATURES

Uplands (28)

Wetlands (29-33)

CHIPPEWA-AGE DUNAL COMPLEX (34)

GLACIAL LAKE BEACH FEATURES (35)

#### CLIMATICALLY MODERATE, HIGH-LEVEL OUTWASH PLAIN

##### OUTWASH PLAINS AND ASSOCIATED SLOPES

###### Uplands

###### Level to Moderately Sloping (<15%)

###### Non-calcareous

Non-banded (36-38)

Banded (39-42)

###### Calcareous

Non-banded (43-46)

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<sup>2</sup>The ecosystem groups reflect the hierarchy of the Landscape Ecosystem Type Classification (Part 3, Item 1); ecosystem type numbers are listed in parentheses at the lowest level of the hierarchy in which they occur. For example, ecosystem types 36-38 make up the group of non-banded ecosystems within the successively more inclusive groupings of non-calcareous, level to gently sloping, upland, outwash plains, climatically moderate, and finally, outwash plain. The major landform of Outwash Plain is a large ecosystem group including ecosystem types 1-103.

Banded (47-48)

Strongly to Steeply Sloping (>15%)

Non-lake-affected (49-50)

Lake-affected (51-52)

Wetlands (53-58)

**DEEP OUTWASH ON MORAINÉ LANDFORMS**

Level to Moderately Sloping (<15%) (59-60)

Strongly to Steeply Sloping (>15%)

West and south aspects (61-62)

North and east aspects (63-64)

**LITTLE CARP RIVER GORGE AND RIVERINE ECOSYSTEMS**

Uplands (65-69)

Wetlands (70-73)

**DUNES (74)**

**GLACIAL LAKE BEACH FEATURES**

Glacial Lake Algonquin basin (75-78)

Glacial Lake Nipissing basin (79-80)

**ICE-MEDIATED, SHALLOW, PONDED DEPRESSIONS**

Uplands (81-84)

Wetlands (85)

**ICE-LAKE-MARGIN SHORES AND TERRACES**

Shores

Uplands (86-87)

Wetlands (88-89)

Low Terraces

Uplands (90-93)

Wetlands (94-95)

High Terraces

Uplands

Non-calcareous (96-97)

Calcareous (98-102)

Wetlands (103)

**ICE-CONTACT TERRAIN**

**KETTLE-KAME LANDFORMS**

UPLANDS (104-107)

WETLANDS (108)

**MORaine**

**OUTWASH OVER TILL**

Uplands (109-117)

Wetlands (118-119)

**LACUSTRINE DEPOSITS OVER TILL**

Uplands (120-123)

Wetlands (124-125)

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## Ecological Species Groups of the University of Michigan Biological Station

by Burton V. Barnes and Douglas R. Pearsall

Vegetation is an important component of landscape ecosystems. However, we never deal just with plants, but always and necessarily with ecological systems, of which plants are a notable part. To distinguish and map the local landscape ecosystem types of UMBS we use as much of the total vegetative complement as possible--overstory, understory, and ground-cover layers; trees, shrubs, vines, herbs, and mosses. Because of the enormous human disturbances of logging and multiple post-logging fires, the overstory vegetation is not as useful in distinguishing ecosystems here as in old-growth forests that are relatively undisturbed by humans. Therefore, the ground-cover layer (groundflora), particularly herbaceous species, is by far the most important vegetative layer in identifying and mapping landscape ecosystems.

The great indicator value of the groundflora in distinguishing forest sites and assessing their productivity has been recognized for many years (Cajander 1926, Rowe 1956, Ellenberg 1988). Plants integrate many important environment factors that are difficult to measure directly. Furthermore, herbs often have narrower tolerance ranges to moisture, nutrient, and light conditions than trees and shrubs. The use of plants as phytometers, however, is not without limitations. One of these is that the use of a single indicator plant or a few indicators may give misleading results or the indicator species may be absent from the sample by chance. This problem is mitigated by using many indicator plants and developing groups whose species have similar ecological requirements and therefore indicate a specific range of site conditions. Based on experience throughout UMBS lands and careful attention to the soils and physiographic features where each species occurs, we subjectively arrange ground-cover species into ecological species groups based on their environmental tolerances. In most cases, several to many species form the group; it is named by the most representative species of the group. Each species group is indicative of a particular range of soil moisture, fertility, acidity, and light intensity. The presence and abundance of these groups are used together with physiography, soil, and trees and shrubs of the understory and overstory to distinguish and map the ecosystem types.

The concept of ecological groups is attributed to DuVigneaud (1946) (see Whittaker 1978), but plant ecologists have long recognized the occurrence of plants with similar distributions. Ecological species groups have been developed and used most extensively in ecosystem research in West Germany (Schlenker 1950, Ellenberg 1950). The approach we used is that developed by ecologists in the southwestern state of Baden-Württemberg. It has been used intensively there in ecosystem identification, description, and mapping for over 45 years (Barnes 1984). We have developed and used ecological species groups in both old-growth (Barnes et al. 1982, Pregitzer and Barnes 1982, Spies and Barnes 1985, Simpson et al., 1992) and highly disturbed forests (Archambault et al. 1989). Methods for their determination and evaluation are given in Spies and Barnes (1985). Ecological species groups are developed for a given macroclimatic area,

in the case of UMBS, the area is in the Onaway Subdistrict (12.1) of Albert et al. (1986). Because plant response to environmental factors, and hence indicator value of a given species, changes from one regional ecosystem type to another, the set of ecological species groups must be determined anew when significant changes occur in macroclimate and physiography. Because, many individual species may be incorporated in the groups (sometimes over 100), their grouping facilitates multivariate statistical analyses of research results.

### Ecological Species Groups At UMBS

Through intensive field reconnaissance, keen observation, and study of plot data we have determined the groups of plant species that occur together under certain conditions of light intensity, soil moisture, and soil nutrient status. Soil moisture is determined through an assessment of soil drainage class (Soil Survey Staff 1975) and topographic position along continua from extremely dry (excessively drained) to extremely wet (very poorly drained). Nutrient status is estimated by pH readings along continua from extremely acid (pH 4.0 and below) to alkaline (pH 8.0). Through these procedures we have identified 22 ecological species groups that include 92 species, mostly herbs. Species lacking significant indicator value (those occurring over a very broad range of site conditions and very rare species) were not included. Ecological species groups were developed independently of the ecosystem types. That is, species groups were not developed to correspond to specific ecosystem types or groups. Instead, the ecological tolerances of each species were determined along gradients of moisture, nutrient status (as indicated by pH), and light. Groups were formed to indicate a specific range of one or more of these factors, e.g., moist and highly acid; extremely dry; wet and basic. Ecosystem types are typically characterized by more than one ecological species group (see ecosystem type descriptions in Appendix A). Most species groups occur in several ecosystem types, and occasionally some (e. g., the *Clintonia borealis* group) can be found in both uplands and wetlands.

Some groups indicate extremes; the *Cladina* spp. group, for example, indicates extremely dry, very acid sites, typically on excessively drained outwash. At the other extreme, the *Caulophyllum thalictroides* group indicates rich, moist to very moist, upland sites. In contrast, groups such as the *Maianthemum canadense* and *Pteridium aquilinum* occur over a wide range of conditions and are of less value in distinguishing ecosystems. The set of species groups presented below represents the ninth revision; it is a hypothesis for testing and will come under analytical scrutiny as part of the research program.

## Classification of Ecological Species Groups of UMBS

The classification of the ecological species groups shown below is arranged to indicate their relationships to conditions of soil moisture and fertility.

### UPLAND SPECIES GROUPS

#### I. Groups characteristic of dry sites

- A. Groups characteristic of acid, infertile sites (listed in approximate order of increasing moisture)
  - 1. *Cladina*
  - 2. *Gaultheria*
- B. Groups characteristic of calcareous, moderately fertile to fertile sites (listed in approximate order of increasing moisture)
  - 3. *Oryzopsis*
  - 4. *Ostrya*
  - 5. *Hepatica*

#### II. Groups characteristic of moist sites

- A. Groups characteristic of acid, infertile sites (listed in approximate order of increasing moisture)
  - 6. *Polygala*
  - 7. *Clintonia*
- B. Groups characteristic of calcareous, moderately fertile to fertile sites (listed in approximate order of increasing moisture)
  - 8. *Polygonatum*
  - 9. *Osmorhiza*
  - 10. *Caulophyllum*
  - 11. *Rhamnus*
  - 12. *Toxicodendron*
  - 13. *Prunella*
  - 14. *Arisaema*

#### III. Groups occurring over a broad range of soil moisture (listed in approximate order of increasing moisture)

- 15. *Pteridium*
- 16. *Maianthemum*
- 17. *Aralia*

### WETLAND SPECIES GROUPS

#### I. Groups characteristic of wet, somewhat poorly drained to poorly drained sites (listed in approximate order of increasing fertility)

- 18. *Chamaedaphne*
- 19. *Ilex*
- 20. *Coptis*
- 21. *Onoclea*
- 22. *Typha*

## List and Description of the Ecological Species Groups

The composition of each ecological species group is shown below together with a brief description of the indicator value of each group. The species in each group are listed in decreasing order of their relative indicator value, i.e., the first named species is the most reliable indicator of the conditions specified. The ecological characterization that follows each list specifies the soil moisture and fertility requirements of that group. In some cases a light requirement, such as very light shade, is also given. If no light requirement is given, assume that the species group can exist under the typical forest canopy of the soil conditions described. For example, extremely dry and dry ecosystems will not support as dense a canopy as a moist or very moist ecosystem, and shade characteristically increases along an increasing moisture gradient.

### UPLAND SPECIES GROUPS

#### 1. *Cladina* group

*Cladina* spp.  
*Danthonia spicata*  
*Hieracium venosum*  
*Arctostaphylos uva-ursi*  
*Comptonia peregrina*

Characteristic of extremely dry, very infertile, open sites. High coverage of this group is interpreted as a sign of severe burning.

#### 2. *Gaultheria* group

*Gaultheria procumbens*  
*Vaccinium angustifolium*  
*Diphasiastrum tristachyum*  
*Cypripedium acaule*  
*Melampyrum lineare*  
*Gaylussacia baccata*

Characteristic of very dry, very infertile sites. The *Gaultheria* group requires at least some forest floor development; it occurs with the *Cladina* group but not on bare mineral soil.

#### 3. *Oryzopsis* group<sup>1</sup>

*Oryzopsis asperifolia*

Characteristic of dry to somewhat moist, moderately fertile sites where calcareous parent material lies within 250 cm of the surface. *Oryzopsis* occurs widely on calcareous outwash, both banded and non-banded soils.

#### 4. *Ostrya* group

*Ostrya virginiana*

Indicates dry to somewhat moist, fertile to very fertile sites with coarse (i.e., pebbles and cobbles) calcareous material within 150 cm or till within 250 cm of the surface.

<sup>1</sup>Three species groups include only one member: the *Oryzopsis*, *Ostrya*, and *Toxicodendron* groups. In each case that species has been found to indicate a particular set of site conditions not specifically indicated by other species. For example, the *Oryzopsis* and *Ostrya* groups both indicate dry, calcareous substrate, but are not grouped together because *Oryzopsis* tends to occur in a wide range of calcareous sites whereas *Ostrya* is only found in fertile to very fertile sites.

5. *Hepatica* group*Hepatica americana**Cornus rugosa**Aquilegia canadensis*

Highly restricted to dry to somewhat moist, very fertile sites where calcareous parent material is within 50 cm of the surface such as on beach features and some very coarse outwash.

6. *Polygala* group*Polygala paucifolia**Aster macrophyllus**Mitchella repens**Lonicera dioica**Linnaea borealis**Anemone quinquefolia*

Indicates somewhat moist to moist sites that are infertile or poor to moderately fertile. Occurs on similar but slightly less fertile sites than does the *Polygonatum* group.

7. *Clintonia* group*Clintonia borealis**Cornus canadensis**Medeola virginiana*

Characteristic of very moist to wet, infertile sites. Occurs in uplands and infertile wetlands with the *Coptis* group. Co-occurs with the *Polygonatum* group but on infertile microsites in fertile ecosystems.

8. *Polygonatum* group*Polygonatum pubescens**Trillium grandiflorum**Streptopus roseus**Viola pubescens**Pyrola elliptica*

Characteristic of moist, moderately fertile to fertile sites, typically where calcareous parent material is present within 250 cm of the surface. Among outwash ecosystems, the *Polygonatum* group only occurs where there are thick, heavy-textured bands or in calcareous outwash that is close to Douglas Lake. Indicates slightly better nutrient conditions than the *Polygala* group.

9. *Osmorhiza* group*Osmorhiza claytonii**Erythronium americanum**Botrychium virginianum**Uvularia grandiflora**Actaea pachypoda**Actaea rubra**Dicentra cucullaria**Claytonia virginica*

Characteristic of moist to very moist, fertile to very fertile sites. Almost exclusively found in ecosystems that support fertile hemlock-northern hardwood forests, as opposed to pine-red oak forests.

10. *Caulophyllum* group

*Caulophyllum thalictroides*  
*Dirca palustris*  
*Thalictrum dioicum*  
*Allium tricoccum*  
*Adiantum pedatum*  
*Dentaria diphylla*  
*Cornus alternifolia*

Only occurs on moist to wet, very fertile sites, the richest uplands on UMBS property. May occur in wetlands that are inundated for only short periods, but it is more common in uplands, especially at Colonial Point.

11. *Rhamnus* group

*Rhamnus alnifolia*  
*Cornus stolonifera*

Characteristic of very moist to wet, fertile, lightly shaded sites. Occurs in outwash plains with high water table where an open canopy has resulted from cutting. Also, it occurs at the margins of non-forested wetlands.

12. *Toxicodendron* group

*Toxicodendron radicans*

Characteristic of very moist to wet, very fertile, lightly shaded sites. Occurs on slightly less fertile sites than the *Caulophyllum* group, but may co-occur with the *Caulophyllum* or *Prunella* groups along road edges in fertile ecosystems.

13. *Prunella* group

*Prunella vulgaris*  
*Petasites palmatus*

Characteristic of very moist to wet, very fertile, heavily shaded sites. Mostly restricted to fertile, deeply shaded forests on the Pellston Plain.

14. *Arisaema* group

*Arisaema triphyllum*  
*Circaea lutetiana*  
*Matteuccia struthiopteris*

Characteristic of very moist to wet, very fertile sites. Occurs with the *Caulophyllum* group but also in wetlands inundated for long periods, such as intermittent streams and muck-filled depressions.

15. *Pteridium* group

*Pteridium aquilinum*  
*Apocynum androsaemifolium*

The most widespread group at UMBS. Occurs over a wide range of moisture and pH conditions if light intensity is moderate to high. *Pteridium aquilinum* is typical of dry, sandy, burned-over sites where it spreads by rhizomes. The extensive burning following logging probably has increased the amount of *Pteridium* compared with its occurrence in presettlement time.

16. *Maianthemum* group

*Maianthemum canadense*

*Trientalis borealis*

*Smilacina racemosa*

*Lycopodium clavatum*

Characteristic of dry to moist, infertile to fertile sites. The *Maianthemum* group occurs virtually everywhere except the extremely dry and infertile or moist and very fertile sites.

17. *Aralia* group

*Aralia nudicaulis*

*Acer pensylvanicum*

*Pyrola chlorantha*

*Viburnum acerifolium*

Occurs on dry to moist, moderately fertile to very fertile sites. Of similar ecological breadth as the *Maianthemum* group, but does not occur on infertile sites. Thus, it is a useful group for differentiating among the predominantly dry ecosystems of UMBS. The *Aralia* group also occurs in wetlands, where *Aralia nudicaulis* may be extremely vigorous and dominate the groundcover.

#### WETLAND SPECIES GROUPS

18. *Chamaedaphne* group

*Chamaedaphne calyculata*

*Sphagnum* spp.

*Ledum groenlandicum*

*Vaccinium macrocarpon*

*Vaccinium oxycoccos*

Restricted to wet, extremely infertile sites such as kettle-hole bogs and forested former beach pools.

19. *Ilex* group

*Ilex verticillata*

*Nemopanthus mucronatus*

*Carex crinita*

*Carex intumescens*

*Thelypteris palustris*

*Potentilla palustris*

Characteristic of wet, infertile sites including the margins of bogs and forested former beach pools.

20. *Coptis* group

*Coptis trifolia*

*Mitella nuda*

*Gymnocarpium dryopteris*

*Rubus pubescens*

Common in infertile to moderately fertile forested wetlands, especially coniferous swamps.

21. *Onoclea* group

*Onoclea sensibilis*  
*Alnus rugosa*  
*Eupatorium maculatum*  
*Scutellaria gallericulata*  
*Scutellaria lateriflora*  
*Viburnum trilobum*  
*Lobelia cardinalis*  
*Clematis virginiana*

Characteristic of moderately fertile to fertile wetlands, especially where *Alnus rugosa* or a shrub species of *Salix* (e.g., *S. lucida*) forms the dominant canopy; it also occurs in deciduous forested swamps.

22. *Typha* group

*Typha latifolia*  
*Typha angustifolia*  
*Calamagrostis in expansis*  
*Myrica gale*  
*Spiraea alba*  
*Iris versicolor*

Characteristic of fertile, non-forested wetlands such as lake and stream margins. Occurs with the *Onoclea* group but also in areas of longer inundation.

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## Guide to Using the Classification and Map of Cover Types of UMBS

by Douglas R. Pearsall and Burton V. Barnes

### What Are Cover Types?

Cover types are groups or aggregates of plants that occupy or "cover" a given piece of land at a particular time. They are the types of vegetation that dominate a given area. In forests, they are the species of the dominant overstory or upper canopy layer of vegetation. In certain swamps, shrubs may form the vegetative cover; grasses of various kinds dominate prairie landscapes. Vegetation maps are typically maps of the existing cover types.

### How Are They Determined?

Cover types are typically identified and mapped using aerial photographs of an area. A combination of black-white and color infra-red photographs serves this purpose very well. Ground checking may follow their initial determination from aerial photographs. For very large tracts of land, regions or continents, mapping from satellite imagery is particularly useful.

To define the types, criteria are established specifying what constitutes each cover type. The criteria defining cover types are typically set by the investigator for the area to be mapped. In some cases, individual species or combinations of two or three species may occupy distinctive areas of a landscape. Thus one might recognize and establish a jack pine type, a black oak--white oak type, and a bigtooth aspen type. In addition, the amount (based on number of trees, basal area, or canopy coverage) of the species that must be present to be mapped as a given type is specified for the particular area. For example, one may decide that the red pine type must have 75% red pine for it to be called "the red pine type." If there is less than 75%, the type might be distinguished as red pine--red oak (approximately 50% pine and 50% oak). In other cases, a mixture of species occurs and the types may be defined very generally: mixed hardwoods, hardwood--conifer, conifer--hardwood, pine--oak, etc. Typically, cover types are necessarily rather broad categories because of the complexity of the existing vegetation on the ground, especially on lands that have been disturbed by humans. Thus what might be identified as an "aspen" cover type in the Lake States might be defined as "at least 25% of trembling or bigtooth aspen." Such a type, because of its very general definition, could have various mixtures of species that are not specified! Therefore, it is important to read the legend of the map (or the accompanying classification) to understand the degree of resolution of the map.

### What Do Cover Types Mean Ecologically?

Cover type maps and classifications are quite useful to gain an understanding of the general types of vegetation of an area. For example, one can interpret the extent to which conifers and hardwoods (broadleaf angiosperms) dominate an area. Also, one often can get a good idea of the species composition and distribution over an area. Cover type maps and documentation are indispensable in land management.

The cover types may or may not provide a useful understanding of their supporting landform and soil. In forests largely undisturbed by humans (natural or near natural forests), the species composition of the cover types can indicate marked differences in moisture, drainage, and nutrient status. However, where severe human disturbance has occurred, such as throughout UMBS lands, the cover types may be misleading as to the site conditions where they occur. Also, cover types do not necessarily indicate the successional trend for an area. Nevertheless, a cover type map and classification are very useful in studies of animals that require particular cover types for food, shelter, or other needs.

### **How To Use The Classification And Map**

The existing vegetative cover types of the UMBS, including the Colonial Point Preserve, have been determined, classified, briefly described, and mapped. The cover types are extremely diverse (67 types) due to: 1) the marked physiographic (parent material, landform, etc.) and soil diversity of UMBS, and 2) the widespread and severe human-caused disturbances of logging, post-logging fires, and plantings that occurred from about 1880 to 1935. Because of the different kinds, frequencies, and severity of the disturbances, many more different kinds of cover types are now present than one would expect to have found prior to European settlement in the early to middle nineteenth century. Except for some of the wetlands, the forest overstories of today are greatly different and we perceive more complex in composition than at the times of the General Land Office Surveys of 1840 and 1855 when the first record of forest composition was obtained. In the presettlement forest of 1850, areas dominated by bigtooth and trembling aspens were probably less than 1%, whereas today these species cover at least 50%.

The cover type classification and map are extremely valuable for several reasons. First, they provide, in part, the baseline information that could help determine the nature and patterns of change in overstory forest cover that took place from 1850 to the present. A map of the presettlement cover types also is required before these changes can be determined. Second, they provide the information necessary to assess changes in the forest overstory that occur over time associated with climatic change. Third, they are invaluable for studying the diversity of animal and plant species associated with each type and animal-plant interactions of many kinds. Fourth, they provide the detailed data to assist the development of remote sensing techniques that eventually could map similar areas in northern Lower Michigan at this fine scale of resolution.

### **Methods Used In Distinguishing and Mapping Cover Types**

The first approximations of the cover type classification and maps were completed through interpretation of aerial photographs (1978 color infra-red and 1987 black and white infra-red) with reference to a 1969 cover type map by Marilyn Williamson. All roads, lakeshores, section lines, and boundaries were traced from 1983 United States Geological Survey 7.5" quadrangle maps; UMBS boundaries have been updated. Sections of the first maps were traced onto smaller transparencies for field use. Cover types were then field-checked during the 1991 field season (May-August), and modifications were made where necessary. During the fall of 1991, cover type boundaries were reinterpreted from the

1987 photographs in light of the field mapping, and second approximations of the map and classification were produced. As a result of subsequent field work, these products have been further revised for this 1994 approximation.

The present cover type maps are drawn at a scale of 1:16,300 (approximately 4 inches to the mile) to match the 1987 photographs and cover the entire UMBS property and Colonial Point Preserve. Cover types on private property mostly or wholly surrounded by UMBS land have been mapped to provide continuity. Types that span less than 16 m across the longest axis were not mapped. Some error of placement exists due to inconsistency of scale among photographs, but probably does not exceed 16 m and is mostly less than 7 m.

Roads serve as type boundaries, and cover types that cross roads are labeled on both sides of the road. Section lines and property boundaries are not type boundaries; types should be interpreted to cross these lines unless a type boundary has been drawn to coincide with the section or property line.

Cover type definitions represent ranges of percent total areal coverage for predominant (>75% or 40-75%) and subordinate (20-40%) species or species combinations. Associate species comprise 20% or less of total coverage. Sixty-seven cover types, 46 upland and 21 wetland, have been identified, described, and mapped.

### Using The Cover Type Definitions

A type may consist of one, two, or more components, often simply one or two species. However, two or more species may form a single component. In a type with two components, they are separated by two hyphens (--), whereas one hyphen (-) is used when multiple species comprise one component within a type. Each component also has a percentage cover associated with it. Examples:

- 1) Bigtooth aspen--Red oak; 40-75% *Populus grandidentata*, 20-40% *Quercus rubra* This type has two species as components.
- 2) Red maple-beech; >75% *Acer rubrum* and *Fagus grandifolia*. This type has one component of two species, red maple and beech.
- 3) Bigtooth aspen--Northern hardwood-hemlock; 40-75% *Populus grandidentata*; 20-40% species of the Northern hardwood-hemlock type. This type has two components: bigtooth aspen and Northern hardwood-hemlock. The second component is made up of several species of northern hardwoods (sugar maple, beech, red maple, yellow birch, white ash, and basswood, etc.), and hemlock.

## ITEM 1

Classification of the Cover Types of UMBS<sup>1</sup>

by Douglas R. Pearsall

## UPLAND COVER TYPES

## FORESTED

## I. Hardwood (deciduous broadleaf forest)

A. Bigtooth Aspen (types with >40% *Populus grandidentata*)

Cover types dominated by bigtooth aspen are the most extensive type on UMBS property due to logging of the presettlement forest and post-logging fires between 1880 and 1930.

## 1. Bigtooth aspen

>75% *Populus grandidentata*. Associates include *Quercus rubra*, *Pinus resinosa*, *Pinus strobus*, and *Populus tremuloides*. Characteristic of excessively drained to well drained sites on outwash, ice-margin features and the interlobate moraine.

## 2. Bigtooth aspen--Red oak

40-75% *Populus grandidentata*; 20-40% *Quercus rubra*. Associates include *Pinus resinosa*, *Fagus grandifolia*, and *Acer rubrum*. An extensive type on dry, high-level outwash plains and the interlobate moraine.

## 3. Bigtooth aspen--Red oak-red pine

40-75% *Populus grandidentata*; 20-40% *Quercus rubra* and *Pinus resinosa*. Similar to type 2 but on even drier sites.

## 4. Bigtooth aspen--Red pine

40-75% *Populus grandidentata*; 20-40% *Pinus resinosa*. Associates include *Quercus rubra* and *Pinus strobus*. Characteristic of very dry outwash plains and dunes.

## 5. Bigtooth aspen--White pine

40-75% *Populus grandidentata*; 20-40% *Pinus strobus*. *Pinus resinosa* is an associate. Characteristic of Pellston Plain<sup>2</sup> sites of relatively low disturbance and moderately high water table.

<sup>1</sup> Cover types are defined as percentage canopy coverage as interpreted from 1987 aerial photographs and 1991-1993 field reconnaissance. In forests, the cover is the dominant overstory tree community. In nonforested areas (marshes, shrub swamps, meadows, and disturbed sites) the cover is typically herbs and shrubs. Types within each major heading (e. g., A. Bigtooth Aspen) are listed in approximate order of decreasing areal coverage.

<sup>2</sup> The Pellston Plain is a broad, flat outwash plain located west of and partly on UMBS property (Sections 1, 2, 11, and 12 of T36N, R4W and Sections 22-27, and 35-36 of T37N, R4W). Due to its low physiographic position it is subject to climatic extremes.

6. Bigtooth aspen--Northern hardwood-hemlock  
40-75% *Populus grandidentata*; 20-40% species of the Northern hardwood-hemlock type.<sup>3</sup> Characteristic of moderately moist, nutrient rich sites.
  7. Bigtooth aspen--Red maple  
40-75% *Populus grandidentata*; 20-40% *Acer rubrum*. *Populus tremuloides* and *Fagus grandifolia* are associates. Characteristic of high-level outwash east of Douglas Lake and areas of moderately high water table near the southwest end of Douglas Lake.
  8. Bigtooth aspen--Beech  
40-75% *Populus grandidentata*, 20-40% *Fagus grandifolia*. Associates include *Quercus rubra*, *Betula papyrifera*, and *Acer rubrum*. Characteristic of somewhat excessively drained soil in fire-prone physiographic positions on west-facing slopes on the interlobate moraine.
  9. Bigtooth aspen--Trembling aspen  
40-75% *Populus grandidentata*; 20-40% *Populus tremuloides*. Characteristic of areas of moderately high water table on the Pellston Plain and wetland margins.
  10. Bigtooth aspen--Paper birch  
40-75% *Populus grandidentata*; 20-40% *Betula papyrifera*. Characteristic of somewhat excessively drained soils in fire-prone positions such as lake borders and west-facing slopes of the interlobate moraine.
  11. Bigtooth aspen--Jack pine  
40-75% *Populus grandidentata*; 20-40% *Pinus banksiana*. An infrequent type associated with exceedingly dry areas on the Pellston Plain.
- B. Trembling Aspen (types with >40% *Populus tremuloides*)
12. Trembling aspen  
>75% *Populus tremuloides*. Associates include *Pinus strobus*, *Picea glauca*, *Populus balsamifera*, *Pinus banksiana*, and *Salix* spp. Occurs in areas of climatic extremes (e.g., Pellston Plain and frost pocket depressions) and especially where the water table is high.
  13. Trembling aspen--White pine-white spruce  
40-75% *Populus tremuloides*; 20-40% *Pinus strobus* and *Picea glauca*. *Abies balsamea* is an associate. Characteristic of areas of high water table on the Pellston Plain. Canopy density is variable, and openings with dense bracken fern groundcover are common.

<sup>3</sup> The Northern hardwood-hemlock cover type is defined as >75% combined canopy dominance of *Acer saccharum*, *Fagus grandifolia*, *Fraxinus americana*, *Acer rubrum*, *Betula alleghaniensis*, *Tilia americana*, *Quercus rubra*, *Ostrya virginiana* and *Tsuga canadensis*.

## 14. Trembling aspen--Bigtooth aspen

40-75% *Populus tremuloides*; 20-40% *Populus grandidentata*. Associates are *Pinus strobus* and *Pinus resinosa*. Characteristic of areas of moderately high water table on the Pellston Plain and wetland margins.

## 15. Trembling aspen--White pine-red pine

40-75% *Populus tremuloides*; 20-40% *Pinus strobus* and *Pinus resinosa*. *Populus grandidentata* is an associate. Characteristic of areas of the Pellston Plain with moderately high water table.

## 16. Trembling aspen--Paper birch

40-75% *Populus tremuloides*; 20-40% *Betula papyrifera*. Many associates, including *Populus grandidentata*, *Populus balsamifera*, *Acer saccharum*, *Fraxinus americana*, *Fraxinus nigra*, *Tilia americana*, and *Tsuga canadensis*. Characteristic of seasonally wet areas on gentle slopes adjacent to wetlands.

## 17. Trembling aspen--Red oak

40-75% *Populus tremuloides*; 10-40% *Quercus rubra*. *Populus grandidentata* and *Prunus serotina* are associates. An uncommon type of dry areas on the Pellston Plain; it has a sparse canopy.

## 18. Trembling aspen--Red pine

40-75% *Populus tremuloides*; 20-40% *Pinus resinosa*. Associates include *Pinus banksiana* and *Populus grandidentata*. Occurs where red pine has been planted under trembling aspen and in dry areas of the Pellston Plain.

C. Red Oak (types with >40% *Quercus rubra*)

## 19. Red oak

>75% *Quercus rubra*. Associates include *Populus grandidentata*, *Pinus resinosa*, *Pinus strobus*, species of the Northern hardwood-hemlock type, *Acer rubrum*, and *Betula papyrifera*. Characteristic of dry, high-level outwash and areas at the Colonial Point Preserve<sup>4</sup> where outwash is present over till.

## 20. Red oak--Bigtooth aspen

40-75% *Quercus rubra*; 20-40% *Populus grandidentata*. Associates are *Pinus resinosa*, *Pinus strobus*, *Betula papyrifera*, and *Acer rubrum*. Characteristic of high-level outwash where fire frequency is relatively high.

## 21. Red oak--Red pine

40-75% *Quercus rubra*; 20-40% *Pinus resinosa*. *Populus grandidentata* and *Pinus strobus* are associates. Characteristic of very dry, high-level outwash.

<sup>4</sup> The Colonial Point Preserve is a portion of the Colonial Point Peninsula in Burt Lake, Michigan (Sections 28 and 29, T36N, R3W), purchased by the Little Traverse Conservancy and managed by UMBS.

22. Red oak--Northern hardwood-hemlock  
40-75% *Quercus rubra*; 20-40% species of the Northern hardwood-hemlock type. *Pinus strobus* is an associate. An extensive type of the Colonial Point Preserve.
23. Red oak--Paper birch  
40-75% *Quercus rubra*; 20-40% *Betula papyrifera*. *Populus grandidentata* is an associate. Characteristic of areas similar to the Bigtooth aspen--Paper birch type (#10), but on somewhat drier sites more removed from the influence of Douglas Lake.
24. Red oak--Red maple  
40-75% *Quercus rubra*; 20-40% *Acer rubrum*. Associates include *Populus grandidentata* and *Fagus grandifolia*. This type and type 23 are characteristic of areas with somewhat greater moisture availability than type 20 but with a similar high fire frequency.
- D. Red maple
25. Red maple--Bigtooth aspen  
40-75% *Acer rubrum*; 20-40% *Populus grandidentata*. *Fagus grandifolia* is an associate. Characteristic of high-level outwash east of Douglas Lake.
- E. Red maple-Beech (types with >40% combined dominance of *Acer rubrum* and *Fagus grandifolia*)
26. Red maple-beech  
>75% *Acer rubrum* and *Fagus grandifolia*. *Populus grandidentata* and *Betula papyrifera* are associates. Characteristic of high-level outwash and moist soils on the interlobate moraine.
27. Red maple-beech--Bigtooth aspen  
40-75% *Acer rubrum* and *Fagus grandifolia*; 20-40% *Populus grandidentata*. Characteristic of somewhat drier soils on high-level outwash and the interlobate moraine.
- F. Paper Birch
28. Paper birch--Northern hardwood-hemlock  
40-75% *Betula papyrifera*; 20-40% species of the Northern hardwood-hemlock type. Associates include *Populus grandidentata* and *Quercus rubra*. Characteristic of ice-contact slopes and lake terraces on the south shore of Douglas Lake.
- G. Northern Hardwood-Hemlock (types with >40% combined dominance of *Acer saccharum*, *Fagus grandifolia*, *Acer rubrum*, *Betula alleghaniensis*, *Fraxinus americana*, *Tilia americana*, *Quercus rubra*, *Ostrya virginiana*, and *Tsuga canadensis*.)

## 29. Northern hardwood-hemlock

>75% *Acer saccharum*, *Fagus grandifolia*, *Acer rubrum*, *Betula alleghaniensis*, *Fraxinus americana*, *Tilia americana*, *Quercus rubra*, *Ostrya virginiana*, and *Tsuga canadensis*. Associates include *Populus grandidentata*, *Quercus rubra*, *Pinus strobus*, and *Betula papyrifera*. Characteristic of calcareous outwash plains, ice-contact features, and moraines where till is at or near the surface.

## 30. Northern hardwood-hemlock--Bigtooth aspen

40-75% species of the Northern hardwood-hemlock type; 20-40% *Populus grandidentata*. *Betula papyrifera* is an associate.

## II. Conifer (evergreen forest)

A. Red Pine (types with >40% *Pinus resinosa*)

## 31. Red pine

>75% *Pinus resinosa*. *Populus grandidentata*, *Pinus strobus*, and *Quercus rubra* are associates. Often represented by plantations and occasionally natural stands. Typical of dry, excessively drained and fire-prone sites.

## 32. Red pine--Bigtooth aspen

40-75% *Pinus resinosa*; 20-40% *Populus grandidentata*. Associates include *Quercus rubra* and *Pinus strobus*. Characteristic of very dry outwash plains.

## 33. Red pine--White pine

40-75% *Pinus resinosa*; 20-40% *Pinus strobus*. Associates include *Populus grandidentata*, *Populus tremuloides*, and *Pinus banksiana*. Characteristic of fire-prone sites such as west-facing lakeshore terraces and the Pellston Plain.

## 34. Red pine--Jack pine

40-75% *Pinus resinosa*; 20-40% *Pinus banksiana*. *Populus grandidentata* and *Pinus strobus* are associates. This type is the result of plantings.

B. White Pine (types with >40% *Pinus strobus*)

## 35. White pine

>75% *Pinus strobus*. Associates include *Populus grandidentata*, *Pinus resinosa*, *Quercus rubra*, *Betula papyrifera*, and species of the Northern hardwood-hemlock type. Small stands of emergent white pine occur on lakeshore terraces and at the Colonial Point Preserve, otherwise this type is the result of plantings.

## 36. White pine--Bigtooth aspen

40-75% *Pinus strobus*; 20-40% *Populus grandidentata*. Associates include *Pinus resinosa*, *Populus tremuloides*, and *Betula papyrifera*. Characteristic of dry outwash plains.

37. White pine--Northern hardwood-hemlock  
40-75% *Pinus strobus*; 20-40% species of the Northern hardwood-hemlock type. Characteristic of shallow sand soil over clay at the Colonial Point Preserve.
38. White pine--Red pine  
40-75% *Pinus strobus*; 20-40% *Pinus resinosa*. Associates include *Populus grandidentata*, *Betula papyrifera*, and *Pinus banksiana*. This type is less common than the Red pine--White pine type (#33) and is characteristic of somewhat more moist sites.
- C. Jack Pine (types with >40% *Pinus banksiana*)
39. Jack pine  
>75% *Pinus banksiana*. *Populus grandidentata*, *Quercus rubra* and *Pinus strobus* are associates. Characteristically in plantations, although there are small natural stands on the Pellston Plain.
40. Jack pine--Red pine-white pine-bigtooth aspen  
40-75% *Pinus banksiana*; 20-40% *Pinus resinosa*, *Pinus strobus*, and *Populus grandidentata*. *Quercus rubra* is an associate. This type is the result of mixed pine plantings.
41. Jack pine--Red oak  
40-75% *Pinus banksiana*; 20-40% *Quercus rubra*. *Populus grandidentata* is an associate. The result of jack pine planting on an exceedingly dry site.
- D. Hemlock (types with >40% *Tsuga canadensis*)
42. Hemlock  
>75% *Tsuga canadensis*. Associates include species of the Northern hardwood-hemlock type and *Populus grandidentata*. An infrequent type; a large stand of hemlock occurs on outwash near the mouth of the Little Carp River.
43. Hemlock--Northern hardwood-hemlock  
40-75% *Tsuga canadensis*, 20-40% species of the Northern hardwood-hemlock type. Characteristic of areas at the Colonial Point Preserve where drainage is somewhat impeded.
- E. Scot's Pine
44. Scot's pine  
>75% *Pinus sylvestris*. Plantations of various age and density.

NON-FORESTED AND PARTIALLY FORESTED<sup>5</sup>A. Bracken Fern (types with >60% *Pteridium aquilinum*).

Bracken fern is ubiquitous and forms a groundcover under upland forests and is rarely a cover type.

## 45. Bracken fern

>75% *Pteridium aquilinum*. Characteristic of severely disturbed areas such as power and gas lines and roadsides.

## 46. Bracken fern--Trembling aspen-fire cherry

40-75% *Pteridium aquilinum*, grasses; 20-40% *Populus tremuloides* and *Prunus pensylvanica*. Associates include *Prunus serotina*, *Pinus banksiana*, *Prunus pumila*, *Amelanchier* spp., shrubs, and herbs. Characteristic of severely disturbed areas.

## WETLAND COVER TYPES

## FORESTED

## I. Conifer (evergreen forest)

A. Conifer (types with >40% combined dominance of *Picea glauca*, *Thuja occidentalis*, and *Abies balsamea*)

The conifer types are common in areas of little water movement in Reese's Swamp<sup>6</sup> and Mullett Creek Swamp<sup>7</sup>.

## 47. Conifer

>75% *Picea glauca*, *Thuja occidentalis*, and *Abies balsamea*. Associates include *Acer rubrum*, *Populus tremuloides*, *Tsuga canadensis*, and *Betula papyrifera*.

## 48. Conifer--Trembling aspen-hardwood

40-75% species of the conifer type; 20-40% *Populus tremuloides*, *Acer rubrum*, and *Betula papyrifera*. *Tsuga canadensis* is an associate.

## 49. Conifer-hemlock--Trembling aspen-hardwood

40-75% *Picea glauca*, *Thuja occidentalis*, *Abies balsamea*, and *Tsuga canadensis*; 20-40% *Populus tremuloides*, *Acer rubrum*, and *Betula papyrifera*. Characteristic of the northern edges of Reese's Swamp, adjacent to the Hogsback Road dunes.

<sup>5</sup> Areas of mappable size in which trees comprise less than 40% of areal coverage.

<sup>6</sup> Reese's Swamp is located between the north shore of Burt Lake and Hogsback Road (Sections 3 and 4, T36N, R3W).

<sup>7</sup> Mullett Creek Swamp is in the southeast corner of UMBS property (SE 1/4 Section 26 and NE 1/4 Section 35 of T37N, R3W).

B. Northern White-Cedar (types with >40% *Thuja occidentalis*)

Although northern white-cedar is probably the most abundant wetland conifer, it rarely dominates the canopy. Northern white-cedar-dominated cover types are characteristic of wetlands with less restricted drainage than the conifer types.

## 50. Northern white-cedar

>75% *Thuja occidentalis*. Associates include species of the conifer type, *Acer rubrum*, *Populus tremuloides*, and *Betula papyrifera*. Characteristic of margins of the Little Carp River and fireprone terraces of Burt Lake.

## 51. Northern white-cedar--Conifer-hemlock

40-75% *Thuja occidentalis*; 20-40% *Picea glauca*, *Abies balsamea*, and *Tsuga canadensis*.

## 52. Northern white-cedar--Conifer-trembling aspen-hardwood

40-75% *Thuja occidentalis*; 20-40% combined coverage of other species of the conifer and hardwood types. An abundant type in Reese's Swamp.

## C. Black Spruce

## 53. Black spruce--leatherleaf

40-75% *Picea mariana*; 20-40% *Chamaedaphne calyculata*. Common associates include *Larix laricina*, *Ilex verticillata*, *Nemopanthus mucronatus*, and *Vaccinium myrtilloides*. Characteristic of depressions with trapped drainage.

## D. Balsam Fir

## 54. Balsam fir

>75% *Abies balsamea*. A windthrow area in a conifer swamp with scattered tall *Thuja occidentalis* and *Picea mariana* and dense *Abies balsamea* less than 5 m in height.

## II. Hardwood (deciduous broadleaf forest)

A. Trembling Aspen (types with >40% *Populus tremuloides*)

## 55. Trembling aspen-hardwood

40-75% *Populus tremuloides*, 20-40% *Acer rubrum*, *Betula papyrifera*. *Fraxinus nigra* and *Betula alleghaniensis* are associates. A variant of this type that includes *Acer saccharum* and *Tilia americana* occurs near the mouth of the Little Carp River.

## 56. Trembling aspen-hardwood--White spruce-white pine-speckled alder

40-75% species of the Trembling aspen-hardwood type; 20-40% *Picea glauca*, *Pinus strobus*, and *Alnus rugosa*. This is a windthrow area in Reese's swamp with open canopy and dense subcanopy of speckled alder; white pine is characteristic of the dry beach ridges of this area.

## 57. Trembling aspen--Conifer

40-75% *Populus tremuloides*; 20-40% species of the conifer type. Associates include *Tilia americana* and *Betula alleghaniensis*. Characteristic of the southern part of Reese's Swamp near Burt Lake.

## 58. Trembling aspen-hardwood--Hemlock

40-75% species of the trembling aspen-hardwood type; 20-40% *Tsuga canadensis*. Associates include *Picea glauca* and *Abies balsamea*. Characteristic of the northern edge of Reese's Swamp near the Hogsback Road dune.

## 59. Trembling aspen--Balsam poplar

40-75% *Populus tremuloides*; 20-40% *Populus balsamifera*. *Picea glauca*, *Acer rubrum*, and *Abies balsamea* are associates. Characteristic of intermittent stream channels on the Pellston Plain and flats of the Maple River.

## B. Balsam Poplar

## 60. Balsam poplar

>75% *Populus balsamifera*. Associates include *Populus tremuloides*, *Acer rubrum*, and *Abies balsamea*. Characteristic of stream flats on the Pellston Plain.

C. Red Maple (types with >40% *Acer rubrum*)

## 61. Red maple

>75% *Acer rubrum*. Associates include *Fraxinus nigra*, *Populus tremuloides*, *Thuja occidentalis*, *Acer saccharinum*, *Tilia americana*, and *Betula alleghaniensis*. The most abundant cover type in the Maple River Swamp.<sup>8</sup>

## 62. Red maple--Black ash

40-75% *Acer rubrum*; 20-40% *Fraxinus nigra*. Associates include *Thuja occidentalis* and *Betula alleghaniensis*. Characteristic of the areas of highest water table in the Maple River Swamp.

NON-FORESTED AND PARTIALLY FORESTED<sup>5</sup>

## A. Sedge--Cattail

## 63. Sedge--cattail

>75% *Carex* spp. and *Typha* spp. Characteristic of margins of the Maple River.

<sup>8</sup> The Maple River Swamp includes the wetlands surrounding the Maple River at its head in the southwest corner of Douglas Lake.

B. Willow (types with >40% *Salix* spp.)

64. Willow--speckled alder

>75% *Salix* spp. and *Alnus rugosa*. A dense cover type of restricted drainage in the Maple River Swamp.

65. Willow--sedge

40-75% *Salix* spp., 20-40% *Carex* and *Scirpus* spp. A type occurring only at the head of a small drainageway in Mullett Creek Swamp.

C. Leatherleaf

66. Leatherleaf

>75% *Chamaedaphne calyculata*. *Picea mariana* and *Larix laricina* are associates. Characteristic of extremely acidic, trapped drainages.

D. Sparsely Vegetated Sand

67. Sparsely vegetated sand

Beaches with sparse woody and herbaceous vegetation.

**Appendix A**

**Descriptions of Landscape Ecosystem Types  
of the University of Michigan Biological Station**

**Douglas R. Pearsall, Richard M. Ring,  
and Burton V. Barnes**

**APPENDIX A**  
**Landscape Ecosystems of the**  
**University of Michigan Biological Station**

**Ecosystem 1:** Excessively drained medium sand; low-level outwash plain in the Pellston Plain; white pine - red pine - hemlock - red oak/*Cladina*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain. Excessively drained medium sand, acidic in all horizons; water table below 300 cm. Trembling aspen - bigtooth aspen overstory; trembling aspen - white pine understory; *Pteridium* - *Gaultheria* - *Cladina* ground-cover species groups. Eastern white pine - red pine - eastern hemlock - northern red oak presettlement cover type (eastern white pine, eastern hemlock, and northern red oak are hereafter referred to as white pine, hemlock, and red oak). Five plots.

**Physiography**

**LANDFORM:** Broad outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**SLOPES:** Level (0 - 1%); very slight southern aspect.

**ELEVATION:** 210 - 216 m.

**Soil**

**DRAINAGE:** Excessively drained; water table below 300 cm during growing season.

**TEXTURE:** Medium sand in all horizons.

**PH:** 4.9 (4.6 - 5.6) in the E horizon to 5.9 (5.7 - 6.5) in the C horizon.

**DEVELOPMENT:** Organic horizons limited or absent, Oi 2.0 cm thick, Oe 0.3 cm, Oa 0.2 cm; no A horizon; E horizon strongly developed, 24 (11 - 43) cm thick, typically with charcoal mixed in the upper 3 (2 - 7) cm (salt and pepper E/A); Bs1 and Bs2 horizons well developed, 31 (23 - 39) and 26 (18 - 32) cm thick, respectively; BC 25 (12 - 43); moderate ortstein development.

**PEBBLES AND COBBLES:** Very low percent pebbles (maximum 5%); cobbles usually absent, to 2%.

**Vegetation**

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): trembling aspen (56/64/80), bigtooth aspen (23/25/40). Other species: black cherry, white pine, red oak. Mean no. of stems/plot=10. One of the five sample plots in this type had no overstory. The overstory is sparse in this type and the thees are small and slow-growing.

UNDERSTORY: Dominants (% rel. density/% frequency): trembling aspen (36/100), serviceberry (22/40), white pine (17/40). Other species: bigtooth aspen, red maple. Mean no. of stems/plot=31.

GROUND COVER: Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Cladina*. Most common ground-cover species: *Pteridium aquilinum*, *Amelanchier* spp., *Gaultheria procumbens*. Most common tree species: trembling aspen, red maple, black cherry, choke cherry, bigtooth aspen. Diversity of ground-cover species is the lowest of all UMBS ecosystem types. High coverages of *Pteridium aquilinum* and *Amelanchier* spp., reflect the low moisture availability throughout the ecosystem.

PRESETTLEMENT COVER TYPE: white pine - red pine - hemlock - red oak.

### Comments

This ecosystem represents the extreme in climate (both hot and cold) and excessive soil drainage of UMBS ecosystems. Its low physiographic position and droughty soils contribute to its fire susceptibility as well. The vegetation reflects severe post-logging fires; there are sparse bigtooth and trembling aspens of poor vigor, and abundant lichens and bracken fern. In contrast, the least severely disturbed part of this ecosystem (W 1/2, NW 1/4 Sec. 25, T37N, R4W) has a higher percent coverage of the *Gaultheria* species group, thicker organic horizons, and greater overstory density than the rest.

### Similar Ecosystems

Distinguished from type 2 by the deeper water table, from type 7 by a lower percentage of fine sand and silt, and from type 8 by greater distance from Douglas Lake. Type 1 also was apparently more severely burned than these types and has thinner organic horizons. Also distinguished from types 2, 7, and 8 by lower percent coverage of the *Gaultheria* species group and shorter, less vigorous-looking overstory trees. Distinguished from type 4 by the lack of a well-developed overstory of red and white pines and by lack of the *Polygala* species group in the ground-cover. Distinguished from high-level ecosystems 36 and 37 by being subject to the climatic extremes of the Pellston Plain. The high-level types have almost no trembling aspen in the overstory, whereas trembling aspen is a significant overstory species in type 1. This difference in aspen composition may reflect close proximity to the abundant seed sources for trembling aspen along the Maple River or the difference in climatic extremes (trembling aspen is more tolerant of extreme cold than bigtooth aspen).

### Location

West of the Chippewa-age dunes on the Pellston Plain and not adjacent to the Maple River. Sec. 35 and 36 and S 1/2 Sec. 25 and 26, T37N, R4W; Sec. 1 and 2, T36N, R4W.

NUMBER OF OCCURRENCES: 7.

AREA: Avg. Size (ha)/total area for type (ha)/percent of total mapped area: 34.2/239.4/5.64.

PLOTS: 8803, 8920, 8921, 9202, 9449.

**Ecosystem 2:** Somewhat excessively drained medium to fine sand; low-level outwash plain in the Pellston Plain; white pine - red pine - hemlock - red oak/*Gaultheria*.

**SYNOPSIS:** Gently sloping outwash plain in the Pellston Plain. Somewhat excessively drained medium sand, acidic in all horizons; water table between 200 and 300 cm. Trembling aspen - bigtooth aspen overstory; trembling aspen - bigtooth aspen understory; *Pteridium* - *Gaultheria* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping outwash plains adjacent to the central outwash channel now occupied by the Maple River; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 209 - 219 m.

### Soil

Somewhat excessively drained, medium to fine sand, acidic in all horizons; water table between 200 and 300 cm during growing season.

### Vegetation

Outside of the pine plantations, scattered bigtooth and trembling aspens form an open canopy over a sparse understory of the aspens and serviceberry. The ground-cover is dominated by dense *Pteridium aquilinum*; the *Pteridium*, *Gaultheria*, and *Cladina* species groups all are common.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

Ecosystem 2 has little natural vegetation as it is bisected by Robinson Rd., has a power line and sand road cutting through it, and has been used for pine plantations some of which have been recently cut. It is interpreted as a non-calcareous version of type 11, which occupies much greater area than type 2 further north along the central channel.

### Similar Ecosystems

Distinguished from ecosystem 1 by being adjacent to the Maple River channel and having thicker organic horizons and greater coverage of herbaceous plants. Distinguished from type 11 by lacking calcareous soil above 250 cm and the *Oryzopsis* species group.

### Location

Generally on gentle slopes near the Maple River channel on the southern part of UMBS property; NE Sec. 2, T36N R4W; N 1/2 Sec. 25 and SE Sec. 35, T37N R4W.

**NUMBER OF OCCURRENCES:** 2.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 8.2/16.4/0.39.

**Ecosystem 3:** Well drained medium sand; raised features in low-level outwash plain in the Pellston Plain; hemlock - beech/*Maianthemum*.

**SYNOPSIS:** Level, raised outwash features in wetland complex in the Pellston Plain. Well drained medium sand, acidic in all horizons; water table between 70 and 200 cm. Trembling aspen - paper birch overstory; balsam fir understory; *Pteridium* - *Maianthemum* ground-cover species groups. Hemlock - American beech (hereafter referred to as beech) presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping raised outwash features in large wetland complex; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 219 - 221 m.

### Soil

Well drained medium sand, acidic in all horizons; water table between 70 and 200 cm in late summer.

### Vegetation

Trembling aspen, paper birch, and red maple compose the overstory. Balsam fir is found with the above species in the understory. The *Pteridium* and *Maianthemum* species groups are abundant in the ground-cover. Presettlement cover type was hemlock - beech.

### Comments

Unique among Pellston Plain acidic outwash ecosystems in not having a pine-dominated overstory in the presettlement or present forest. Being surrounded by wetlands may have insulated this small upland from distant seed sources and protected it from fire.

### Similar Ecosystems

Distinguished from type 4 by a lack of pines in the overstory and lesser coverage of the *Gaultheria* species group. Distinguished from types 5 and 6 both by a deeper water table and greater coverage of the *Clintonia* and *Rhamnus* groups.

### Location

Northwest of Marl Bay; NE 1/4 NW 1/4 Sec. 18, T37N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.5/1.5/0.04

**PLOTS:** None.

**Ecosystem 4:** Well drained to moderately well drained medium sand; low-level outwash plain in the Pellston Plain; white pine - red pine - hemlock/*Maianthemum*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain. Well drained to moderately well drained medium sand, acidic in all horizons; water table between 70 and 200 cm. Red maple - white pine - trembling aspen overstory; white pine - red maple understory; *Pteridium* - *Gaultheria* - *Maianthemum* ground-cover species groups. White pine - red pine - hemlock presettlement cover type. Six plots.

### Physiography

**LANDFORM:** Broad outwash plains covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**SLOPES:** Level to gently sloping (0 - 2.5%); southern aspect.

**ELEVATION:** 216 - 220 m.

### Soil

**DRAINAGE:** Well drained to moderately well drained; water table varies between 70 and 200 cm during the growing season.

**TEXTURE:** Medium sand in all horizons, rarely loamy sand in the C horizon.

**pH:** 4.9 (4.5 - 5.6) in E and A horizons to 5.8 (5.0 - 6.2) in C horizon.

**DEVELOPMENT:** Organic horizons poorly to moderately developed, Oi 1.9 cm thick, Oe 1.2 cm, Oa 0.3 cm; occasional development of A horizon (to 1 cm); E horizon well developed, 26 (8 - 55) cm thick; Bs horizons well developed, Bs1 24 (10 - 35) cm thick, often strongly cemented into a hardpan at interface with E horizon, Bs2 25 (11 - 47) cm thick.

**PEBBLES AND COBBLES:** Pebbles mostly less than 5%, but parent material below 140 cm may contain up to 50% pebbles; cobbles usually absent, maximum 2%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% relative dominance/% frequency): white pine (28/38/67), red maple (25/25/67), trembling aspen (25/24/100), bigtooth aspen (10/10/50). Other species: black cherry, red pine, balsam fir, paper birch, white spruce. Mean no. of stems/plot = 25.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (27/100), serviceberry (15/67). Other species: trembling aspen, balsam fir, paper birch, white spruce, black cherry, bigtooth aspen, white pine, choke cherry, red pine, balsam poplar, fire cherry, willows. Mean no. of stems/plot = 42.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Maianthemum*; very low coverages of *Aralia*, *Clintonia*, *Polygala*, *Orzyopsis*, *Osmorhiza*. Most common ground-cover species: *Pteridium aquilinum*, *Gaultheria procumbens*, *Amelanchier* spp., *Maianthemum canadense*. Most common tree species:

red maple, black cherry, white pine. The higher species richness as compared with types 1 and 2 corresponds with the higher water table and greater moisture availability.

PRESETTLEMENT COVER TYPE: white pine - red pine - hemlock.

### Comments

Ecosystem 4 is probably the most productive of the UMBS Pellston Plain ecosystems. Moisture availability is good in spring and fall, and the water table is not so high that it restricts root growth, as it does in type 5. The most extensive stands of mature white and red pines on UMBS property occur in this ecosystem, indicating, in part, less severe post-logging fires than on much of the plain. However, with continued fire suppression, the overstory will likely succeed to white pine and red maple (in the next 150 - 300 yrs.). Some portions near Van Creek resemble old-growth: large trees (red and white pines to 50 cm dbh and 100 ft. tall), abundant large woody debris, and good vertical structural diversity. The oldest trees are about 100 yrs. old. The large expanse of type 4 north of Van Creek contains inclusions of type 5 that were too small to be mapped.

### Similar Ecosystems

Distinguished from ecosystem 15 by the lack of the *Polygala* species group and *Toxicodendron radicans* in the ground-cover. Distinguished from type 5 by a deeper water table, fewer overstory trembling aspen and understory white spruce, and less coverage of the *Clintonia* and *Rhamnus* species groups.

### Location

Mostly in a broad area along both sides of Van Creek upstream of its confluence with the Maple River. S 1/2 Sec. 23 and 24 and N 1/2 Sec. 25 and 26, T37N R4W.

NUMBER OF OCCURRENCES: 6.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
50.2/301.3/7.09.

PLOTS: 8907, 8916, 9102, 9103, 9139, 9140.

**Ecosystem 5:** Somewhat poorly drained to well drained medium sand; low-level outwash plain in the Pellston Plain; white spruce - balsam fir/*Clintonia*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain. Somewhat poorly drained to well drained, acidic in all horizons; water table above 90 cm. Trembling aspen overstory; trembling aspen - nannyberry - white spruce understory; *Pteridium* - *Clintonia* - *Maianthemum* ground-cover species groups. White spruce - balsam fir presettlement cover type. Three plots.

### Physiography

**LANDFORM:** Broad outwash channel covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**SLOPES:** Level to gently sloping (0 - 3.5%); mostly southern aspects.

**ELEVATION:** 216 - 222 m.

### Soil

**DRAINAGE:** Somewhat poorly drained to well drained; water table above 90 cm throughout the growing season.

**TEXTURE:** Loamy sand to sandy loam in A and E horizons, medium sand in all horizons.

**pH:** 5.3 (4.7 - 5.9) in A and E horizons to 6.2 in C horizon.

**DEVELOPMENT:** Organic horizons poorly developed, Oi 1.6 cm thick, Oe 0.6 cm, Oa 2.3 cm; A horizon typically present, 9.5 (7 - 12) cm thick; E horizon well developed, 16 (8 - 31) cm thick and occasionally mottled; Bs horizons moderately developed and not always distinguishable, 49 (42 - 56) cm thick, strongly cemented at interface with E horizon.

**PEBBLES AND COBBLES:** Pebbles typically 0 - 5%; cobbles 1 - 2%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): trembling aspen (81/96/100), white pine (14/3/100). Other species: balsam fir, black cherry, northern white-cedar. Mean no. of stems/plot = 17.

**UNDERSTORY:** Most common species (% rel. density/% frequency): trembling aspen (43/83), white spruce (14/32). Other species: serviceberry, red maple, balsam fir, balsam poplar, wild-raisin. Mean no. of stems/plot = 61.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Clintonia*, *Maianthemum*, *Rhamnus*, *Gaultheria*, *Aralia*, *Polygala*. Most common ground-cover species: *Pteridium aquilinum*, *Cornus canadensis*, *Amelanchier* spp., *Cornus stolonifera*. Most common tree species: trembling aspen, black cherry.

**PRESETTLEMENT COVER TYPE:** white spruce - balsam fir.

### Comments

Most of ecosystem 5 has a fairly open canopy and dense herbaceous layer dominated by grasses; some wetland species are present. Some of the highest known densities of black flies have been encountered in ecosystem 5.

### Similar Ecosystems

Distinguished from type 4 by a more white spruce and balsam fir in the overstory and a ground-cover with higher coverages of the *Clintonia* and *Rhamnus* species groups. Distinguished from type 16 by a lack of calcareous material above 100 cm and lack of the *Prunella* species group.

### Location

This ecosystem is mostly restricted to north of Van Creek, near Van Road, and depressions in type 4. It borders the wetlands north of the Maple River near Douglas Lake; NE 1/4 Sec. 23 and S 1/2 Sec. 24, T37N R4W.

NUMBER OF OCCURRENCES: 8.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 5.7/45.2/1.06.

PLOTS: 8818, 9107, 9108.

**Ecosystem 6:** Somewhat poorly drained medium sand; low-level outwash plain in the Pellston Plain; white spruce - balsam fir/*Rhamnus*.

**SYNOPSIS:** Level outwash plain in a wetland complex in the Pellston Plain. Somewhat poorly drained medium sand; water table between 30 and 100 cm. Trembling aspen - red maple overstory; trembling aspen paper birch understory; *Pteridium* - *Rhamnus* - *Clintonia* ground-cover species groups. White spruce - balsam fir presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping outwash plain in a large wetland complex; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 219 m.

### Soil

Somewhat poorly drained medium sand with well developed A horizon; water table between 30 and 100 cm in late summer.

### Vegetation

Trembling aspen dominates the overstory, accompanied by red maple. The understory is composed of trembling aspen, paper birch, and serviceberry; speckled alder and nannyberry are occasional. The species-rich ground-cover includes the *Rhamnus* and *Clintonia* species groups; the *Onoclea* group is occasional. Presettlement cover type was white spruce - balsam fir.

### Comments

The presence of occasional wetland species in the ground-cover and understory reflects the high water table. Muck does not accumulate, but is mixed with sand to form an A horizon. General Land Office notes describe a trembling aspen - paper birch forest that was probably maintained by fire and frequent blowdowns.

### Similar Ecosystems

Distinguished from type 5 by lack of conifers (white spruce, white pine, and balsam fir) in all strata. Distinguished from nearby wetland types 23 - 25 by a lack of standing water and accumulated muck.

### Location

Northwest of Marl Bay: NE 1/4 NW 1/4 Sec. 1, T37N R3W; west of the Maple River wetlands: NE 1/4 Sec. 25, T37N R4W.

**NUMBER OF OCCURRENCES:** 2.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 5.6/11.2/ 0.26.

**PLOTS:** None.

**Ecosystem 7:** Somewhat excessively drained to well drained, banded, medium sand; low-level outwash plain in the Pellston Plain; white pine - red pine - hemlock - red oak/*Gaultheria*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain. Somewhat excessively drained to well drained, banded, medium sand; water table between 200 and 350 cm. Trembling aspen overstory; trembling aspen - serviceberry understory; *Pteridium* - *Gaultheria* - *Oryzopsis* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. One plot.

### Physiography

**LANDFORM:** Broad outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**SLOPES:** Level; no aspect.

**ELEVATION:** 215 - 219 m.

### Soil

**DRAINAGE:** Somewhat excessively drained to well drained; water table between 200 and 350 cm throughout the growing season.

**TEXTURE:** Medium sand to loamy sand in upper horizons (E, Bs1, Bs2), medium sand in C horizon; thin (< 1 cm) bands of loamy sand occur at varying depths, generally becoming thicker towards the south end of UMBS property.

**pH:** 4.9 in E horizon to 5.5 in C.

**DEVELOPMENT:** Organic horizons poorly developed, Oi 3.7 cm thick, Oe 1 cm, Oa 1 cm; no A horizon; E, Bs1 and Bs2 horizons well developed (17, 46, and 17 cm thick, respectively).

**PEBBLES AND COBBLES:** Absent.

### Vegetation

**OVERSTORY:** Dominant (% rel. density/% rel. dominance): trembling aspen (88/99). Other species: bigtooth aspen, white pine. Mean no. of stems/plot = 16.

**UNDERSTORY:** Most common species (% rel. density): serviceberry (47), trembling aspen (31). Other species: white pine, black cherry, red maple, bigtooth aspen, willow. Mean no. of stems/plot = 32.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Oryzopsis*. Most common ground-cover species: *Pteridium aquilinum*, *Vaccinium angustifolium*, *Gaultheria procumbens*, *Amelanchier* spp., *Melampyrum lineare*. Most common tree species: red maple, black cherry, red oak, balsam fir.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

The presence of bands of finer texture than medium sand slows drainage through the profile. The added moisture availability is reflected in the ground-cover vegetation and greater height of overstory, relative to non-banded ecosystems 1 and 2.

### Similar Ecosystems

Distinguished from type 8 in that it is further from Douglas Lake and its overstory is somewhat shorter and dominated by trembling aspen; bigtooth aspen dominates type 8. These types are otherwise very similar and are only separated here based on the potentially significantly different climatic situations; type 7 may be more frost-prone and extreme than the lake-moderated type 8. Distinguished from type 1 by presence of loamy sand bands in the soil and greater coverage of the *Gaultheria* species group, and from other climatically extreme banded types (9, 10, 17, 18, and 19) in a generally more depauperate herbaceous layer.

### Location

Generally east of the Chippewa-age dunes; NW 1/4 Sec. 1, T36N R4W; Sec. 25 and 36, T37N R4W.

NUMBER OF OCCURRENCES: 7.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 3.9/27.2/0.64.

PLOTS: 8925.

**Ecosystem 8:** Somewhat excessively drained to well drained, banded, medium sand; low-level outwash plain within 1000 m of Douglas Lake; white pine - red pine - hemlock - red oak/*Gaultheria*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain within 1000 m of Douglas Lake. Somewhat excessively drained, banded, medium sand, acidic in all horizons; water table below 200 cm. Bigtooth aspen - trembling aspen overstory; trembling aspen - red maple understory; *Pteridium* - *Gaultheria* - *Cladina* - *Maianthemum* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. One plot.

### Physiography

**LANDFORM:** Broad outwash plain covered by Glacial Lake Algonquin; within 1000 m of Douglas Lake and within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west..

**SLOPES:** Level; no aspect.

**ELEVATION:** 219 m.

### Soil

**DRAINAGE:** Somewhat excessively drained to well drained; water table between 200 and 300 cm during the growing season.

**TEXTURE:** Medium sand in all horizons, with thin bands of slightly loamy sand present above 250 cm.

**pH:** 4.7 in E horizon to 6.0 in C.

**DEVELOPMENT:** Organics poorly developed, Oi 3.7 cm thick, Oe 0.7 cm, Oa 0.5 cm; no A horizon; well developed E horizon, 24 cm thick; Bs1 and Bs2 horizons moderately developed, 22 and 30 cm thick, respectively; BC horizon sometimes present, 54 cm thick.

**PEBBLES AND COBBLES:** Pebbles 0% (E horizon) to 10% (BC); cobbles absent.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): bigtooth aspen (59/80), trembling aspen (23/12), red maple (18/8). Mean no. of stems/plot = 22.

**UNDERSTORY:** Most common species (% rel. density): serviceberry (48), trembling aspen (24), red maple (10), paper birch (10). Other species: white pine, bigtooth aspen. Mean no. of stems/plot = 21.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Cladina*, *Maianthemum*. Most common ground-cover species: *Pteridium aquilinum*, *Amelanchier* spp., *Maianthemum canadense*. Most common tree species: black cherry, red maple, red oak.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

Type 8 is located between a Glacial Lake Algonquin shoreline feature to the west and wetlands near Maple Bay of Douglas Lake to the east. As such, it is not likely as severely affected by the climatic extremes on the Pellston Plain; it is somewhat lake-moderated.

### Similar Ecosystems

Distinguished from ecosystem 7 by a less severe climate due to relative proximity to Douglas Lake; type 7 is more central in the climatically extreme Pellston Plain. Also distinguished by a somewhat taller canopy of bigtooth aspen; trembling aspens of shorter stature dominate type 7. Distinguished from high-level banded outwash (type 39) by a lack of the *Maianthemum* species group.

### Location

West of the wetlands surrounding Maple Bay of Douglas Lake, and east of the Glacial Lake Algonquin shoreline feature extending north from the interlobate moraine; NE 1/4 Sec. 25, T37N R4W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
17.5/17.5/0.41.

PLOTS: 9128.

**Ecosystem 9:** Moderately well drained to somewhat poorly drained, banded, medium sand; low-level outwash plain within 1000 m of Douglas Lake; red maple - elm/*Clintonia*.

**SYNOPSIS:** Level outwash plain on the Pellston Plain within 1000 m of Douglas Lake. Moderately well drained to somewhat poorly drained, banded, medium sand to fine sand, neutral in 2C, acidic above. Red maple-trembling aspen overstory; wild-raisin - red maple understory; *Pteridium* - *Clintonia* - *Maianthemum* - *Prunella* ground-cover species groups. Red maple - American elm (hereafter referred to as elm) presettlement cover type. One plot.

### Physiography

**LANDFORM:** Broad outwash plain covered by Glacial Lake Algonquin, within 1000 m of Douglas Lake and within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west..

**SLOPES:** Level (< 1%); no aspect.

**ELEVATION:** 218 m.

### Soil

**DRAINAGE:** Moderately well drained to somewhat poorly drained; water table at 50 - 150 cm during growing season.

**TEXTURE:** Medium sand to fine sand in A, E, and Bs horizons; loamy sand in C; silt loam in the 2C horizon.

**pH:** 4.5 in A horizon to 5.5 in Bs; 4.9 in C and 7.0 in 2C.

**DEVELOPMENT:** Organics moderately developed, Oi 0.5 cm thick, Oe 5.2 cm, Oa 1.7 cm; thick A horizon (23 cm) present; E horizon also well developed, 16 cm thick; moderate Bs, 46 cm thick; C 40 cm thick, underlain by 2C.

**PEBBLES AND COBBLES:** Less than 1% pebbles; cobbles absent.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): red maple (75/94), trembling aspen (15/4), black cherry (10/2). Mean no. of stems/plot = 20.

**UNDERSTORY:** Most common species (% rel. density): wild-raisin (42), red maple (32). Other species: winterberry, speckled alder, trembling aspen, black cherry, paper birch, serviceberry, beech. Mean no. of stems/plot = 69.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Clintonia*, *Maianthemum*, *Prunella*. Most common ground-cover species: *Pteridium aquilinum*, *Coptis trifolia*, *Cornus canadensis*, *Amelanchier* spp., *Maianthemum canadense*. Most common tree species: red maple, red oak, paper birch, black cherry, trembling aspen, mountain-ash. High coverage of *Coptis trifolia* and *Cornus canadensis* indicate the moist, acidic conditions.

**PRESETTLEMENT COVER TYPE:** red maple - elm.

### Comments

Type 9 occurs, like other wetland margin ecosystems, as a relatively narrow band separating true wetlands (defined as having a muck or peat horizon) and uplands. Ecosystem 9 is represented by one small area on UMBS property, and is distinguished by the presence of a thick silt layer in the subsurface soil and very high density of *Viburnum cassinoides*.

### Similar Ecosystems

Ecosystem 9 is similar to ecosystem 10 in physiographic position, being between upland and wetland ecosystems. Distinguished from type 10 by a thick A horizon and thick subsurface layer of silt and the very high density of *Viburnum cassinoides* in the understory. Distinguished from adjacent wetlands by mineral soil at the surface and absence of the *Onoclea* species groups.

### Location

A narrow strip around the western edge of the wetlands bordering Maple Bay of Douglas Lake; NE 1/4 NE 1/4 Sec. 25, T37N R4W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.8/2.8/0.07.

PLOTS: 9138

**Ecosystem 10:** Moderately well drained to somewhat poorly drained, banded, medium sand; low-level outwash plain in the Pellston Plain; white pine - hemlock - red maple/*Clintonia*.

**SYNOPSIS:** Gently sloping outwash plains in depressions in the Pellston Plain. Moderately well drained to somewhat poorly drained, banded, medium sand, acidic in all horizons; water table between 50 and 150 cm. Bigtooth aspen - trembling aspen - red maple overstory; red maple - serviceberry - wild-raisin understory; *Pteridium* - *Clintonia* ground-cover species groups. White pine - hemlock - red maple presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping outwash plains around the perimeter of wetland depressions; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west..

**ELEVATION:** 215 m.

### Soil

Moderately well drained to somewhat poorly drained medium sand, acidic in all horizons, banded with loamy sand; water table between 50 and 150 cm in the growing season.

### Vegetation

The overstory may contain components of both upland and wetland ecosystems; bigtooth and trembling aspens and red maple typically dominate, accompanied by white pine and paper birch. Red maple, serviceberry, and wild-raisin occupy the understory. Acid indicators including the *Gaultheria* and *Clintonia* species groups are characteristically found under the *Pteridium* species group in the ground-cover. Presettlement cover type was likely white pine - hemlock - red maple.

### Comments

A wetland margin ecosystem, type 10 is typically a narrow strip distinguished by greater pit-and-mound topography than in surrounding uplands.

### Similar Ecosystems

Ecosystem 10 is most similar in physiography and soils to ecosystems 4 and 9. Distinguished from type 4 lesser dominance of red and white pines in the overstory, and a more dense understory. Distinguished from type 9 by the lack of an A horizon and subsurface layer of silt and greater distance (> 1000 m) from Douglas Lake.

### Location

Mostly surrounding wetland depressions in the eastern portion of the Pellston Plain; SW 1/4 SE 1/4 Sec. 36, T37N R4W.

**NUMBER OF OCCURRENCES:** 4.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.0/8.1/0.19.  
**PLOTS:** None

**Ecosystem 11:** Somewhat excessively drained medium sand, calcareous in C horizon; low-level outwash plain in the Pellston Plain; white pine - red pine - hemlock - red oak/*Oryzopsis*.

**SYNOPSIS:** Level to steeply sloping outwash plain in the Pellston Plain. Somewhat excessively drained medium sand, calcareous in C horizon; water table between 200 and 300 cm. Trembling aspen - bigtooth aspen - white pine overstory; trembling aspen - white pine understory; *Pteridium* - *Gaultheria* - *Oryzopsis* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Broad outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**SLOPES:** Mostly very gently sloping (0 - 1%) with a slight southern aspect but some gentle to steep slopes (5 - 35%) with various aspects along the banks of the Maple River.

**ELEVATION:** 210 - 216 m.

### Soil

**DRAINAGE:** Somewhat excessively drained; water table between 200 and 300 cm during the growing season.

**TEXTURE:** Fine to medium sand in the E and B horizons; medium sand in C.

**pH:** 4.5 (4.4 - 4.6) in E horizon to 6.7 (5.8 - 7.6) in C.

**DEVELOPMENT:** Organics poorly developed, Oi 2.2 cm thick, Oe 1.9 cm, Oa 0.8 cm; no A horizon; well developed E horizon, 17 (14 - 20) cm thick; Bs horizon well developed, Bs1 31 (12 - 50) and Bs2 22 (13 - 30) cm thick; BC sometimes distinguishable, 76 cm thick.

**PEBBLES AND COBBLES:** Pebbles 0 - 5% above 1 m, to 10% below 1 m; cobbles less than 1%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): trembling aspen (54/59/100), bigtooth aspen (26/25/75), white pine (16/15/50). Other species: paper birch, black cherry, red maple. Mean no. of stems/plot = 17.

**UNDERSTORY:** Most common species (% rel. density/% rel. frequency): trembling aspen (29/100), white pine (25/100), bigtooth aspen (16/75), serviceberry (10/100), black cherry (10/75). Other species: red maple, paper birch. Mean no. of stems/plot = 177.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Oryzopsis*, *Maianthemum*, *Polygala*. Most common ground-cover species: *Pteridium aquilinum*, *Amelanchier* spp., *Oryzopsis asperifolia*, *Melampyrum lineare*. Most common tree species: red maple, red oak. This ecosystem has a slightly higher water table and pH than ecosystem 1, which is reflected in slightly higher species richness and the presence of *Oryzopsis*.

PRESETTLEMENT COVER TYPE: white pine - red pine - hemlock - red oak.

### Comments

Although all the parent material on the Pellston Plain was calcareous at the time of deposition, type 11 and the other calcareous outwash types have soils that are not as deeply leached of calcium carbonate as the non-calcareous ecosystems. Generally larger particle sizes and more textural discontinuities associated with higher melt water velocities towards the northern and central parts of the outwash channel may contribute to slower leaching. Larger particle sizes present less total surface area for a given volume of material, and textural discontinuities inhibit percolation. The *Oryzopsis* species group indicates the presence of calcareous parent material.

### Similar Ecosystems

Distinguished from ecosystem 1 by the presence of the *Oryzopsis* species group in the ground-cover, reflecting calcareous parent material. Distinguished from type 15 by deeper water table, less distinct pit-and-mound development, and lower coverage of the *Polygala* species group in the ground-cover.

### Location

Broad areas mostly on the west side of the Maple River; Sec. 26 and 35 and W 1/2 Sec. 25 and 36, T37N R4W; N 1/2 Sec. 2, T36N R4W.

NUMBER OF OCCURRENCES: 11.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
15.4/169.1/3.98.

PLOTS: 8924, 8927, 894D, 9136, 9325.

**Ecosystem 12:** Well drained medium sand, calcareous in C horizon; low-level outwash plain in the Pellston Plain; hemlock - northern hardwood/*Osmorhiza*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain. Well drained medium sand, calcareous in C horizon; water table between 90 and 200 cm. White pine - basswood - trembling aspen overstory; sugar maple - black cherry - serviceberry understory; *Pteridium* - *Osmorhiza* - *Ostrya* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Two plots.

### Physiography

**LANDFORM:** Broad outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**SLOPES:** Level (< 1%); very slight southern aspect.

**ELEVATION:** 220 - 222 m.

### Soil

**DRAINAGE:** Well drained; water table between 90 and 200 cm in the growing season.

**TEXTURE:** Loamy sand in E and Bsh horizons; medium sand in other horizons.

**pH:** 6.3 (6.0 - 6.7) in E horizon to 7.5 (7.2 - 7.7) in C.

**DEVELOPMENT:** Organic horizons minimally developed, Oi 1.7 cm thick, Oe 0.25 cm, Oa 0 cm; no A horizon; E horizon moderately developed, 18 (12 - 24) cm thick, with good biological activity; Bsh sometimes present; Bs and BC horizons moderately well developed 32 (27 - 37) and 37 cm thick; Bs horizon typically with abundant, moderately cemented ortsteins.

**PEBBLES AND COBBLES:** Pebbles mostly 2 - 3%, to 50% in C horizon; cobbles 1 - 5%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): trembling aspen (60/59/100), white pine (16/24/50), basswood (11/12/50). Other species: red maple, sugar maple, white spruce, eastern hop-hornbeam, black cherry. Mean no. of stems/plot = 16.

**UNDERSTORY:** Most common species (% rel. density/% frequency): sugar maple (27/50), black cherry (24/50), serviceberry (11/50), white pine (11/50), trembling aspen (10/50). Other species: red maple, hop-hornbeam, basswood, choke cherry. Mean no. of stems/plot = 31.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Osmorhiza*, *Ostrya*, *Polygonatum*. Most common ground-cover species: *Pteridium aquilinum*, *Amelanchier* spp., *Erythronium americanum*. Most common tree species: sugar maple, red maple, trembling aspen, American elm, black cherry. Although this ecosystem shows heavy disturbance, as does much of the Pellston Plain, the high coverage of the *Osmorhiza* group

as well as the presence of other high moisture and nutrient requiring groups indicate potential for hemlock-northern hardwood vegetation.

PRESETTLEMENT COVER TYPE: hemlock - northern hardwood.

### Comments

Being closer than other UMBS lands to the source of the outwash that formed the Pellston Plain, Ecosystem 12 has generally coarser parent material (finer particles were carried further south). The calcareous gravelly sand is considered the primary reason for the development of a fertile, dry-mesic to mesic northern hardwood forest in contrast with the pine - oak forest over most of the presettlement Pellston Plain. Although only a very small portion of UMBS land now supports the presettlement vegetation type, woodlots to the north and west do have northern hardwoods. Most of Ecosystem 12 reflects severe and recent burning, there being only scattered aspen clones in an otherwise desolate landscape. One vestige of the original ground-cover that persists is the trout lily, *Erythronium americanum*, which is quite common amongst the lichen, blackberry, and poverty grass. Apparently the below-ground portions of this perennial survived the most recent disturbance, and since trout lily completes its life cycle in the months of April to June, the shoots avoid the extreme heat and drought of July and August. Most other ground-cover species found in the forested portion of this ecosystem have shoots that persist through the summer, leaving them vulnerable to desiccation in the disturbed area.

### Similar Ecosystems

Distinguished from type 13 by more gravel and higher pH of the soil; type 13 occurs as elevated features further downstream in the historic outwash channel and does not support the *Osmorhiza* species group.

### Location

In the northwest portion of UMBS property, on the west side of Van Creek south of Van Road; E 1/2 Sec. 22, T37N R4W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 16.9/16.9/0.40.

PLOTS: 9201, 9203.

**Ecosystem 13:** Somewhat excessively drained medium sand, calcareous in C horizon; raised outwash features in the low-level Pellston Plain; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Gently sloping, raised outwash features in the Pellston Plain. Somewhat excessively drained medium sand, calcareous in the C horizon; water table between 200 and 300 cm. Bigtooth aspen overstory; sugar maple - hop-hornbeam understory; *Pteridium* - *Ostrya* - *Polygonatum* - *Polygala* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping, slightly elevated features in outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 221 - 223 m.

### Soil

Somewhat excessively drained gravely medium sand, calcareous above 250 cm in the C horizon; water table 200 - 300 cm during the growing season.

### Vegetation

The overstory is dominated by bigtooth aspen; red maple and occasionally sugar maple are associates. Among saplings of the overstory trees, scattered hop-hornbeam, maple-leaf viburnum, and beaked hazlenut occur in the understory. The ground-cover includes the *Ostrya*, *Polygonatum* and *Polygala* species groups, indicative of the dry-mesic conditions. Presettlement cover type was hemlock - northern hardwood.

### Comments

There are only two of these subtle features on UMBS property, but more are evident on aerial photos of land to the north of Van Road. They may be piles of material carried by small ice blocks deposited downstream from the melting glacier to the northwest.

### Similar Ecosystems

Distinguished from type 12 by greater depth to calcareous material, its occurrence as isolated features in non-calcareous outwash, and lack of the *Osmorhiza* species group.

### Location

East of the confluence of Van Creek and the Maple River; N 1/2 Sec. 25, T37N R4W.

**NUMBER OF OCCURRENCES:** 3.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.2/3.6/0.08.

**PLOTS:** None.

**Ecosystem 14:** Well drained medium sand, calcareous in C horizon; raised outwash features in low-level Pellston Plain; hemlock - northern hardwood/*Aralia*.

**SYNOPSIS:** Level, raised outwash features in the Pellston Plain. Well drained medium sand, calcareous in the C horizon; water table between 70 and 200 cm. Trembling aspen - paper birch overstory and understory; *Pteridium* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to very gently sloping elevated outwash feature in wetland complex; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 219 - 221 m.

### Soil

Well drained medium sand, strongly acidic in upper 30 cm, calcareous at 40 - 50 cm in the C horizon; water table between 70 and 200 cm in late summer.

### Vegetation

Trembling aspen and paper birch occupy the overstory and understory; balsam fir is occasional in the understory. The *Pteridium* species group is predominant in the ground-cover; the *Aralia* group is also present. Presettlement cover type was hemlock - northern hardwood.

### Comments

The open canopy of trembling aspen and paper birch contrasts with the hemlock - northern hardwood forest cited in the General Land Office survey notes. The ground-cover dominance by the *Pteridium* species group probably reflects this change. Highly acidic surface soils and the change in overstory composition could explain the absence of species groups that indicate the calcareous soil (e. g., the *Polygonatum* group).

### Similar Ecosystems

Distinguished from types 12 and 13 by the lack of the *Polygonatum* species group in the ground-cover and northern hardwood species in the overstory and understory.

### Location

Northwest of Marl Bay; NW 1/4 NW 1/4 SEC. 18, T37N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.7/1.7/0.04.

**PLOTS:** None.

**Ecosystem 15:** Well drained to moderately well drained medium sand, calcareous below 175 cm; low-level outwash plain in the Pellston Plain; white pine - red pine - hemlock - red oak/*Polygala*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain. Well drained medium sand, calcareous in C horizon below 175 cm; water table between 70 and 200 cm. Red pine - white pine - trembling aspen overstory; balsam fir - white pine understory; *Polygala* - *Pteridium* - *Maianthemum* - *Clintonia* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. Three plots.

### Physiography

**LANDFORM:** Broad outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**SLOPES:** Level; no aspect.

**ELEVATION:** 219 - 220m.

### Soil

**DRAINAGE:** Well drained to moderately well drained; water table between 70 and 200 cm in growing season.

**TEXTURE:** Sand in all horizons.

**pH:** 4.5 (4.2 - 4.8) in E horizon to 6.0 (5.8 - 6.1) in C.

**DEVELOPMENT:** Organics moderately developed, Oi 1.7 cm thick, Oe 1.1 cm, Oa 0.8 cm; no A horizon; E horizon 24 (16 - 32) cm thick; Bs1 and Bs2 horizons well developed, 31 and 44 (30 - 62) cm thick.

**PEBBLES AND COBBLES:** Pebbles variable, 0 - 45%; cobbles mostly few, 10% maximum.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): white pine (32/38/100), paper birch (23/21/100), trembling aspen (16/16/67), red pine (10/11/33). Other species: bigtooth aspen, white spruce, balsam fir. Mean no. of stems/plot = 9.

**UNDERSTORY:** Most common species (% rel. density/% frequency): balsam fir (69/100), white pine (18/67). Other species: white spruce, red pine, trembling aspen, black cherry. Mean no. of stems/plot = 42.

**GROUND COVER:** Dominant ecological species groups: *Polygala*, *Pteridium*, *Maianthemum*, *Clintonia*, *Aralia*. Most common ground-cover species: *Pteridium aquilinum*, *Maianthemum canadense*, *Cornus canadensis*, *Aralia nudicaulis*. Most common tree species: beech, red maple, white pine, black cherry.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

Type 15 is located in the central portion of an abandoned south-flowing outwash channel. Like ecosystem 4, type 15 supports some of the most mature red and white pine stands on UMBS property. Pit and mound topography is well developed, and both the *Polygala* and *Gaultheria* species groups are present in the ground-cover, reflecting the spatial differences related to microtopography. The shallow water table prevented adequate sampling of the C horizon below 1 m, hence the acidic pH values. Deeper soil is circumneutral to calcareous.

### Similar Ecosystems

Distinguished from ecosystem 4 by the presence of calcareous material above 250 cm and by the *Polygala* species group in the ground-cover. Distinguished from type 16 by a deeper water table, a lower abundance of white spruce and balsam fir in the understory and overstory, and lack of the *Prunella* species group.

### Location

Extending from Van Creek near Van Road to just south of Douglas Lake Road; W 1/2 Sec. 23, SE 1/4 Sec. 22, Sec. 26, T37N R4W.

NUMBER OF OCCURRENCES: 6.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
20.9/125.7/2.96.

PLOTS: 8906, 8915, 8922.

**Ecosystem 16:** Somewhat poorly drained to well drained medium sand, calcareous in C horizon; low-level outwash plain in the Pellston Plain; white spruce - balsam fir/*Prunella*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain. Somewhat poorly drained to well drained loamy sand to medium sand, calcareous in the C horizon; water table 30 - 90 cm. White spruce - balsam fir - trembling aspen overstory; balsam fir understory; *Pteridium* - *Polygala* - *Maianthemum* - *Aralia* - *Prunella* ground-cover species groups. White spruce - balsam fir presettlement cover type. Two plots.

### Physiography

**LANDFORM:** Broad outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**SLOPES:** Level (< 1%); slight southern aspect.

**ELEVATION:** 221 - 222 m.

### Soil

**DRAINAGE:** Somewhat poorly drained to well drained; water table 30 - 90 cm during the growing season.

**TEXTURE:** Loamy sand to sandy loam in A horizon; medium sand in all others.

**pH:** 5.2 (5.0 - 5.4) in A horizon to 6.5 (6.0 - 6.9) in C.

**DEVELOPMENT:** Organics poorly developed, Oi 0.8 cm thick, Oe 0.3 cm, Oa 0 cm; A horizon present, averaging 10 cm thick; strongly developed E horizon, 22 (20 - 24) cm thick; weak to moderate Bs horizons, Bs1 19 cm and Bs2 11 cm thick, with some mottling.

**PEBBLES AND COBBLES:** Pebbles typically 1 - 5%, 20% maximum in upper horizons, up to 50% in C; cobbles absent in upper horizons, to 3% in C.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): white spruce (44/61/100), balsam fir (27/27/100), trembling aspen (16/9/100). Other species: balsam poplar, northern white-cedar, white pine, paper birch, black cherry. Mean no. of stems/plot = 59.

**UNDERSTORY:** Most common species (% rel. density/% frequency): balsam fir (73/100), white spruce (23/100). Other species: northern white-cedar, choke cherry, paper birch, black cherry. Mean no. of tree stems per plot = 119.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Polygala*, *Maianthemum*, *Aralia*, *Osmorhiza*, *Polygonatum*, *Clintonia*, *Prunella*. Most common ground-cover species: *Pteridium aquilinum*, *Maianthemum canadense*, *Cornus canadensis*, *Prunella vulgaris*. Most common tree species: balsam fir, black cherry, white spruce.

**PRESETTLEMENT COVER TYPE:** white spruce - balsam fir.

### Comments

Type 16 is in the center of the channel created by glacial melt water in the Pellston Plain. Balsam fir is very common and its presence in the overstory and understory limits light availability, resulting in one of the darkest forest floors on station property. There are numerous gaps wherein a lush, diverse herbaceous layer reveals the abundant moisture available here. Calcareous soil lies below the depth sampled; high water table hindered sampling efforts.

### Similar Ecosystems

Distinguished from type 12 by a higher water table. Distinguished from type 5 by a higher density of balsam fir, a more dense canopy in general, and presence of the *Prunella* species group.

### Location

Mostly near Van Creek in the northwest corner of UMBS property; W 1/2 Sec. 23 and NE 1/4 Sec. 22, T37N R4W.

NUMBER OF OCCURRENCES: 9.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 6.6/39.4/0.87.

PLOTS: 9130, 9147.

**Ecosystem 17:** Somewhat excessively drained to well drained, banded, medium sand, calcareous in C horizon below 200 cm; low-level outwash plain in the Pellston Plain; white pine - red pine - hemlock - red oak/*Aralia*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain. Somewhat excessively drained to well drained, banded, medium sand to loamy medium sand, calcareous in C horizon below 200 cm; water table between 200 and 300 cm. Bigtooth aspen - trembling aspen overstory; serviceberry - trembling aspen - red maple understory; *Pteridium* - *Gaultheria* - *Oryzopsis* - *Maianthemum* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. Three plots.

### Physiography

**LANDFORM:** Broad outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**SLOPES:** Level (< 1%); slight southeastern aspect.

**ELEVATION:** 213 - 216 m.

### Soil

**DRAINAGE:** Somewhat excessively drained to well drained; water table between 200 and 300 cm in the growing season.

**TEXTURE:** Medium sand to loamy medium sand in upper horizons, with thin bands of loamy sand to sandy loam in the B horizons; medium sand in the C.

**pH:** 4.8 (4.7 - 4.9) in the E horizon to 5.7 (5.5 - 5.8) in upper C.

**DEVELOPMENT:** Organics poorly to moderately developed, Oi 2.8 cm thick, Oe 1.0 cm, Oa 0.9 cm; no A horizon; E horizon moderately developed, 13 (8 - 18) cm thick; Bs horizons well developed, Bs1 32 (14 - 43) and Bs2 36 (30 - 41) cm thick.

**PEBBLES AND COBBLES:** 0 - 3% pebbles; cobbles absent.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (39/45/100), trembling aspen (36/42/100), red maple (11/10/67). Other species: black cherry, red oak, balsam fir, paper birch. Mean no. of stems/plot = 34.

**UNDERSTORY:** Most common species (% rel. density/% frequency): serviceberry (32/100), bigtooth aspen (16/100), trembling aspen (15/100), black cherry (15/67), red maple (14/100). Other species: white pine, red oak, wild-raisin, paper birch. Mean no. of stems/plot = 45.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Oryzopsis*, *Maianthemum*, low coverages of *Aralia*, *Polygala*. Most common ground-cover species: *Pteridium aquilinum*, *Gaultheria procumbens*, *Vaccinium angustifolium*, *Oryzopsis asperifolia*. Most common tree species: balsam fir, black cherry.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

Type 17 occurs near the rim of the central melt water channel in the Pellston Plain, at the western end of a gradient of increasingly higher water table and soil pH towards the foot slope of the interlobate moraine to the east. It is recognized by the presence of the *Oryzopsis* and *Aralia* species groups in the ground-cover, and by the better pit-and-mound development than drier types.

### Similar Ecosystems

Distinguished from types 18 and 19 by deeper water table, less distinct pit-and-mound development, and lower abundance of the *Toxicodendron* and *Osmorhiza* species groups.

### Location

Mostly between the Maple River and the interlobate moraine to the east; Sec. 36, T37N R4W and N 1/2 Sec. 1, T36N R4W.

NUMBER OF OCCURRENCES: 6.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 6.6/39.4/0.93.

PLOTS: 9204, 9205, 9324.

**Ecosystem 18:** Well drained to moderately well drained, banded, medium sand, calcareous in C horizon; low-level outwash plain in the Pellston Plain; hemlock - northern hardwood/*Toxicodendron*.

**SYNOPSIS:** Gently sloping outwash plains marginal to wetlands in the Pellston Plain. Well drained to moderately well drained, banded medium sand, calcareous in C horizon; water table between 100 and 200 cm. Trembling aspen - bigtooth aspen - red maple overstory; red maple - serviceberry understory; *Pteridium* - *Oryzopsis* - *Aralia* - *Toxicodendron* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping outwash plains in narrow strips circumferential to wetland depressions; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 214 m.

### Soil

Well drained to moderately well drained medium sand with bands of loamy sand to clay above 150 cm, calcareous in C horizon; water table between 100 and 200 cm in the growing season.

### Vegetation

Many species may occupy the overstory, including trembling and bigtooth aspens, red maple, American elm, and paper birch. Saplings of red maple are common in the understory, along with serviceberry and beaked hazelnut. The ground-cover is characterized by the *Aralia* and *Toxicodendron* species groups; the *Gaultheria*, *Pteridium*, and *Oryzopsis* groups are also present. Presettlement cover type was hemlock - northern hardwood.

### Comments

Type 18 is central in the gradient of calcareous, banded ecosystems 17, 18, and 19, and is typified by moderate pit-and-mound development and the *Aralia* and *Toxicodendron* species groups in the ground-cover.

### Similar Ecosystems

Distinguished from type 17 by its higher water table and by the presence of the *Toxicodendron* species group. Distinguished from type 19 by a deeper water table, due to its relatively higher landscape position, and lack of the *Osmorhiza* species group.

### Location

Between the Chippewa-age dunes and the interlobate moraine on the east side of the Pellston Plain; Sec. 36, T37N R4W, and N 1/2 Sec. 1, T36N R4W.

**NUMBER OF OCCURRENCES:** 4.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.6/6.5/0.15.  
Plots: None.

**Ecosystem 19:** Moderately well drained to somewhat poorly drained, banded, medium sand, calcareous in C horizon; low-level outwash plain in the Pellston Plain; hemlock - northern hardwood/*Osmorhiza*.

**SYNOPSIS:** Gently sloping outwash plains marginal to wetlands in the Pellston Plain. Moderately well drained to somewhat poorly drained, banded, medium sand, calcareous in C horizon; water table between 30 and 100 cm. Red maple - trembling aspen - bigtooth aspen overstory; red maple - serviceberry understory; *Osmorhiza* - *Arisaema* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping outwash plains around the edges of wetland depressions; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 213 - 214 m.

### Soil

Moderately well drained to somewhat poorly drained medium sand with bands of loamy sand to clay, calcareous above 250 cm; water table above 100 cm during the growing season.

### Vegetation

The overstory is dominated by trembling and bigtooth aspens, with red maple, paper birch, white ash, and American elm as associates. Red maple, serviceberry, beaked hazelnut and cranberrybush occupy the understory. The ground-cover includes the *Osmorhiza* and *Arisaema* species groups, and sedges (*Carex* spp.) are common. Presettlement cover type was hemlock northern hardwood.

### Comments

A calcareous "wetland margin" ecosystem, type 19 typically occurs between type 18 and a wetland depression. Its extent depends on slope percent; the more level the slope surrounding the wetland, the wider type 19 will be.

### Similar Ecosystems

Distinguished from adjacent wetlands by a lack of muck soil at the surface and wetland species groups such as *Onoclea* or *Typha*. Distinguished from type 18 by the *Osmorhiza* species group, absent in type 18, and clay bands that are typically thicker than in type 18.

### Location

Around wetland depressions in the eastern portion of the Pellston Plain; SW 1/4 SE 1/4 Sec. 36, T37N R4W, and N 1/2 Sec. 1, T36N R4W.

**NUMBER OF OCCURRENCES:** 8.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.9/7.2/0.17.

**Plots:** None.

**Ecosystem 20:** Well drained to moderately well drained medium sand over clay loam; low-level outwash plain over moraine in the Pellston Plain; hemlock - northern hardwood/*Clintonia*.

**SYNOPSIS:** Gently sloping outwash plain over moraine in the Pellston Plain. Well drained to moderately well drained sand over clay to clay loam. Bigtooth aspen - trembling aspen - white pine overstory; red maple - serviceberry understory; *Pteridium* - *Gaultheria* - *Clintonia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping outwash plain over moraine; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 217 - 218 m.

### Soil

Well drained to moderately well drained, shallow (50 - 300 cm) medium sand outwash over clay till; water table undetermined.

### Vegetation

Bigtooth aspen dominates the overstory; trembling aspen, white pine, paper birch, and white ash are associates. Serviceberry and red maple are the most common understory plants, and the *Pteridium*, *Gaultheria*, and *Clintonia* species groups are all common in the ground-cover, indicating the acidic soil. Presettlement cover type was probably hemlock - northern hardwood.

### Comments

Ecosystem 20 is a "two-storied" ecosystem of outwash sand over clay till. Of very limited extent on UMBS property, it occurs on the gentle foot slopes of the interlobate moraine on the east side of the Pellston Plain. Subsurface water from the moraine flowing over the underlying till keeps moisture availability good throughout the growing season. Most of this gentle slope is not on UMBS property and has recently been clear-cut, so the true extent of type 20 (and types 21 and 22) and its pattern of occurrence is not well known.

### Similar Ecosystems

Distinguished from types 21 and 22 by a lack of the *Osmorhiza* and *Arisaema* species groups.

### Location

In the eastern portion of Pellston Plain outwash plain, where it overlays the lower moraine slope; SW 1/4 SE 1/4 Sec. 36, T37N R4W.

**NUMBER OF OCCURRENCES:** 5.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.8/3.9/0.09.  
**PLOTS:** None.

**Ecosystem 21:** Moderately well drained to somewhat poorly drained medium sand over clay loam; low-level outwash plain over moraine in the Pellston Plain; hemlock - northern hardwood/*Osmorhiza*.

**SYNOPSIS:** Gently sloping outwash plain over moraine in the Pellston Plain. Well drained to somewhat poorly drained medium sand over clay loam. Bigtooth aspen - trembling aspen overstory; northern hardwood - serviceberry understory; *Pteridium* - *Osmorhiza* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping outwash plain over moraine; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 219 m.

### Soil

Moderately well drained to somewhat poorly drained, shallow (50 - 300 cm) medium sand outwash over clay loam till; water table undetermined.

### Vegetation

The overstory is predominantly bigtooth and trembling aspens; red maple, white ash, white pine, yellow birch, and basswood are associates. Saplings of the northern hardwood species and serviceberry are common understory plants. The *Osmorhiza* and *Polygonatum* species groups in the ground-cover, growing with the *Pteridium* and *Aralia* groups, indicate the mesic, nutrient-rich conditions of type 21. Presettlement cover type was hemlock - northern hardwood.

### Comments

Type 21 occurs where sandy outwash overlays clay loam till on the gentle foot slopes of the interlobate moraine. The underlying till impedes downward soil water movement, and subsurface flow from the moraine to the east keeps soil water in the rooting zone throughout the growing season. A mesic forest is developing under the aspen canopy.

### Similar Ecosystems

Distinguished from type 22 by deeper sand over the till, the lack of an A horizon, the lack of a conifer overstory, and the lack of the *Arisaema* species group in the ground-cover. Distinguished from type 20 by lack of the *Clintonia* species group.

### Location

In the eastern portion of the Pellston Plain outwash plain where it meets the lower moraine slope; SW 1/4 SE 1/4 Sec. 36, T37N R4W.

**NUMBER OF OCCURRENCES:** 10.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.6/15.9/0.37.  
**PLOTS:** None.

**Ecosystem 22:** Somewhat poorly drained, medium sand over clay loam; low-level outwash plain over moraine in the Pellston Plain; hemlock - northern hardwood/*Arisaema*.

**SYNOPSIS:** Gently sloping outwash plain over moraine in the Pellston Plain. Moderately well drained to somewhat poorly drained sand over clay loam. White pine - trembling aspen - balsam fir - hemlock overstory; balsam fir - white ash - hemlock understory; *Pteridium* - *Arisaema* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping outwash plain over moraine; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 218 - 219 m.

### Soil

Somewhat poorly drained, shallow (less than 50 cm) medium sand outwash over clay loam till; water table undetermined.

### Vegetation

White pine, trembling aspen, balsam fir, hemlock and northern white-cedar occur in the overstory. The understory is composed of balsam fir, white ash, and hemlock. The ground-cover is typically sparse, with the *Polygonatum*, *Maianthemum*, and *Arisaema* species groups all present; the latter group reflects the very moist and nutrient rich site conditions. Presettlement cover type was probably hemlock - northern hardwood.

### Comments

Ecosystem 22 occurs where clay loam till is within 50 cm of the surface; it covers a very small area on UMBS property. Till so near the surface contributes to the wet-mesic conditions, enabling the *Arisaema* species group to occur here.

### Similar Ecosystems

Distinguished from types 20 and 21 by shallower outwash over the till, the presence of an A horizon, and the greater abundance of conifers in the overstory. Distinguished from type 16 by clay loam till near the surface, gently sloping topography, and the presence of occasional stones and boulders at the surface.

### Location

Near the base of the gentle foot slope on the east side of the Pellston Plain; SW 1/4 SE 1/4 Sec. 36, T37N R4W.

**NUMBER OF OCCURRENCES:** 2.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.9/3.8/0.09.

**Plots:** None.

**Ecosystem 23:** Outwash-lake plain shrub willow swamp in Pellston Plain; willow/*Onoclea*.

**SYNOPSIS:** Small depressions in outwash plain on the Pellston Plain. Groundwater-fed; sand mixed with muck over sand. No overstory or understory; *Onoclea* - *Rhamnus* ground-cover species groups. Shrub willow presettlement cover type. One plot.

### Physiography

**LANDFORM:** Small topographic depressions in level to very gently sloping outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 218 - 220 m.

### Hydrology

Subsurface flow originating in extensive upland-wetland complex to northwest; water at the surface in spring, below 75 cm in late summer (saturated<sup>1</sup>); pH < 6.0.

### Soil

A horizon (32 cm thick; 50 % mineral soil content in sapric muck matrix) over medium sand; pH 5.0 at 10 cm.

### Vegetation

**OVERSTORY:** Absent.

**UNDERSTORY:** Absent.

**GROUND COVER:** Dominant species groups: *Onoclea*, *Rhamnus*. Most common ground-cover species: *Salix* spp., *Carex comosa*, *Dryopteris spinulosa*, *Scutellaria lateriflora*, *Solanum dulcamara*. Most common tree species in ground-cover: red maple.

### Comments

Greg Zogg's type 1 (Zogg 1993). Of very limited distribution, occurring in small, wet depressions in the midst of uplands. It probably has the most drastic change in water level throughout growing season of any UMBS wetland type.

### Similar Ecosystems

Clearly distinguished from other types in Pellston Plain (types 24 - 27 and 29 - 33) by dense coverage of *Salix* spp. and predominantly mineral hydric soils.

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<sup>1</sup> Refers to the water regime modifier of Cowardin et al. (1979).

**Location**

Three small areas: one in the Maple River wetlands (SE 1/4 SE 1/4 Sec. 24, T37N R4W) and two northwest of Marl Bay (NE 1/4 NW 1/4 Sec. 18 T37N R3W).

NUMBER OF OCCURRENCES: 3.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.8/8.5/0.20.

PLOTS: 9248.

**Ecosystem 24:** Outwash-lake plain shrub alder swamp in Pellston Plain; alder /*Onoclea*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain. Groundwater-fed; sapric muck over medium sand. Sparse black ash - balsam poplar overstory; alder understory; *Onoclea* - *Typha* - *Coptis* ground-cover species groups. Alder presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Level to very gently sloping outwash plain reworked by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 218 m.

### Hydrology

Subsurface flow originating in extensive upland-wetland complex to northwest, draining into Douglas Lake; standing water in spring, at 40-60 cm in late summer (seasonally flooded); pH 6.8.

### Soil

Less than 50 cm (average 40 cm) sapric muck over medium sand; pH 7.3 at 10 cm.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): black ash (35/36/60), trembling aspen (23/21/40), willows (20/20/20). Other species: balsam poplar, red maple. Mean no. of stems/plot = 9.

**UNDERSTORY:** Most common species (% rel. density/% frequency): speckled alder (93/100). Other species: black ash, balsam poplar, red maple, willow, nannyberry. Mean no. of stems/plot = 197.

**GROUND COVER:** Dominant species groups: *Onoclea*, *Typha*, *Coptis*. Most common ground-cover species: *Alnus rugosa*, *Solanum dulcamara*, *Glyceria striata*. Most common tree species in ground-cover: black ash, red maple, balsam poplar.

**PRESETTLEMENT COVER TYPE:** Shrub alder.

### Comments

Greg Zogg's type 2 (Zogg 1993). This type has the highest values for water chemistry parameters (pH, Ca and Mg concentration, specific conductivity, total alkalinity) among the Pellston Plain wetlands.

### Similar Ecosystems

Distinguished from type 25 by open canopy, but has considerable overlap in ground flora species; hydrologic linkage to Maple River unlikely; additional sampling would be useful to test for differences among the two types (e.g., to what extent can vegetative differences be explained by light conditions associated with human-caused disturbance).

**Location**

In the Maple River wetlands SE 1/4 Sec. 24, T37N R4W) and just north of Robinson Rd. (SE 1/4 Sec. 36, T37N R4W).

NUMBER OF OCCURRENCES: 6.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 3.8/22.6/0.53.

PLOTS: 9242, 9243, 9245, 9246, 9247.

**Ecosystem 25:** Outwash-lake plain hardwood swamp in Pellston Plain; American elm - red maple - black ash/*Onoclea*.

**SYNOPSIS:** Level outwash plain in the Pellston Plain. Groundwater-fed; sapric muck over medium sand. Red maple - black ash overstory; speckled alder - red maple - wild raisin - black ash understory; *Onoclea* - *Ilex* - *Coptis* ground-cover species groups. Elm - red maple - black ash presettlement cover type. Six plots.

### Physiography

**LANDFORM:** Level to very gently sloping outwash plain reworked by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 217 - 218 m.

### Hydrology

Subsurface flow originating in extensive upland-wetland complex to northwest and Maple River (draining out of Douglas Lake); water occasionally up to 20 cm above surface in spring, below 50 cm in late summer (seasonally flooded); pH 6.25.

### Soil

Less than 50 cm sapric muck (avg. 40 cm) over medium sand, typically with a thin (< 10 cm) layer of silt loam - fine sandy loam at *ca* 100 cm; pH 7.0 at 10 cm.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): red maple (77/81/100), black ash (12/15/33). Other species: silver maple, trembling aspen, balsam poplar, American elm, paper birch. Mean no. of stems/plot = 12.

**UNDERSTORY:** Most common species (% rel. density/% frequency): speckled alder (39/83), red maple (20/100), wild-raisin (15/17), black ash (14/83). Other species: nannyberry, winterberry, trembling aspen, balsam poplar, American elm, American cranberry-bush, wild grape. Mean no. of stems/plot = 95.

**GROUND COVER:** Dominant species groups: *Onoclea*, *Ilex*, *Coptis*. Most common ground-cover species: *Onoclea sensibilis*, mosses, *Alnus rugosa*, *Ilex verticillata*. Most common tree species in ground-cover: red maple, black ash, American elm.

**PRESETTLEMENT COVER TYPE:** elm - red maple - black ash.

### Comments

Greg Zogg's type 3 (Zogg 1993). This is a rich, hardwood-dominated ecosystem located between Maple River riparian wetlands (types 31 - 33) and Douglas Lake or type 24. It has some hydrological linkage to the Maple River.

### Similar Ecosystems

Distinguished from the main types in Reese's Swamp (types 53 - 56) by higher water table in the spring, but more rapid draw-down throughout growing season, dominance of

hardwoods, and virtual absence of balsam fir, white spruce, hemlock, and northern white-cedar in any strata (perhaps unable to establish given current hydrologic regime, although they may have been components in presettlement time).

#### **Location**

In the Maple River wetlands (SE 1/4 Sec. 24 and NE 1/4 Sec. 25, T37N R4W, and NW 1/4 Sec. 30, T37N R3W) north of Robinson Rd. (SE 1/4 Sec. 36, T37N R4W) and north of Marl Bay (N 1/2 Sec. 18, T37N R3W).

NUMBER OF OCCURRENCES: 8.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 8.2/65.4/1.54.

PLOTS: 8817, 9133, 9134, 9153, 9249, 9250.

**Ecosystem 26:** Outwash-lake plain conifer swamp in Pellston Plain; northern white-cedar - white spruce - balsam fir/*Coptis*.

**SYNOPSIS:** Level outwash plain on the Pellston Plain. Groundwater-fed; muck over sand over clay or sandy clay loam. Northern white-cedar - balsam fir - trembling aspen overstory; northern white-cedar - balsam fir understory; *Coptis* - *Clintonia* ground-cover species groups. Northern white-cedar - white spruce - balsam fir presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping outwash plain or outwash plain over moraine covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 219 - 224 m.

### Hydrology

Groundwater-fed; water at 30 - 50 cm in late summer.

### Soil

40 - 50 cm sapric muck over medium sand; till may be within 3 m of the surface near the interlobate moraine.

### Vegetation

Northern white-cedar, balsam fir, and trembling aspen form the overstory. The understory is composed of northern white-cedar and balsam fir. Ground-cover species groups include *Coptis* and *Clintonia*; mosses have high coverage. Presettlement cover type was northern white-cedar - white spruce - balsam fir.

### Comments

Type 26 is of limited extent on UMBS land; a much more extensive conifer wetland is on adjacent land just west of the interlobate moraine.

### Similar Ecosystems

Other conifer wetlands in outwash plains (types 55 and 56) differ in that they are not subject to the climatic extremes of the Pellston Plain.

### Location

Occurs in two areas: one near the southwest corner of UMBS property (SW 1/4 SW 1/4 Sec. 6, T36N R3W) and one northwest of Marl Bay (N 1/2 Sec. 18, T37N R3W).

**NUMBER OF OCCURRENCES:** 6.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.3/7.5/0.18.

**PLOTS:** None.

**Ecosystem 27:** Outwash-lake plain foot-slope hardwood swamp in Pellston Plain; American elm - red maple - black ash/*Arisaema*.

**SYNOPSIS:** Gently sloping drainages on the Pellston Plain. Intermittent surface-flow; medium sand over clay loam. Trembling aspen overstory; black ash - white ash - red maple understory; *Arisaema* - *Osmorhiza* ground-cover species groups. Elm - red maple - black ash presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping drainage in outwash plain over moraine covered by glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 216 - 220 m.

### Hydrology

Intermittent stream, groundwater-fed; water at surface in spring, 30 - 70 cm in summer.

### Soil

5 - 10 cm sapric muck over 0 - 60 cm medium sand outwash over clay loam till.

### Vegetation

Trembling aspen dominates an overstory that may include white ash, basswood, black ash, red maple, or American elm. Black ash, white ash, and red maple are common in the understory. The ground-cover is lush and species rich, including the *Arisaema*, *Osmorhiza*, and *Polygonatum* species groups. Presettlement cover type was likely American elm - red maple - black ash.

### Comments

These narrow, linear drainages extend down into UMBS property only 100 - 150 m. It may be possible to further distinguish them based on depth to clay and corresponding vegetational patterns.

### Similar Ecosystems

Distinguished from types 118 and 119 by being in a more climatically extreme location and comprising narrower drainages.

### Location

At the eastern edge of the Pellston Plain where it meets the gentle lower slope of the interlobate moraine; SE 1/4 Sec. 36, T37N R4W.

**NUMBER OF OCCURRENCES:** 6.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.1/0.8/0.02.

**PLOTS:** None.

**Ecosystem 28:** Moderately well drained medium sand, calcareous in C horizon; alluvial terrace in Pellston Plain; American elm - balsam poplar - red ash/*Toxicodendron*.

**SYNOPSIS:** Level alluvial terrace on the Pellston Plain. Moderately well drained medium sand, calcareous in C horizon; water table between 30 and 150 cm. Balsam poplar - trembling aspen - elm overstory; maple-leaf viburnum - nannyberry - alder understory; *Toxicodendron* - *Rhamnus* ground-cover species groups. Elm - balsam poplar - red ash presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping alluvial terrace; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 205 - 215 m.

### Soil

Moderately well drained to well drained medium sand and coarse sand with gravel, calcareous in C horizon below 75 cm; water between 30 and 150 cm all year.

### Vegetation

The overstory is a mixture of balsam poplar, trembling aspen, American elm, red maple, basswood, and occasional red ash. The understory is typically dense with maple-leaf viburnum, nannyberry, and some speckled alder. Upland and wetland species occur in the ground-cover, such as the *Toxicodendron* and *Rhamnus* species groups, and *Thalictrum dioicum*, *Clematis virginiana*, and many grasses, young shrubs, and tree seedlings. Presettlement cover type was likely American elm - balsam poplar - red ash.

### Comments

Some of the terraces identified as type 28 appear to be of alluvial deposits, whereas others were likely carved out of the glacial outwash plain as the Maple River cut off meanders. High light intensity, calcareous soil, and good moisture availability likely contribute to the lush, species-rich ground flora.

### Similar Ecosystems

Distinguished from often adjacent types 31, 32, and 33 by a lack of muck at the soil surface, absence of standing water, and lower coverage of wetland species, especially the *Onoclea* species group.

### Location

Along the Maple River from just north of its confluence with Van Creek (NW 1/4 Sec. 25, T37N R4W) to the southern UMBS boundary (NE 1/4 Sec. 2, T36N R4W).

**NUMBER OF OCCURRENCES:** 17.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.8/47.1/1.11.

**PLOTS:** None.

**Ecosystem 29:** Outwash-lake plain hardwood intermittent stream channel swamp in Pellston Plain; black ash - elm/*Onoclea*.

**SYNOPSIS:** Stream channel in level outwash plain in the Pellston Plain. Intermittent flow; muck over sand and gravel. Trembling aspen - balsam poplar overstory; willow - black ash - elm understory; *Onoclea* - *Typha* ground-cover species groups. Black ash - elm presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to very gently sloping intermittent stream channel in outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 217 - 220 m.

### Hydrology

Intermittent stream flow; water table varies from above the surface to 30 cm depth throughout growing season (seasonally flooded); pH 6.5 - 7.0.

### Soil

Highly variable; 5 - 30 cm sapric muck over medium sand and gravel; pH 7.0 at 10 cm.

### Vegetation

Trembling aspen and balsam poplar dominate the overstory; associates include black ash, willows, paper birch, American elm, northern white-cedar, and rarely red ash. Willows, black ash, American elm, and speckled alder compose the understory. The *Onoclea* species group is very common and the *Typha* group common in the ground-cover. Species that prefer flowing water, including *Caltha palustris* and *Myosotis scorpioides* occupy the narrow intermittent stream channels. Presettlement cover type was black ash - elm.

### Comments

Greg Zogg's type 4 (Zogg 1993) has been split here into forested and non-forested types 29 and 30. The non-forested areas occur often enough and are sufficiently easy to map to merit this distinction.

### Similar Ecosystems

Distinguished from types 31 and 32 by greater diversity of ground flora and more variable light conditions.

### Location

Along Van Creek (S 1/2 Sec. 23, T37N R4W) and the stream flowing into Marl Bay (NE 1/4 NE 1/4 Sec. 18, T37N R3W).

**NUMBER OF OCCURRENCES:** 4.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 4.9/19.6/0.46.

**PLOTS:** None.

**Ecosystem 30:** Outwash-lake plain herbaceous intermittent stream channel marsh in Pellston Plain; sweet gale - meadowsweet/*Typha*.

**SYNOPSIS:** Stream channel in level outwash plain. Intermittent flow; muck over sand and gravel. No overstory; willow - alder understory; *Typha* ground-cover species groups. No plots.

### Physiography

**LANDFORM:** Level to very gently sloping intermittent stream channel, becoming ponded in summer, in outwash plain covered by Glacial Lake Algonquin; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 218 - 220 m.

### Hydrology

Intermittent stream flow; water table varies from above the surface to 30 cm depth throughout growing season (seasonally flooded); pH 6.5 - 7.0.

### Soil

Highly variable; 5 - 30 cm sapric muck over medium sand and gravel; pH 7.0 at 10 cm.

### Vegetation

No overstory. Scattered willows and speckled alders compose the sparse understory. *Myrica gale* and *Spiraea alba* are ground-cover shrubs; the *Typha* species group dominates the ground-cover species groups.

### Comments

Greg Zogg's type 4 (Zogg 1993) has been split here into forested and non-forested types 29 and 30.

### Similar Ecosystems

Distinguished from type 31 by shorter duration of inundation and intermittent stream flow.

### Location

Along Van Creek; SW 1/4 Sec. 23, T37N R4W.

**NUMBER OF OCCURRENCES:** 5.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.8/4.0/0.09.

**PLOTS:** None.

**Ecosystem 31:** Outwash-lake plain herbaceous streamside marsh in Pellston Plain; sweet gale - meadowsweet/*Typha*.

**SYNOPSIS:** Level streamside flats in the Pellston Plain. Stream-fed; muck over alluvium and sand. No overstory; willow understory; *Typha* ground-cover species groups. No plots.

### Physiography

**LANDFORM:** Level to gently sloping streamside flat; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 216 - 217 m.

### Hydrology

Stream and groundwater inputs; water above surface in spring, below 20 cm in late summer (semipermanently flooded); pH 6.5.

### Soil

20 - 40 cm sapric (and occasionally hemic) muck over alluvium and sand; pH 6.5 at 10 cm.

### Vegetation

No overstory. Sparse willows form the understory. The *Typha* species group is dominant in the ground-cover; the shrubs *Myrica gale* and *Spiraea alba* also occur.

### Comments

Greg Zogg's type 5 (Zogg 1993). This type is common in upper reaches of the Maple River and is characterized by very high light conditions.

### Similar Ecosystems

Distinguished from type 32 by total absence of overstory vegetation, and a low density understory; characterized by longer duration of flooding (permanently flooded in some years) than either type 30 or 32.

### Location

Along the Maple River; SE 1/4 Sec. 24 and NE 1/4 NE 1/4 Sec. 25, T37N R4W.

**NUMBER OF OCCURRENCES:** 5.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.5/2.4/0.06.

**PLOTS:** None.

**Ecosystem 32:** Outwash-lake plain shrub alder streamside swamp in Pellston Plain; alder/*Onoclea*.

**SYNOPSIS:** Level streamside flat in the Pellston Plain. Stream-fed; muck over sand. Trembling aspen - balsam poplar overstory; speckled alder understory; *Onoclea* - *Typha* ground-cover species groups. Elm - balsam poplar - red ash presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping streamside flat; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 208 - 217 m.

### Hydrology

Stream and groundwater inputs; water above surface in spring, at 20 - 50 cm in late summer (seasonally flooded); pH 6.5.

### Soil

25 cm sapric muck over medium sand.

### Vegetation

Sparse overstory trembling aspens and balsam poplars occur. The understory is a dense thicket of speckled alder. The *Onoclea* and *Typha* species groups typify the ground-cover species groups. Presettlement forest was likely American elm - balsam poplar - red ash.

### Comments

Greg Zogg's type 6 (Zogg 1993), type 32 comprises considerable area along lower reaches of the Maple River, often adjacent to (upland) floodplains characterized by very infrequent inundation; occurrence is sometimes associated with beaver dams.

### Similar Ecosystems

Distinguished from types 29 - 31 by a dense shrub layer of speckled alder.

### Location

Along the Maple River from roughly 1/4 mile downstream from Maple Bay (NE 1/4 NE 1/4 Sec. 25, T37N R4W) to Robinson Rd. (NE 1/4 NW 1/4 Sec. 36, T37N R4W).

**NUMBER OF OCCURRENCES:** 21.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.5/10.3/0.24.

**PLOTS:** None.

**Ecosystem 33:** Riverine oxbow hardwood swamp in Pellston Plain; American elm - balsam poplar - red ash/*Onoclea*.

**SYNOPSIS:** Level abandoned channels in the Pellston Plain. Stream-fed; muck over sand. Balsam poplar - trembling aspen - elm overstory; speckled alder - nannyberry understory; *Onoclea* ground-cover species groups. Elm - balsam poplar - red ash presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to very gently sloping abandoned stream channel; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 211 - 215 m.

### Hydrology

Flooded by stream or inundated via groundwater flow in early spring, cut off from stream at least by late spring but portions may remain inundated into late summer.

### Soil

10 - 30 cm sapric muck over medium and coarse sand.

### Vegetation

Balsam poplar, trembling aspen, American elm, and red maple dominate the overstory. Speckled alder usually forms a dense understory, complimented by nannyberry, maple-leaf viburnum, and small elms. The *Onoclea* species group is abundant in the ground-cover; the *Toxicodendron* and *Rhamnus* groups are also present. Presettlement cover type was probably American elm - balsam poplar - red ash.

### Comments

Depth of muck and water in type 33 vary relative to depth of the abandoned channel and length of time since abandonment. More recently abandoned and deeper channels have less accumulated muck and deeper water and a greater abundance of herbaceous vegetation relative to shrubs and trees.

### Similar Ecosystems

Distinguished from types 29 and 30 by a lack of flowing water and species that prefer flowing water, such as *Caltha palustris* and *Myosotis scorpioides*.

### Location

Along the Maple River from just north of its confluence with Van Creek (NW 1/4 Sec. 25, T37N R4W) to 1/2 mile south of Douglas Lake Rd. (NW 1/4 NW 1/4 Sec. 36, T37N R4W).

**NUMBER OF OCCURRENCES:** 6.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.1/6.5/0.15.

**PLOTS:** None.

**Ecosystem 34:** Somewhat excessively drained medium sand; dunes on low-level outwash plain in the Pellston Plain; white pine - red pine - hemlock - red oak/*Gaultheria*.

**SYNOPSIS:** Gently to steeply sloping dunes over outwash plain in the Pellston Plain. Somewhat excessively drained medium sand. Bigtooth aspen - red maple overstory; white pine - red maple understory; *Pteridium* - *Gaultheria* - *Maianthemum* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. Two plots.

### Physiography

**LANDFORM:** Chippewa-age dunes over outwash plain; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**SLOPES:** Gently to steeply sloping (3.5 - 25%); all aspects.

**ELEVATION:** 216 - 221 m.

### Soil

**DRAINAGE:** Somewhat excessively drained; water table below 300 cm all year.

**TEXTURE:** Medium sand in all horizons.

**pH:** 4.4 (4.1 - 4.7) in E horizon to 5.5 (5.4 - 5.7) in C.

**DEVELOPMENT:** Organic horizons moderately developed, Oi 2.25 cm thick, Oe 1.25 cm, Oa 0.67 cm; no A horizon; E horizon well developed, 19 (18 - 20) cm thick; Bs horizons well developed, Bs1 19 cm and Bs2 or BC horizon 55 (52 - 57) cm thick.

**PEBBLES AND COBBLES:** Absent.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): red maple (54/66/100), bigtooth aspen (23/30/50). Other species: red pine, red oak, trembling aspen, white pine, white birch. Mean no. of stems/plot = 31.

**UNDERSTORY:** Most common species (% rel. density/% frequency): white pine (60/100), red maple (23/100), red pine (12/50). Other species: red oak, serviceberry, beech. Mean no. of stems/plot = 85.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Maianthemum*. Most common ground-cover species: *Pteridium aquilinum*, *Gaultheria procumbens*, *Amelanchier* spp., *Vaccinium angustifolium*, *Maianthemum canadense*. Most common tree species: red oak, white pine, red maple.

**PRESETTLEMENT FOREST:** white pine - red pine - hemlock - red oak.

### Comments

These dunes are thought to have developed in the dry Chippewa period, roughly 7500 years ago. Blowing sand accumulated on the eastern margin of the abandoned outwash channel, the center of which is now occupied by the East Branch of the Maple River. They

reach a height of 6 m above the underlying outwash plain and in general appear less severely disturbed than the outwash ecosystems to the west; organic horizons are thicker on the dunes and there is less of the *Cladina* species group in the ground-cover. Abundant red maple in the overstory reflects influence of the mesic to wet ecosystems east of the dunes, but white pine will likely become more dominant in the future.

### Similar Ecosystems

Type 34 is most similar to the dunes in high-level terrain, type 74. Both types have very similar physiography, soil profile development, and vegetation. Type 34 experiences climatic extremes and type 74 is more moderated. Type 34 is distinguished from types 1, 36, and 37 by gently to moderately sloping "dune" physiography and total lack of pebbles in the soil.

### Location

In a roughly north-south line that marks the eastern margin of the central outwash channel, now occupied by the East Branch of the Maple River; S 1/2 Sec. 25 and Sec. 26, T37N R4W, and N 1/2 Sec. 1, T36N R4W. Chippewa-age dunes also occur parallel to the main Maple River, to the west of UMBS property.

NUMBER OF OCCURRENCES: 6.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 5.5/32.7/0.77.

PLOTS: 9228, 9323.

**Ecosystem 35:** Well drained medium sand over sandy clay loam; glacial lake beach over moraine in Pellston Plain; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Gently sloping beach over moraine in the Pellston Plain. Well drained medium sand over sandy loam to sandy clay loam. Bigtooth aspen - northern hardwood overstory; hop-hornbeam - sugar maple - red maple understory; *Pteridium* - *Polygonatum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping Glacial Lake Algonquin beach over moraine; within broad, climatically extreme Pellston Plain that is a cold air sink due to position between elevated portions of the Emmet Moraine to the east and west.

**ELEVATION:** 220 - 229 m.

### Soil

Well drained, gravely, medium sand, 1 - 1.5 meters in depth, over sandy loam to sandy clay loam till.

### Vegetation

A mosaic of disturbance-related overstory vegetation including old fields, young bigtooth aspen clones, and northern hardwood forest. The understory in forested areas includes hop-hornbeam, sugar maple, and red maple. The *Polygonatum* species group is characteristic; other ground-cover species include *Corylus cornuta* and the *Polygala* species group. Presettlement cover type was probably hemlock - northern hardwood.

### Comments

Type 35 is a relatively inconspicuous Glacial Lake Algonquin beach extending south on the west side of the interlobate moraine from the more dramatic Algonquin-age feature at the northern tip of the moraine.

### Similar Ecosystems

Distinguished from type 109, adjacent upslope from type 35, by a lower percent slope and the surficial gravely, calcareous beach deposit. Distinguished from other Lake Algonquin shoreline features (types 75 - 78) by glacial till within 3 m of the surface.

### Location

A north-south linear strip along the northwest lower slope of the interlobate moraine; SE 1/4 Sec. 25, T37N R4W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 7.8/7.8/0.18.

**PLOTS:** None.

**Ecosystem 36:** Excessively drained medium sand; high-level outwash-lake plain; white pine - red pine - hemlock - red oak/*Gaultheria*.

**SYNOPSIS:** Level to gently sloping high-level outwash plain. Excessively drained medium sand, acidic in all horizons. Bigtooth aspen - red oak - red pine overstory; white pine - red maple - trembling aspen understory; *Pteridium* - *Cladina* - *Gaultheria* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. Seventeen plots.

### Physiography

**LANDFORM:** High-level outwash plain reworked by Glacial Lake Algonquin.

**SLOPES:** Gently sloping (1 - 5%); mostly southwest to southeast aspects.

**ELEVATION:** 195 - 225 m.

### Soil

**DRAINAGE:** Excessively drained.

**TEXTURE:** Medium sand (occasionally fine or coarse sand) in all horizons.

**pH:** 4.8 (4.1 - 5.5) in E horizon to 6.0 (5.2 - 6.9) in C.

**DEVELOPMENT:** Organic horizons poorly developed, Oi 1.8 cm thick, Oe 0.8 cm, Oa 0.7 cm; no A horizon; E horizon moderately developed, 12 (6 - 19) cm thick, occasionally with a salt-and-pepper layer up to 8 cm thick; Bs1 horizon moderately to well developed, 29 (6 - 52) cm; Bs2 usually present, 24 (4 - 36) cm; BC horizon usually present, 29 (4 - 81) cm.

**PEBBLES AND COBBLES:** Pebbles 0 - 5% in upper (E and B) horizons, 0 - 50% in C; cobbles usually absent, less than 3% throughout.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (35/46/88), red oak (28/29/91), and red pine (16/13/53). Other species: white pine, red maple, trembling aspen, paper birch, beech. Mean no. of stems/plot = 29.

**UNDERSTORY:** Most common species (% rel. density/% frequency): white pine (37/94), red maple (37/88), red pine (15/77). Other species: red oak, beech, bigtooth aspen, paper birch, serviceberry, jack pine, black cherry, American elm, trembling aspen. Mean no. of stems/plot = 24.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Cladina*, *Gaultheria*. Most common ground-cover species: *Pteridium aquilinum*, *Cladina* spp., *Vaccinium angustifolium*, *Carex pennsylvanica*, *Gaultheria procumbens*. Most common tree species: white pine, red oak, red pine. The ground-cover is the most sparse of all high-level outwash ecosystems. Some areas were burned so severely that the organic soil surface horizons have been destroyed entirely, and mosses and lichens form the only ground-cover species groups. Less disturbed areas typically have high coverages of blueberries, huckleberries, and wintergreen, and occasionally *Cypripedium acaule*.

### Comments

Type 36 is familiar to students and researchers at UMBS as "poor aspen," being, of the high-level ecosystems, the driest and most depauperate and having the shortest aspens. Aspen height and apparent vigor is indeed less here than in ecosystems with banded or calcareous soils, and less than those with water table within three meters of the surface. Type 36 shows the effects of logging and burning: scarified soils with abundant charcoal near the surface, high coverage of lichens and many charred pine stumps. Some areas have old red pines (greater than 100 years), many with fire scars, although most of the type supports bigtooth aspen - red oak forest with dominant trees between 60 and 70 years old.

### Similar Ecosystems

Distinguished from type 37 by being below the Glacial Lake Algonquin shoreline and generally lower pH in the C horizon. Distinguished from type 1 by a more moderated climate, fewer trembling aspens and more bigtooth aspens in the overstory. Distinguished from type 38 by a lack of the *Aralia* species group. Distinguished from type 39 by an absence of loamy sand bands in the soil and lower coverage of the *Maianthemum* species group.

### Location

Occurs on the Glacial Lake Algonquin lake floor south of Riggsville Road; parts of Sec. 3 - 7, T36N R3W, and Sec. 32 - 34, T37N R3W.

NUMBER OF OCCURRENCES: 16.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
17.8/284.5/6.70.

PLOTS: 8918, 9111, 9122, 9126, 9150, 9408, 9409, 9410, 9411, 9412, 9413, 9417, 9423, 9424, 9425, 9446, 9447.

**Ecosystem 37:** Excessively drained medium sand; high-level outwash plain; white pine - red pine - hemlock - red oak/*Gaultheria*.

**SYNOPSIS:** Level to gently sloping high-level outwash plain. Excessively drained medium sand, acidic in all horizons. Bigtooth aspen - red oak - red maple overstory; white pine - red pine - paper birch understory; *Pteridium* - *Gaultheria* - *Cladina* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. Thirteen plots.

### Physiography

**LANDFORM:** High-level outwash plain above the Glacial Lake Algonquin shoreline.

**SLOPES:** Level to gently sloping (1 - 5%); mostly southwest to southeast aspects.

**ELEVATION:** 225 - 241 m.

### Soil

**DRAINAGE:** Excessively drained.

**TEXTURE:** Medium sand (rarely fine sand) in all horizons.

**pH:** 4.8 (4.2 - 5.4) in E horizon to 6.3 (5.5 - 8.5) in C.

**DEVELOPMENT:** Organic horizons poorly developed, Oi 2.3 cm thick, Oe 0.7 cm, Oa 0.8 cm; no A horizon; E horizon moderately developed, 15 (6 - 22) cm thick; Bs1 horizon moderately to well developed, 28 (15 - 65) cm; Bs2 usually present, 24 (10 - 38) cm; BC horizon usually present, 51 (19 - 125) cm.

**PEBBLES AND COBBLES:** Pebbles 0 - 5% in upper (E and B) horizons, 0 - 25% in C; cobbles usually absent, less than 5% throughout.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (43/54/88), red oak (30/27/91), and red maple (17/15/79). Other species: white pine, red pine, paper birch, beech. Mean no. of stems/plot = 32.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (46/92), white pine (19/85), beech (11/46), red oak (10/62). Other species: red pine, bigtooth aspen, paper birch, serviceberry, black cherry. Mean no. of stems/plot = 34.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Cladina*, rarely *Aralia*. Most common ground-cover species: *Pteridium aquilinum*, *Cladina* spp., *Vaccinium angustifolium*, *Amelanchier* spp., *Gaultheria procumbens*. Most common tree species: red maple, red oak, white pine, bigtooth aspen. The ground-cover here is not as depauperate as in type 36, though burning is evident.

### Comments

As part of an archipelago of islands in Glacial Lake Algonquin, the sand in type 37 was not subject to wave action and rinsing by lake waters. That is one theory for the generally higher pH of sands above the glacial shoreline than those below. Type 37 is generally on

the southern portion of the outwash "islands," further from Douglas Lake and its potential effects on humidity and temperature than types 44 - 46, which are more calcareous and support different ground-cover and overstory vegetation.

### Similar Ecosystems

Distinguished from type 36 by being above the Glacial Lake Algonquin shoreline and generally higher pH in the C horizon. Distinguished from type 1 by a more moderated climate, fewer trembling aspens and more bigtooth aspens in the overstory. Distinguished from type 38 by a lack of the *Aralia* species group. Distinguished from type 39 by an absence of loamy sand bands in the soil and lower coverage of the *Maianthemum* species group.

### Location

Occurs on the broad outwash plain south of Douglas Lake; parts of Sec. 25 - 27 and 30 - 34, T37N R3W.

NUMBER OF OCCURRENCES: 4.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
52.4/209.8/4.94.

PLOTS: 8805, 8913, 8919, 9414, 9415, 9416, 9418, 9419, 9420, 9421, 9422, 9458, 9459.

**Ecosystem 38:** Somewhat excessively drained medium sand; high-level outwash plain within 0.5 km of Douglas Lake and the interlobate moraine; white pine - red pine - hemlock - red oak/*Aralia*.

**SYNOPSIS:** Level to gently sloping high-level outwash plain. Somewhat excessively drained medium to fine sand, acidic in all horizons. Bigtooth aspen - beech - red maple overstory; beech - red oak understory; *Pteridium* - *Aralia* - *Maianthemum* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. One plot.

### Physiography

**LANDFORM:** A narrow strip of high-level outwash plain within 0.5 km of Douglas Lake and the interlobate moraine.

**SLOPES:** Level to gently sloping (0 - 3%); southeast to northeast aspect.

**ELEVATION:** 231 - 241 m.

### Soil

**DRAINAGE:** Excessively drained.

**TEXTURE:** Medium sand to fine sand in all horizons.

**pH:** 4.8 in E horizon to 5.8 in C.

**DEVELOPMENT:** Organic horizons well developed, Oi 2.5 cm thick, Oe 1.2 cm, Oa 3 cm; no A horizon; E horizon well developed, 19 cm thick; Bs1 17 cm thick; Bs2 23 cm thick; BC 55 cm thick.

**PEBBLES AND COBBLES:** Pebbles 1% or less in all horizons; cobbles absent.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): beech (43/62), red maple (27/23), bigtooth aspen (20/13). Other species: sugar maple, red oak. Number of trees/plot = 30.

**UNDERSTORY:** Most common species (% rel. density): beech (53), red oak (32). Other species: red maple, sugar maple, bigtooth aspen. Number of stems/plot = 34.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Aralia*, *Maianthemum*. Most common ground-cover species: *Pteridium aquilinum*, *Acer pensylvanicum*, *Amelanchier* spp., *Vaccinium angustifolium*, *Maianthemum canadense*. The most common tree species in the ground-cover are red oak, white birch, and red maple.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

Deep, well-sorted outwash sand typifies the soil of type 38, making it very similar to types 36 and 37. However, the ground-cover vegetation includes the *Aralia* species group,

indicating greater effective moisture. The source of the increased moisture is unclear, but may be related to proximity to Douglas Lake or the interlobate moraine. If till exists at a depth greater than that sampled (4.5 m) but within the reach of deep-rooting species like red oak, moisture could be entering the system via that route. Alternatively, but not exclusively, the long term effect of proximity to Douglas Lake could influence effective moisture directly through climatic moderation and added humidity and indirectly through less susceptibility to fire, reducing loss of organic horizons.

### Similar Ecosystems

Distinguished from types 1, 36, and 37 by closer proximity to the interlobate moraine and Douglas Lake, presence of the *Aralia* species group, and greater thickness of soil organic horizons, especially the Oa.

### Location

On the north rim of high-level outwash plain south of Maple Bay of Douglas Lake; SE 1/4 Sec. 30, T37N R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
15.5/15.5/0.36.

PLOTS: 9318.

**Ecosystem 39:** Somewhat excessively drained, banded, medium sand; high-level outwash-lake plain; white pine - red pine - hemlock - red oak/*Maianthemum*.

**SYNOPSIS:** Level to gently sloping outwash plain below the Glacial Lake Algonquin shoreline. Somewhat excessively drained, banded, medium sand, acidic in all horizons. Bigtooth aspen - red maple - white birch overstory; red maple - red oak understory; *Pteridium* - *Gaultheria* - *Maianthemum* ground-cover species groups. Presettlement cover type was white pine - red pine - hemlock - red oak. Four plots.

### Physiography

**LANDFORM:** Outwash in low topographic positions typically modified by glacial lakes.

**SLOPES:** Level to moderately sloping (1 - 7%); all aspects.

**ELEVATION:** 192 - 225 m.

### Soil

**DRAINAGE:** Somewhat excessively drained.

**TEXTURE:** Medium sand to fine sand; thin bands of loamy sand to sandy loam (less than 10 cm accumulated thickness in the upper 200 cm) occur at various depths.

**pH:** 4.8 (4.3 - 6.2) in E horizon; 5.9 (5.3 - 7.3) in C.

**DEVELOPMENT:** Organic horizons poorly developed, Oi 2.9 cm thick, Oe 1.4 cm, Oa 0.6 cm; no A horizon; E horizon well developed, 17 (10 - 35) cm; Bs1 well developed, 34 (18 - 48) cm; Bs2 also well developed, 26 (19 - 34) cm.

**PEBBLES AND COBBLES:** Pebbles usually 0 - 3%; cobbles 1% or less.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (62/75/89), red maple (20/15/67). Other species: trembling aspen, red oak, paper birch, white pine. Mean no. of stems/plot = 38.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (35/100), beech (24/50), paper birch (17/50), red oak (11/50). Other species: serviceberry, white pine, balsam fir. Mean no. of stems/plot = 20.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Maianthemum*, and rarely *Aralia*. Most common ground-cover species: *Pteridium aquilinum*, *Amelanchier* spp., *Vaccinium angustifolium*, *Gaultheria procumbens*, *Trientalis borealis*, *Aralia nudicaulis*. The most common tree species in the ground-cover are red maple, red oak, bigtooth aspen, and paper birch.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

Ecosystem 39 became familiar to the ecosystem researchers as "lightly banded" outwash, defined by the presence of textural bands of not more than 10 cm accumulated thickness in

the upper 200 cm of soil. The bands slow downward water movement, increasing moisture availability to plants as reflected by the presence of the *Maianthemum* species group.

### Similar Ecosystems

Distinguished from type 59 by its restriction to outwash not on morainal landforms and more consistent occurrence of banding (type 39 is less variable in thickness of bands) and ground-cover composition (type 59 has greater coverage of the *Aralia* species group). Distinguished from types 36 and 37 by the presence of the *Maianthemum* species group and the presence of loamy sand bands in the soil. Distinguished from type 47 by a lack of calcareous material in the C horizon and the absence of the *Oryzopsis* species group. Distinguished from type 40 by lower coverage of northern hardwood tree species in the overstory and ground-cover.

### Location

In outwash plain reworked by glacial Lake Algonquin; parts of Sec. 3 - 5, T36N R3W, and Sec. 25, 27, 31, 32, 33, and 34, T37N R3W.

NUMBER OF OCCURRENCES: 32.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
3.3/104.3/2.46.

PLOTS: 9112, 9113, 9214, 9220.

**Ecosystem 40:** Somewhat excessively drained to well drained, banded, medium sand; high-level outwash plain; hemlock - northern hardwood/*Aralia*.

**SYNOPSIS:** Level to moderately sloping high-level outwash plain east of Douglas Lake. Somewhat excessively drained to well drained, medium to loamy sand, acidic in all horizons. Red maple - sugar maple overstory; red maple - beech - sugar maple understory; *Pteridium* - *Aralia* - *Maianthemum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Seven plots.

### Physiography

**LANDFORM:** High-level outwash plain east of Douglas Lake.

**SLOPES:** Mostly level to moderately sloping (0 - 7%); northeast and east to southwest aspects.

**ELEVATION:** 237 - 241 m.

### Soil

**DRAINAGE:** Somewhat excessively drained to well drained.

**TEXTURE:** Mostly medium sand (over 90% in C horizon); sometimes loamy sand in E and Bs1 horizons.

**pH:** 4.8 (4.3 - 5.4) in E horizon; 5.9 (5.2 - 6.7) in C; occasional gravel lenses pH 6.8.

**DEVELOPMENT:** Organic horizons moderately developed, Oi 2.5 cm thick, Oe 1.9 cm, Oa 1.0 cm; no A horizon; E horizon well developed, 17 (10 - 24) cm thick; Bs1 and Bs2 horizons well developed, 31 (15 - 42) and 34 (17 - 57) cm; occasionally distinct BC, 46 (43 - 49) cm; gravel lenses occasional, up to 9 cm thick.

**PEBBLES AND COBBLES:** Pebbles mostly less than 5%, to 20% in gravel lens; cobbles mostly absent, 3% in gravel lens.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): red maple (70/84/100), sugar maple (13/7/71). Other species: bigtooth aspen, beech, paper birch, red oak, white pine, trembling aspen, black cherry. Mean no. of stems/plot = 34.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (39/100), beech (19/57), sugar maple (13/86). Other species: red oak, serviceberry, white pine, bigtooth aspen, eastern hemlock, trembling aspen, eastern hop-hornbeam, balsam fir, striped maple, paper birch. Mean no. of stems/plot = 63.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Aralia*, *Maianthemum*. Most common ground-cover species: *Pteridium aquilinum*, *Maianthemum canadense*, *Amelanchier* spp., *Aralia nudicaulis*. Most common tree species in ground-cover: red maple, beech, sugar maple, red oak.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Much of the overstory of type 40 has been recently cut (within the last 30 - 50 yrs.), and young forests of bigtooth aspen and white pine are typical. Unlike the outwash plain south of Douglas Lake, however, there is less evidence of severe burning and organic layers are generally thicker. Seedlings of northern hardwood species are more common here than south of Douglas Lake.

### Similar Ecosystems

Distinguished from type 39 by higher topographic position, restriction to east of Douglas Lake, and greater coverage of northern hardwood seedlings in the ground-cover. Distinguished from type 41 by greater distance from the drumlinized morain and lesser coverage of the *Ostrya* and *Aralia* species groups in the ground-cover.

### Location

East of Douglas Lake; Sec. 23, 25, and 26, T37N R3W.

NUMBER OF OCCURRENCES: 3.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
25.4/76.3/1.80.

PLOTS: 9110, 9118, 9120, 9123, 9309, 9310, 9311.

**Ecosystem 41:** Well drained, banded, medium sand; high-level outwash plain within 0.9 km of the drumlinized moraine; hemlock - northern hardwood/*Ostrya*.

**SYNOPSIS:** Level to gently sloping high-level outwash plain. Well drained, heavily banded medium to fine sand, acidic in all horizons. Red maple - sugar maple - beech overstory; beech - sugar maple - red maple understory; *Maianthemum* - *Aralia* - *Ostrya* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Five plots.

### Physiography

**LANDFORM:** High-level outwash plain east of Douglas Lake and within 0.9 km of the drumlinized moraine; a small portion was covered by Glacial Lake Algonquin.

**SLOPES:** Level to gently sloping, 0 - 3%; mostly northeast to south aspects.

**ELEVATION:** 237 - 241 m.

### Soil

**DRAINAGE:** Well drained.

**TEXTURE:** Medium sand or fine sand throughout profile, with greater than 10 cm accumulated thickness of loamy sand to sandy loam bands above 150 cm; occasional calcareous gravel lenses.

**pH:** 4.5 (4.3 - 4.8) in E horizon to 5.9 (5.7 - 6.4) in C; occasional gravel lens of pH 7.8.

**DEVELOPMENT:** Organic horizons moderately to well developed, Oi 4.3 cm thick, Oe 1.9 cm, Oa 2.6 cm; A horizon occasionally present, to 6 cm thick; E horizon well developed, 18 (10 - 24) cm thick; occasional Bh (1 cm) or Bsh (13 cm); Bs1 and Bs2 horizons well developed, 35 (22 - 48) and 42 (27 - 67) cm thick; occasionally distinct BC, 19 (12 - 26) cm thick; C horizon sometimes with layers of fine sand, loamy sand, sandy loam, or gravel.

**PEBBLES AND COBBLES:** Pebbles mostly few, 0 - 3%, to 40% in gravel lens; cobbles mostly absent, 0 - 5%, to 35% in gravel lens.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): red maple (43/55/100), sugar maple (26/20/100), beech (20/21/80). Other species: bigtooth aspen, eastern hop-hornbeam, yellow birch, eastern hemlock, white pine, paper birch. Mean no. of stems/plot = 41.

**UNDERSTORY:** Most common species (% rel. density/% frequency): beech (39/100), sugar maple (29/100), red maple (13/100). Other species: eastern hop-hornbeam, serviceberry, eastern hemlock, bigtooth aspen, balsam fir, yellow birch, striped maple, paper birch, white pine. Mean no. of stems/plot = 59.

**GROUND COVER:** Dominant ecological species groups: *Maianthemum*, *Aralia*, *Ostrya*, *Pteridium*. Most common ground-cover species: *Ostrya virginiana*, *Maianthemum canadense*, *Aralia nudicaulis*. Most common tree species in the ground-cover are beech, sugar maple, and red maple.

**Ecosystem 42:** Well drained, banded, medium sand; high-level outwash-lake plain; hemlock - northern hardwood/*Aralia*.

**SYNOPSIS:** Gently sloping high-level outwash-lake plain. Well drained, heavily banded, medium to fine sand, acidic in all horizons. Red maple - bigtooth aspen - red pine overstory; trembling aspen - white pine - bigtooth aspen - red maple understory; *Pteridium* - *Gaultheria* - *Maianthemum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Outwash in shallow, ponded depressions, outlet channels, and former offshore areas in the Glacial Lake Algonquin basin.

**SLOPES:** Gently sloping, (0 - 4%); all aspects.

**ELEVATION:** 193 - 220 m.

### Soil

**DRAINAGE:** Well drained.

**TEXTURE:** Medium to fine sand in all horizons; thick bands are loamy sand to silt loam.

**pH:** 4.8 (4.5 - 5.3) in E, to 5.6 in C; bands 6.0 (5.7 - 6.8).

**DEVELOPMENT:** Organic horizons poorly to moderately developed, Oi 2.9 cm thick, Oe 1.9 cm, Oa 0.8 cm; no A horizon; E horizon well developed, 41 (23 - 78) cm thick; Bs1 moderate, 21 (13 - 29) cm thick; Bs2 or BC well developed, 41 (23 - 78) cm thick; thick (50 - 150 cm) band of loamy sand to silt loam present above 300 cm.

**PEBBLES AND COBBLES:** Pebbles typically 0 - 3% in, to 20% in the C horizon; cobbles 0 - 1%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): red maple (34/38/80), bigtooth aspen (23/29/60), red pine (17/18/60). Other species: beech, white pine, paper birch, red oak, sugar maple, balsam fir. Mean no. of stems/plot = 33.

**UNDERSTORY:** Most common species (% rel. density /% frequency): trembling aspen (28/20), white pine (21/40), bigtooth aspen (15/20), red maple (15/80). Other species: red oak, red pine, beech, balsam fir, striped maple, paper birch, sugar maple. Mean no. of stems/plot = 66.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Maianthemum*, *Aralia*. Most common ground-cover species: *Pteridium aquilinum*, *Amelanchier* spp., *Aralia nudicaulis*, *Gaultheria procumbens*, *Vaccinium angustifolium*, *Maianthemum canadense*. The most common tree species in the ground-cover are red maple, red oak, white pine, and beech.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

The thick bands of sandy loam to loamy sand in type 42 indicate a period of slack water in the deposition of the parent materials. Overstory trees are typically taller and more vigorous-looking in type 42 than in drier, surrounding outwash ecosystems.

### Similar Ecosystems

Distinguished from type 60 by topographic position (type 60 occurs on upper and middle slopes on the interlobate moraine) and thicker, more continuous bands in the soil; type 42 is probably more productive than type 60. Distinguished from often-adjacent type 48 by absence of heavier (silt loam vs. sandy loam) calcareous bands and a lack of the *Osmorhiza* and *Polygonatum* species groups. Distinguished from type 82 by sand at the surface, as opposed to sandy loam bands at or within 30 cm of the surface, and lower coverage of the *Polygonatum* species group.

### Location

On the Glacial Lake Algonquin lake floor between Riggsville and Hogsback Rds. (SW 1/4 Sec. 34 and S 1/2 Sec. 33, T37N R3W) and below the eastern foot slopes of the interlobate moraine (SE 1/4 Sec. 5, T36N R3W, and NE 1/4 Sec. 31, T37N R3W).

NUMBER OF OCCURRENCES: 22.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.1/45.7/1.08.

PLOTS: 8810, 9146, 9208, 9218, 9219.

**Ecosystem 43:** Excessively drained medium sand, calcareous in C horizon below 200 cm; high-level outwash plain within 0.5 km of Douglas Lake and the interlobate moraine; hemlock - northern hardwood/*Oryzopsis*.

**SYNOPSIS:** Gently sloping high-level outwash plain. Excessively drained medium sand, calcareous in the C horizon below 200 cm. Bigtooth aspen - red oak - beech overstory; red oak - beech understory; *Pteridium* - *Oryzopsis* - *Aralia* ground-cover species groups. White pine - red pine - hemlock - red oak. No plots.

### Physiography

**LANDFORM:** Gentle, south-facing slopes on a narrow outwash plain.

**ELEVATION:** 236 - 240 m.

### Soil

Excessively drained, medium sand; calcareous above 250 cm.

### Vegetation

The overstory is dominated by bigtooth aspen with some red oak, beech and sugar maple. Red oak and beech are common in the understory. The *Pteridium*, *Aralia*, and *Oryzopsis* groups are present in the ground-cover.

### Comments

Type 43 is a small area on the same landform as type 38, a narrow strip of high-level outwash plain separating the terraces south of Maple Bay on Douglas Lake from the shallow ponded depression to the south.

### Similar Ecosystems

Distinguished from type 44 by closer proximity to the interlobate moraine and Douglas Lake. The significance of these features in terms of moisture availability or climatic moderation needs to be investigated.

### Location

On the saddle of the narrow outwash formation south of Maple Bay of Douglas Lake; SE 1/4 Sec. 30, T37N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.8/0.8/0.02.

**PLOTS:** None.

**Ecosystem 44:** Excessively drained to somewhat excessively drained medium sand, calcareous in C horizon; high-level outwash plain; hemlock - northern hardwood/*Oryzopsis*.

**SYNOPSIS:** Level to gently sloping high-level outwash plain. Excessively drained medium to coarse sand, calcareous in C horizon below 200 cm. Bigtooth aspen - red maple - red oak overstory; red maple - beech - white pine - red oak understory; *Pteridium* - *Gaultheria* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Nineteen plots.

### Physiography

**LANDFORM:** High-level outwash plains and adjacent gentle slopes.

**SLOPES:** Mostly level, to moderately sloping (0 - 10%); all aspects.

**ELEVATION:** 226 - 241 m.

### Soil

**DRAINAGE:** Excessively drained to somewhat excessively drained.

**TEXTURE:** Medium sand above 150 cm, medium to coarse sand below 150 cm.

**pH:** 4.8 (4.3 - 5.9) in E Horizon; 6.7 (5.4 - 9.0) in C.

**DEVELOPMENT:** Organic horizons limited, Oi 2.3 cm thick, Oe 1.0 cm, Oa 0.8 cm; no A horizon; E horizon moderately developed, 14 (5 - 23) cm thick; Bs1 well developed, 38 (12 - 77) cm thick; Bs2 34 (4 - 87); BC 47 (25 - 75) cm thick.

**PEBBLES AND COBBLES:** Pebbles 0 - 20% in E and B horizons, sometimes 40 - 50% below 150 cm; cobbles mostly absent above 150 cm (10% maximum), 2 - 10% below 150 cm.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (32/37/95), red maple (25/27/95), red oak (15/12/79). Other species: paper birch, white pine, beech, sugar maple, red pine. Mean no. of stems/plot = 34.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (30/100), beech (23/79), white pine (21/79), red oak (11/68). Other species: serviceberry, paper birch, striped maple, sugar maple, red pine, bigtooth aspen. Mean no. of stems/plot = 50.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Aralia*, *Maianthemum*, *Oryzopsis*. The most common ground-cover species are *Pteridium aquilinum*, *Amelanchier* spp., *Vaccinium angustifolium*, *Gaultheria procumbens*, and *Oryzopsis asperifolia*. The most common tree seedlings are red maple, red oak, white pine, and beech.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Type 44 is a moderately calcareous outwash ecosystem. Parent material of pH 7.5 - 8.0 generally occurs above 250 cm in the profile, and its presence is indicated by *Oryzopsis asperifolia*. It is likely that relative proximity to Douglas Lake, which influences effective moisture and patterns of fire susceptibility, has influenced patterns of succession in type 44; xeric type 37 borders to the south, away from Douglas Lake, and mesic type 45 lies closest to the lake.

### Similar Ecosystems

Distinguished from type 45 by being further from Douglas Lake, by lacking a northern hardwood overstory, by lower coverages of the *Polygonatum* and *Ostrya* groups in the ground-cover, and by thinner organic horizons. Distinguished from type 43 by location (type 43 is within 0.5 km of both Douglas Lake and the interlobate moraine). Distinguished from types 36 and 37 by the presence of calcareous parent material and the *Oryzopsis* species group. Distinguished from type 76, Glacial Lake Algonquin beaches topographic position (type 76 occurs at the Lake Algonquin shoreline (225 m)), and by less gravely surface soils.

### Location

On high-level outwash "islands" south and east of Douglas Lake; Sec. 26 - 34, T37N R3W.

NUMBER OF OCCURRENCES: 8.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
30.7/245.8/5.79.

PLOTS: 8802, 8807, 8809, 8912, 8917, 9109, 9209, 9212, 9213, 9426, 9433, 9434, 9435, 9436, 9437, 9438, 9439, 9440, 9448.

**Ecosystem 45:** Somewhat excessively drained medium sand, calcareous in C horizon; high-level outwash plain within 0.4 km of Douglas Lake; hemlock - northern hardwood/*Ostrya*.

**SYNOPSIS:** Level to gently sloping high-level outwash plain within 0.4 km of Douglas Lake. Somewhat excessively drained medium to coarse sand, calcareous in C horizon. Sugar maple - beech overstory and understory; *Ostrya* - *Aralia* - *Maianthemum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Thirteen plots.

### Physiography

**LANDFORM:** High-level outwash plain within 0.4 km of Douglas Lake.

**SLOPES:** Level to gently sloping (0 - 3%); all aspects.

**ELEVATION:** 238 - 240 m.

### Soil

**DRAINAGE:** Somewhat excessively drained.

**TEXTURE:** Medium sand in all horizons; occasionally loamy sand in the E and Bs1 horizons; coarse sand occasional in C horizon.

**pH:** 4.9 (4.2 - 5.7) in E, 7.0 (5.6 - 8.6) in C.

**DEVELOPMENT:** Organic horizons well developed, Oi 3.6 cm thick, Oe 1.8 cm, Oa 2.4 cm; no A horizon; moderate E horizon, 13 (6 - 22) cm thick; Bs1 well developed, 29 (2 - 59) cm thick; moderate Bs2, 42 (22 - 60) cm thick, BC 31 (3 - 97) cm thick.

**PEBBLES AND COBBLES:** Pebbles variable, 0 - 30% in upper horizons, to 50% in C; cobbles typically 3 - 5%, to 20% in the C.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): sugar maple (35/47/100), beech (17/18/77), red maple (14/12/85). Other species: paper birch, eastern hop-hornbeam, basswood, red oak, bigtooth aspen. Mean no. of stems/plot = 46.

**UNDERSTORY:** Most common species (% rel. density/% frequency): sugar maple (65/100), beech (20/100). Other species: eastern hop-hornbeam, red maple, serviceberry, eastern hemlock, striped maple, white pine, red oak, basswood. Mean no. of stems/plot = 60.

**GROUND COVER:** Dominant ecological species groups: *Ostrya*, *Aralia*, *Maianthemum*, *Polygonatum*, *Oryzopsis*. The most common ground-cover species are *Ostrya virginiana*, *Acer pensylvanicum*, *Maianthemum canadense*, and *Oryzopsis asperifolia*. The most common tree seedlings are sugar maple, beech, and red maple.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Type 45 forms a strip of fertile, dry-mesic northern hardwood forest ranging from 100 - 300 m wide and hugging the north rim of the high-level outwash plain south of Douglas Lake. Its pattern of occurrence so closely mirrors the shoreline of Douglas Lake that some relationship is apparent, possibly coincidental but likely one of cause-and-effect. It is probable that the material composing the high-level outwash plain becomes finer with increasing distance from the source (and hence, the lake). The coarser particles closer to the lake would have been less easily leached of their calcium carbonate coating than the finer particles to the south, and the ecosystem differences along that gradient could be due to the textural and chemical properties of the parent material. In this scenario, the lake shore configuration of type 45 would be coincidental. However, it seems likely that Douglas Lake could be directly related to the ecosystem patterns as well, through climatic moderation and the resultant differences in fire susceptibility.

### Similar Ecosystems

Distinguished from types 98, 99 and 77 by physiographic feature (98 and 99 are on ice-margin terraces, type 77 is at the Glacial Lake Algonquin shoreline). Distinguished from type 46 by less pronounced pit-and-mound topography and absence of the *Caulophyllum* species group.

### Location

Along the north rim of the high-level outwash plain south of Douglas Lake, and a small area on high-level outwash plain east of the lake; Sec. 28 and 29 and N 1/2 of Sec. 32 and 33 and NW 1/4 NW 1/4 Sec. 26, T37N R3W.

NUMBER OF OCCURRENCES: 4.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 9.0/36.0/0.85.

PLOTS: 8801, 8808, 9206, 9207, 9210, 9211, 9402, 9403, 9404, 9405, 9406, 9407, 9445.

**Ecosystem 46:** Well drained medium sand, calcareous in C horizon; high-level outwash plain within 0.4 km of Douglas Lake; hemlock - northern hardwood/*Osmorhiza*.

**SYNOPSIS:** Level to gently sloping high-level outwash plain. Well drained medium to coarse sand, calcareous in C horizon. Sugar maple - basswood overstory; sugar maple understory; *Ostrya* - *Caulophyllum* - *Aralia* ground-cover Hemlock - northern hardwood presettlement cover type. One plot.

### Physiography

**LANDFORM:** Level to gently sloping high-level outwash plain.

**ELEVATION:** 239 - 241 m.

### Soil

**DRAINAGE:** Well drained.

**TEXTURE:** Loamy sand in A, BE, and Bs1 horizons; medium sand in Bs2, BC and C horizons.

**pH:** 6.1 in A horizon to 7.7 in C.

**DEVELOPMENT:** Organics well developed, Oi 2.3 cm thick, Oe 2.2 cm, Oa 3.5 cm; thin A horizon, 1 cm thick; BE horizon 15 cm thick; Bs1 24 cm thick; Bs2 54 cm thick, BC 62 cm thick.

**PEBBLES AND COBBLES:** Pebbles 3% in A and B horizons, 5% in C; cobbles 1% in A and B, 10% in C.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): sugar maple (46/67), basswood (25/20). Other species: eastern hop-hornbeam, white ash. Mean no. of stems/plot = 48.

**UNDERSTORY:** Most common species (% rel. density): sugar maple (90). Other species: eastern hop-hornbeam. Mean no. of stems/plot = 30.

**GROUND COVER:** Dominant ecological species groups: *Ostrya*, *Caulophyllum*, *Aralia*, *Oryzopsis*. Most common ground-cover species: *Ostrya virginiana* and *Dirca palustris*. Most common tree species: sugar maple, white ash, and red oak.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Slightly greater pit-and-mound development in type 46 than in type 45, combined with the presence of the *Caulophyllum* species group, led to speculation that a heavier parent material (i. e. till) underlies these two small areas. All auger borings to date have failed to reveal till, but have been hampered by pebbles and cobbles in the soil. It could be that the more pronounced textural discontinuities associated with the calcareous gravel here are responsible for the observed differences in microtopography and vegetation.

### Similar Ecosystems

Distinguished from type 45 by greater pit-and-mound development and the presence of the *Osmorhiza* and *Caulophyllum* species groups. Distinguished from lake terrace types 99 - 101 by physiographic position.

### Location

Two areas on the north rim of high-level outwash plain south of Douglas Lake; SE 1/4 Sec. 29 and SW 1/4 Sec. 28, T37N R3W.

NUMBER OF OCCURRENCES: 2.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.7/3.3/0.08.

PLOTS: 9401.

**Ecosystem 47:** Somewhat excessively drained, banded, medium sand, calcareous below 200 cm; high-level outwash-lake plain; white pine - red pine - hemlock - red oak/*Oryzopsis*.

**SYNOPSIS:** Level to gently sloping high-level outwash-lake plain in low physiographic positions. Somewhat excessively drained, banded, medium sand, calcareous below 200 cm. Jack pine - trembling aspen overstory; serviceberry - white pine - red maple understory; *Gaultheria* - *Pteridium* - *Oryzopsis* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. One plot.

### Physiography

**LANDFORM:** Outwash in low-lying positions associated with melt water from stranded ice blocks.

**SLOPES:** Level to gently sloping (0 - 3%); all aspects.

**ELEVATION:** 220 - 225 m.

### Soil

**DRAINAGE:** Somewhat excessively drained.

**TEXTURE:** Medium sand in all horizons; thin bands of loamy sand in lower B and C horizons.

**pH:** 4.4 in E horizon to 6.1 in C.

**DEVELOPMENT:** Organic horizons moderately well developed, Oi 2.0 cm thick, Oe 0.8 cm, Oa 0.5 cm; E horizon well developed, 14 cm thick; EBs 17 cm thick; Bs and BC horizons 28 and 20 cm thick, respectively.

**PEBBLES AND COBBLES:** Pebbles 1 - 2%; cobbles 0 - 1%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): jack pine (67/80), trembling aspen (33/20). Number of trees/plot = 42.

**UNDERSTORY:** Most common species (% rel. density): serviceberry (39), white pine (39), red maple (15). Red oak also occurs in the understory. Number of stems/plot = 13.

**GROUND COVER:** Dominant ecological species groups: *Gaultheria*, *Pteridium*, *Oryzopsis*. Most common ground-cover species are *Pteridium aquilinum*, *Vaccinium angustifolium*, *Gaultheria procumbens*, and *Oryzopsis asperifolia*. The most common tree seedlings in the ground-cover are red oak and red maple, with balsam fir, beech, white pine, and trembling aspen also present.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

Ecosystem 47 occurs in low-lying positions associated with melt water channels near the level of Glacial Lake Algonquin. Slightly coarser sands in type 47 than in type 39 may

contribute to the presence of calcareous parent material higher in the profile and the greater abundance of the *Oryzopsis* species group. Jack pine plantations occupy part of this ecosystem, as reflected in the description derived from plot data.

### Similar Ecosystems

Distinguished from type 39 by the presence of the *Oryzopsis* species group and calcareous parent material below 200 cm. Distinguished from type 44 and the often adjacent type 76 by the presence of fine-textured bands in the soil and lower relative topographic position.

### Location

In low-lying positions related to the melt water channel leading southeast from a ponded depression south of Maple Bay of Douglas Lake; E 1/2 Sec. 31 and S 1/2 Sec. 32, T37N R3W and NW 1/4 Sec. 5, T36N R3W.

NUMBER OF OCCURRENCES: 4.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 6.0/23.9/0.56.

PLOTS: 9320.

**Ecosystem 48:** Well drained, banded, loamy sand over sandy loam, calcareous in lower C horizons; high-level outwash-lake plain; hemlock - northern hardwood/*Aralia*.

**SYNOPSIS:** Gently sloping high-level outwash-lake plain. Well drained medium and medium loamy sands sandy loam to clay loam layers, calcareous in lower C horizons. Bigtooth aspen - red maple - sugar maple overstory; red maple - sugar maple - white pine - serviceberry understory; *Pteridium* - *Aralia* - *Maianthemum* - *Oryzopsis* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Two plots.

### Physiography

**LANDFORM:** Outwash in low-lying positions associated with ponded or slow-moving melt water.

**SLOPES:** Gently sloping (3 - 8.5%); all aspects.

**ELEVATION:** 216 - 230 m.

### Soil

**DRAINAGE:** Well drained.

**TEXTURE:** Medium sand to loamy medium sand in E, Bs1, and Bs2 horizons; medium sand in C; either clay loam or a sequence of sandy loam then silt loam in 2C (and 3C, 4C) horizons.

**pH:** 4.9 (4.5 - 5.4) in E horizon; 6.0 (5.2 - 6.8) in 2C; 7.9 (7.7 - 8.0) in 3C and 4C.

**DEVELOPMENT:** Organic horizons well developed, Oi 1.5 cm thick, Oe 2.7 cm, Oa 2.3 cm; well-developed E horizon, 16.5 (15 - 18) cm thick; Bs1 and Bs2 25 (21 - 29 and 19.5 (19 - 20) cm thick; C (if present) 56 cm thick; 2C, 3C, and 4C (thick, fine-textured layers) 10 - 200 cm thick.

**PEBBLES AND COBBLES:** Pebbles 1 - 10% in E, Bs1, and Bs2 (upper) horizons, absent in C and lower horizons; cobbles present to 5% in upper horizons, absent below.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (53/65/100), red maple (23/15/100), sugar maple (14/15/50). Other species: trembling aspen, paper birch. Mean no. of stems/plot = 41.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (28/100), sugar maple (24/50), white pine (18/50), and serviceberry (17/50). Other species: red oak, beech, eastern hop-hornbeam, paper birch, red pine, black cherry, striped maple, white ash. Mean no. of stems/plot = 81.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Aralia*, *Gaultheria*, *Maianthemum*, *Oryzopsis*. The most common ground-cover species are *Pteridium aquilinum* and *Aralia nudicaulis*, with *Oryzopsis asperifolia*, *Vaccinium angustifolium*, *Acer pensylvanicum*, and *Viburnum acerifolium* also abundant. The most common tree seedlings are red maple, red oak, and sugar maple.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### **Comments**

Type 48 occurs in outwash associated with ponded or slow-moving glacial melt water. The fine silt and clay particles that compose the thick bands in type 48 are likely derived from glacial till. Moraine ecosystems are either adjacent or near both occurrences of type 48, and melt water from slowly melting ice blocks probably washed the fine particles from the till and deposited them in areas of ponding or slow-moving water.

### **Similar Ecosystems**

Distinguished from type 82 by sand at the surface and location peripheral to ponded depressions. Distinguished from type 60, heavily banded outwash on moraine landforms, by physiographic position and probable greater productivity.

### **Location**

In a ponded depression south of Maple Bay of Douglas Lake (NE 1/4 Sec. 31, T37N R3W) and at the base of Robert's Hill (SE 1/4 SW 1/4 Sec. 34, T37N R3W).

NUMBER OF OCCURRENCES: 4.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 3.8/15.3/0.36.

PLOTS: 9143, 9317.

**Ecosystem 49:** Somewhat excessively drained medium sand; west-facing, strongly to steeply sloping high-level outwash; white pine - red pine - hemlock - red oak/*Maianthemum*.

**SYNOPSIS:** Steep, west-facing, non-lake-affected, high-level outwash slopes. Somewhat excessively drained medium sand, acidic in all horizons. Bigtooth aspen - paper birch overstory; red maple - serviceberry understory; *Pteridium* - *Maianthemum* - *Gaultheria* ground-cover species groups. Red oak - white pine - red pine - hemlock presettlement cover type. No plots.

### Physiography

**LANDFORM:** Strongly to steeply sloping (> 15%), south- and west- facing slopes cut by Glacial Lake Algonquin around perimeters of high-level outwash plains.

**ELEVATION:** 225 - 240 m.

### Soil

**DRAINAGE:** Somewhat excessively drained medium sand, typically acidic in all horizons, sometimes calcareous in C horizon; pebbles and cobbles sometimes present..

### Vegetation

Bigtooth aspen, red oak, red maple, and paper birch compose the overstory. Serviceberry and striped maple are common in the understory. The *Aralia*, *Gaultheria*, and *Maianthemum* species groups occur with the *Pteridium* group in the ground-cover. Presettlement cover type was white pine - red pine - hemlock - red oak.

### Comments

South- and west-facing slopes on outwash features are less complex than those on the interlobate moraine (type 61). Some variation in substrate texture and pH may occur within among slopes in this type.

### Similar Ecosystems

Distinguished from type 50 slope aspect and lower coverage of the *Aralia* species group. Distinguished from types 62 and 64 each by lack of a layer of fine sand in the soil profile, and absence of the *Polygonatum* species group. Distinguished from type 61, west-facing slopes on moraine landforms, by typically shorter and less dissected slopes.

### Location

Below the southern rim of high-level outwash islands (Sec. 26, 32, 33, and 34, T37N R3W).

**NUMBER OF OCCURRENCES:** 10.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.3/23.0/ 0.55.

**PLOTS:** None.

**Ecosystem 50:** Somewhat excessively drained medium sand; north- and east-facing, strongly to steeply sloping high-level outwash; white pine - red pine - hemlock - red oak/*Aralia*.

SYNOPSIS: Steep, north-facing, non-lake-affected, high-level outwash slopes. Somewhat excessively drained medium sand, acidic in all horizons. Bigtooth aspen overstory; red maple - red oak - serviceberry - striped maple understory; *Pteridium* - *Gaultheria* - *Aralia* ground-cover species groups. White pine - red pine - hemlock - red oak. No plots.

### Physiography

LANDFORM: Strongly to steeply sloping (> 15%) northwest-, north-, east-, and southeast-facing outwash slopes on high-level outwash features.

ELEVATION: 229 - 267 m.

### Soil

Somewhat excessively drained medium and coarse sands, typically acidic in all horizons, may be calcareous in C; sometimes gravely.

### Vegetation

Bigtooth aspen is predominant in the overstory; red oak may be locally abundant with red maple and white pine as other associates. The understory may include red maple, red oak, serviceberry, and striped maple. The *Pteridium*, *Gaultheria*, and *Aralia* species groups are most common in the ground-cover; the *Oryzopsis* group may also be present. Presettlement cover type was white pine - red pine - hemlock - red oak.

### Comments

Type 50 is less common on UMBS property than type 49; most of the north-facing slopes on outwash plains are lake-affected (type 52).

### Similar Ecosystems

Distinguished from type 52 by lack of lake-affect and lower coverage of the *Polygonatum* species group. Distinguished from type 49 by slope aspect and presence of the *Aralia* species group.

### Location

Three occurrences on the high-level outwash plain south of Douglas Lake; NE 1/4 NE 1/4 and SE 1/4 Sec. 32, T37N R3W.

NUMBER OF OCCURRENCES: 3.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.6/7.9/0.19.

PLOTS: None.

**Ecosystem 51:** Somewhat excessively drained medium sand, calcareous in C horizon; west- and south-facing, lake-affected, strongly to steeply sloping high-level outwash; hemlock - northern hardwood/*Aralia*.

**SYNOPSIS:** Steep, west- and south-facing, lake-affected, high-level outwash slopes. Somewhat excessively drained medium sand, calcareous in C horizon. Bigtooth aspen overstory; red maple - red oak - serviceberry - striped maple understory; *Pteridium* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Steep (> 15%) northwest-, west- and south-facing slopes adjacent to ice-margin terrain around Douglas Lake.

**ELEVATION:** 225 - 240 m.

### Soil

Somewhat excessively drained medium sand, calcareous in C horizon; gravel and cobbles absent or present.

### Vegetation

Bigtooth aspen is the overstory dominant; associates may include red oak, red maple, white pine, or paper birch. Red maple and red oak are common understory trees; serviceberry, white pine, and striped maple also occur, the latter being locally abundant. The *Aralia* species group is characteristic in the ground-cover with the *Pteridium* and *Gaultheria* groups. Presettlement cover type was white pine - northern hardwood-hemlock.

### Comments

Although local differences in substrate and vegetation may occur (e.g., dense patches of striped maple related to calcareous gravel in the soil), all lake-affected slopes with the stated aspects fall into type 51. These slopes are wave-cut and are typically short (< 100 m), with little apparent difference in vegetation between upper and lower slope positions.

### Similar Ecosystems

Distinguished from north-facing slopes in type 52 by slope aspect and absence of the *Polygonatum* species group. Distinguished from types 49 and 50 by lake-affect and greater coverage of the *Aralia* species group.

### Location

On northwest- to south- facing slopes around Douglas Lake; Sec. 23, NW 1/4 NW 1/4 Sec. 26, Sec. 27 and Sec. 28, T37N R3W.

**NUMBER OF OCCURRENCES:** 6.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.1/12.3/0.29.

**PLOTS:** None.

**Ecosystem 52:** Somewhat excessively drained medium sand, calcareous in C horizon; north- and east-facing, lake-affected, strongly to steeply sloping high-level outwash; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Steep, north- and east-facing, lake-affected, high-level outwash slopes. Somewhat excessively drained medium sand, calcareous in C horizon. Bigtooth aspen - northern hardwood overstory; sugar maple - beech understory; *Polygonatum* - *Osmorhiza* - *Aralia* - *Maianthemum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Steep (> 15%) north-, east-, and southeast-facing slopes adjacent to shores and terraces of Burt and Douglas Lakes.

**ELEVATION:** 190 - 196 m (at Colonial Pt.); 225 - 240 m (around Douglas Lake).

### Soil

Somewhat excessively drained medium sand, sometimes with pebbles and cobbles; calcareous in C horizon.

### Vegetation

The overstory is a mixture dominated by any one of bigtooth aspen, sugar maple, beech, or rarely red oak. Sugar maple and beech are common in the understory; eastern hop-hornbeam, red maple, and red oak also occur. The *Polygonatum* species group characterizes the ground-cover, which also includes the *Osmorhiza*, *Aralia*, and *Maianthemum* groups. Presettlement cover type was probably hemlock - northern hardwood.

### Comments

Some slopes in type 52 just west of Grapevine Point have large beech trees in the overstory and may have escaped severe disturbance. Much of the ecosystem has a northern hardwood-hemlock cover type.

### Similar Ecosystems

Distinguished from types 62 and 64 by a lack of layers of fine sand in the soil profile and physiographic position. Distinguished from types 45 and 46, by slope percent. Distinguished from west- and south-facing lake-affected slopes (type 51) by slope aspect and presence of the *Polygonatum* species group.

### Location

On Colonial Point (NE 1/4 NW 1/4 Sec. 28, T36N R3W) and around Douglas Lake (Sec. 27 - 30 and 32, T37N R3W).

**NUMBER OF OCCURRENCES:** 8.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 3.4/37.4/0.65.

**PLOTS:** None.

**Ecosystem 53:** Outwash-lake plain hardwood swamp; red maple - black ash/*Ilex*.

**SYNOPSIS:** Level high-level outwash-lake plain. Groundwater-fed; muck over medium sand. Black ash - red maple - balsam fir overstory; alder - black ash understory; *Coptis* - *Onoclea* - *Ilex* ground-cover species groups. Red maple - black ash presettlement cover type. Six plots.

### Physiography

**LANDFORM:** Level to very gently sloping high-level outwash plain covered by Glacial Lake Algonquin and, in Reese's Swamp, Glacial Lake Nipissing.

**ELEVATION:** 183 - 194 m (in Reese's Swamp) and 215 - 219 m (in the Mullett Creek wetlands).

### Hydrology

Groundwater flow originating in Douglas Lake basin; standing water in spring, below 70 cm in late summer (seasonally flooded); pH 6.6.

### Soil

19 (less than 30) cm sapric muck over medium sand; pH 5.6 at 10 cm.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): black ash (36/35/83), red maple (30/33/50), balsam fir (24/28/67). Other species: paper birch, balsam poplar, trembling aspen. Mean no. of stems/plot = 14.

**UNDERSTORY:** Most common species (% rel. density/% frequency): speckled alder (54/50), black ash (15/83), balsam fir (11/100). Other species: winterberry, red maple, sugar maple, mountain maple, paper birch, red-osier dogwood, trembling aspen, willow. Mean no. of stems/plot = 108.

**GROUND COVER:** Dominant species groups: *Coptis*, *Onoclea*, *Ilex*. Most common ground-cover species: mosses, *Ilex verticillata*, *Rubus pubescens*, *Onoclea sensibilis*, *Alnus rugosa*. Most common tree species in ground-cover: red maple, black ash, balsam fir.

**PRESETTLEMENT COVER TYPE:** red maple - black ash.

### Comments

This type, Greg Zogg's type 7 (Zogg 1993), occurs in long, narrow, wet plains interspersed among recessional beach strands.

### Similar Ecosystems

Distinguished from type 54 by shallow, acidic muck and open canopy (large blowdowns are common in this type); vegetation differences include overstory dominated by trembling aspen and black ash, only rarely northern white-cedar, and an understory of speckled alder. Distinguished from types 70 - 72 by slightly higher topographic position and by lower total basal area; it has greater influence by precipitation inputs (i.e., lowest values for water

chemistry parameters) than any other type found on level plains (types 23 - 25, 54 - 56, and 70 - 72).

### **Location**

In Reese's Swamp (Sec. 3 and 4, T36N R3W) and the Mullett Creek wetlands (Sec. 26 and 35, T37N R3W).

NUMBER OF OCCURRENCES: 10.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 7.4/74.2/1.75.

PLOTS: 8816, 9264, 9265, 9266, 9269, 9313.

**Ecosystem 54:** Outwash-lake plain hardwood-conifer swamp; black ash - northern white-cedar - balsam fir/*Arisaema*.

**SYNOPSIS:** Level high-level outwash-lake plain. Groundwater-fed; muck over medium sand. Black ash - northern white-cedar - basswood overstory; black ash - balsam fir understory; *Coptis* - *Aralia* - *Onoclea* ground-cover species groups. Black ash - northern white-cedar - balsam fir presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Level to very gently sloping high-level outwash plain covered by Glacial Lakes Algonquin and Nipissing.

**ELEVATION:** 182 - 183 m.

### Hydrology

Groundwater flow originating in Douglas Lake basin; standing water in spring, 62 cm in late summer (seasonally flooded); pH 7.2.

### Soil

24 (20 - 30) cm sapric muck over medium sand; pH 7.1 at 10 cm.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): black ash (31/44/60), northern white-cedar (24/25/80), basswood (15/10/80). Other species: red maple, hemlock, silver maple, trembling aspen, paper birch. Mean no. of stems/plot = 14.

**UNDERSTORY:** Most common species (% rel. density/% frequency): black ash (56/100), balsam fir (11/80). Other species: yellow birch, basswood, American elm, red maple, mountain maple, trembling aspen, red ash, white spruce. Mean no. of stems/plot = 54.

**GROUND COVER:** Dominant species groups: *Coptis*, *Aralia*, *Onoclea*. Most common ground-cover species: *Aralia nudicaulis*, *Onoclea sensibilis*, *Rubus pubescens*, *Mitella nuda*. Most common tree species in ground-cover: red maple, black ash, balsam fir, basswood, American elm, yellow birch.

**PRESETTLEMENT COVER TYPE:** black ash - northern white-cedar - balsam fir.

### Comments

Type 54 (Greg Zogg's (1993) type 8) is located on a former Little Carp River delta, adjacent to Burt Lake (i.e., slightly higher topographic position than types 55 and 56). There is likely some mixing of groundwater with lake waters, as reflected in highest values for water pH and specific conductivity among types 53 - 56.

### Similar Ecosystems

Distinguished from types 55 and 56 by greater dominance of hardwoods, shallower organic matter, deeper water table in late summer, presence of *Eupatorium* spp., *Rubus strigosus* Michx., *Scutellaria* spp. L. and *Veronica* spp. L. in ground flora, and absence of *Alnus rugosa* and *Vaccinium* spp.

**Location**

In the southern portion of Reese's Swamp; S 1/2 Se. 3 and 4, T36N R3W.

NUMBER OF OCCURRENCES: 2.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 4.9/9.8/0.23.

PLOTS: 9135, 9267, 9270, 9272, 9273.

**Ecosystem 55:** Outwash-lake plain conifer-hardwood swamp; northern white-cedar - white spruce - balsam fir - black ash/*Coptis*.

**SYNOPSIS:** Level to gently sloping high-level outwash-lake plain. Groundwater-fed; muck over medium sand. Northern white-cedar - balsam fir overstory; mountain maple - black ash - northern white-cedar - balsam fir understory; *Coptis* - *Maianthemum* - *Clintonia* ground-cover species groups. Northern white-cedar - white spruce - balsam fir - black ash presettlement cover type. Seven plots.

### Physiography

**LANDFORM:** Level to very gently sloping high-level outwash plain covered by Glacial Lake Algonquin (and Nipissing in Reese's Swamp).

**ELEVATION:** 183 - 190 m ( in Reese's Swamp) and 210 - 218 m (in the Mullett Creek wetlands and at North Fishtail Bay).

### Hydrology

Groundwater flow originating in Douglas Lake basin; water above the surface in spring, 40 cm in late summer (semipermanently flooded); pH 6.9.

### Soil

52 (30 - 100) cm combined thickness of hemic and sapric muck (pH 7.6 at 10 cm) over medium sand.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): northern white-cedar (59/74/100), balsam fir (11/11/57). Other species: paper birch, white spruce, hemlock, eastern tamarack, black ash, black spruce, yellow birch, trembling aspen, red maple. Mean no. of stems/plot = 33.

**UNDERSTORY:** Most common species (% rel. density/% frequency): mountain maple (30/29), black ash (21/14), northern white-cedar (13/57), balsam fir (12/14). Other species: winterberry, eastern tamarack, speckled alder, red maple, paper birch, white spruce, eastern hemlock. Mean no. of stems/plot = 14.

**GROUND COVER:** Dominant species groups: *Coptis*, *Maianthemum*, *Clintonia*, *Polygala*, *Aralia*. Most common ground-cover species: mosses, *Aralia nudicaulis*, *Coptis trifolia*, *Rubus pubescens*, *Mitella nuda*, *Clintonia borealis*. Most common tree species in ground-cover: red maple, balsam fir, black ash.

**PRESETTLEMENT COVER TYPE:** northern white-cedar - white spruce - balsam fir - black ash.

### Comments

This type (Greg Zogg's (1993) type 9) has the largest total acreage of any wetland on station property, comprising the majority of Reese's swamp. It may be a good, current-day representative of the cedar-dominated swamps characteristic of the area in presettlement time.

### Similar Ecosystems

Distinguished from type 56 by shallower muck (less than 1 m), less persistent water table, greater abundance of winterberry and eastern tamarack in the understory, the presence of *Actaea* spp. L., *Cornus stolonifera* Michx., *Corylus cornuta* Marsh., *Iris* spp. L. and absence of *Ledum groenlandicum* in the ground-cover.

### Location

In Reese's Swamp (Sec. 3 and 4, T36N R3W), the Mullett Creek wetlands (Sec. 26 and 35, T37N R3W), and a small area adjacent to North Fishtail Bay (SE 1/4 SE 1/4 Sec. 22, T37N R3W).

NUMBER OF OCCURRENCES: 8.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
17.9/143.2/3.37.

PLOTS: 9144, 9145, 9152, 9154, 9258, 9259, 9263.

**Ecosystem 56:** Outwash-lake plain northern white-cedar swamp; northern white-cedar/*Coptis*.

**SYNOPSIS:** Level to gently sloping high-level outwash-lake plain. Groundwater-fed; muck over medium sand. Northern white-cedar - white spruce - balsam fir overstory; balsam fir - northern white-cedar understory; *Coptis* - *Polygala* - *Maianthemum* ground-cover species groups. Northern white-cedar presettlement cover type. Four plots.

### Physiography

**LANDFORM:** Level to very gently sloping high-level outwash plain covered by Glacial Lake Algonquin (and Nipissing in Reese's Swamp).

**ELEVATION:** 187 - 190 m (in Reese's Swamp) and 209 - 211 m (in the Mullett Creek wetlands).

### Hydrology

Groundwater flow originating in Douglas Lake basin; water above the surface in spring, 30 cm in late summer (semipermanently flooded); pH 6.7.

### Soil

171 (100 - 200+) cm combined thickness of fibric or hemic peat and sapric muck over medium sand; pH 7.9 at 10 cm.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): northern white-cedar (63/71/100), white spruce (15/17/50), balsam fir (15/9/75). Other species: red maple, eastern tamarack, paper birch. Mean no. of stems/plot = 35.

**UNDERSTORY:** Most common species (% rel. density/% frequency): balsam fir (59/75), northern white-cedar (30/75). Other species: black ash, red maple, speckled alder, mountain maple, white spruce. Mean no. of stems/plot = 62.

**GROUND COVER:** Dominant species groups: *Coptis*, *Polygala*, *Maianthemum*. Most common ground-cover species: mosses, *Aralia nudicaulis*, *Coptis trifolia*, *Clintonia borealis*, *Linna borealis*. Most common tree species in ground-cover: balsam fir, red maple, northern white-cedar.

**PRESETTLEMENT COVER TYPE:** northern white-cedar.

### Comments

This type (Greg Zogg's (1993) type 10) is located within ca 400 m of moderately steep upland slopes (i.e., wave-cut slopes produced by Glacial Lake Algonquin or Nipissing-age dunes) and is characterized by persistent water tables and deep organic matter build-up. Groundwater discharge is slowed in this area probably due to extensive wetland complex below.

### Similar Ecosystems

Distinguished from types 53 - 55 by greater overstory dominance of northern white-cedar, deeper organic matter, and the most extensive coverage of bryophytes in the ground flora of any UMBS wetland except for bogs (type 108).

### Location

Along the northern fringe of Reese's Swamp (Sec. 3, T36N R3W) and in the Mullett Creek wetlands (Sec. 26 and 35, T37N R3W).

NUMBER OF OCCURRENCES: 4.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 8.3/33.1/0.78.

PLOTS: 9141, 9255, 9256, 9257.

**Ecosystem 57:** Outwash-lake plain shrub willow swamp; northern white-cedar - white spruce - balsam fir/sedge.

**SYNOPSIS:** Gently sloping depression in high-level outwash-lake plain. Groundwater-fed; muck over medium sand. No overstory; willow understory; *Carex vesicaria* ground-cover species groups. Northern white-cedar - white spruce - balsam fir presettlement cover type. No plots.

### Physiography

**LANDFORM:** Shallow depression near head of drainage in gently sloping outwash plain reworked by Glacial Lake Algonquin.

**ELEVATION:** 211 m.

### Hydrology

Groundwater-fed; surface flow in spring, possibly backed up by Indian Trails Rd. and upland features downslope; water 30 - 50 cm below surface in summer; water pH 5.83.

### Soil

3 - 5 cm circumneutral sapric muck over medium sand.

### Vegetation

No overstory. Scattered multi-stemmed shrub willows (mostly *Salix petiolaris*) form the understory. The ground-cover is composed mostly of a sedge (*Carex vesicaria*), with some *Scirpus atrovirens* also present. Presettlement cover type could have been absent or northern white-cedar - white spruce - balsam fir.

### Comments

Type 49 is a small, unique wetland wherein the low species richness and general physiognomy may be related to an altered hydrologic cycle. Indian Trails Rd., a small but built-up road, likely acts as a dam, enhancing the depth and duration of spring inundation. The acidic groundwater may limit species richness.

### Similar Ecosystems

Distinguished from types 23 and 58 by much lower ground-cover species richness and shallower muck at the surface.

### Location

Just north of Indian Trails Rd. in the Mullett Creek wetlands; SW 1/4 NW 1/4 35, T37N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.0/1.0/0.02.

**PLOTS:** None.

**Ecosystem 58:** Outwash-lake plain herbaceous wetland; alder - willow/*Onoclea*.

**SYNOPSIS:** Gently sloping high-level outwash-lake plain. Groundwater-fed; sandy muck over sand. No overstory; willow - alder understory; *Onoclea* ground-cover species groups. Alder - willow presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping outwash plain reworked by Glacial Lake Algonquin.

**ELEVATION:** 210 m.

### Hydrology

Groundwater-fed; water present at surface in spring and summer, possibly backed up by Indian Trails Rd; water pH 7.06.

### Soil

30 cm of circumneutral sapric muck mixed with sand over medium sand.

### Vegetation

No overstory. Widely scattered shrub willow and speckled alders form a sparse understory. A species-rich ground-cover includes grasses, sedges, and forbs such as species in the *Onoclea* species group and *Scirpus atrovirens*.

### Comments

Type 58 could have been a forested conifer wetland that through human activity (cutting and road building) has been converted to a "wet meadow." The water table probably rose following cutting and has remained high due to the elevated intersection of two roads built adjacent to the area, impeding drainage.

### Similar Ecosystems

Distinguished from type 23 by a more moderate climate (other related differences, such as in ground-cover species composition, need investigation). Distinguished from type 57 by much greater ground-cover species richness and higher groundwater pH.

### Location

Northwest of the intersection of Indian Trails Rd. and the gas pipeline in the southeast corner of UMBS property; SE 1/4 NW 1/4 Sec. 35, T37N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 4.4/4.4/0.10.

**PLOTS:** None.

**Ecosystem 59:** Somewhat excessively drained to excessively drained, banded, medium sand; high-level outwash plain on moraine landforms; white pine - red pine - hemlock - red oak/*Maianthemum*.

**SYNOPSIS:** Gently sloping high-level outwash plain on the moraine landforms. Somewhat excessively drained, banded, medium sand, acidic in all horizons. Bigtooth aspen - trembling aspen - red maple overstory; red maple - red oak understory; *Pteridium* - *Gaultheria* - *Aralia* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. Ten plots.

### Physiography

**LANDFORM:** High-level outwash plain on the interlobate moraine.

**SLOPES:** Level to gently sloping (0 - 7%); all aspects.

**ELEVATION:** 250 - 278 m.

### Soil

**DRAINAGE:** Somewhat excessively drained to excessively drained.

**TEXTURE:** Medium sand to medium loamy sand in the E and B horizons; medium sand in the C. Thin bands of loamy sand may occur throughout profile.

**pH:** 4.8 (4.4 - 6.2) in E horizon to 5.6 (5.1 - 6.0) in C.

**DEVELOPMENT:** Organic horizons moderate, Oi 2.7 cm thick, Oe 1.2 cm, Oa 0.7 cm; no A horizon; E horizon 12 (6 - 18) cm thick; Bs1 37 (20 - 55); Bs2 38 (14 - 59) cm thick; BC sometimes present, to 19 cm.

**PEBBLES AND COBBLES:** Pebbles 0 - 4% (maximum 12%); cobbles typically 1% or less, to 6%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (41/44/89), red maple (27/25/75), trembling aspen (18/18/17). Other species: paper birch, beech, red oak. Mean no. of stems/plot = 23.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (51/90), red oak (29/90). Other species: serviceberry, beech. Mean no. of stems/plot = 39.7.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Aralia*, *Maianthemum*. Most common ground-cover species: *Pteridium aquilinum*, *Gaultheria procumbens*, *Amelanchier* spp., *Vaccinium angustifolium*, *Lycopodium tristachyum*. Most common tree species in ground-cover: red maple, beech, red oak, bigtooth aspen.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

Areas mapped as type 59 vary from the poorest outwash on the moraine to areas with distinct banding, somewhat vigorous aspen growth, and abundant plants in the

*Maianthemum* species group. This variable outwash is believed to be of different origin than the outwash in plains to the east and west; banding is more common and spatial patterns of deposition are less apparent.

### Similar Ecosystems

Distinguished from type 39 by physiographic position; greater variability in the amount of banding in the soil and greater coverage of Oak seedlings. Distinguished from type 60 by less than 10 cm accumulated thickness of loamy sand bands above 150 cm and lower coverage of the *Aralia* species group.

### Location

Hill tops and upper slopes on the interlobate moraine; N 1/2 Sec. 6, T36N R3W, and W 1/2 Sec. 31, T37N R3W.

NUMBER OF OCCURRENCES: 8.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
20.3/162.8/3.83.

PLOTS: 8806, 8902, 9114, 9116, 9151, 9222, 9223, 9224, 9456, 9457.

**Ecosystem 60:** Well drained to somewhat excessively drained, banded, medium sand; high-level outwash plain on moraine landforms; hemlock - northern hardwood/*Aralia*.

**SYNOPSIS:** Level to moderately sloping, high-level outwash plain on upper and middle slopes of moraine landforms. Well drained to somewhat excessively drained, banded, medium sand to loamy sand, acidic. Bigtooth aspen - red maple overstory; red maple - sugar maple - striped maple - beech understory; *Aralia* - *Pteridium* - *Maianthemum*. ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Five plots.

### Physiography

**LANDFORM:** High-level outwash plain on moraine landforms.

**SLOPES:** Level to moderate (0 - 12%) middle and upper slopes; all aspects.

**ELEVATION:** 190 - 276 m.

### Soil

**DRAINAGE:** Well drained to somewhat excessively drained.

**TEXTURE:** Medium sand to medium loamy sand in E and B horizons, medium sand in C; greater than 10 cm accumulated thickness of bands of loamy sand or sandy loam above 200 cm.

**pH:** 4.8 (4.6 - 5.0) in E horizon to 5.9 (5.5 - 6.7) in C.

**DEVELOPMENT:** Organic horizons moderately developed, Oi 2.4 cm thick, Oe 1.4 cm, Oa 0.8 cm; no A horizon; E horizon moderately developed, 15 (10 - 20) cm thick; Bs1 and Bs2 horizons well developed, 31 (9 - 45) and 35 (23 - 48) cm thick; BC occasionally present, 26 (13 - 40) cm thick; greater than 10 cm accumulated thickness of bands occurs above 200 cm.

**PEBBLES AND COBBLES:** Pebbles usually less than 5% (maximum 45%); cobbles 0 - 3%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (50/60/100), red maple (30/32/100). Other species: beech, paper birch, striped maple. Mean no. of stems/plot = 29.

**UNDERSTORY:** Most common species (% rel. density /% frequency): red maple (32/100), sugar maple (21/60), striped maple (17/100), beech (16/100). Other species: serviceberry, red oak. Mean no. of stems/plot = 51.

**GROUND COVER:** Dominant ecological species groups: *Aralia*, *Pteridium*, *Maianthemum*. Most common ground-cover species: *Aralia nudicaulis*, *Acer pensylvanicum*, *Amelanchier* spp., *Pteridium aquilinum*, *Viburnum acerifolium*. Most common tree species in ground-cover: sugar maple, red maple, beech, black cherry.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Ecosystem 60 is "heavily banded" outwash on the interlobate moraine. Mostly on upper and middle slopes, the soil textural bands are thought to originate from the Port Huron till that was reworked and buried by later outwash events and that is closer to the surface in adjacent type 109. The boundary between the two ecosystems is often difficult to discern, especially in more recently or heavily disturbed areas.

### Similar Ecosystems

Distinguished from type 59 by greater thickness of textural bands and greater coverage of the *Aralia* species group. Distinguished from type 41 by physiographic position, lack of an A horizon, and lower coverage of the *Polygonatum* species group. Distinguished from type 42 by topographic position and thinner textural bands; bands in type 42 have higher percentages of silt than those in type 60. Distinguished from type 109 by a lack of sandy loam till and lower coverages of the *Polygonatum* species group.

### Location

Upper and middle slopes on the interlobate moraine; N 1/2 Sec. 6, T36N R3W and W 1/2 Sec. 31, T 37N R3W.

NUMBER OF OCCURRENCES: 17.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
7.4/125.2/2.95.

PLOTS: 8901, 8914, 9115, 9450, 9451.

**Ecosystem 61:** Somewhat excessively drained medium sand; west-facing, strongly to steeply sloping high-level outwash on moraine landforms; white pine - red pine - hemlock - red oak/*Maianthemum*.

**SYNOPSIS:** Strongly to steeply sloping west-facing outwash on moraine landforms. Somewhat excessively drained medium sand, acidic in all horizons or with calcareous gravel in C horizon. Bigtooth aspen - paper birch overstory; red maple - serviceberry - balsam fir understory; *Pteridium* - *Aralia* - *Ostrya* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. One plot.

### Physiography

**LANDFORM:** Strongly to steeply sloping outwash on moraine landforms.

**SLOPES:** Strongly to steeply sloping (15 - 35%); southern and western aspects.

**ELEVATION:** 225 - 248 m.

### Soil

**DRAINAGE:** Somewhat excessively drained.

**TEXTURE:** Medium sand in E, Bs1, and C horizons; loamy sand in Bs2; lower B and C horizons often banded with sandy loam and/or coarse gravely sand.

**pH:** 5.0 in E horizon to 7.2 in coarse layers within C horizon.

**DEVELOPMENT:** Organic moderately developed, Oi 3 cm thick, Oe 1.2 cm, Oa 0.2 cm; strongly developed E horizon, 35 cm thick; Bs1 and Bs2 horizons well developed, 31 and 42 cm thick.

**PEBBLES AND COBBLES:** Pebbles 0 - 2% in E and Bs horizons, 0 - 5% in C; no cobbles.

### Vegetation

**OVERSTORY:** Dominants (% rel. density /% rel. dominance): bigtooth aspen (73/93), paper birch (18/6). Other species: red maple. Mean no. of stems/plot = 11.

**UNDERSTORY:** Dominants (% rel. density/): red maple (27), serviceberry (27), balsam fir (20). Other species: paper birch, beech, bigtooth aspen, red oak. Mean no. of stems/plot = 15.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Aralia*, *Ostrya*. Most common ground-cover species: *Pteridium aquilinum*, *Amelanchier* spp., *Ostrya virginiana*. Most common tree species in the ground-cover: red maple, red oak, balsam fir, beech, paper birch, sugar maple.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

The western slopes of the interlobate moraine are quite convoluted; post-glacial erosion combined with shoreline erosion by Glacial Lake Algonquin have created this complex

topographic feature. North-, west-, and south-facing slopes alternate, and fairly consistent differences in ground-cover vegetation occur related to aspect on these steep slopes. Bands of gravel or sandy loam occur irregularly, and in some places the sand has a pinkish hue reminiscent of the sandy loam Port Huron till. South- and west-facing slopes on outwash features are less complex.

### Similar Ecosystems

Distinguished from type 63 by southern and western aspects and lower coverage of the *Aralia* species group. Distinguished from types 62 and 64 by lack of a layer of fine sand in the soil profile and absence of the *Polygonatum* species group.

### Location

On the western slopes of the interlobate moraine (W 1/2 Sec. 6 and W 1/2 Sec. 7, T36N R3W, SW 1/4 Sec. 31, T37N R3W, and NE 1/4 NE 1/4 Sec. 36, T37N R4W).

NUMBER OF OCCURRENCES: 16.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.4/37.9/0.89.

PLOTS: 8820.

**Ecosystem 62:** Well drained fine sandy loam; south-facing, strongly to steeply sloping high-level outwash on moraine landforms; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Strongly to steeply sloping south-facing high-level outwash on moraine landforms. Well drained fine sand to silty clay loam. Bigtooth aspen - red oak - sugar maple overstory; sugar maple - beech - red maple understory; *Polygonatum* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Strongly to steeply sloping (> 15%) south-facing high-level outwash on moraine landforms.

**ELEVATION:** 234 - 241 m.

### Soil

Well drained, fine sandy loam over silty clay loam to at least 100 cm.

### Vegetation

Bigtooth aspen, red oak, and sugar maple occur in the overstory. Sugar maple, beech, red maple and eastern hop-hornbeam compose the understory. The ground-cover is sparse but includes the *Polygonatum* and *Aralia* species groups. Presettlement cover type was northern hardwood-hemlock.

### Comments

The question of how fine-textured, water-laid soils were deposited on the surface of these steep slopes is an intriguing one. One scenario is that melt-water runoff from the top of the moraine was ponded by a glacier positioned directly adjacent to the moraine. This argument is supported by the similar elevational range for types 62 and 64, suggesting concurrent deposition.

### Similar Ecosystems

Distinguished from type 64 by southern aspect and lower coverage of the *Polygonatum* species group.

### Location

A small area on the northwest side of the interlobate moraine; SE 1/4 SE 1/4 Sec. 25, T37N R4W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.2/0.2/0.004.

**PLOTS:** None.

**Ecosystem 63:** Somewhat excessively drained medium sand; north-facing, strongly to steeply sloping high-level outwash on moraine landforms; red oak - white pine - hemlock/*Aralia*.

**SYNOPSIS:** Strongly to steeply sloping, north-facing, high-level outwash on moraine landforms. Somewhat excessively drained medium sand. Bigtooth aspen overstory; red maple - red oak - serviceberry - striped maple understory; *Pteridium* - *Gaultheria* - *Aralia* ground-cover species groups. Red oak - white pine - hemlock presettlement cover type. No plots.

### Physiography

**LANDFORM:** Strongly to steeply sloping (> 15%) northwest-, north-, east-, and southeast-facing outwash on the interlobate moraine.

**ELEVATION:** 229 - 267 m.

### Soil

Somewhat excessively drained medium and coarse sands, sometimes gravelly; may be calcareous above 250 cm.

### Vegetation

Bigtooth aspen is predominant in the overstory; red oak may be locally abundant; red maple and white pine are associates. The understory may include red maple, red oak, serviceberry, and striped maple. The *Pteridium*, *Gaultheria*, and *Aralia* species groups are most common in the ground-cover; the *Oryzopsis* group may also be present. Presettlement cover type was red oak - white pine - hemlock.

### Comments

These north-facing slopes are less common on the interlobate moraine than the west- and south-facing slopes, occurring mainly where the western side of the moraine appears convoluted. They provide a relatively cool, moist contrast to type 61.

### Similar Ecosystems

Distinguished from type 52 (lake-affected slopes) by topographic position and lower coverage of the *Polygonatum* group. Distinguished from type 61 by northern aspect and greater coverage of the *Aralia* species group.

### Location

Mostly on the west side of the interlobate moraine (W 1/2 Sec. 6 and 7, T36N R3W; SW 1/4 Sec 31, T37N R3W; NE 1/4 NE 1/4 Sec. 36, T37N R4W); one small area just south of Douglas Lake (NE 1/4 NE 1/4 Sec. 32, T37N R3W).

**NUMBER OF OCCURRENCES:** 23.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.8/17.3/0.41.

**PLOTS:** None.

**Ecosystem 64:** Well drained fine sandy loam; north-facing, strongly to steeply sloping outwash on moraine landforms; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Strongly to steeply sloping, north-facing, high-level outwash on moraine landforms. Well drained fine sand to very fine sandy loam. Bigtooth aspen - northern hardwood overstory; northern hardwood understory; *Polygonatum* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Strongly to steeply sloping (> 15%) north-facing outwash slopes on the interlobate moraine.

**ELEVATION:** 236 - 243 m.

### Soil

Well drained fine sand to very fine sandy loam at surface.

### Vegetation

Bigtooth aspen dominates the overstory; northern hardwood species including sugar maple, white ash, and yellow birch are associates. The understory is composed of northern hardwood species. The *Polygonatum* species group is characteristic in the ground-cover. Presettlement cover type was hemlock - northern hardwood.

### Comments

Type 64 occupies a very limited area that has not been sufficiently studied to describe in detail. It covers an elevational range similar to type 62 and may be related in origin (see comments, type 62).

### Similar Ecosystems

Distinguished from type 62 by northern aspect, the presence of overstory white ash and yellow birch, and greater coverage of the *Polygonatum* species group.

### Location

A small area on the northwest side of the interlobate moraine; NE 1/4 NE 1/4 Sec. 36, T37N R4W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.8/0.8/0.02.

**PLOTS:** None.

**Ecosystem 65:** Somewhat excessively drained medium sand; steeply sloping high-level outwash in the Little Carp River gorge; white pine - red pine - hemlock - red oak/*Maianthemum*.

**SYNOPSIS:** Steeply sloping high-level outwash; walls of the Little Carp River gorge. Excessively drained sands. Bigtooth aspen overstory; red pine - white pine - red oak understory; *Pteridium* - *Gaultheria* - *Maianthemum* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. No plots.

### Physiography

**LANDFORM:** Steep (25 - 120%) slopes formed by subsidence related to headward advancement of springs in the Little Carp River gorge (the walls of the gorge); all aspects.

**ELEVATION:** 189 - 213 m.

### Soil

Excessively drained medium and coarse sands, some pebbles and cobbles.

### Vegetation

Bigtooth aspen dominates a mixture of species in the overstory including red pine, red oak, white pine, and hemlock. The understory includes red pine, white pine, and red oak. The ground-cover is sparse but includes the *Pteridium*, *Gaultheria*, and *Maianthemum* species groups. The *Cladina*, *Aralia*, and *Polygonatum* species groups are occasional. Presettlement cover type was white pine - red pine - hemlock - red oak.

### Comments

There is some variation in vegetation apparently related to slope position and aspect (e. g., some northern hardwood species and more hemlock on some lower, north- and east-facing slopes), but determining the consistency of these patterns requires more work.

### Similar Ecosystems

Distinguished from types 49 and 50 by generally greater slope percentages and lack of rolling colluvial deposits and springs below the foot slopes.

### Location

Slopes of the Little Carp River Gorge; SW 1/4 Sec. 33, T37N R3W.

**NUMBER OF OCCURRENCES:** 3.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.3/7.0/0.16.

**PLOTS:** None.

**Ecosystem 66:** Well drained medium and coarse sand; rolling colluvial deposits in the Little Carp River gorge; hemlock - northern hardwood/*Polygala*.

**SYNOPSIS:** Gently rolling colluvial deposits in the Little Carp River gorge. Well drained sands. Hemlock - white pine - sugar maple overstory; sugar maple - hemlock understory; *Polygala* - *Clintonia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently rolling colluvial deposits at the base of the steeply sloping walls of Little Carp River Gorge.

**ELEVATION:** 187 - 189 m.

### Soil

Well drained colluvium; mostly medium and coarse sands, pebbles and cobbles locally abundant.

### Vegetation

The well-developed overstory includes hemlock, white pine, sugar maple, paper birch, and white ash. Sugar maple and hemlock are dominant in the understory. The *Polygala* and *Clintonia* species groups are both common in the ground-cover. Presettlement cover type was hemlock - northern hardwood.

### Comments

Type 66 has an enjoyably distinctive physiography and physiognomy; the fairly open understory invites one to leap from one colluvial mound to the next, clearing the seeps between. Includes seeps (type 73) that were too small to map.

### Similar Ecosystems

Distinguished from type 67 by a more rolling physiography, topographic position below steep slopes, and presence of pebbles and cobbles in the soil.

### Location

The Little Carp River gorge; SW 1/4 33, T37N R3W.

**NUMBER OF OCCURRENCES:** 7.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.7/5.1/0.12.

**PLOTS:** None.

**Ecosystem 67:** Well drained to somewhat poorly drained medium sand; alluvial ridge along the Little Carp River; hemlock - northern hardwood/*Clintonia*.

**SYNOPSIS:** Level to gently sloping alluvial ridge. Well drained medium sand; water table between 30 and 150 cm. Bigtooth aspen - trembling aspen overstory; red maple - sugar maple - hemlock - balsam fir understory; *Pteridium* - *Clintonia* - *Maianthemum* ground-cover species groups. Hemlock - northern white-cedar presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping alluvial ridge along the west bank of the Little Carp River.

**ELEVATION:** 181 - 189 m.

### Soil

Well drained to somewhat poorly drained medium sand, calcareous below 80 cm; water table between 30 and 150 cm ; well developed E horizon (30 cm thick); mottled EB below the E.

### Vegetation

Bigtooth and trembling aspens dominate the overstory; associates include red maple, white pine, hemlock, beech, sugar maple, and balsam fir. Red and sugar maples, hemlock, and balsam fir occupy the understory. The *Pteridium*, *Clintonia*, and *Maianthemum* species groups are common; the *Aralia* and *Polygala* groups are also present. Presettlement cover type was hemlock - white pine - northern hardwood.

### Comments

The well-developed E horizon and high coverage of the *Clintonia* species group belie the calcareous substrate. High water table may deter rooting in the calcareous soil, and historical presence of hemlock may have greatly acidified the surface soil. Type 67 is intersected by recessional beach ridges (type 79) and by a few drainages leading from Reese's Swamp to the Little Carp River.

### Similar Ecosystems

Distinguished from type 79 by higher ground-cover species richness and greater coverage of the *Clintonia* species group; type 79 is generally narrower and bounded on both sides by wetlands. Distinguished from type 66 by topographic position (type 66 lies below steeply sloping gorge walls), more level physiography, and lower coverage of the *Polygala* species group.

### Location

Along the west bank of the Little Carp River; Sec. 4, T36N R3W.

**NUMBER OF OCCURRENCES:** 2.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 4.9/9.7/0.23.

**PLOTS:** None.

**Ecosystem 68:** Well drained to moderately well drained silt loam; Nipissing-age delta; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Level to gently sloping Nipissing-age delta. Well drained to moderately well drained silt loam, acidic in all horizons. Balsam fir - trembling aspen overstory; paper birch - balsam fir understory; *Pteridium* - *Maianthemum* - *Polygala* - *Polygonatum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. One plot.

### Physiography

**LANDFORM:** 4000-yr-old delta formed at the mouth of the Little Carp River in Glacial Lake Nipissing, presently elevated above the Little Carp River and Reese's Swamp.

**SLOPES:** Level to gently sloping (0 - 6.5%); east-southeast aspect.

**ELEVATION:** 187 - 189 m.

### Soil

**DRAINAGE:** Well drained to moderately well drained.

**TEXTURE:** Silt loam in the E and B horizons, silty clay loam in the C.

**pH:** 5.5 in the E horizon, 5.3 in B, and 5.4 in C.

**DEVELOPMENT:** Organic horizons limited or absent, Oi 1 cm thick, no Oe or Oa; no A horizon; E horizon 12 cm thick; B also 12 cm thick.

**PEBBLES AND COBBLES:** Absent.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): balsam fir (38/50), trembling aspen (33/37), paper birch (18/11). Other species: northern white-cedar, sugar maple, red maple. No. of trees/plot = 40.

**UNDERSTORY:** Most common species (% rel. density): paper birch (50), balsam fir (40). other species: trembling aspen. No. of stems/plot = 10.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Maianthemum*, *Polygala*, *Polygonatum*. Most common ground-cover species: *Pteridium aquilinum*, *Maianthemum canadense*, *Trillium grandiflorum*. Most common tree seedlings: balsam fir, trembling aspen, paper birch, white ash, red oak.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

This delta deposit is a unique feature on UMBS property. It occurs at and slightly below the Glacial Lake Nipissing shoreline, directly adjacent to the large Nipissing dunes at Hogsback Rd. Rising abruptly 3 m from the modern riparian wetlands on the east side of the Little Carp River, the delta slopes gently down into Reese's swamp, where the wetland hydrology and vegetation take over. As in type 69, soil particle sizes are larger in more

recent (upper) layers, indicating the increasing proximity of the river mouth, and higher water velocities, as the delta was constructed further into the lake.

### **Similar Ecosystems**

Distinguished from type 122 by position below the Glacial Lake Nipissing shoreline and lack of the *Caulophyllum* species group. Distinguished from type 69 by silt loam at the surface.

### **Location**

South of Hogsback Rd. at the base of the Nipissing dunes east of Little Carp River; NE 1/4 Sec. 4, T36N R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 4.1/4.1/0.10.

PLOTS: 9321.

**Ecosystem 69:** Well drained to moderately well drained medium to fine sand; post-Nipissing-age delta; hemlock/*Maianthemum*.

SYNOPSIS: Level to gently sloping post-Nipissing delta. Well drained to moderately well drained sand, acidic in all horizons. Hemlock overstory; no understory; *Maianthemum* ground-cover species groups. Hemlock presettlement cover type. One plot.

### Physiography

LANDFORM: Delta formed in post-Nipissing Burt Lake near the present mouth of the Little Carp River.

SLOPES: Level to very gently sloping (1%); southern aspect.

ELEVATION: 183 - 184 m.

### Soil

DRAINAGE: Well drained to moderately well drained.

TEXTURE: Medium sand in E and Bs horizons, fine sand in BC.

pH: 4.4 in E horizon to 4.7 in BC.

DEVELOPMENT: Well developed organic horizons, Oi 1/5 cm thick, Oe 3.3 cm, Oa 3.9 cm; no A horizon; E horizon extremely thick, 55 cm; Bs horizon 10 cm thick; BC horizon extends below water table.

PEBBLES AND COBBLES: Absent.

### Vegetation

OVERSTORY: Dominants (% rel. density/% rel. dominance): eastern hemlock (72/90), red maple (23/9). Other species: paper birch. Mean no. of stems/plot = 39.

UNDERSTORY: No understory.

GROUND COVER: Dominant ecological species groups: *Maianthemum*. Most common ground-cover species: *Trientalis borealis* and *Maianthemum canadense*. Most common tree species: red maple.

PRESETTLEMENT COVER TYPE: Hemlock.

### Comments

The progressively finer particle sizes in deeper soil horizons may be evidence for the gradual southward movement of the river's mouth into Burt Lake. Larger particle sizes indicate greater depositional velocity, i.e., closer proximity to the source. Aerial photos and the USGS map show the delta of which this ecosystem is a part.

### Similar Ecosystems

Distinguished from type 68 by lack of silt loam soil. Distinguished from type 67 by physiography (wide delta vs. narrow alluvial ridge), greater dominance of hemlock in the overstory, and a deeper E horizon.

### Location

Just east of the Little Carp River near Burt Lake; SE 1/4 Sec. 4, T36N, R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.6/2.6/0.06.

PLOTS: 9303.

**Ecosystem 70:** Outwash-lake plain conifer streamside swamp; northern white-cedar - white spruce - balsam fir/*Coptis*.

**SYNOPSIS:** Level streamside flats in high-level outwash plain. Groundwater-fed stream flow; sapric muck over medium sand. Northern white-cedar - hemlock overstory; black ash - northern white-cedar - alder understory; *Coptis* ground-cover species groups. Northern white-cedar - white spruce - balsam fir presettlement cover type. No plots.

### Physiography

**LANDFORM:** Narrow (<10 m), level to gently sloping streamside flat.

**ELEVATION:** 183 - 185 m.

### Hydrology

Groundwater-fed stream flow; water above or near the surface throughout the growing season (intermittently exposed); pH 7.0

### Soil

50 cm sapric muck over medium sand.

### Vegetation

Northern white-cedar and hemlock dominate the overstory, accompanied by black ash and white pine. The understory is composed of black ash, northern white-cedar, and speckled alder. The *Coptis* species group typifies the ground-cover, dominated by mosses.

### Comments

This type (Zogg's type 11; Zogg 1993) as well as types 71 and 72, is found in narrow strips along upstream reaches of Little Carp River in the "gorge", a feature formed by the subsidence of lake-plain and outwash deposits by subsurface groundwater flow originating in Douglas Lake.

### Similar Ecosystems

Distinguished from the vegetationally similar types 71 and 72 primarily by hydrologic regime (i.e., the most persistent water table of any on UMBS property).

### Location

Along the Little Carp River mostly north of Hogsback Rd; SW 1/4 Sec. 33, T37N R3W.

**NUMBER OF OCCURRENCES:** 5.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.6/8.1/0.19.

**PLOTS:** None.

**Ecosystem 71:** Outwash-lake plain streamside conifer-hardwood swamp; hemlock - northern white-cedar - black ash/*Clintonia*.

**SYNOPSIS:** Level streamside flats in high-level outwash plain. Groundwater- and stream-fed; muck over medium sand. Hemlock - northern white-cedar overstory; northern white-cedar - alder understory; *Clintonia* - *Polygala* - *Typha* - *Onoclea* ground-cover species groups. Hemlock - northern white-cedar - black ash presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping streamside flats in high-level outwash plain, sometimes separated from stream by a small (< 1 m) levee.

**ELEVATION:** 181 - 185 m.

### Hydrology

Groundwater and stream flow; water above the surface in early spring, within 20 cm in late summer (semipermanently flooded); pH 6.5

### Soil

10 - 30 cm sapric muck over medium sand.

### Vegetation

Hemlock and northern white-cedar dominate the overstory; black ash paper birch and yellow birch also occur. The understory is composed of northern white-cedar, speckled alder, paper birch, and yellow birch. The *Clintonia*, *Polygala*, *Typha*, and *Onoclea* species groups are found in the ground-cover. Presettlement forest was likely hemlock - northern white-cedar - black ash.

### Comments

Type 71 represents an expansion of Zogg's (1993) type 12 to include what are mostly mixed conifer-hardwood wetlands along the Little Carp River. Small portions are dominated by hardwoods.

### Similar Ecosystems

Distinguished from type 70 by shallower muck, more hardwoods in the canopy, and lower coverage of the *Coptis* species group in the ground-cover. Distinguished from types 54 and 55 by lower fluctuation in the water table and by location along rivers.

### Location

Along Little Carp River; SW 1/4 Sec. 33, T37N R3W and Sec. 4, T36N R3W.

**NUMBER OF OCCURRENCES:** 5.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.9/4.5/0.11.

**PLOTS:** None.

**Ecosystem 72:** Outwash-lake plain streamside shrub alder swamp; alder/*Ilex*.

**SYNOPSIS:** Level streamside flats in high-level outwash plain. Groundwater- and stream-fed; muck over medium sand. Sparse paper birch - red maple - white ash overstory; alder understory; *Ilex* - *Onoclea* ground-cover species groups. Shrub alder presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping streamside flats, sometimes separated from stream by a small (< 1 m) levee.

**ELEVATION:** 184 m.

### Hydrology

Groundwater-fed stream flow; standing water in spring, below 50 cm in late summer (seasonally flooded); pH 6.4.

### Soil

10 - 30 cm sapric muck over medium sand.

### Vegetation

A sparse overstory includes paper birch, red maple, and white ash. Speckled alder dominates the understory accompanied by red maple, black ash, and white ash. The *Ilex* and *Onoclea* species groups characterize the ground-cover species groups. Presettlement cover type was probably shrub alder.

### Comments

Type 72 is Zogg's type 13 (Zogg 1993). Alder density varies in this type from very dense to scattered. In at least one small area a patch of *Sphagnum* spp. provides suitable habitat for sundews (*Drosera rotundifolia*) and other acidophiles.

### Similar Ecosystems

Distinguished from type 24 and type 36 by much greater coverage of the *Ilex* species group (e.g., *Ilex verticillata*, *Thelypteris palustris* (Salisb.) Schott, and *Carex crinita* Lam. are all common in this type); however, they share many overstory and understory species in common; more detailed sampling is warranted especially for comparisons with type 32.

### Location

In the upper reaches of the Little Carp River; SW 32, T37N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.6/1.6/0.04.

**PLOTS:** None.

**Ecosystem 73:** Colluvium conifer-hardwood seep wetland in the Little Carp River gorge; hemlock - northern hardwood/*Coptis*.

SYNOPSIS: Gently rolling colluvial deposits in the Little Carp River gorge. Spring-fed, shallow stream; sand. Hemlock - northern hardwood overstory and understory; *Coptis* - *Arisaema* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

LANDFORM: Seeps in rolling colluvium at the base of steep walls of the Little Carp River gorge.

ELEVATION: 187 - 189 m.

### Hydrology

Spring-fed, very small, shallow (< 5 cm) stream flow; water at surface year-round.

### Soil

Sand at surface under very shallow water.

### Vegetation

The overstory of surrounding uplands (type 59) contains hemlock and northern hardwoods including yellow birch and basswood. Hemlock is the primary understory plant, with some northern hardwoods present. A diverse ground-cover in the seeps includes mosses, the *Coptis* and *Arisaema* species groups, and *Myosotis scorpioides*. Presettlement cover type was hemlock - northern hardwood.

### Comments

Too small and scattered to be mapped (a pencil line obscures the entire type), these spring-fed seeps occur within upland type 66. The cold flowing water supports *Myosotis scorpioides*, but is shallow enough that mosses and the *Coptis* group can grow here as well. Organic matter seems not to accumulate here. At their lower ends these seeps become tributaries to the Little Carp River.

### Similar Ecosystems

Distinguished from all other wetlands by the very shallow flowing water and lack of accumulated organic matter.

### Location

Very small seeps in colluvial deposits (type 66); SW 1/4 Sec. 33, T37N R3W.

NUMBER OF OCCURRENCES: 0 (not mapped).

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: (not mapped).

PLOTS: None.

**Ecosystem 74:** Excessively drained to somewhat excessively drained medium sand to fine sand; dunes on high-level outwash-lake plain; white pine - red pine - hemlock - red oak/*Gaultheria*.

**SYNOPSIS:** Level to steeply sloping dunes on high-level outwash plain. Excessively drained medium sand, acidic in all horizons. Bigtooth aspen - red pine - red oak - white pine overstory; white pine - red pine - red maple understory; *Pteridium* - *Cladina* - *Gaultheria* - *Maianthemum* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Dunes of various types (e.g. parabolic, linear, simple, and complex) and sizes (2 - 15 m in height, 10 m to 1.3 km in length), mostly near glacial lake shorelines, but a few on the leeward (eastern) side of the interlobate moraine.

**SLOPES:** Level to steeply sloping (0 - 50%); all aspects.

**ELEVATION:** 189 - 250 m.

### Soil

**DRAINAGE:** Excessively drained to somewhat excessively drained.

**TEXTURE:** Medium sand to fine sand in all horizons.

**pH:** 4.9 (4.8 - 5.3) in the E horizon to 5.5 (5.3 - 5.8) in C.

**DEVELOPMENT:** Organic horizons limited, Oi 1.8 cm thick, Oe 1.3 cm, Oa 1.2 cm; no A horizon; E horizon 20 (10 - 31) cm thick; Bs1 30 (18 - 40) cm thick; BC 24 (10 - 39) cm thick.

**PEBBLES AND COBBLES:** Absent.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% rel. frequency): bigtooth aspen (36/37/100), red pine (25/24/100), red oak (23/23/80), white pine (12/14/60). Mean no. of stems/plot = 37.

**UNDERSTORY:** Dominants (% rel. density/% rel. frequency): white pine (59/100), red pine (18/80), red maple (12/100). Other species: red oak, balsam fir, beech. Mean no. of stems/plot = 53.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Cladina*, *Gaultheria*, *Maianthemum*. Most common ground-cover species: *Pteridium aquilinum*, *Cladina* spp., *Vaccinium angustifolium*. Most common tree seedlings: red maple, white pine, serviceberry. The large Nipissing-age dunes on the edge of Reese's swamp are colonized by wetland and moisture-requiring species at the base of their swamp-side slopes, and are park-like with much bare soil and graminoid ground-cover on their upland sides.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

These dunes were mapped to reflect the full extent of the aeolian landforms. They occur on a variety of other landforms (outwash plains, moraine, beaches), and the degree to which typical dune vegetation (as characterized above) predominates is related to the depth of the dune sand and the relative moisture and fertility conditions of the underlying substrate. In most (99% or more) of the area mapped as type 74, dune vegetation persists out to the limits of the mapped area. In a few areas though, particularly near somewhat poorly drained till and Reese's Swamp, plants from the adjacent ecosystems occur. Dunes that occur within type 36 on the Glacial Lake Algonquin lake floor are only distinguishable by physiography and soil (dunes have medium sand with very little variation in particle size and no pebbles); the vegetation is essentially the same.

### Similar Ecosystems

Distinguished from type 36 by a total lack of pebbles in the soil and dune physiography. Distinguished from the Chippewa-age dunes on the Pellston Plain (type 34) by much less red maple in the overstory and understory.

### Location

Along shorelines of glacial lakes and on the east side of the interlobate moraine; Sec. 32 - 34, T37N R3W, and Sec. 3 - 6, T36N R3W.

NUMBER OF OCCURRENCES: 25.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
5.4/136.3/3.21.

PLOTS: 9124, 9227, 9301, 9304, 9308.

**Ecosystem 75:** Somewhat excessively drained medium sand; glacial lake beaches; white pine - red pine - hemlock - red oak/*Maianthemum*.

**SYNOPSIS:** Level to gently sloping Algonquin-age beach. Somewhat excessively drained medium sand, acidic in all horizons. Paper birch - bigtooth aspen - red oak overstory; serviceberry - red maple understory; *Pteridium* - *Maianthemum* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping Glacial Lake Algonquin beach feature.

**ELEVATION:** 224 - 225 m.

### Soil

Somewhat excessively drained medium to medium fine sand with some pebbles, acid in all horizons.

### Vegetation

Paper birch, bigtooth aspen, and red oak compose the overstory. The understory is serviceberry and red maple. The *Maianthemum* species group characterizes the ground-cover; the *Pteridium* group is also abundant. Presettlement cover type was white pine - red pine - hemlock - red oak.

### Comments

Type 75 is part of the same feature as type 76, which has a coarse, calcareous soil more characteristic of Glacial Lake Algonquin beaches. The low pH of the soil in type 75 is enigmatic in light of the calcareous soil in other areas of these beaches.

### Similar Ecosystems

Distinguished from other Glacial Lake Algonquin beaches (types 76 - 78) by acidic soil and lack of the *Oryzopsis* and *Hepatica* species groups.

### Location

One small area at the base of the interlobate moraine on its east side; SW 1/2 Sec. 5, T36N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.1/1.1/0.03.

**PLOTS:** None.

**Ecosystem 76:** Somewhat excessively drained medium sand, calcareous in C horizon; glacial lake beaches; white pine - red pine - hemlock - red oak or hemlock - northern hardwood/*Oryzopsis*.

**SYNOPSIS:** Level to gently sloping Algonquin-age beaches. Somewhat excessively drained medium sand, calcareous in C horizon. Bigtooth aspen - red maple - red pine overstory; red maple - white pine - red oak understory; *Pteridium* - *Gaultheria* - *Oryzopsis* ground-cover species groups. White pine - red pine - hemlock - red oak or hemlock - northern hardwood presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Linear Glacial Lake Algonquin beaches, capped by dunes near the interlobate moraine; 3 - 100 m wide and up to 1.3 km long.

**SLOPES:** Level to gently sloping (0 - 4%); all aspects.

**ELEVATION:** 219 - 226 m.

### Soil

**DRAINAGE:** Somewhat excessively drained.

**TEXTURE:** Medium sand to coarse sand in all horizons.

**pH:** 5.1 (4.3 - 6.4) in E horizon to 7.0 (5.5 - 7.9) in C.

**DEVELOPMENT:** Moderately thick organic horizons, Oi 2.1 cm thick, Oe 1.1 cm, Oa 1.2; no A horizon; E horizon 13.5 (8 - 18) cm thick; Bs1 37 (15 - 53) cm thick; Bs2 and BC (if present) 22 (15 - 29) and 45 (25 - 57) cm thick, respectively; lenses of pebbles or coarse sand may occur at any depth.

**PEBBLES AND COBBLES:** Pebbles variable, 0 - 50%; cobbles usually absent, to 3%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% rel. frequency): bigtooth aspen (35/40/100), red maple (35/38/100), red pine (11/15/40). Other species: jack pine, red oak, white pine, paper birch, beech. Mean no. of stems/plot = 49.

**UNDERSTORY:** Dominants (% rel. density/% frequency): red maple (52/100), white pine (19/80), red oak (10/60). Other species: red pine, paper birch, beech, bigtooth aspen, serviceberry, balsam poplar. Mean no. of stems/plot = 38.

**GROUND COVER:** Dominant ecological species groups: *Pteridium*, *Gaultheria*, *Oryzopsis*. Most common ground-cover species: *Pteridium aquilinum*, *Gaultheria procumbens*, *Oryzopsis asperifolia*, *Vaccinium angustifolium*. Most common tree seedlings: red oak, red maple, beech, white pine.

**PRESETTLEMENT COVER TYPE:** White pine - red pine - hemlock - red oak or hemlock - northern hardwood.

### Comments

Type 76 comprises subtle Glacial Lake Algonquin beaches (such as the one that crosses Riggsville Rd. in Sec. 5, T36N R3W) or peripheral portions of more distinct shoreline features. Different forest types can arise and are probably related to seed source and fire frequency; soil and ground-cover vegetation remain consistent throughout.

### Similar Ecosystems

Distinguished from types 77 and 80 by more subtle physiography, fewer cobbles; lack of the *Polygonatum* and *Caulophyllum* species groups. Distinguished from type 75 by calcareous soil in the C horizon and presence of the *Oryzopsis* group. Distinguished from type 78 by a much deeper water table, less dramatic microtopography, and absence of the *Aralia* species group.

### Location

At Glacial Lake Algonquin shorelines in the basins of Burt, Douglas, and Mullett Lakes (NW 1/4 Sec. 5, T36N R3W and SE 1/4 Sec. 32, S 1/2 Sec's 33 and 34, NW 1/4 Sec. 35, and Sec. 26, T37N R3W) and at the northern tip of the interlobate moraine (NE 1/4 Sec. 25, T37N R4W).

NUMBER OF OCCURRENCES: 10.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 8.6/86.1/2.03.

PLOTS: 9121, 9125, 9129, 9142, 9307.

**Ecosystem 77:** Somewhat excessively drained medium sand, calcareous in the C horizon; glacial lake beaches; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Level to moderately sloping Algonquin-age beaches and gravel bars. Somewhat excessively drained medium sand, calcareous in the C horizon. Sugar maple - red pine - jack pine overstory; red maple - sugar maple - eastern hop-hornbeam understory; *Pteridium* - *Oryzopsis* - *Maianthemum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Linear Glacial Lake Algonquin beaches and gravel bars, 10 to 80 m wide and up to 1.2 km long.

**SLOPES:** Level to moderately sloping (0 - 12%); all aspects.

**ELEVATION:** 224 - 226 m.

### Soil

**DRAINAGE:** Somewhat excessively drained.

**TEXTURE:** Medium sand to medium loamy sand in A, E, and Bs horizons; medium sand to coarse sand in C.

**pH:** 5.0 (4.7 - 5.4) in E horizon; 6.0 in A; 7.4 (6.8 - 8.6) in C.

**DEVELOPMENT:** Organic horizons limited, Oi 2.3 cm thick, Oe 1.7 cm, Oa 1.0 cm; A horizon occasionally present, to 8 cm thick; E horizon 15.5 (12 - 20) cm thick; Bs1 38 (27 - 50) cm thick; Bs2 or BC (if present) 32 (12 - 48) and 25 (3 - 38) cm thick, respectively.

**PEBBLES AND COBBLES:** Pebbles variable, 2 - 50%; cobbles average 0 - 5% in E, A, and Bs horizons, 20 - 30% in C horizon.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): sugar maple (27/35/60), red pine (22/28/60), jack pine (10/13/60). Other species: red oak, eastern hop-hornbeam, bigtooth aspen, red maple, white ash, eastern hemlock, paper birch, beech, white pine. Mean no. of stems/plot = 39.

**UNDERSTORY:** Dominants (% rel. density/% frequency): red maple (29/100), sugar maple (28/60), eastern hop-hornbeam (22/40). Other species: white pine, beech, serviceberry, red pine, red oak, paper birch, white ash, basswood, striped maple, eastern hemlock. Mean no. of stems/plot = 67.

**GROUND COVER:** Dominant species groups: *Pteridium*, *Oryzopsis*, *Maianthemum*. Most common ground-cover species: *Oryzopsis asperifolia*, *Pteridium aquilinum*, *Amelanchier* spp., *Maianthemum canadense*. Most common tree species in ground-cover: sugar maple, red oak, red maple.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Features mapped as type 77 are typically cobbly. One explanation of this trait is that, during formation, they were near enough to a source of cobbles for Glacial Lake Algonquin wave action to have moved and deposited the cobbles there, forming the features. Alternatively, type 77 may represent the very coarse remnants of other features (e.g., moraines or eskers) left after waves have removed most of the smaller particles. Pine plantations occur on or very near these beaches (and hence provide a strong seed source), but the successional trend is towards northern hardwood forests.

### Similar Ecosystems

Distinguished from type 76 by more abundant cobbles, more distinctive topography, and presence of the *Polygonatum* species group. Distinguished from type 80, Glacial Lake Nipissing features at Colonial Point, by higher elevation and absence of the *Caulophyllum* species group. Distinguished from type 78 by a deeper water table and poorly developed microtopography, and from type 75 by calcareous soil and presence of the *Polygonatum* group.

### Location

At Glacial Lake Algonquin shorelines (E 1/2 Sec. 34, W 1/2 Sec 23 T37N R3W, and NE 1/4 Sec. 25, T37N R4W).

NUMBER OF OCCURRENCES: 4.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 4.5/18.1/0.43.

PLOTS: 8813, 9137, 9226, 9305, 9306.

**Ecosystem 78:** Moderately well drained, banded, medium sand, calcareous in the C horizon; glacial lake beaches; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Gently sloping Algonquin-age beach. Moderately well drained, banded, medium sand, calcareous in the C horizon; water table between 50 and 130 cm. Northern hardwood - trembling aspen overstory; northern hardwood - eastern hop-hornbeam - balsam fir understory; *Pteridium* - *Polygonatum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping Glacial Lake Algonquin beach feature; strongly developed pit-and-mound topography.

**ELEVATION:** 224 - 225 m.

### Soil

Moderately well drained medium and coarse sand with pebbles, banded with fine sand and fine sandy loam below 100 cm, calcareous at 100 cm; water table varies from 50 - 130 cm through growing season.

### Vegetation

The overstory is a fairly even mixture of northern hardwood species, trembling aspen, white pine, and balsam fir. A dense understory includes northern hardwood species, eastern hop-hornbeam, and balsam fir. The *Polygonatum* species group characterizes a diverse ground-cover; species in the *Osmorhiza* group are uncommon, but seedlings of northern hardwood trees and members of the *Pteridium* group are abundant. Presettlement cover type was hemlock - northern hardwood.

### Comments

The high water table in type 78 is due to the proximity of the drumlinized moraine, adjacent to the north. Relatively impermeable till probably underlies the beach deposits here, impeding downward water movement; the high water table deterred verification of the presence of till.

### Similar Ecosystems

Distinguished from type 35 by deeper sand over till and poorer drainage. Distinguished from all other beach ecosystems by much more pronounced pit-and-mound topography.

### Location

Just south of Dotski Rd.; NE 14 Sec. 22, T37N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.9/1.9/0.03.

**PLOTS:** None.

**Ecosystem 79:** Well drained to moderately well drained medium sand; glacial lake beaches; white pine - white spruce - balsam fir/*Maianthemum*.

**SYNOPSIS:** Gently sloping Nipissing-age recessional beaches. Well drained to moderately well drained medium sand, acidic in all horizons; water table 50 - 100 cm. Northern white-cedar - white pine - trembling aspen - white spruce overstory; northern white-cedar - balsam fir - white pine - white spruce understory; *Maianthemum* - *Polygala* - *Clintonia* - *Gaultheria* ground-cover species groups. White pine - white spruce - balsam fir presettlement cover type. No plots.

### Physiography

**LANDFORM:** Narrow (mostly 3 - 15 m wide), level to very gently sloping, linear beaches formed by recessional stages of Glacial Lake Nipissing.

**ELEVATION:** 182 - 187 m.

### Soil

Well drained to moderately well drained medium to coarse sand with pebbles, mottled in E and B horizons, acidic in all horizons; water table 50 - 100 cm.

### Vegetation

A mixture of upland and wetland trees such as northern white-cedar, white pine, trembling aspen, and white spruce occur in the overstory. Northern white-cedar, balsam fir, white pine, and white spruce all occur in the understory. The *Maianthemum*, *Polygala*, *Clintonia*, and *Gaultheria* species groups all can be found in the ground-cover. Presettlement cover type was likely white pine - white spruce - balsam fir.

### Comments

These beach strands are visible in aerial photographs of Reese's Swamp; the taller canopy of white pine and trembling aspens, relative to the surrounding wetlands, give them away. They appear somewhat discontinuous, and have been found in some places to be covered by muck and wetland vegetation. An interesting potential development related to some global change scenarios is whether the wetlands will "swallow" these narrow uplands as organic matter accumulation increases, or whether predicted global warming will result in more rapid decomposition of the organic deposits in such wetlands, exposing more beach area.

### Similar Ecosystems

Distinguished from other glacial lake beaches by being surrounded by wetlands. Distinguished from type 67 by narrower landform, shallower water table, lack of a hemlock - northern hardwood overstory, and lower coverage of the *Clintonia* species group.

### Location

In Reese's Swamp; Sec. 3 and 4, T36N R3W.

**NUMBER OF OCCURRENCES:** 9.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.3/11.5/0.27.

**PLOTS:** None.

**Ecosystem 80:** Well drained medium sand, calcareous in C horizon; glacial lake gravel bars and beaches at Colonial Point; hemlock - northern hardwood/*Caulophyllum*.

**SYNOPSIS:** Gently to moderately sloping pre-Nipissing and Nipissing-age gravel bars and beaches. Well drained medium and coarse sand, calcareous in C horizon. Northern hardwood overstory and understory; *Caulophyllum* - *Osmorhiza* - *Polygonatum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently to moderately sloping ridge-like gravel bars and beaches of pre-Nipissing and Nipissing age at Colonial Point.

**ELEVATION:** 189 - 207 m.

### Soil

Well drained medium to coarse sand with pebbles and cobbles, calcareous in C horizon.

### Vegetation

Northern hardwood species dominate the overstory and understory, particularly eastern hop-hornbeam in the understory. The *Caulophyllum* species group characterizes the ground-cover, which also includes the *Osmorhiza* and *Polygonatum* groups. Presettlement cover type was hemlock - northern hardwood.

### Comments

There are three occurrences of Glacial Lake Nipissing (or pre-Nipissing) shoreline features at Colonial Point. A distinctive linear ridge extends out from the base of the Nipissing-cut slope and crosses Colonial Point Rd., increasing in height with distance from the shore. On this ridge, the *Caulophyllum* group indicates better moisture conditions than on most glacial lake features, probably due to the position of the gravel bar; it is on a moist terrace. The other two are long narrow features extending from northwest to southeast along the top of the Colonial Point peninsula.

### Similar Ecosystems

Distinguished from other glacial lake shoreline features (types 75 - 79) by presence of the *Caulophyllum* species group. Distinguished from adjacent ecosystems at Colonial Point by gravely soil and ridge-like physiography.

### Location

At Colonial Point; Sec. 28, T36N R3W.

**NUMBER OF OCCURRENCES:** 3.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.0/3.1/0.07.

**PLOTS:** None.

**Ecosystem 81:** Somewhat excessively drained medium sand; ice-contact ridges in shallow ponded depressions; hemlock - northern hardwood/*Maianthemum*.

**SYNOPSIS:** Gently sloping small ice-contact ridges. Somewhat excessively drained medium sand. Patchy trembling aspen - bigtooth aspen overstory and understory; *Pteridium* - *Maianthemum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping small (< 2 m high), linear, ice-contact ridges in shallow ponded depression.

**ELEVATION:** 226 - 228 m.

### Soil

Somewhat excessively drained medium sand.

### Vegetation

An overstory may or may not be present. If present it includes trembling and bigtooth aspens and some sugar maple. The same species are found in the understory. Ground-cover species groups include *Pteridium*, and *Maianthemum*; *Aralia* is also occasional. Presettlement cover type was probably hemlock - northern hardwood.

### Comments

These small ridges could be piles of outwash deposited against the small remnant ice-blocks that formed the shallow ponded depression. Further investigation of substrate stratification and texture would be informative.

### Similar Ecosystems

Distinguished from dunes (type 74) by smaller size and occasional presence of northern hardwood species in all strata.

### Location

In the ponded depression south of Maple Bay of Douglas Lake; N 1/2 Sec 31, T37N R3W.

**NUMBER OF OCCURRENCES:** 5.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.7/3.3/0.08.

**PLOTS:** None.

**Ecosystem 82:** Well drained to moderately well drained loamy fine sand to sandy loam; shallow ponded depressions; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Gently sloping shallow ice-block depressions. Well drained fine sandy loam, calcareous in C horizon. Red maple - trembling aspen - bigtooth aspen overstory; serviceberry - red maple understory; *Pteridium* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. One plot.

### Physiography

**LANDFORM:** Shallow ice-block depressions mostly filled with outwash and ponded-water deposits.

**SLOPES:** Very gently sloping (< 1%); all aspects.

**ELEVATION:** 225 - 227 m.

### Soil

**DRAINAGE:** Well drained to moderately well drained.

**TEXTURE:** A, E, and Bs2 horizons are loamy fine sand; Bs1 is fine sandy loam; BC and C are fine sand; band in C is clay loam; 2C is very fine sandy loam.

**pH:** 5.3 in A; 5.4 in E; 6.0 - 6.2 in B horizons; 6.7 in C (band in C is 7.3); 7.9 in 2C.

**DEVELOPMENT:** Thick organic horizons, Oi 3.3 cm thick, Oe 2.2 cm, Oa 2.0 cm; A horizon 3 cm thick; Bs1 and Bs2 18 and 16 cm thick, respectively; BC 39 cm thick; band of clay loam in C horizon 30 cm thick; C horizon 56 cm thick.

**PEBBLES AND COBBLES:** Pebbles 0 -1% throughout; cobbles absent.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): red maple (32/42), trembling aspen (27/30), bigtooth aspen (18/14), serviceberry (18/14). Other species: paper birch. Mean no. of stems/plot = 22.

**UNDERSTORY:** Most common species (% rel. density): serviceberry(79), red maple (18). Other species: black cherry. Mean no. of stems/plot = 28.

**GROUND COVER:** Dominant species groups: *Pteridium*, *Aralia*. Most common ground-cover species: *Pteridium aquilinum*, *Viburnum acerifolium*, *Gaultheria procumbens*. Most common tree species in ground-cover: red maple, red oak.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Multiple soil strata (seven horizons identified above 160 cm) reflect the variation in water velocity and sediment content over the period of deposition. It is likely that as the small ice blocks that formed those depressions melted, pockets of debris were washed off at different times and settled in the surrounding ponded water.

**Similar Ecosystems**

Distinguished from ecosystems 48 by fine sand at the surface and lack of the *Osmorhiza* species group. Distinguished from type 42 presence of the *Polygonatum* group.

**Location**

In the ponded depression south of Maple Bay of Douglas Lake (N 1/2 Sec 31, T37N R3W) and along Riggsville Rd. (SE 1/4 Sec. 27, T37N R3W).

NUMBER OF OCCURRENCES: 3.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.2/6.7/0.16.

PLOTS: 9221.

**Ecosystem 83:** Moderately well drained to somewhat poorly drained medium sand; wetland margins in high-level outwash and ice-contact terrain; white pine - hemlock - red maple/*Clintonia*..

**SYNOPSIS:** Gently sloping outwash plains on wetland margins. Moderately well drained medium sand, acidic in all horizons; water table between 50 and 300 cm. Bigtooth aspen - trembling aspen - white pine - red maple overstory; red maple - white pine - balsam fir understory; *Pteridium* - *Clintonia* - *Maianthemum* - *Gaultheria* ground-cover species groups. White pine - hemlock - red maple presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping outwash plains or lake terrace deposits peripheral to wetlands; well-developed pit-and-mound topography.

**ELEVATION:** 194 - 219 m.

### Soil

Moderately well drained to somewhat poorly drained medium sand to loamy sand, acidic in all horizons; water table between 50 and 300 cm through the growing season.

### Vegetation

The overstory may include both bigtooth and trembling aspens, white pine, red maple, paper birch, balsam fir, and hemlock. Red maple, white pine, and balsam fir compose the understory. The ground-cover is characterized by the *Clintonia* species group, but also includes the *Pteridium*, *Maianthemum*, and *Gaultheria*, groups. Presettlement cover type was white pine - hemlock - red maple.

### Comments

Depth of water table seems to be the controlling factor for development of microtopography and relative abundance of ground-cover species. Type 83 spans the gap between drier upland types and downslope wetlands.

### Similar Ecosystems

Distinguished from adjacent wetlands by mineral soil at the surface and absence of wetland species groups in the ground-cover. Distinguished from adjacent uplands by a water table within 300 cm of the surface and presence of the *Clintonia* species group. Distinguished from type 84 by the absence of fine sand and sandy loam in the soil profile and lack of the *Osmorhiza* species group.

### Location

In the ponded depression south of Maple Bay of Douglas Lake (N 1/2 Sec. 31 T37N R3W), adjacent to the Mullett Creek wetlands (NW 1/4 Sec. 35, S 1/2 Sec. 26, T37N R3W), and north of Hogsback Rd. (NW 1/4 NW 1/4 Sec. 3, T36N R3W).

**NUMBER OF OCCURRENCES:** 12.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 3.3/39.8/0.94.  
**PLOTS:** None.

**Ecosystem 84:** Moderately well drained to somewhat poorly drained medium fine sand to sandy loam, calcareous in C horizon; wetland margins in shallow ponded depressions; American elm - red maple - black ash/*Osmorhiza*.

Gently sloping outwash plains (in shallow ponded depressions) on wetland margins. Moderately well drained fine sand to sandy loam, calcareous in C horizon; water table between 50 and 300 cm. Trembling aspen - red maple overstory; red maple understory; *Maianthemum* - *Aralia* - *Osmorhiza* ground-cover species groups. Elm - red maple - black ash presettlement cover type. No plots.

### Physiography

LANDFORM: Level to gently sloping ponded depressions.

ELEVATION: 226 m.

### Soil

Moderately well drained to somewhat poorly drained medium and fine sand to sandy loam, calcareous in C horizon; water table 50 - 300 cm through growing season. May be underlain by till of the adjacent interlobate moraine.

### Vegetation

Trembling aspen and red maple are most abundant in the overstory; other species include northern white-cedar and black ash (occasional). Red maple is the dominant understory stem, accompanied by serviceberry and black ash. The ground-cover includes upland and wetland species, such as the *Maianthemum*, *Aralia*, and *Osmorhiza* species groups, as well as some of the *Onoclea* group. Presettlement cover type was American elm - red maple - black ash.

### Comments

Type 84 has not been studied in great detail. Indeed, the complex array of ecosystems in the ponded depression deserves more work.

### Similar Ecosystems

Distinguished from type 83 by calcareous soils and presence of the *Osmorhiza* species group. Distinguished from adjacent wetlands (type 85) by absence of muck at the surface and lower coverage of wetland species groups.

### Location

In the ponded depression south of Maple Bay of Douglas Lake; N 1/2 Sec 31, T37N R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.1/1.1/0.03.

PLOTS: None.

**Ecosystem 85:** Ice-contact ponded depression hardwood swamp; American elm - red maple - black ash/*Onoclea*.

**SYNOPSIS:** Gently sloping shallow ponded depression. Groundwater-fed; muck over fine sandy loam; water table 30 - 200 cm. Red maple - trembling aspen overstory; red maple - black ash understory; *Onoclea* - *Ilex* - *Clintonia* - *Toxicodendron* ground-cover species groups. Elm - red maple - black ash presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping shallow ponded depression.

**ELEVATION:** 225 m.

### Hydrology

Groundwater-fed; water at surface in spring, fluctuating between 30 and 200 cm through growing season.

### Soil

5 - 15 cm sapric muck over layers of ponded deposits (fine sand to fine sandy loam); calcareous above 150 cm.

### Vegetation

Red maple and trembling aspen dominate the overstory; other species include black ash and northern white-cedar. Red maple and black ash are common in the understory, accompanied by northern white-cedar and serviceberry. Members of the *Onoclea*, *Ilex*, *Clintonia*, and *Toxicodendron* species groups, as well as sedges and tree seedlings compose the ground-cover species groups. Presettlement cover type was American elm - red maple - black ash.

### Comments

These wetlands are located in the lowest portions of the shallow ponded depression and are surrounded by wetland margins and dry ice-contact ridges. This ponded depression is very complex due to the fine-scale processes of ice-block melting and ponding of melt water combined with the concurrent larger-scale outwash events.

### Similar Ecosystems

Distinguished from type 124 at Colonial Point by lack of the *Caulophyllum* species group. Distinguished from types 54 and 25 by shallower muck deposits.

### Location

In the ponded depression south of Maple Bay of Douglas Lake; N 1/2 Sec 31, T37N R3W.

**NUMBER OF OCCURRENCES:** 3.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.3/0.9/0.02.

**PLOTS:** None.

**Ecosystem 86:** Well drained medium sand, calcareous in C horizon; beach-terrace; white pine/grasses.

SYNOPSIS: Level beach-terrace. Well drained medium sand, calcareous in C horizon. Sparse white pine overstory and understory; beach grasses - *Toxicodendron* ground-cover species groups. No plots.

### Physiography

LANDFORM: Level beach-terrace above the gravel beach at Sedge Point.

ELEVATION: 218 m.

### Soil

Well drained medium sand, calcareous above 150 cm; water table 80 - 150 cm through growing season.

### Vegetation

Small white pines form an open overstory and understory. The ground-cover is composed mostly of grasses; the *Toxicodendron* species group and *Smilacina stellata* are also present. Presettlement cover type, if present, was white pine.

### Comments

Type 86 is evidently a "young" ecosystem. Relatively recently deposited sands have formed the terrace above the cobbly beach at Sedge Point. It will probably become, through soil development and succession, type 90.

### Similar Ecosystems

Distinguished from type 87 by elevated position above the active beach. Distinguished from type 90 by lack of a well developed E horizon, calcareous soil, and a poorly developed canopy of white pines.

### Location

At Sedge Point; SW 1/4 Sec. 22, T37N R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.3/1.3/0.03.

PLOTS: None.

**Ecosystem 87:** Somewhat poorly drained medium sand or gravel and cobbles; beaches; red maple - willow/*Typha*.

**SYNOPSIS:** Gently sloping active beaches. Somewhat poorly drained medium sand and gravel, calcareous at surface; water table above 40 cm. Rare red maple or silver maple - willow overstory and understory; sparse *Typha* - *Toxicodendron* ground-cover species groups. Maple - willow presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping active beaches of Douglas and Burt Lakes.

**ELEVATION:** 217 m (Douglas Lake), and 181 m (Burt Lake).

### Soil

Somewhat poorly drained medium sand, coarse sand, gravel, and cobbles, calcareous at surface; water table above 40 cm all year.

### Vegetation

Usually there is no overstory or understory, but red and silver maples and willows do occur. Ground-cover vegetation may be absent or include *Scirpus americanus*, the *Typha* and *Toxicodendron* species groups, *Ammophila breviligulata*, *Myrica gale*, *Spiraea alba*, or other species. Presettlement cover type was red maple - willow.

### Comments

Type 87 includes all active beaches. Patterns of differing substrate and vegetation probably do occur but were not identified.

### Similar Ecosystems

Distinguished from type 86 by position at the lakeshore, not above it.

### Location

Shores of Douglas and Burt Lakes.

**NUMBER OF OCCURRENCES:** 7.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.3/2.3/0.05.

**PLOTS:** None.

**Ecosystem 88:** Lake shore herbaceous emergent wetland; rushes/*Typha*.

**SYNOPSIS:** Gently sloping lake shores. Lake water, over medium sand (sometimes with muck). No overstory or understory; *Typha* ground-cover species groups. No plots.

### Physiography

**LANDFORM:** Level to gently sloping lake shore.

**ELEVATION:** 185 and 217 m.

### Hydrology

Lake water inputs; variable hydrologic flux throughout the growing season, particularly in areas with considerable wave-action, but typically with standing water early in the growing season (seasonally flooded); pH > 7.0.

### Soil

Medium sand, with limited organic matter build-up in protected coves.

### Vegetation

Overstory and understory lacking. The *Typha* species group and rushes, *Scirpus americanus* and *S. validus* in particular, form the ground-cover species groups.

### Comments

This type (Greg Zogg's (1993) type 16) includes a number of widely dispersed, small wetlands. The most characteristic feature of the type is episodic disturbance events associated with wave action; vegetation density varies somewhat with disturbance regime. Type 88 has not been mapped.

### Similar Ecosystems

Distinguished from type 31 by much greater abundance of aquatic macrophytes, including the above-mentioned rushes.

### Location

Sporadic occurrence along margin of Douglas and Burt Lakes; good examples at Sedge Point (SE 1/4 SE 1/4, Sec. 21 and SW 1/4 SW 1/4, Sec. 22, T37N R3W) Pine Point (W1/2 NE 1/4, Sec. 27, T37N R3W), and Marl Bay (Sec. 18, T37N R3W).

**NUMBER OF OCCURRENCES:** Undetermined (not mapped).

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: not mapped.

**PLOTS:** None.

**Ecosystem 89:** Ice-margin herbaceous beach pool wetland; willow - alder/*Typha*.

**SYNOPSIS:** Beach pools. Groundwater-fed; muck over medium sand. No overstory; willow - alder understory; *Typha* ground-cover species groups. No plots.

### Physiography

**LANDFORM:** Beach pools created and cut off from the lake by formation and closure of hooked spits.

**ELEVATION:** 217 m.

### Hydrology

Groundwater-fed; water level controlled by Douglas Lake; completely inundated in spring, may be entirely dry by late summer; pH of water 7.2.

### Soil

5 - 20 cm sapric muck over medium sand, calcareous.

### Vegetation

Overstory is absent. Speckled alder and willows occur in an understory marginal to the pool. Ground-cover varies from semi-aquatic vegetation at the shore (*Salix* spp., *Cornus stolonifera*, *Myrica gale*, *Spiraea alba*) to aquatic plants towards the center, such as the *Typha* species group, *Nuphar* spp., and *Potamogeton amphibium*. Presettlement cover type was willow - alder.

### Comments

After being cut off from the lake, these beach pools slowly fill (over a period of centuries) and become forested wetlands (type 94).

### Similar Ecosystems

Distinguished from other wetlands by hydrology; these are semipermanent ponds with water level controlled by Douglas Lake.

### Location

At Sedge Point (SW 1/4 Sec. 22, T37N R3W), Pine Point (SE 1/4 SE 1/4 Sec. 22 and NW 1/4 Sec 27, T37N R3W), and just west of Grapevine Point (Sec. 29, T37N R3W).

**NUMBER OF OCCURRENCES:** 6.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.1/0.7/0.02.

**PLOTS:** None.

**Ecosystem 90:** Moderately well drained to well drained medium sand; low lake terraces; white pine - red pine/*Clintonia*.

**SYNOPSIS:** Level lake terraces. Moderately well drained medium sand, acidic in all horizons; water table between 30 and 150 cm. Red maple - white pine - red pine overstory; balsam fir - red maple - white pine understory; *Gaultheria* - *Pteridium* - *Clintonia* ground-cover species groups. White pine - red pine presettlement cover type. Two plots.

### Physiography

**LANDFORM:** Lake terraces formed by shoreline accretion or spit formation.

**SLOPES:** Level.

**ELEVATION:** 218 m.

### Soil

**DRAINAGE:** Moderately well drained to well drained; water table varies from 30 cm in early spring to as low as 150 cm.

**TEXTURE:** Medium sand in the E and B horizons, fine sand in the C.

**pH:** 4.9 (4.8 - 5.0) in the E horizon; 5.1 (4.7 - 5.5) in B or Bs; 4.5 in C.

**DEVELOPMENT:** Thick organic layers, Oi 3.3 cm thick, Oe 3.2 cm, Oa 2.5 cm; no A horizon; strongly developed E horizon, 44 (34 - 54) cm thick; B or Bs horizon 24 cm thick.

**PEBBLES AND COBBLES:** Absent.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): red maple (42/56/100), white pine (24/33/100), red pine (10/7/100). Other species: paper birch, trembling aspen, bigtooth aspen, beech, balsam fir, red oak. Mean no. of stems/plot = 47.

**UNDERSTORY:** Most common species (% rel. density/% frequency): balsam fir (27/50), red maple (21/100), white pine (18/100), mountain holly (11/50). Other species: red oak, wild-raisin, paper birch, serviceberry, beech, sugar maple, black spruce, red pine. Mean no. of stems/plot = 60.

**GROUND COVER:** Dominant species groups: *Gaultheria*, *Pteridium*, *Clintonia*, *Maianthemum*. Most common ground-cover species: *Pteridium aquilinum*, *Vaccinium myrtilloides*, *Maianthemum canadense*, *Gaultheria procumbens*. Most common tree species in ground-cover: red oak, beech, white pine, red maple, trembling aspen.

**PRESETTLEMENT COVER TYPE:** white pine - red pine.

### Comments

The small area of type 90 at Marl Bay has fewer pines and more balsam fir. It has similar soil and ground flora and so has not been distinguished.

**Similar Ecosystems**

Distinguished from type 91 by more acidic soils, fewer red maples and more red pines in the overstory, and lower coverage of the *Aralia* species group. Distinguished from type 93 by acidic soil and a pine-dominated overstory.

**Location**

At Sedge Point (SW 1/4 Sec. 22, T37N R3W) and Pine Point (SE 1/4 SE 1/4 Sec. 22 and NW 1/4 Sec. 27, T37N R3W).

NUMBER OF OCCURRENCES: 6.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.6/15.5/0.37.

PLOTS: 9106, 9233.

**Ecosystem 91:** Moderately well drained to well drained medium sand; low lake terraces; white pine - hemlock - red maple/*Aralia*.

**SYNOPSIS:** Level lake terraces. Moderately well drained medium sand, neutral in C horizon; water table between 30 and 150 cm. Red maple - white pine - paper birch overstory; red maple understory; *Aralia* - *Gaultheria* - *Maianthemum* - *Clintonia* ground-cover species groups. White pine - hemlock - red maple presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level terrace constructed by Douglas Lake shoreline accretion; low (< 1 m high) ridges demarcate former shorelines.

**ELEVATION:** 218 m.

### Soil

Moderately well drained to well drained medium sand, neutral in C horizon; water table varies from 30 - 150 cm through growing season.

### Vegetation

The overstory is a mixture of red maple, white pine and paper birch; silver maple occurs in this type at Marl Bay. The understory is mostly red maple. Ground-cover species include the *Aralia*, *Gaultheria*, *Maianthemum*, and *Clintonia* groups. Presettlement cover type was likely white pine - hemlock - red maple.

### Comments

The soil is intermediate in pH between types 90 and 93. Cobbly, gravely shoreline areas may be more likely to form calcareous low terraces (type 93), whereas sandy shorelines may become more quickly acidic, as in type 90. Type 91 is likely derived from shorelines that were slightly gravely. Type 91 at Marl Bay differs slightly in having more undulating terrain (probably related to more recent origin or more dynamic shoreline processes) and silver maples, as opposed to red maples on the shore.

### Similar Ecosystems

Distinguished from type 92 (on Pell's Island) by landscape position and lower coverages of the *Polygala* species group and *Taxus canadensis*. Distinguished from type 90 less acidic soil and lower coverage of the *Clintonia* and *Gaultheria* groups. Distinguished from type 93 by less calcareous soils and absence of the *Osmorhiza* species group.

### Location

At Sedge Point (SW 1/4 Sec. 22, T37N R3W), Maple Bay (S 1/2 Sec. 30, T37N R3W), and Marl Bay (N 1/2 Sec. 18, T37N R3W).

**NUMBER OF OCCURRENCES:** 9.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.3/21.1/0.50.

**PLOTS:** None.

**Ecosystem 92:** Moderately well drained to well drained medium sand; low lake terraces on Pell's Island; white pine - hemlock - red maple/*Polygala*.

SYNOPSIS: Level lake terraces. Moderately well drained medium to coarse sand, acidic in all horizons; water table between 30 and 150 cm. Red maple - white pine overstory; red maple - serviceberry - northern white-cedar - balsam fir understory; *Taxus canadensis* - *Polygala* - *Aralia* - *Clintonia* - *Maianthemum* ground-cover species groups. White pine - hemlock - red maple presettlement cover type. No plots.

### Physiography

LANDFORM: Level terrace constructed by Douglas Lake.

ELEVATION: 218 m.

### Soil

Moderately well drained to well drained medium to coarse sand, acidic in all horizons; water table varies from 30 - 120 cm through the growing season.

### Vegetation

Red maple and white pine are most common in the overstory; associates include paper birch, northern white-cedar, and hemlock. Red maple, serviceberry, northern white-cedar, and balsam fir all occur in the understory. *Taxus canadensis* is very abundant in the ground-cover; species groups include *Polygala*, *Aralia*, *Clintonia*, and *Maianthemum*. Presettlement cover type was white pine - hemlock - red maple.

### Comments

Sand deposited by currents in Douglas Lake has formed this terrace on the shoreward end of Pell's Island, enough so that the island becomes a peninsula in late summer of dry years. Canada yew, very rare on the bulk of UMBS property, is extremely abundant in type 92; deer obviously do not make it out to the island.

### Similar Ecosystems

Distinguished from type 91 by much greater coverage of the *Polygala* group and Canada yew, and by being an island. Distinguished from type 90 by a lower component of red pine, more hardwoods, and lower coverage of the *Clintonia* species group.

### Location

On Pell's Island; NW 1/4 Sec. 29, T37N R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 4.4/4.4/0.10.

PLOTS: None.

**Ecosystem 93:** Moderately well drained to well drained medium sand, calcareous in C horizon; low lake terraces; hemlock - northern hardwood/*Osmorhiza*.

SYNOPSIS: Level, low lake terraces. Moderately well drained medium sand, calcareous in C horizon; water table between 30 and 150 cm. Sugar maple - basswood overstory; sugar maple understory; *Osmorhiza* - *Ostrya* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. One plot.

### Physiography

LANDFORM: Lake terrace formed by shoreline accretion.

SLOPES: Level.

ELEVATION: 218 m.

### Soil

DRAINAGE: Moderately well drained to well drained; water table varies from 30 cm in early spring to as low as 150 cm.

TEXTURE: Medium sand in all horizons.

pH: 5.9 in the A horizon to 6.8 in the C (@ 90 cm).

DEVELOPMENT: Organic horizons limited or absent, Oi 3.2 cm thick, Oe 0.8 cm, Oa absent; A horizon well developed, 24 cm thick; Bsh 10 cm thick; Bs 50 cm thick.

PEBBLES AND COBBLES: Pebbles absent in the A and Bsh horizons, 2 - 6% in Bs and C; cobbles 2% in C horizon, absent above.

### Vegetation

OVERSTORY: Dominants (% rel. density/% rel. dominance): sugar maple (73/95), basswood (15/4). Other species: paper birch, American elm. Mean no. of stems/plot = 26.

UNDERSTORY: Most common species (% rel. density): sugar maple (98). Other species: serviceberry. Mean no. of stems/plot = 50.

GROUND COVER: Dominant species groups: *Osmorhiza*, *Ostrya*, *Aralia*. Most common ground-cover species: *Ostrya virginiana*, *Aralia nudicaulis*, *Osmorhiza claytonii*. Most common tree species in ground-cover: sugar maple, white ash, beech.

PRESETTLEMENT COVER TYPE: hemlock - northern hardwood.

### Comments

Low (< 1 m) ridges are evident in type 93 on the east side of Grapevine Point, suggesting former shorelines of Douglas Lake. Calcareous material, having pH above 7.0 and probably as high as 8.0, probably occurs above 150 cm; high water table hinders sampling this deeply.

**Similar Ecosystems**

Distniguated from types 90 - 92 by less acidic soils, lack of pines in the overstory, and pesence of the *Osmorhiza* species group.

**Location**

At Grapevine Point and Pine Point; S 1/2 Sec. 28 and NW 1/4 NE 1/4 Sec. 27, T37N R3W.

NUMBER OF OCCURRENCES: 11.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.7/7.2/0.17.

PLOTS: 9231.

**Ecosystem 94:** Ice-margin closed beach pool red maple swamp; red maple/*Ilex*.

**SYNOPSIS:** Former beach pools closed from lake inputs. Precipitation- and groundwater-fed, highly acidic; muck over medium sand. Red maple - black ash overstory; red maple - paper birch - black ash understory; *Ilex* ground-cover species groups. Red maple - black ash presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Former beach pools in level to gently sloping lake terraces. Formed as hooked spits merged with upland, cutting off surface-flow from Douglas Lake.

**ELEVATION:** 217 - 218 m.

### Hydrology

Precipitation-fed (some lake-groundwater influence nearest to lake); standing water in spring, below 50 cm in late summer (seasonally flooded); pH 4.5 - 5.9.

### Soil

34 (less than 50) cm hemic, sapric, and rarely fibric muck over medium sand; buried muck layers found occasionally; pH 4.0 at 10 cm.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): red maple (84/82/100), black ash (11/15/20). Other species: northern white-cedar. Mean no. of stems/plot = 14.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (46/100), winterberry (17/60), black ash (17/40). Other species: elm, speckled alder, trembling aspen, northern white-cedar. Mean no. of stems/plot = 22.

**GROUND COVER:** Dominant species groups: *Ilex*. Most common ground-cover species: *Ilex verticillata*, mosses, *Lycopus uniflorus*, *Carex intumescens*, *Carex crinita*. Most common tree species in ground-cover: red maple, balsam fir, white pine.

**PRESETTLEMENT COVER TYPE:** red maple - black ash.

### Comments

This type, Greg Zogg's type 15 (Zogg 1993), occurs in strings of former beach pools around Douglas Lake. Subtle vegetational variability is apparent in plots within this type, corresponding to vertical and horizontal distance from the alkaline-circumneutral lake waters. Alternating layers of muck and sand found in some of these swamps suggest fluctuations in the level of Douglas Lake, either inundating (for sand to accumulate) or abandoning (for muck to accumulate) the former pools.

### Similar Ecosystems

Distinguished from type 108 by a fully developed hardwood canopy.

**Location**

At Sedge Point (SW 1/4 Sec. 22, T37N R3W) and Pine Point (SE 1/4 SE 1/4 Sec. 22 and NW 1/4 Sec. 27, T37N R3W).

NUMBER OF OCCURRENCES: 16.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:0.4/6.1/0.14.

PLOTS: 9251, 9252, 9253, 9254, 9260.

**Ecosystem 95:** Ice-margin open beach pool hardwood swamp; American elm - red maple/*Onoclea*.

**SYNOPSIS:** Beach pool (still open to Douglas Lake at one end). Groundwater- and lakewater-fed, calcareous; muck over medium sand. Red maple - yellow birch - northern white-cedar - hemlock overstory; red maple understory; *Onoclea* ground-cover species groups. Elm - red maple presettlement cover type. No plots.

### Physiography

**LANDFORM:** Beach pool formed by elongation of Hook Point in North Fishtail Bay; still open to Douglas Lake at lakeward end.

**ELEVATION:** 217 - 218 m.

### Hydrology

Groundwater- and lakewater-fed; water level controlled by and coincident with Douglas Lake.

### Soil

Sapric muck over medium sand.

### Vegetation

Red maple, yellow birch, northern white-cedar, and hemlock occur in the overstory. Red maple dominates the understory. The *Onoclea* species group typifies the ground-cover species groups. Presettlement cover type was likely American elm - red maple.

### Comments

Douglas Lake, with water pH near 8.0, influences the water chemistry of type 95 and likely is responsible for the striking contrast in vegetation between this and the beach pools cut off from the lake (type 94).

### Similar Ecosystems

Distinguished from type 94 by being open to Douglas Lake at one end, much lower coverage of *Sphagnum* moss and the *Ilex* species group, and much greater abundance of the *Onoclea* group.

### Location

At Sedge Point (SW 1/4 Sec. 22, T37N R3W) and Pine Point (SE 1/4 SE 1/4 Sec. 22 and NW 1/4 Sec 27, T37N R3W).

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.5/1.5/0.04.

**PLOTS:** None.

**Ecosystem 96:** Excessively drained medium sand; high ice-margin terraces; white pine - red pine - hemlock - red oak/*Gaultheria*.

**SYNOPSIS:** High ice-margin terrace. Excessively drained medium sand, acidic in all horizons. Bigtooth aspen - red maple - white pine overstory; white pine - red maple - beech - red pine - red oak understory; *Gaultheria* - *Pteridium* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Ice-margin terrace later modified by Glacial Lake Algonquin.

**SLOPES:** Level to gently sloping (0 - 5%); mostly northern and western aspects.

**ELEVATION:** 218 - 225 m.

### Soil

**DRAINAGE:** Excessively drained.

**TEXTURE:** Medium sand in all horizons; occasional fine sand in C horizon.

**pH:** 4.9 (4.2 - 6.0) in E horizon to 5.4 (5.0 - 5.7) in C.

**DEVELOPMENT:** Organic horizons variable, Oi 2.1 cm thick, Oe 1.5 cm, Oa 1.4 cm; no A horizon; E horizon 22 (12 - 29) cm thick; Bs1 29 (2 - 44) cm thick; Bs2 42.5 (26 - 84) cm thick; BC 57 (34 - 90) cm thick.

**PEBBLES AND COBBLES:** Pebbles 0 - 5% in all horizons; cobbles usually absent, to 1%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (44/54/100), red maple (26/27/100), white pine (15/9/60). Other species: red oak, paper birch, red pine, beech. Mean no. of stems/plot = 24.

**UNDERSTORY:** Most common species (% rel. density/% frequency): white pine (30/100), red maple (22/80), beech (16/40), red pine (10/40), red oak (10/80). Other species: serviceberry, paper birch, bigtooth aspen. Mean no. of stems/plot = 50.

**GROUND COVER:** Dominant species groups: *Gaultheria*, *Pteridium*. Most common ground-cover species: *Pteridium aquilinum*, *Gaultheria procumbens*, *Amelanchier* spp., *Vaccinium angustifolium*. Most common tree species in ground-cover: red maple, red oak, white pine.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

The driest and poorest of the terrace ecosystems, type 96 is analogous to "poor aspen" of the outwash ecosystems (types 36 and 37).

### Similar Ecosystems

Distinguished from type 97 less frequent occurrence of fine sand in the parent material and absence of the *Aralia* species group. Distinguished from outwash type 36 by landscape position.

### Location

Between the shores of Douglas Lake and high-level outwash plains south and east of the lake; Sec. 27, 33, 34, and 29, T37N R3W.

NUMBER OF OCCURRENCES: 8.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 5.2/41.8/0.98.

PLOTS: 8811, 9232, 9234, 9316, 9322.

**Ecosystem 97:** Somewhat excessively drained medium sand to fine sand; high ice-margin terraces; white pine - red pine - hemlock - red oak/*Aralia*.

**SYNOPSIS:** Gently sloping high ice-margin terraces. Somewhat excessively drained medium to fine sand, acidic in all horizons. Bigtooth aspen - red maple - white birch overstory; red maple - white pine - striped maple understory; *Aralia* - *Maianthemum* - *Pteridium* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. Four plots.

### Physiography

**LANDFORM:** Ice-margin terraces reworked by Glacial Lake Algonquin, typically directly below steep, Algonquin-cut slopes (types 46 and 47).

**SLOPES:** Gently sloping (1 - 6%); mostly northern and northwestern aspects.

**ELEVATION:** 218 - 225 m.

### Soil

**DRAINAGE:** Somewhat excessively drained.

**TEXTURE:** Medium sand in E and Bs1 horizons; Medium sand to fine sand in Bs2 and C horizons.

**pH:** 5.1 (4.6 - 5.8) in E horizon to 6.0 (5.6 - 6.7) in C.

**DEVELOPMENT:** Organic horizons of moderate thickness, Oi 2.6 cm thick, Oe 2.4 cm, Oa 0.8 cm; no A horizon; E horizon 15.5 (12 - 18) cm thick; Bs1 and Bs2 horizons 28 (18 - 37) cm and 27 (18 - 36) cm thick, respectively; Bs3 or BC horizon occasional, 33 (15 - 50) cm thick.

**PEBBLES AND COBBLES:** Pebbles 0 - 4% in all horizons; cobbles usually less than 1%, occasionally concentrated to 20%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (42/60/100), red maple (21/14/100), paper birch (14/13/75). Other species: red oak, eastern hemlock, beech, white pine, striped maple, red pine. Mean no. of stems/plot = 40.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (50/100), white pine (12/75), striped maple (10/75). Other species: serviceberry, red oak, beech, paper birch, eastern hemlock, bigtooth aspen, eastern hop-hornbeam, red pine, balsam fir. Mean no. of stems/plot = 89.

**GROUND COVER:** Dominant species groups: *Aralia*, *Maianthemum*, *Pteridium*. Most common ground-cover species: *Pteridium aquilinum*, *Aralia nudicaulis*, *Maianthemum canadense*, *Acer pensylvanicum*. Most common tree species in ground-cover: red maple, red oak, white pine, beech.

**PRESETTLEMENT COVER TYPE:** white pine - red pine - hemlock - red oak.

### Comments

Type 97 covers the greatest area of the terrace ecosystems. The greater tree height, relative to type 96, and good vigor of *Aralia nudicaulis* indicates better moisture availability than in type 96. Being situated at the foot of the steep, Algonquin-cut slopes, type 97 may receive substantial groundwater inputs within the rooting zone of the overstory trees.

### Similar Ecosystems

Distinguished from type 96 by greater frequency of fine sand in the profile and presence of the *Aralia* species group. Distinguished from types 98 - 102 by acidic soil in all horizons and lack of the *Polygonatum* species group (type 98, and the *Ostrya* group in (types 99 - 102). Distinguished from type 90 by a deeper water table, thinner organic horizons, and fewer red pines in the overstory.

### Location

Between the shores of Douglas Lake and high-level outwash plains south and east of the lake; Sec. 27, 33, 34, and 29, T37N R3W.

NUMBER OF OCCURRENCES: 10.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 4.0/40.2/0.95.

PLOTS: 9101, 9105, 9132, 9315.

**Ecosystem 98:** Somewhat excessively drained loamy medium sand, calcareous in C horizon; high ice-margin terraces; hemlock - northern hardwood/*Aralia*.

**SYNOPSIS:** Gently to moderately sloping high ice-margin terraces. Somewhat excessively drained loamy medium sand, calcareous in C horizon. Sugar maple - bigtooth aspen overstory; sugar maple - red maple - hemlock - red oak - serviceberry understory; *Aralia* - *Ostrya* - *Maianthemum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Four plots.

### Physiography

**LANDFORM:** Ice-margin terraces modified by Glacial Lake Algonquin, mostly directly below steep Algonquin-cut slopes.

**SLOPES:** Gently to moderately sloping (2 - 10%); all aspects.

**ELEVATION:** 218 - 225 m.

### Soil

**DRAINAGE:** Somewhat excessively drained.

**TEXTURE:** Loamy medium sand in A, E, and Bsh horizons; loamy medium sand to medium sand in Bs1; medium sand to fine sand in Bs2, BC and C horizons.

**pH:** 5.1 (4.4 - 5.8) in A horizon; 4.9 (4.7 - 5.2) in E; 5.8 (5.1 - 6.7) in Bs1; 5.7 (5.7 - 5.8) in Bs2; 6.8 (6.4 - 7.3) in BC; 6.9 (6.0 - 8.0) in C.

**DEVELOPMENT:** Moderately thick organic horizons, Oi 3.0 cm thick, Oe 0.8 cm, Oa 2.0 cm; A or AE horizon, if present, 11 (5 - 16) cm thick; E horizon, if present 14 (5 - 23) cm thick; Bsh occasional, 17 cm thick; Bs1 38 (21 - 53) cm thick; Bs2 or BC 29 (20 - 38) or 22 (12 - 32) cm thick, respectively.

**PEBBLES AND COBBLES:** Pebbles variable, 0 - 25% throughout; cobbles usually 1% or less, to 15%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): sugar maple (41/51/100), bigtooth aspen (25/33/75). Other species: red maple, beech, paper birch, eastern hemlock, red oak, basswood, eastern hop-hornbeam, white ash. Mean no. of stems/plot = 43.

**UNDERSTORY:** Most common species (% rel. density/% frequency): sugar maple (36/75), red maple (19/25), eastern hemlock (14/25), red oak (11/25), serviceberry (10/50). Other species: striped maple, beech, eastern hop-hornbeam, white ash, black cherry. Mean no. of stems/plot = 50.

**GROUND COVER:** Dominant species groups: *Aralia*, *Ostrya*, *Maianthemum*. Most common ground-cover species: *Ostrya virginiana*, *Pteridium aquilinum*, *Maianthemum canadense*, *Acer pensylvanicum*. Most common tree species in ground-cover: sugar maple, beech, red oak, white ash.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Types 98 - 102 represent a diverse array of calcareous terraces formed by currents marginal to the ice blocks in Douglas Lake. Proximity to the ice blocks and velocity of the currents determined what particles were deposited and the slope percent of the resulting terrace.

### Similar Ecosystems

Distinguished from types 99 and 101 by fewer cobbles and less calcareous soil, and lower coverages of the *Ostrya*, and *Osmorhiza* species groups, respectively. Distinguished from type 100 by an absence of till and absence of the *Caulophyllum* group. Distinguished from type 102 by a lack of thick layers of fine sand in the profile.

### Location

On terraces around Grapevine Point (S 1/2 Sec. 28, T37N R3W) and the North Fishtail Bay kame (Sec. 22, T37N R3W).

NUMBER OF OCCURRENCES: 7.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
10.8/76.2/1.78.

PLOTS: 9104, 9229, 9230, 9332.

**Ecosystem 99:** Somewhat excessively drained medium sand, calcareous in C horizon; high ice-margin terraces; hemlock - northern hardwood/*Ostrya*.

**SYNOPSIS:** Gently sloping high ice-margin terraces. Somewhat excessively drained medium sand. Sugar maple - red oak overstory; sugar maple - eastern hop-hornbeam understory; *Ostrya* - *Aralia* - *Maianthemum* - *Polygonatum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. One plot.

### Physiography

**LANDFORM:** Ice-margin terraces modified by Glacial Lake Algonquin.

**SLOPES:** Gently sloping (1 - 6%); all aspects.

**ELEVATION:** 189 - 190 m (at Colonial Point) and 218 - 225 m.

### Soil

**DRAINAGE:** Somewhat excessively drained.

**TEXTURE:** Medium sand in all horizons.

**pH:** 4.6 in E horizon to 5.9 in C (@ 90 cm).

**DEVELOPMENT:** Organic horizons limited or absent, Oi 1.8 cm thick, Oe 0.3 cm, Oa 0.5 cm; no A horizon; E horizon 15 cm thick; Bs horizon 68 cm thick.

**PEBBLES AND COBBLES:** Pebbles 5% in E, absent below; cobbles 2% in E, absent below.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): sugar maple (85/98), red oak (10/1). Other species: white pine. Mean no. of stems/plot = 20.

**UNDERSTORY:** Most common species (% rel. density): sugar maple (80), eastern hop-hornbeam (11). Other species: basswood, beech, serviceberry. Mean no. of stems/plot = 86.

**GROUND COVER:** Dominant species groups: *Ostrya*, *Aralia*, *Maianthemum*, *Polygonatum*. Most common ground-cover species: *Ostrya virginiana*, *Maianthemum canadense*, *Viburnum acerifolium*. Most common tree species in ground-cover: sugar maple, white ash, red oak.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

The soil is more variable than indicated by the data used in this description. Calcareous parent material is usually found above 150 cm, and may have more pebbles or cobbles. Dense patches of *Ostrya virginiana* within this type have been observed to correspond to concentrations of calcareous cobbles in the soil.

**Similar Ecosystems**

Distinguished from type 98 by greater coverage of the *Ostrya* species group.

**Location**

At Colonial Point (NE 1/4 Sec. 28, T36N R3W) and on terraces around Grapevine Point (S 1/2 Sec. 28, T37N R3W) and the North Fishtail Bay kame (Sec. 22, T37N R3W).

NUMBER OF OCCURRENCES: 4.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.5/10.0/0.24.

PLOTS: 9330.

**Ecosystem 100:** Well drained medium sand over sandy loam, calcareous in C horizon; high ice-margin terraces; hemlock - northern hardwood/*Caulophyllum*.

**SYNOPSIS:** Gently sloping high ice-margin terrace. Well drained medium sand over sandy loam, calcareous in C horizon. Northern hardwood - hemlock overstory and understory; *Osmorhiza* - *Polygonatum* - *Ostrya* - *Caulophyllum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping ice-margin terrace at least 3 m above the current lake level, with till in parent material; occurs in both the Douglas Lake and Burt Lake basins.

**ELEVATION:** 189 - 225 m.

### Soil

Well drained medium sand over sandy loam till, calcareous in C horizon.

### Vegetation

Northern hardwood species and eastern hemlock occupy the overstory and understory, particularly eastern hop-hornbeam in the understory. The *Caulophyllum* species group is distinctive in a species-rich ground-cover that also includes the *Osmorhiza*, *Polygonatum*, and *Ostrya* groups. Presettlement cover type was hemlock - northern hardwood.

### Comments

Glacial till was apparently "rafted" onto these terraces by pieces of the disintegrating ice. Further study is needed to determine the depth and thickness of the till.

### Similar Ecosystems

Distinguished from other high terraces by well-developed microtopography and presence of the *Caulophyllum* species group. Distinguished from the adjacent wet terrace at Colonial Point (type 103) by lack of water and muck at the surface, and absence of the *Arisaema* species group.

### Location

West of Grapevine Point (SW 1/4 SW 1/4 Sec. 28, T37N R3W) and on Colonial Point (SW 1/4 SE 1/4 Sec. 28, T36N R3W).

**NUMBER OF OCCURRENCES:** 2.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.1/2.1/0.05.

**PLOTS:** None.

**Ecosystem 101:** Well drained loamy medium sand, calcareous in C horizon; high ice-margin terraces; hemlock - northern hardwood/*Osmorhiza*.

**SYNOPSIS:** Level to gently sloping high ice-margin terraces. Well drained calcareous loamy medium sand. Sugar maple - red oak - basswood overstory; sugar maple understory; *Osmorhiza* - *Ostrya* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. One plot.

### Physiography

**LANDFORM:** Ice-margin terraces modified by Glacial Lake Algonquin.

**SLOPES:** Level to gently sloping (0 - 3%); all aspects.

**ELEVATION:** 222 - 227 m.

### Soil

**DRAINAGE:** Well drained.

**TEXTURE:** Loamy medium sand in A and Bsh horizons; medium sand in Bs horizon; coarse sand in C horizon.

**pH:** 5.9 in A horizon to 6.7 in C.

**DEVELOPMENT:** Well developed organic horizons, Oi 1.1 cm thick, Oe 1.4 cm, Oa 2.3 cm; A horizon 9 cm thick; Bsh 15 cm thick; Bs 59 cm thick.

**PEBBLES AND COBBLES:** Pebbles increase from A (1%) to C (60%) horizons; cobbles roughly 1% throughout.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): sugar maple (66/94), red oak (13/3), basswood (13/2). Other species: white ash, eastern hop-hornbeam, black cherry. Mean no. of stems/plot = 32.

**UNDERSTORY:** Species (% rel. density): sugar maple (100). Mean no. of stems/plot = 13.

**GROUND COVER:** Dominant species groups: *Osmorhiza*, *Ostrya*. Most common ground-cover species: *Osmorhiza claytonii*, *Ostrya virginiana*, *Galium triflorum*, *Botrychium virginianum*. Most common tree species in ground-cover: sugar maple, white ash.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

The cobbles in the substrate are evident as one climbs the sudden, short slope in Grapevine Point Trail onto this terrace; they are all underfoot. This coarse material was likely deposited by a torrential current flowing between the ice block in South Fishtail Bay and Grapevine Point. The high percentage of pebbles in the profile made distinguishing different Bs horizons difficult.

### Similar Ecosystems

Distinguished from type 100 by a lack of till in the parent material and absence of the *Caulophyllum* species group in the ground-cover. Distinguished from types 98 and 99 by presence of the *Osmorhiza* group.

### Location

On Grapevine Point; SW 1/4 SE 1/4 Sec. 28, T37N R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.5/1.5/0.04.

PLOTS: 9331.

**Ecosystem 102:** Well drained fine sand; high ice-margin terraces; hemlock-northern hardwood/*Polygonatum*.

**SYNOPSIS:** Gently sloping high ice-margin terrace. Well drained fine sand. Paper birch - sugar maple - red maple overstory; sugar maple - striped maple understory; *Aralia* - *Pteridium* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. One plot.

### Physiography

**LANDFORM:** Ice-margin terraces modified by Glacial Lake Algonquin.

**SLOPES:** Gently sloping (4 - 6%); southwestern aspect.

**ELEVATION:** 220 - 222 m.

### Soil

**DRAINAGE:** Well drained.

**TEXTURE:** Medium fine sand in the E horizon; fine sand in the Bs and BC horizons; medium sand in the C.

**pH:** 5.6 in the E horizon to 6.3 in the C.

**DEVELOPMENT:** Moderate organic horizons, Oi 1.6 cm thick, Oe 0.8 cm, Oa 1.2 cm; no A horizon; E horizon strongly developed, 33 cm thick; Bs and BC horizons 32 and 36 cm thick, respectively.

**PEBBLES AND COBBLES:** Pebbles 2% throughout; cobbles 1% throughout.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): paper birch (40/62), sugar maple (27/27), red maple (11/5). Other species: basswood, eastern hemlock, trembling aspen. Mean no. of stems/plot = 45.

**UNDERSTORY:** Most common species (% rel. density): sugar maple (39), striped maple (24). Other species: red maple, basswood, serviceberry, paper birch. Mean no. of stems/plot = 46.

**GROUND COVER:** Dominant species groups: *Aralia*, *Pteridium*, *Maianthemum*, *Polygonatum*, *Ostrya*. Most common ground-cover species: *Aralia nudicaulis*, *Acer pensylvanicum*, *Pteridium aquilinum*, *Ostrya virginiana*. Most common tree species in ground-cover: sugar maple, red maple, red oak, beech.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Type 102 occupies a small area on the high terrace on the western south shore of Douglas Lake. Fine sand in the profile indicates deposition by a more calm current than that responsible for other high terrace types, particularly 98 - 101. Taken together these types

suggest a diverse set of events surrounding the ice blocks in Douglas Lake. The thick E horizon is evidence for long-term dominance by conifers, quite likely by hemlock.

### **Similar Ecosystems**

Distinguished from all other terraces by greater amounts of fine sand in the profile.

### **Location**

One mile west of Grapevine Point near the shore of Douglas lake; SE 1/4 SW 1/4 Sec. 29, T37N R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.6/0.6/0.02.

PLOTS: 9314.

**Ecosystem 103:** Ice-margin-lake terrace hardwood swamp; black ash - basswood/*Arisaema*.

SYNOPSIS: Level terrace of Glacial Lake Nipissing age. Groundwater-fed; muck over sand over sandy loam till. White ash - basswood - black ash overstory and understory; *Arisaema* - sedge ground-cover species groups. Black ash - basswood presettlement cover type. No plots.

### Physiography

LANDFORM: Level terrace below steep slope at the Glacial Lake Nipissing shoreline at Colonial Point.

ELEVATION: 189 m.

### Hydrology

Groundwater-fed; standing water in spring and through summer in years with above-average rainfall.

### Soil

Sapric muck over sand over sandy loam till.

### Vegetation

White ash, basswood, and black ash compose the overstory and understory. The ground-cover has a fairly high coverage of wetland sedges (e. g., *Carex intumescens*); the *Arisaema* species group is also present. Presettlement cover type was black ash - basswood.

### Comments

A very small ecosystem that occurs only where till underlies the Nipissing terrace.

### Similar Ecosystems

Distinguished from the adjacent upland terrace (type 100) by the presence of surface water, muck, and wetland species in the ground-cover. Distinguished from type 125 by landscape position and fewer black ash and balsam poplar in the overstory.

### Location

At the base of the Glacial Lake Nipissing-cut slope on Colonial Point; SE 1/4 28, T36N R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.3/0.3/0.01.

PLOTS: None.

**Ecosystem 104:** Somewhat excessively drained medium sand, calcareous in C horizon; kames; hemlock - northern hardwood/*Osmorhiza*.

**SYNOPSIS:** Level to steeply sloping kames. Somewhat excessively drained medium to loamy sand, calcareous in C horizon. Sugar maple - basswood overstory; sugar maple - eastern hop-hornbeam understory; *Ostrya* - *Osmorhiza* ground-cover species groups. Hemlock - northern hardwood presettlement cover type cover. Seven plots.

### Physiography

**LANDFORM:** Kames; large and small hills composed of water-laid sands and gravels.

**SLOPES:** Level to steeply sloping (0 - 25%); all aspects.

**ELEVATION:** 225 - 243 m.

### Soil

**DRAINAGE:** Somewhat excessively drained.

**TEXTURE:** Medium sand to medium loamy sand in A and E horizons; medium sand in all others.

**pH:** 5.7 (5.0 - 6.5) in A horizon; 5.1 (4.7 - 5.5) in E to 6.6 (5.9 - 8.5) in C.

**DEVELOPMENT:** Organic horizons poorly or well developed, Oi 2.3 cm thick, Oe 1.0 cm, Oa 2.8 cm; A horizon occasionally present, 6 (4 - 8) cm thick; E horizon 10 (4 - 16) cm thick; Bs1 48 (27 - 76) cm thick; Bs2 and BC horizons, if present, 50 cm and 42 (21 - 55) cm thick, respectively.

**PEBBLES AND COBBLES:** Pebbles mostly less than 5% above the C horizon, to 30% in C; cobbles 0 - 2% above the C, 0 - 20% in C.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): sugar maple (69/86/100), basswood (11/4/80), bigtooth aspen (10/4/80). Other species: white ash, beech, red maple, paper birch, eastern hop-hornbeam. Mean no. of stems/plot = 26.

**UNDERSTORY:** Dominants (% rel. density/% rel. frequency): sugar maple (49/100), eastern hop-hornbeam (29/100). Other species: beech, red maple, serviceberry, striped maple, white ash, red oak, basswood.

**GROUND COVER:** Dominant species groups: *Ostrya*, *Osmorhiza*, *Polygonatum*, *Maianthemum*. Most common ground-cover species: *Ostrya virginiana*, *Amelanchier* spp., *Pteridium aquilinum*, *Trillium grandiflorum*. Most common tree species in ground-cover: sugar maple, beech, white ash, red oak, basswood.

**PRESETTLEMENT COVER TYPE:** Hemlock - northern hardwood.

### Comments

Type 104 occurs in three locations; the North Fishtail Bay Kame is by far the largest. Variation in ground-cover composition occurs on the North Fishtail Bay kame and is

probably related to slope aspect and soil properties, but no attempt has been made to identify specific patterns. A "sister" kame occurs adjacent to Munro Lake north of UMBS property.

### **Similar Ecosystems**

Distinguished from type 106 by convex topography, lack of a frost-pocket effect and a more fully developed overstory. Distinguished from type 105 (the north end of Pell's Island) by physiographic position and lower component of white pine in the overstory. Distinguished from adjacent calcareous high terrace ecosystems by elevation; type 104 is above the Glacial Lake Algonquin shoreline.

### **Location**

Mostly northwest of North Fishtail Bay (Sec. 22, T37N R3W); one small kame just east of Bryant Rd. near Douglas Lake (NW 1/4 NW 1/4 Sec. 32, T37N R3W), and one near the southeast corner of UMBS property SW 1/4 NW 1/4 Sec. 25, T37N R3W.

NUMBER OF OCCURRENCES: 3.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
19.8/50.3/1.40.

PLOTS: 8814, 8903, 8910, 8928, 9225, 892d, 895d.

**Ecosystem 105:** Somewhat excessively drained medium sand, calcareous in C horizon; kamic island; hemlock - northern hardwood/*Osmorhiza*.

**SYNOPSIS:** Level to steeply sloping kamic island. Somewhat excessively drained, gravely medium sand, calcareous in C horizon. Sugar maple - basswood - white pine - northern white-cedar overstory; sugar maple - basswood - eastern hop-hornbeam understory; *Polygonatum* - *Osmorhiza* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to steeply sloping elongate kamic feature between two ice-block depressions in Douglas Lake; the northern half of Pell's Island.

**ELEVATION:** 217 - 222 m.

### Soil

Somewhat excessively drained gravely medium and coarse sand, calcareous above in C horizon.

### Vegetation

The overstory is composed of sugar maple, basswood, white pine, and northern white-cedar. Sugar maple, basswood, and eastern hop-hornbeam are prevalent in the understory. The *Polygonatum* and *Osmorhiza* species groups characterize the ground-cover species groups. Presettlement cover type was hemlock - northern hardwood.

### Comments

Pell's Island is most likely a kame built between two stranded ice-blocks. It was submerged in Glacial Lake Algonquin and functioned as a gravel bar. Currents in the Douglas Lake basin built a long terrace of accreted sand that connects to the mainland in late summer of dry years.

### Similar Ecosystems

Distinguished from other kames (type 104) and calcareous lake terraces (types 98 - 101) by more overstory white pine and northern white-cedar and because it is an island; it thus experiences a unique local climate and is isolated from large herbivores (i. e., deer).

### Location

On Pell's Island; NW 1/4 Sec. 29, T37N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 5.1/5.1/0.12.

**PLOTS:** None.

**Ecosystem 106:** Somewhat excessively drained to well drained medium sand, calcareous in C horizon; ice-block depression; hemlock - northern hardwood/*Polygonatum*.

SYNOPSIS: Gently sloping floor of ice-block depression. Somewhat excessively drained medium sand, calcareous in C horizon. Patchy trembling aspen overstory; trembling aspen - northern hardwood understory; *Pteridium* - *Polygonatum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

LANDFORM: Gently sloping floor of ice-block depression (kettle); frost-pocket.

ELEVATION: 224 - 228 m.

### Soil

Somewhat excessively drained to well drained medium sand to medium fine sand with gravel, calcareous in C horizon.

### Vegetation

Trembling aspen dominates the overstory; northern hardwood species also occur. Northern hardwood species form the understory where the canopy is dense; in more open areas trembling aspen is dominant. The *Pteridium* group dominates the ground-cover, accompanied by the *Polygonatum* and *Aralia* species groups and northern hardwood seedlings; in treeless areas *Rubus allegheniensis* and *Rhus typhina* are very common. Presettlement cover type was hemlock - northern hardwood.

### Comments

A frost-pocket (or severe disturbance) effect is apparent in the central portions of this broad low-lying ecosystem. Trees are sparse and trembling aspen is much more abundant than bigtooth aspen. Type 106 surrounds Gate's Bog.

### Similar Ecosystems

Distinguished from type 107 by gravelly, calcareous soil and presence of the *Polygonatum* species group in the ground-cover.

### Location

Northwest of North Fishtail Bay; NW 1/4 Sec. 22, T37N R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
10.2/10.2/0.24.

PLOTS: None.

**Ecosystem 107:** Well drained to moderately well drained, gleyed, medium sand; ice-block depression; white pine - red pine - hemlock - red oak/*Gaultheria*.

**SYNOPSIS:** Level to gently sloping floor of steep-walled ice-block depression; well drained to moderately well drained medium and fine sand. Trembling aspen overstory; white pine understory; *Pteridium* - *Gaultheria* - *Aralia* ground-cover species groups. White pine - red pine - hemlock - red oak presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping floor of steep-walled ice-block depression; frost-pocket.

**ELEVATION:** 223 - 225 m.

### Soil

Well drained to moderately well drained medium and fine sand to loamy sand, gleyed in lowest portion of depression.

### Vegetation

Trembling aspen dominates the overstory; white pine and red pine are associates. White pine is most common in the understory. The ground-cover includes the *Pteridium*, *Gaultheria*, and occasionally the *Aralia* species group. Presettlement cover type was white pine - red pine - hemlock - red oak.

### Comments

The lowest portion of this depression likely has a water table within 200 cm in spring, as indicated by the gleyed (grayish; reduced iron) soil there. More thorough study is needed to determine the extent of the gleyed soil through the rest of the depression.

### Similar Ecosystems

Distinguished from type 106 acidic, gleyed, soil and absence of the *Polygonatum* species group.

### Location

West of Grapevine Point; NW 1/4 NW 1/4 Sec. 33, T37N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 6.1/6.1/0.14.

**PLOTS:** None.

**Ecosystem 108:** Ice-contact kettle-hole leatherleaf bog; leatherleaf/*Chamaedaphne*.

**SYNOPSIS:** Kettle-hole depressions. Precipitation-fed; highly acidic peat and muck over sand. Rare and very sparse overstory of white spruce - tamarack - white pine; tamarack - mountain holly understory; *Chamaedaphne* ground-cover species groups. No presettlement cover type. Four plots.

### Physiography

**LANDFORM:** Kettle-hole depressions.

**ELEVATION:** 194 - 224 m.

### Hydrology

Precipitation-fed with some lake influence; water above the surface in spring, 10 - 50 cm in late summer (semipermanently flooded); pH < 5.0.

### Soil

78 (50 - 200) cm combined thickness of fibric, hemic, and sapric muck (pH 4.0 at 10 cm).

### Vegetation

**OVERSTORY:** Species occurring (% rel. density/% rel. dominance/% frequency): white spruce (50/50/25), eastern tamarack (33/40/25), white pine (17/10/25). Mean no. of stems/plot = 2. Two of the four plots had no overstory.

**UNDERSTORY:** Only two species (% rel. density/% frequency): eastern tamarack (67/25), mountain holly (33/25). Mean no. of stems/plot = 1.

**GROUND COVER:** Dominant species groups: *Chamaedaphne*. Most common ground-cover species: mosses, *Chamaedaphne calyculata*. Most common tree species in ground-cover: elm, eastern tamarack.

**PRESETTLEMENT COVER TYPE:** Never forested; leatherleaf.

### Comments

Type 108, Greg Zogg's type 14 (Zogg 1993), is the classic "bog" ecosystem, characterized by deep organic matter build-up, acidophilic flora, and extremely ombrotrophic conditions.

### Similar Ecosystems

Distinguished from type 94 by greater hydrologic isolation from groundwater, a more open canopy, and more acid-indicating plants.

### Location

Gates Bog (NW 1/4 NW 1/4 Sec. 22, T37N R3W); Bryant's and Gleason's bogs (SW 1/4 Sec. 29, T37N R3W); just south of Hogsback Rd. (NW 1/4 Sec. 4, T36N R3W); west of Maple Bay (SE 1/4 NE 1/4 Sec. 25, T37N R4W).

**NUMBER OF OCCURRENCES:** 6.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.9/6.1/0.13.

**PLOTS:** 9244, 9261, 9262, 9268.

**Ecosystem 109:** Somewhat excessively drained medium sand over sandy loam, calcareous in 2C horizons; gentle mid-slopes on moraine landforms; hemlock - northern hardwood/*Polygala*.

**SYNOPSIS:** Gentle middle slopes on the interlobate moraine. Somewhat excessively drained medium sand over sandy loam till, acid in all horizons; water table below 300 cm. Bigtooth aspen - red maple - beech overstory; red maple - beech - striped maple understory; *Aralia* - *Maianthemum* - *Pteridium* - *Polygala* - *Polygonatum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Eleven plots.

### Physiography

**LANDFORM:** Middle and upper slopes on the interlobate moraine.

**SLOPES:** Level to moderately sloping (0 - 12%); mostly eastern aspects.

**ELEVATION:** 225 - 264 m.

### Soil

**DRAINAGE:** Somewhat excessively drained; water table below 300 cm.

**TEXTURE:** Loamy sand to sandy loam in A horizon (if present); medium sand to medium sandy loam in E, Bs1, Bs2, and C horizons; 2C typically sandy loam, sometimes loamy sand or sandy clay loam.

**pH:** 5.7 (5.0 - 6.3) in A, or 4.8 (4.3 - 5.9) in E to 6.0 (5.3 - 6.7; rarely 7.8) in 2C.

**DEVELOPMENT:** Organic horizons moderate, Oi 2.4 cm thick, Oe 1.1 cm, Oa 1.9 cm; A rarely present, 6 (4 - 7) cm thick; E 16 (6 - 25) cm thick; Bs1 37 (21 - 74) cm thick; Bs2 39 (23 - 69) cm thick.

**PEBBLES AND COBBLES:** Pebbles usually 1 - 2%, to 10% above 2C, 50% maximum in 2C; cobbles less than 5%, to 50% in 2C.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): bigtooth aspen (46/57/90), red maple (27/27/90), beech (13/10/70). Other species: sugar maple, paper birch, striped maple, red oak. Mean no. of stems/plot = 34.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (35/80), beech (19/70), striped maple (17/60), sugar maple (12/80), serviceberry (11/80). Other species: red oak, white ash, eastern hop-hornbeam, balsam fir, yellow birch, alternate-leaved dogwood, wild-raisin. Mean no. of stems/plot = 44.

**GROUND COVER:** Dominant ecological species groups: *Aralia*, *Maianthemum*, *Pteridium*, *Polygala*, and *Polygonatum*. Most common ground-cover species: *Pteridium aquilinum*, *Aralia nudicaulis*, *Viburnum acerifolium*, and *Acer pensylvanicum*. Most common trees: red maple, sugar maple, red oak, and beech.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

The till in type 109 (and 110) appears more intermixed with outwash sand than in other moraine types, and earned the nickname "dry till" for the ecosystem. The Port Huron till here could have been reworked by Greatlakean outwash to create this condition.

### Similar Ecosystems

Distinguished from type 113, often adjacent downslope, by landscape position and lower coverages of the *Clintonia* and *Osmorhiza* species groups. Distinguished from type 110 by greater coverage of the *Aralia* and *Polygala* groups.

### Location

On the interlobate moraine; parts of Sec. 6 and 7, T36N R3W, Sec. 30 and 31, T37N R3W, and SW 1/4 Sec. 25, T37N R4W.

NUMBER OF OCCURRENCES: 10.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
16.6/166.1/3.91.

PLOTS: 8804, 8819, 8904, 8905, 8908, 8909, 8923, 8953, 9117, 9148, 9319.

**Ecosystem 110:** Somewhat excessively drained to well drained medium sand over sandy loam, calcareous in 2C horizons; very gentle midslopes on moraine at Colonial Point; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Gently sloping outwash deposits on moraine at Colonial Point. Greater than 100 cm loamy sand to medium sand over sandy loam till, calcareous in 2C horizons; water table below 120 cm. Sugar maple - red maple - hemlock - beech overstory; beech - sugar maple understory; *Maianthemum* - *Polygonatum* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Eight plots.

### Physiography

**LANDFORM:** Moraine covered by less than 350 cm outwash at Colonial Point.

**SLOPES:** Very gently sloping (1 - 3%); all aspects.

**ELEVATION:** 198 - 207 m.

### Soil

**DRAINAGE:** Somewhat excessively drained to well drained; water table below 120 cm.

**TEXTURE:** Loamy sand to medium sand in A (if present) and E horizons; medium sand to loamy sand in Bs1, Bs2 or BC, and C horizons; sandy loam (rarely clay or clay loam) in 2C and below.

**pH:** 4.7 (4.2 - 5.3) in A, or 5.0 (4.4 - 5.8) in E to 6.6 (6.0 - 7.0) in 2C; rarely 7.8 in 4C horizon (at 170 cm).

**DEVELOPMENT:** Organic horizons moderate, Oi 2.5 cm thick, Oe 1.4 cm, Oa 3.5 cm; A (where present) 12 (10 - 17) cm thick; E horizon 22 (4 - 35) cm thick; Bs1 horizon 35 (24 - 45) cm thick; Bs2 28 (15 - 45) cm thick; BC 47 (31 - 75) cm thick.

**PEBBLES AND COBBLES:** Pebbles usually 1% or less, maximum 5%; cobbles usually absent, to 5%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): sugar maple (30/40/75), red maple (20/17/88), eastern hemlock (14/20/38), beech (16/15/75), red oak (13/8/75). Other species: yellow birch, bigtooth aspen, eastern hop-hornbeam, basswood, white ash, white pine. Mean no. of stems/plot = 23.

**UNDERSTORY:** Most common species (% rel. density/% frequency): beech (55/88), sugar maple (37/88). Other species: eastern hemlock, red maple, eastern hop-hornbeam, yellow birch. Mean no. of stems/plot = 43.

**GROUND COVER:** Dominant ecological species groups: *Maianthemum*, *Polygonatum*, and *Aralia*. Most common ground-cover species: *Maianthemum canadense*, *Streptopus roseus*, *Polygonatum pubescens*, *Acer pensylvanicum*, and *Smilacina racemosa*. Most common trees: beech and sugar maple.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

As in type 109, there is more sand interspersed with layers of till here than in other moraine ecosystems. The till is of the same texture, sandy loam, as in most moraine ecosystems.

### Similar Ecosystems

Distinguished from type 111 by greater depth of sand over till and lower coverage of the *Polygonatum* species group relative to the *Maianthemum* group (vice-versa for type 111). Distinguished from type 109 lower coverages of the *Polygala* and *Aralia* groups.

### Location

On Colonial Point; Sec's 28 and 33, T36N R3W.

NUMBER OF OCCURRENCES: 6.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 7.8/46.7/1.10.

PLOTS: 9236, 9237, 9238, 9241, 9333, 9432, 9452, 9453.

**Ecosystem 111:** Well drained loamy sand over sandy loam, calcareous in 2C horizon; gentle middle slopes on moraine at Colonial Point; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Gently sloping outwash deposits over moraine at Colonial Point. Well drained loamy sand (30 - 100 cm) over sandy loam till, calcareous in 2C horizon; water table below 120 cm. Sugar maple - beech - red maple - red oak overstory; sugar maple - beech understory; *Polygonatum* - *Maianthemum* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Moraine covered by very shallow (30 - 100 cm) outwash at Colonial Point.

**SLOPES:** Very gentle to moderate middle slopes (1 - 13%); all aspects.

**ELEVATION:** 195 - 207 m.

### Soil

**DRAINAGE:** Well drained; water table below 120 cm.

**TEXTURE:** Sandy loam, loam, or loamy sand in A and EB horizons (where present); loamy sand to sand in E, Bs, and C horizons; sandy loam to loamy sand (rarely sandy clay loam) in 2C and below.

**pH:** 5.3 (5.2 - 5.3) in A, or 4.9 (4.4 - 5.5) in E to 6.6 (5.5 - 7.8) in 2C - 5C horizons.

**DEVELOPMENT:** Organic horizons limited, Oi 2.5 cm thick, Oe 0.7 cm, Oa 0.9 cm; A horizon 8 (7 - 9) cm thick; E and EB 14 (12 - 15) cm thick; Bs1 27 (22 - 37) cm thick; Bs2 or BC 21 (11 - 28) cm thick; C horizon 6 cm (when present).

**PEBBLES AND COBBLES:** Pebbles 1 - 3%; cobbles 0 - 2%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): sugar maple (32/43/100), beech (30/31/100), red maple (18/16/80), red oak (10/8/60). Other species: yellow birch, white ash, eastern hemlock, eastern hop-hornbeam, basswood, white pine. Mean no. of stems/plot = 18.

**UNDERSTORY:** Most common species (% rel. density/% frequency): sugar maple (52/100), beech (47/100). Other species: red maple, striped maple, eastern hemlock. Mean no. of stems/plot = 56.

**GROUND COVER:** Dominant ecological species groups: *Polygonatum*, *Maianthemum*, *Aralia*. Most common ground-cover species: *Maianthemum canadense*, *Acer pensylvanicum*, *Streptopus roseus*, *Trillium grandiflorum*, and *Polygonatum pubescens*. Most common tree species: sugar maple and beech.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Shallower till here than in neighboring type 110 corresponds to a perceptible increase in pit-and-mound development. Sugar maple seedlings are more abundant than beech seedlings here, in contrast to type 110.

### Similar Ecosystems

Distinguished from type 110 by shallower sand over till, lower coverage of the *Maianthemum* group relative to the *Polygonatum* group, and more distinct pit-and-mound topography. Distinguished from type 112 by lower pH of outwash and till, and absence of the *Osmorhiza* species group.

### Location

On Colonial Point; Sec. 28, T36N R3W.

NUMBER OF OCCURRENCES: 4.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
4.13/16.5/0.39.

PLOTS: 9328, 9427, 9428, 9429, 9454.

**Ecosystem 112:** Well drained sandy loam, calcareous in 2C horizon; very gentle slopes on moraine at Colonial Point; hemlock - northern hardwood/*Osmorhiza*.

**SYNOPSIS:** Gently sloping moraine at Colonial Point. Well drained sandy loam, calcareous in 2C; water table below 120 cm. Sugar maple - red maple - red oak overstory; sugar maple - beech understory; *Polygonatum* - *Maianthemum* - *Osmorhiza* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. One plot.

### Physiography

**LANDFORM:** Moraine covered by very shallow (30 - 100 cm) outwash.

**SLOPES:** Very gentle middle slopes (1 - 3%); all aspects.

**ELEVATION:** 198 - 206 m.

### Soil

**DRAINAGE:** Well drained; water table below 120 cm.

**TEXTURE:** Sandy loam in all horizons.

**pH:** 5.6 in A to 7.9 in 3C (at 120 cm)

**DEVELOPMENT:** Organic horizons limited or absent, Oi 2.3 cm thick, Oe 0.0 cm, Oa 0.0 cm; A horizon 12 cm thick; Bs 33 cm thick; 2C 74 cm thick.

**PEBBLES AND COBBLES:** Pebbles 2 - 10%; cobbles 2 - 10%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): sugar maple (62/90), red maple (14/5), red oak (10/3). Other species: eastern hop-hornbeam, beech. Mean no. of stems/plot = 29.

**UNDERSTORY:** Most common species (% rel. density): sugar maple (81), beech (19). Mean no. of stems/plot = 59.

**GROUND COVER:** Dominant ecological species groups: *Polygonatum*, *Maianthemum*, *Osmorhiza*. Most common ground-cover species: *Maianthemum canadense*, *Polygonatum pubescens*, *Smilacina racemosa*. Most common tree seedlings: Sugar maple, beech, white ash.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Till is essentially at the surface here, although sand is mixed in with it. Surface cobbles occur, and a well-developed A horizon points to rapid decomposition and mixing of organic matter. The *Osmorhiza* species group typically has higher coverage than in the randomly located sample plot; its presence greatly aided mapping this type.

**Similar Ecosystems**

Distinguished from type 111 by higher pH in soils and presence of the *Osmorhiza* species group. Distinguished from type 113 by higher soil pH and absence of the *Clintonia* species group.

**Location**

On Colonial Point; SE 1/4 Sec. 28, T36N R3W.

NUMBER OF OCCURRENCES: 1.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.3/2.3/0.05.

PLOTS: 9431.

**Ecosystem 113:** Well drained loamy sand over sandy loam, calcareous in 2C horizon; gentle lower slopes on moraine landforms; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Gentle lower slopes on the interlobate and drumlinized moraines. Well drained loamy sand over sandy loam till, calcareous in 2C; water table below 200 cm. Red maple - bigtooth aspen - sugar maple overstory; red maple - sugar maple - beech understory; *Aralia* - *Maianthemum* - *Pteridium* - *Polygala* - *Clintonia* - *Polygonatum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Thirteen plots.

### Physiography

**LANDFORM:** Lower slopes on the interlobate and drumlinized moraines.

**SLOPES:** Mostly level to moderately sloping (0 - 13%), rarely steeply sloping (25%); all aspects.

**ELEVATION:** 195 - 255 m.

### Soil

**DRAINAGE:** Well drained; water table below 200 cm.

**TEXTURE:** Loamy sand to sand (rarely sandy loam) in A, E, B, and C horizons; sandy loam to loam in 2C and 3C horizons.

**pH:** 5.5 (4.9 - 6.5) in A and 5.5 (4.6 - 6.5) in E horizon to 6.6 (5.1 - 7.9) in 2C or 7.3 (5.3 - 8.4) in 3C.

**DEVELOPMENT:** Organic horizons moderate, Oi 2.4 cm thick, Oe 0.9 cm, Oa 1.2 cm; A horizon 8 (4 - 15) cm thick; E horizon 12 (2 - 25) cm thick; Bs1 29 (8 - 65) cm thick; Bs2 26 (7 - 65) cm thick; BC and C horizons (occasional) 32 (14 - 47) and 72 (13 - 92) cm thick.

**PEBBLES AND COBBLES:** Pebbles 1 - 4% (maximum 15%); cobbles usually 1% or less, rarely to 50%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): red maple (31/38/100), bigtooth aspen (29/33/100), sugar maple (13/12/83). Other species: beech, trembling aspen, paper birch, white pine, eastern hemlock, eastern hop-hornbeam, basswood, white ash, striped maple, red oak, red pine. Mean no. of stems/plot = 36.

**UNDERSTORY:** Most common species (% rel. density/% frequency): red maple (33/83), sugar maple (19/91), beech (15/100). Other species: white ash, serviceberry, striped maple, beaked hazelnut, red oak, yellow birch, paper birch, alternate-leaved dogwood, eastern hop-hornbeam, red pine, white pine, trembling aspen, black cherry, basswood, eastern hemlock. Mean no. of stems/plot = 51.

**GROUND COVER:** Dominant ecological species groups: *Aralia*, *Maianthemum*, *Pteridium*, *Polygala*, *Clintonia*, *Polygonatum*. Most common ground-cover species: *Aralia nudicaulis*, *Acer pensylvanicum*, *Viburnum acerifolium*, *Maianthemum canadense*.

*Pteridium aquilinum*, *Amelanchier* spp. Most common tree seedlings: sugar maple, red maple, white ash, beech.

PRESETTLEMENT COVER TYPE: hemlock - northern hardwood.

### Comments

Known as "good aspen" to years of ecology students at UMBS, type 113 has become the standard against which other morainal ecosystems are measured. Till here is not as mixed with outwash sand as in adjacent type 109, and the moisture and nutrients provided by the till enable aspens to flourish here, if only for a few decades.

### Similar Ecosystems

Distinguished from type 109 (often adjacent upslope) by greater coverages of the *Clintonia* and *Polygonatum* species groups and more distinct pit-and-mound topography. Distinguished from types 111 and 112 (at Colonial Point) by greater coverage of the *Clintonia* and *Aralia* groups.

### Location

On the interlobate moraine (parts of Sec. 6 and 7, T36N R3W, 30 and 31, T37N R3W, and SW 1/4 Sec. 25, T37N R4W), the drumlinized moraine (Sec. 22 - 24, T37N R3W) and at the base of Robert's Hill, on its north side (S 1/2 Sec. 34, T37N R3W).

NUMBER OF OCCURRENCES: 15.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area:  
7.5/112.0/2.64.

PLOTS: 8812, 8815, 8911, 8926, 8951, 9127, 9302, 9326, 9441, 9442, 9443, 9444, 9455.

**Ecosystem 114:** Well drained sandy clay loam; level to moderate upper slopes on moraine landforms; northern hardwood-hemlock/*Osmorhiza*.

**SYNOPSIS:** Level to moderately sloping upper and middle moraine slopes. Well drained shallow sand over clay loam till. Bigtooth aspen - northern hardwood overstory; Sugar maple - beech - yellow birch understory; *Osmorhiza* - *Polygonatum* - *Maianthemum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to moderately sloping upper and middle slopes on the north end of the interlobate moraine.

**ELEVATION:** 235 - 247 m.

### Soil

Well drained clay to sandy clay loam till at surface or covered by less than 50 cm of sand; water table below 300 cm..

### Vegetation

Bigtooth aspen dominates an overstory of mixed northern hardwood species. Sugar maple, beech, and yellow birch occur in the understory. Northern hardwood seedlings occur with members of the *Osmorhiza*, *Polygonatum*, and *Maianthemum* species groups in the ground-cover. Presettlement cover type was northern hardwood-hemlock.

### Comments

Type 114 occurs at the highest point at the northern end of the interlobate moraine and part way down the western slope. The heavy till at the surface here could be of Greatlakean origin.

### Similar Ecosystems

Distinguished from type 122 by lack of lacustrine deposits, steeper slopes, and lack of the *Caulophyllum* species group. Distinguished from type 113 by higher slope position and shallower depth of sand over till. Distinguished from type 109 heavier till and shallower sand at the surface.

### Location

On top of the northern tip of the interlobate moraine; NE 1/4 SE 1.4 Sec. 25, T37N R4W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.5/2.5/0.06.

**PLOTS:** None.

**Ecosystem 115:** Moderately well drained loamy sand over sandy loam; very gently sloping moraine at Colonial Point; hemlock - northern hardwood/*Polygonatum* (ferns in pits).

**SYNOPSIS:** Very gently sloping moraine at Colonial Point. Well drained to moderately well drained loamy sand over sandy loam till, acidic in all horizons; water table between 70 and 120 cm. Sugar maple - red maple - beech overstory; sugar maple - beech understory; *Polygonatum* - *Maianthemum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. One plot.

### Physiography

**LANDFORM:** Moraine covered by outwash (less than 150 cm) at Colonial Point.

**SLOPES:** Level to very gently sloping (0 - 3%); all aspects.

**ELEVATION:** 198 - 208 m.

### Soil

**DRAINAGE:** Moderately well drained; water table between 70 and 120 cm.

**TEXTURE:** Loamy sand in AE, Bhs, and Bs horizons; sandy loam in 2C.

**pH:** 4.0 in AE to 5.5 in 2C.

**DEVELOPMENT:** Organic horizons moderate, Oi 4.2 cm thick, Oe 0.7 cm, Oa 0.0 cm; AE horizon 23 cm thick; Bhs horizon 24 cm thick; Bs horizon 53 cm thick. Hardpan present in lower Bs horizon.

**PEBBLES AND COBBLES:** Pebbles 1%; cobbles 1 - 2%.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance): sugar maple (54/74), red maple (29/22), beech (13/4). Other species: eastern hop-hornbeam. Mean no. of stems/plot = 24.

**UNDERSTORY:** Most common species (% rel. density): sugar maple (49), beech (49). Other species: red maple. Mean no. of stems/plot = 33.

**GROUND COVER:** Dominant ecological species groups: *Polygonatum*, *Maianthemum*. Most common ground-cover species: *Viola pubescens*, *Streptopus roseus*, *Maianthemum*, *Osmunda cinnamomea*. Most common tree seedlings: sugar maple, beech.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Type 115 often has concave physiography, leading to imperfect drainage. The till here is of the same texture (sandy loam) as in types 110 - 112, but drainage patterns have led to differences in pit-and-mound development and ground-cover (i.e., more *Dryopteris* spp. in pits in type 115).

**Similar Ecosystems**

Distinguished from type 116 by a much denser canopy and much lower ground-cover species richness. Distinguished from type 117 by lower water table and absence of wetland plant species in pits. Distinguished from types 110 - 112 higher water table and more dramatic microtopography.

**Location**

On Colonial Point; Sec. 28, T36N R3W.

NUMBER OF OCCURRENCES: 15.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.6/9.2/0.22.

PLOTS: 9235.

**Ecosystem 116:** Moderately well drained to somewhat poorly drained loamy sand to medium sand over sandy loam, calcareous in 2C horizon; gentle lower slopes on moraine landforms; hemlock - northern hardwood/*Osmorhiza*.

**SYNOPSIS:** Gentle lower slopes of the interlobate moraine. Moderately well drained medium sand over sandy loam till, calcareous in 2C horizon; water table between 70 and 200 cm. Trembling aspen - white ash - paper birch - basswood overstory; trembling aspen - black ash - white ash - basswood understory; *Aralia* - *Polygonatum* - *Pteridium* - *Osmorhiza* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Two plots.

### Physiography

**LANDFORM:** Lower slopes on the interlobate moraine.

**SLOPES:** Level to gently sloping (0 - 5%); all aspects.

**ELEVATION:** 195 - 237 m.

### Soil

**DRAINAGE:** Moderately well drained to somewhat poorly drained; water table between 70 and 200 cm.

**TEXTURE:** Loamy sand in A horizon; loamy sand to medium sand in E, B, and C horizons; sandy loam to sand in 2C.

**pH:** 6.2 (6.0 - 6.3) in A horizon to 7.4 (6.8 - 8.1) in 2C.

**DEVELOPMENT:** Organic horizons limited, Oi 0.9 cm thick, Oe 1.0 cm, Oa 0.1 cm; A horizon 17 (15 - 18) cm thick; Bs 36 (12 - 60) cm thick; BC 12 cm thick; C horizon 9 cm thick.

**PEBBLES AND COBBLES:** Pebbles 0 - 5% in upper horizons, 2 - 20% in 2C; cobbles typically absent above 2C, 3 - 6% in 2C.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): trembling aspen (30/41/100), white ash (22/21/100), paper birch (15/18/50), basswood (16/14/100). Other species: red maple, beech, red oak, black ash, sugar maple. Mean no. of stems/plot = 24.

**UNDERSTORY:** Most common species (% rel. density/% frequency): trembling aspen (26/100), black ash (22/50), white ash (11/100), basswood 10/100). Other species: red maple, sugar maple, serviceberry, beech, striped maple, red-osier dogwood, yellow birch, paper birch, eastern hop-hornbeam, black cherry, red oak, willow. Mean no. of stems/plot = 150.

**GROUND COVER:** Dominant ecological species groups: *Aralia*, *Polygonatum*, *Pteridium*, *Osmorhiza*, *Maianthemum*, *Coptis*, *Caulophyllum*, *Polygala*, *Rhamnus*. Most common ground-cover species: *Aralia nudicaulis*, *Pteridium aquilinum*, *Corylus cornuta*, *Rubus pubescens*, *Cornus alternifolia*, *Sanicula marilandica*, *Amelanchier* spp., *Uvularia grandiflora*, *Galium triflorum*. Most common tree species: sugar maple, red maple, white

ash, basswood, beech, trembling aspen. The most species-rich ground-cover on UMBS property.

PRESETTLEMENT COVER TYPE: hemlock - northern hardwood.

### **Comments**

Type 116 occurs on lower moraine slopes, mostly below the Glacial Lake Algonquin shoreline, where the slope becomes more gentle. Groundwater from the moraine above and to the west flows over the surface of the till here, creating near-wetland conditions in spring and early summer. On some maps from the early part of this century, the area in the S 1/2 Sec. 5 and 6, T36N R3W was labeled a "bog", however, muck does not accumulate at the soil surface.

### **Similar Ecosystems**

Distinguished from types 115 and 117 at Colonial Point by a more species-rich ground-cover, higher soil pH, and more open canopy.

### **Location**

On the eastern side of the interlobate moraine; Sec. 5 and 6, T36N R3W, and Sec. 30 - 32, T37N R3W.

NUMBER OF OCCURRENCES: 10.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.4/24.1/0.57.

PLOTS: 9131, 9149.

**Ecosystem 117:** Moderately well drained to somewhat poorly drained loamy sand over sandy loam; level moraine at Colonial Point; hemlock - northern hardwood/*Aralia*, *Arisaema*.

**SYNOPSIS:** Gently sloping moraine at Colonial Point. Moderately well drained to somewhat poorly drained sand over sandy loam, acidic in all horizons; water table between 30 and 90 cm. Hemlock - northern hardwood overstory and understory; *Aralia* - *Arisaema* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gently sloping moraine with outwash overburden at Colonial Point; strongly developed microtopography.

**ELEVATION:** 199 - 201 m.

### Soil

Moderately well drained to somewhat poorly drained loamy sand, 30 - 150 cm deep, over sandy loam to sandy clay loam till; water table above 70 cm in spring, at surface in pits into summer.

### Vegetation

Hemlock dominates the overstory; sugar maple, beech, yellow birch and basswood are associates. A sparse understory includes the same species. The *Aralia* species group typifies the ground-cover on mounds, whereas the *Arisaema* group occurs in the pits with some wetland species including *Ranunculus recurvatus*. Presettlement cover type was hemlock - northern hardwood.

### Comments

A greater percentage of the ground surface in type 117 is upland than wetland, but the high water table and strong microtopography produce a fine-scale mosaic of wetland and upland ecosystems that is here mapped as one type.

### Similar Ecosystems

Type 124 is a wetland that has upland mounds within it; it has a higher water table and a hardwood-dominated overstory. Type 115 has better drainage; the pits in type 115 do not have the *Arisaema* species group or wetland species occurring in them.

### Location

On Colonial Point; SW 1/4 NW 1/4 Sec. 28, T36N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.0/2.0/0.05.

**PLOTS:** None.

**Ecosystem 118:** Morainal mid-slope channel hardwood wetland; white ash - basswood/*Osmorhiza*.

**SYNOPSIS:** Gently sloping mid-slope channel in outwash deposits over moraine. Intermittently stream-fed; shallow muck over sand and sandy clay loam. Trembling aspen - balsam poplar overstory; sugar maple - eastern hop-hornbeam understory; *Osmorhiza* - *Arisaema* ground-cover species groups. White ash - basswood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Intermittent stream channel in gentle mid-slopes on the interlobate moraine and at Colonial Point.

**ELEVATION:** 189 - 240 m.

### Hydrology

Intermittent stream flow; standing water in spring, below 40 cm in late summer (seasonally flooded); pH 7.0.

### Soil

5-15 cm sapric muck over loamy sand and occasionally sandy loam or sandy clay loam till; pH 7.5 at 10 cm.

### Vegetation

Trembling aspen and balsam poplar dominate the overstory, accompanied by paper birch, white ash, basswood, and occasional eastern hop-hornbeam. The understory includes sugar maple, eastern hop-hornbeam, beech, and striped maple. A species-rich ground-cover includes the *Osmorhiza* and *Arisaema* species groups, and some species in the *Coptis* group. Presettlement cover type was likely white ash - basswood.

### Comments

Type 118 (type 17 of Zogg (1993)) consists of several large areas (> 50 m<sup>2</sup>), plus numerous smaller pieces that vary considerably in hydrologic flux; it is transitional to uplands.

### Similar Ecosystems

Distinguished from closely allied type 119 by greater abundance of members of the *Osmorhiza* species group, especially *Botrychium virginianum*, and its patchy distribution in a network of stream channels among uplands, whereas type 119 occurs in a single, long (> 500 m) channel

**Location**

On the interlobate moraine (W 1/2 Sec. 5, T36N R3W and NE 1/4 SE 1/4 Sec. 25 and NE 1/4 NE 1/4 Sec. 36, T37N R4W) and at Colonial Point (SE 1/4 NW 1/4 Sec. 28, T36N R3W).

NUMBER OF OCCURRENCES: 10.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.4/4.3/0.10.

PLOTS: None.

**Ecosystem 119:** Morainal lower-slope channel conifer-hardwood wetland; northern white-cedar - black ash/*Arisaema*.

**SYNOPSIS:** Gently sloping lower-slope channel in outwash deposits over moraine. Intermittently stream-fed; 10 - 50 cm muck over sand and sandy clay loam. Trembling aspen - balsam poplar overstory; northern white-cedar - black ash - red maple understory; *Arisaema* - *Coptis* - *Onoclea* ground-cover species groups. Northern white-cedar - black ash presettlement cover type. No plots.

### Physiography

**LANDFORM:** Narrow stream channel (< 10 m) in gently sloping outwash deposits on drumlinized ground moraine.

**ELEVATION:** 217 - 225 m.

### Hydrology

Intermittent stream flow; standing water in spring, below 40 cm in late summer; pH 7.0.

### Soil

10-50 cm sapric muck over medium sand and sandy clay loam till; pH 7.5 at 10 cm.

### Vegetation

The overstory is dominated by trembling aspen and balsam poplar; associates include paper birch, basswood, yellow birch, and northern white-cedar. Northern white-cedar, black ash, and red maple are common in the understory. The *Arisaema* species group is common in the ground-cover, accompanied by the *Coptis* and *Onoclea* groups. Presettlement cover type was likely northern white-cedar - black ash.

### Comments

This type is characterized by variable vegetation composition (associated with hydrologic and light conditions) within a long, narrow stream channel. Water regime is typically stable throughout the growing season, but with some episodic fluxes following heavy rains.

### Similar Ecosystems

Distinguished from type 118 by greater abundance of members of the *Arisaema* species group.

### Location

Along an intermittent stream leading north from North Fishtail Bay; NE 1/4 Sec. 22, T37N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 4.0/4.0/0.09.

**PLOTS:** None.

**Ecosystem 120:** Well drained medium sand and silt over sandy loam; gentle upper slopes on moraine at Colonial Point; hemlock - northern hardwood/*Polygonatum*.

**SYNOPSIS:** Level to gently sloping lacustrine deposits over moraine. Well drained sand and silt over sandy loam. Northern hardwood overstory and understory; *Polygonatum* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to gently sloping upper slopes of lacustrine deposits over glacial moraine at Colonial Point; poorly to moderately developed microtopography.

**ELEVATION:** 206 - 208 m.

### Soil

Well drained sand, 50 - 150 cm deep, over lacustrine silt; sandy loam till probably occurs between 200 and 400 cm.

### Vegetation

Sugar maple dominates the overstory; hemlock is occasional. Sugar maple, beech, and eastern hop-hornbeam occupy the understory. A very sparse ground-cover is characterized by the *Polygonatum* species group; members of the *Caulophyllum* group are occasional. Presettlement cover type was hemlock - northern hardwood.

### Comments

Type 120 occupies the outer margins of the lacustrine deposits of Colonial Point.

### Similar Ecosystems

Distinguished from types 121 and 122 by a lack of clay and absence of the *Caulophyllum* species group. Distinguished from types 110 - 112 by lacustrine silt deposits.

### Location

At Colonial Point; NW 1/4 Sec. 28, T36N R3W.

**NUMBER OF OCCURRENCES:** 3.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.8/2.5/0.06.

**PLOTS:** None.

**Ecosystem 121:** Well drained sandy loam over clay; gently sloping lacustrine deposits over moraine at Colonial Point; hemlock - northern hardwood/*Osmorhiza*.

SYNOPSIS: Level to gently sloping lacustrine deposits on moraine at Colonial Point. Well drained sand over clay. Sugar maple - red maple - white pine overstory; sugar maple - beech - eastern hop-hornbeam; *Aralia* - *Maianthemum* - *Polygonatum* - *Osmorhiza* - *Ostrya* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Two plots.

### Physiography

LANDFORM: Lacustrine deposits over moraine at Colonial Point.

SLOPES: Very gently to moderately sloping (1 - 15%); all aspects.

ELEVATION: 189 - 208 m.

### Soil

DRAINAGE: Well drained.

TEXTURE: Sandy loam in A, EB, and Bsh horizons; medium sand in Bs; clay to silt loam in 2C.

pH: 4.5 in A to 5.7 in 2C; 7.5 in 3C (at 265 cm).

DEVELOPMENT: Organic horizons limited, Oi 2.7 cm thick, Oe 0.3 cm, Oa 0.3 cm; A or AE horizon 11 (8 - 14) cm thick; EB or Bsh 11.5 (11 - 12) cm thick; Bs 45 cm thick.

PEBBLES AND COBBLES: Pebbles 0 - 2% in A and E horizons, absent elsewhere; cobbles absent.

### Vegetation

OVERSTORY: Dominants (% rel. density/% rel. dominance/% frequency): sugar maple (53/72/100), red maple (14/14/50), white pine (15/9/50). Other species: red oak, basswood, eastern hop-hornbeam, beech. Mean no. of stems/plot = 21.

UNDERSTORY: Most common species (% rel. density/% frequency): sugar maple (59/100), beech (26/100), eastern hop-hornbeam (11/100). Other species: red maple, basswood. Mean no. of stems/plot = 50.

GROUND COVER: Dominant ecological species groups: *Aralia*, *Maianthemum*, *Polygonatum*, *Osmorhiza*, *Ostrya*. Most common ground-cover species: *Maianthemum canadense*, *Aralia nudicaulis*, *Ostrya virginiana*. Most common tree seedlings: sugar maple, beech, white ash.

PRESETTLEMENT COVER TYPE: hemlock - northern hardwood.

### Comments

Type 121 is part of a complex array of ecosystems developed on lacustrine deposits in the central portion of Colonial Point.

### Similar Ecosystems

Distinguished from type 122 by more convex topography, better drainage, and lower coverage of the *Caulophyllum* species group. Distinguished from type 120 by the presence of heavy silt loam to clay deposits and greater coverage of the *Osmorhiza* group.

### Location

At Colonial Point; NW 1/4 Sec. 28, T36N R3W.

NUMBER OF OCCURRENCES: 7.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 2.1/14.4/0.34.

PLOTS: 9239, 9430.

**Ecosystem 122:** Well drained to moderately well drained loamy sand over silty clay, calcareous in 2C horizon; very gently sloping lacustrine deposits over moraine at Colonial Point; hemlock - northern hardwood/*Caulophyllum*.

**SYNOPSIS:** Gently sloping lacustrine deposits over moraine at Colonial Point. Well drained sand to sandy loam over silty clay, calcareous in 2C. Sugar maple - white pine overstory; beech - sugar maple - eastern hop-hornbeam understory; *Caulophyllum* - *Polygonatum* - *Aralia* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. Five plots.

### Physiography

**LANDFORM:** Lacustrine deposits over moraine at Colonial Point.

**SLOPES:** Very gently to gently sloping (0 - 5%); all aspects.

**ELEVATION:** 189 - 208 m.

### Soil

**DRAINAGE:** Well drained to moderately well drained.

**TEXTURE:** Loam (sandy loam to silt loam) in A horizon; silty clay loam to silty clay in E (where present); loamy sand in BS horizons; Silty clay, clay loam, or silty clay loam in C and 2C horizons.

**pH:** 5.6 in E horizon or 5.9 in A to 8.0 in 2C.

**DEVELOPMENT:** Organic horizons limited, Oi 3.0 cm thick, Oe 0.4 cm, Oa 0.4 cm; A horizon 14 (9 - 20) cm thick; E horizon 6 (2 - 10) cm thick; Bs1 and Bs2 (where present) each 15 cm thick; C horizon 103 cm thick; 2C may comprise layers of subtly different textures, 60 - 80 cm thick.

**PEBBLES AND COBBLES:** Pebbles 1 - 2% in A, E, Bs, and C horizons, usually absent in 2C; cobbles 0 - 5% in upper horizons, absent in 2C.

### Vegetation

**OVERSTORY:** Dominants (% rel. density/% rel. dominance/% frequency): sugar maple (56/75/100), white pine (15/13/80). Other species: beech, eastern hop-hornbeam, white ash, red maple, basswood, bigtooth aspen, red oak. Mean no. of stems/plot = 25.

**UNDERSTORY:** Most common species (% rel. density/% frequency): beech (53/100), sugar maple (24/100), eastern hop-hornbeam (13/80). Other species: white ash, basswood, black cherry, striped maple, red maple, choke cherry. Mean no. of stems/plot = 66.

**GROUND COVER:** Dominant species groups: *Caulophyllum*, *Polygonatum*, *Aralia*, *Osmorhiza*, *Ostrya*. Most common ground-cover species: *Aralia nudicaulis*, *Ostrya virginiana*, *Viola pubescens*, *Caulophyllum thalictroides*, *Dirca palustris*, *Lonicera canadensis*. Most common tree species in the ground-cover: sugar maple, beech, white ash, basswood.

**PRESETTLEMENT COVER TYPE:** hemlock - northern hardwood.

### Comments

Type 121 has heavy lacustrine deposits closest to the surface of the ecosystems in this group at Colonial Point. It may be the most productive upland ecosystem on UMBS land.

### Similar Ecosystems

Distinguished from type 121 by more concave topography, somewhat poorer drainage and greater coverages of the *Caulophyllum* and *Arisaema* species groups. Distinguished from type 120 by shallower sand at the surface, heavier lacustrine deposits, and far greater coverage of the *Caulophyllum* group.

### Location

On Colonial Point; Sec. 28 and 33, T36N R3W.

NUMBER OF OCCURRENCES: 8.

AREA: Avg. size (ha)/total area for type (ha)/percent of total mapped area: 1.3/10.1/0.24.

PLOTS: 9240, 9271, 9274, 9327, 9329.

**Ecosystem 123:** Somewhat poorly drained medium sand over clay; level wetland margins on moraine at Colonial Point; hemlock - northern hardwood/*Arisaema*.

**SYNOPSIS:** Gently sloping wetland margins in lacustrine deposits. Somewhat poorly drained sand over clay. Northern hardwood overstory and understory; *Arisaema* ground-cover species groups. Hemlock - northern hardwood presettlement cover type. No plots.

### Physiography

**LANDFORM:** Gentle slopes at the periphery of concave wetland depressions in lacustrine deposits (type 125) at Colonial Point; very strongly developed microtopography.

**ELEVATION:** 198 - 208 m.

### Soil

Somewhat poorly drained sand, 40 - 100 cm deep, over lacustrine clay.

### Vegetation

Northern hardwood species form the overstory and understory. The *Arisaema* group typifies the ground-cover species groups. Presettlement cover type was hemlock - northern hardwood.

### Comments

Type 123 is a wetland margin ecosystem typically only a few meters wide. It separates type 125 from surrounding outwash uplands.

### Similar Ecosystems

Distinguished from type 117 lacustrine deposits in the soil and lack of a hemlock-dominated overstory.

### Location

At Colonial Point; Sec. 28, T36N R3W.

**NUMBER OF OCCURRENCES:** 5.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.4/2.1/0.05.

**PLOTS:** None.

**Ecosystem 124:** Moraine-lake plain upper slope hardwood swamp; American elm - black ash/*Arisaema*, *Caulophyllum*.

**SYNOPSIS:** Gently sloping lacustrine deposits over moraine at Colonial Point. Groundwater-fed; 10 -20 cm muck over sand and silty clay loam. Black ash - balsam poplar - elm - trembling aspen overstory; elm - black ash understory; *Arisaema* - *Onoclea* - *Toxicodendron* ground-cover species groups. Elm - black ash presettlement cover type. No plots.

### Physiography

**LANDFORM:** Level to very gently sloping upper slope of the Colonial Point moraine, covered by glacial lake offshore deposits; well-developed microtopography.

**ELEVATION:** 204 - 207 m.

### Hydrology

Groundwater-fed; water at surface in spring and remaining in pits into early summer and following heavy rains.

### Soil

10 - 20 cm sapric muck over lacustrine deposits: 0 - 150 cm sand over silty clay loam.

### Vegetation

The overstory is a mixture of black ash, balsam poplar, American elm, trembling aspen, and white ash. Elm and black ash are most common in the understory. Ground-cover is diverse and includes the *Arisaema*, *Onoclea*, and *Toxicodendron* species groups in pits and the *Caulophyllum* group on mounds. Many wetland sedges (e. g., *Carex intumescens* and *C. stipata*) and grasses (e. g., *Glyceria striata*) also occur.

### Comments

Some stumps of the once-dominant American elm still can be found in type 124. The feeling one gets in type 124 is of a dense, young, well-lit wetland. The abundance of young elms and their impending demise ensures the continuance of this open-canopy character.

### Similar Ecosystems

Distinguished from type 125 by larger size, smaller trees in the overstory, greater abundance of elms in the overstory and understory, shallower muck, less persistent surface water, and lower coverage of the *Onoclea* species group.

### Location

At Colonial Point; NE 1/4 SW 1/4 Sec. 28., T36N R3W.

**NUMBER OF OCCURRENCES:** 1.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 3.0/3.0/0.07.  
**PLOTS:** None.

**Ecosystem 125:** Moraine-lake plain mid-slope depression hardwood swamp; black ash - red maple/*Onoclea*.

**SYNOPSIS:** Subtle depressions in gently sloping moraine at Colonial Point. Groundwater-fed; 15 - 30 cm muck over sand over silt, clay, or sandy clay loam. Black ash - balsam poplar - red maple overstory and understory; *Onoclea* - *Arisaema* ground-cover species groups. Black ash - red maple presettlement cover type. No plots.

### Physiography

**LANDFORM:** Concave depressions in gently sloping moraine at Colonial Point, may or may not have lacustrine surficial deposits; strongly developed microtopography.

**ELEVATION:** 199 - 207 m.

### Hydrology

Groundwater-fed; water at surface in spring, above 100 cm in late summer.

### Soil

15 - 30 cm sapric muck over lacustrine or morainal deposits; 0 - 100 cm sand over lacustrine silt or clay or sandy clay loam till.

### Vegetation

Black ash, balsam poplar, red maple, yellow birch, and hemlock all occur in the overstory and understory. The *Onoclea* species group is abundant in the ground-cover; the *Arisaema* group also occurs. Presettlement forest was likely black ash - red maple.

### Comments

These wetland depressions could be the result of short-term recessional stages of Glacial Lake Algonquin. Subtle sandy rises that might be recessional beaches often border them.

### Similar Ecosystems

Distinguished from types 117 and 123 by poorer drainage, deeper muck, and greater coverage of the *Onoclea* species group. Distinguished from type 124 by smaller size, deeper muck, and absence of the *Caulophyllum* species group. Distinguished from the terrace wetland (type 103) by topographic position, deeper muck, and greater dominance of black ash in the overstory. Distinguished from types 118 and 119 by lack of flowing water.

### Location

At Colonial Point; NW 1/4 Sec. 28, T36N R3W.

**NUMBER OF OCCURRENCES:** 8.

**AREA:** Avg. size (ha)/total area for type (ha)/percent of total mapped area: 0.3/2.3/0.05.

**PLOTS:** None.