

Natural Feature Inventories of Prioritized Sites in the Walloon Lake Watershed

Summary Report 2016



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Cover Photos: (Front) Mesic northern forest in Indian Garden Preserve. (Back) Large diameter sugar maple in Bois LeDuc-BC-MSF old-growth. Photos by Phyllis J. Higman.

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Executive Summary

The Walloon Lake Trust and Conservancy, in cooperation with Tip of the Mitt Watershed Council and the Michigan Natural Features Inventory (MNFI), initiated a natural features inventory within the Walloon Lake Watershed in 2015. This project was designed as a multi-year effort to identify occurrences of vulnerable species, vernal pools and high quality examples of natural communities in the watershed. Work conducted in 2015 focused on identifying priority survey areas, conducting natural community surveys on selected sites, identifying vulnerable species for future surveys, and delineating potential vernal pools throughout the watershed.

Forty-nine potential sites for natural community field surveys were identified, forty of which occur in the watershed. Fourteen sites were surveyed in 2015. Three rich conifer swamps, two hardwood-conifer swamps, one poor conifer swamp, one northern wet meadow, six mesic northern forests and one dry-mesic northern forest were documented during surveys. From a statewide, historical perspective, the forests surveyed at Walloon Lake are relatively small remnants occurring in a highly fragmented matrix. However, they include some of the most representative remaining forests around Walloon Lake today and are of high regional significance.

Many of the surveyed sites are sizable, contiguous forests blocks that capture the majority of the remaining natural cover at the site. They retain considerable diversity with buffered interior conditions, and are subject to many of the natural disturbances

that characterized them historically. They contribute substantially to local ecological diversity and the natural character of the region, and they provide important ecosystem services, including helping to sustain water quality. For these reasons combined, eight surveyed sites were entered as element occurrences in Michigan's Natural Heritage Database.

The survey sites face many threats due to the fragmented nature of the watershed and competing land uses. Considerations for biodiversity management and ecosystem integrity are provided for each natural community type, which can help minimize these threats. Site summaries are provided for each documented natural community occurrence and include a floristic quality assessment for each.

Thirty-seven vulnerable species were identified as targets for future surveys based upon the natural community data obtained in 2015. These include thirteen plants, six birds, four reptiles, three amphibians, three mammals, two mussels, and six snails.

Ninety-five potential vernal pools were delineated in or near the watershed. These small wetlands provide critical breeding habitat for amphibians and invertebrates and are important for nutrient cycling, water storage and infiltration, and groundwater recharge. Yet, little is known about them and they are often overlooked on the landscape. Surveys to determine their distribution and status in the Walloon Lake watershed, will further our understanding of these wetlands so that better protective measures can be taken.

Acknowledgements

We would like to express our deep appreciation to the Walloon Lake Trust and Conservancy, the Petoskey Foundation, and the Charlevoix Foundation for supporting and funding this work. We also thank the Tip of the Mitt Watershed Council for their support and assistance in developing the project. It is a privilege to get to know these lands to assess their status as natural communities and their regional and statewide significance.

The surveyed lands surrounding Walloon Lake are remarkable. They shape the character of the landscape and provide

important ecological services for the community. They currently form a backbone of natural diversity around the lake that can easily be altered by competing land uses. They will only be sustained through deliberate understanding and consideration of their role, along with careful land use planning. We thank you for this opportunity.

We would also like to thank our colleagues, Helen Enander, Joshua Cohen, David Cuthrell, Peter Badra and our director, Brian Klatt, for contributing to this effort, and Nancy Toben, our contracts manager, for always keeping us on track.



Spring emergence of yellow lady slipper at Cherry Hill Preserve. Photo by Phyllis Higman.

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Introduction

Little Traverse Bay, located in northwest Michigan, is Lake Michigan's fourth largest bay (Tip of the Mitt Watershed Council (TOMWC 2012)). In order to better protect the water quality and ecological integrity of the Little Traverse Bay Watershed, it is imperative to know what important natural features occur in the watershed, where they occur, the threats they face, and what management options can benefit them. Natural features inventories provide invaluable information for land managers and private landowners to inform their protection, stewardship, and land use decisions.

Walloon Lake is a 4600 acre lake within the Little Traverse Bay Watershed that drains into the Bear River and out into Little Traverse Bay and Lake Michigan at Petoskey (TOMWC 2012). The Walloon Lake Trust and Conservancy (Conservancy) preserves and protects the quality of Walloon Lake and its watershed for the benefit of current and future generations. To support their mission and improve land protection efforts, the Conservancy, in cooperation with the Tip of the Mitt Watershed Council and the Michigan Natural Features Inventory (MNFI), initiated a

natural features inventory within the Walloon Lake Watershed in 2015. This project was designed as a multi-year effort to identify occurrences of vulnerable species, vernal pools and high quality examples of natural communities in the watershed. Surveys were conducted to verify these occurrences and identify their condition and threats. These data will help inform wetland protection and restoration strategies for improving water quality in the watershed, while protecting the highest quality natural features, including natural communities, vulnerable species and vernal pools.

The first year of the inventory in 2015 focused on providing an ecological overview of the entire Walloon Lake Watershed and identifying high quality natural communities on priority conservation lands. Photo interpretation of potential vernal pools was also prioritized for 2015, capitalizing on MNFI's expertise and on-going initiative to build awareness and protection for these particularly vulnerable and often overlooked wetlands. Little is known about their status, distribution and ecology in Michigan.

Methods

Natural Community Surveys

Aerial photos were reviewed for all Walloon Lake Trust and Conservancy and Little Traverse Conservancy preserves and very high priority (VHP) and high priority (HP) parcels identified in two priority conservation focus areas; South Arm Creek and Schoof's Creek Subwatersheds. Priority conservation lands or parcels were identified by the Conservancy in collaboration with Little Traverse Conservancy (LTC), TOMWC, and MNFI. Current imagery was compared with imagery from 1938, which provides a useful reference for logging

history. Areas that were forested in the 1930's tend to have been the first cut and subsequently skipped over in the second round of logging in the late 1800s. Forests that were intact in 1938 were compared to preserve and priority parcel boundaries to identify forest blocks that remain intact currently. These have a higher likelihood of being more representative of historic conditions and natural disturbance regimes. They are also likely to have fewer impacts from anthropogenic disturbances.

These findings were used in conjunction with assessments of the current landscape context to help direct natural community field surveys for 2015. Survey sites were selected based upon potential site quality, accessibility, and available budget. Surveys were conducted primarily during June through September of 2015, with several follow-up surveys in May of 2016. Surveyors determined the natural community types at each site, assessed their condition, and threats, and recorded all plant species observed during surveys. A floristic quality assessment (FQA) was also conducted for each site using the Universal Floristic Quality Assessment (FQA) Calculator (Reznicek et al. 2014; Freyman et al. 2015).

Natural communities are recognizable assemblages of interacting plants, animals, and other organisms that occur across the landscape under similar environmental conditions. They are predominantly structured by natural processes (Cohen et al. 2014). Examples of natural processes include windthrow events, nutrient rich ground water seepage, seasonal water fluctuations and fire. Natural communities serve as critical benchmarks for understanding the “complex and essential relationships” (Tallamy 2009) that sustain these ecosystems. They are a valuable tool

for understanding threats on the landscape and identifying management strategies to achieve desired outcomes under current conditions.

Collected data were reviewed for each natural community documented to determine whether they meet specified criteria (NatureServe 2010) for status as element occurrences (EO) in Michigan’s Natural Heritage Database. Element occurrences are exemplary natural communities that are representative of historical conditions, and become part of NatureServe’s national database (Biotics). Biotics is used to track high quality natural communities and vulnerable species across the country (NatureServe 2015). Qualified occurrences at Walloon Lake were entered into Michigan’s Natural Heritage database.

Element occurrences were ranked from A-D, where A is an excellent representation of historic conditions and D is poorly representative of those conditions. Ranks are determined primarily by size, landscape context, and condition (Nature-Serve 2010). The regional significance of each natural community surveyed was also assessed independent of EO status. Understanding the regional importance of sites is critically important in areas that have been highly fragmented, or otherwise disturbed.

Vernal Pool Delineation

Potential vernal pools were identified by reviewing 1998 color-infrared-leaf-off, 2012 true/natural color-leaf-on, and best available

mosaic aerial imagery. Polygons of apparently suitable areas were mapped in ArcGIS to direct future on-ground surveys.

Results and Discussion

Natural Community Surveys

Forty-nine potential target sites for natural community field surveys were identified through the aerial photo interpretation. Forty sites were located within the watershed boundary and fourteen of these

were selected for survey. Occurrences of rich conifer swamp, hardwood-conifer swamp, poor conifer swamp, northern wet meadow, mesic northern forest and dry-mesic northern forest were documented.

Eight of these were entered into the Michigan Natural Heritage Database as EOs, and all are considered regionally important for

their ecological diversity and provision of ecosystem services in the Walloon Lake Watershed (Figure 1, Table 1).

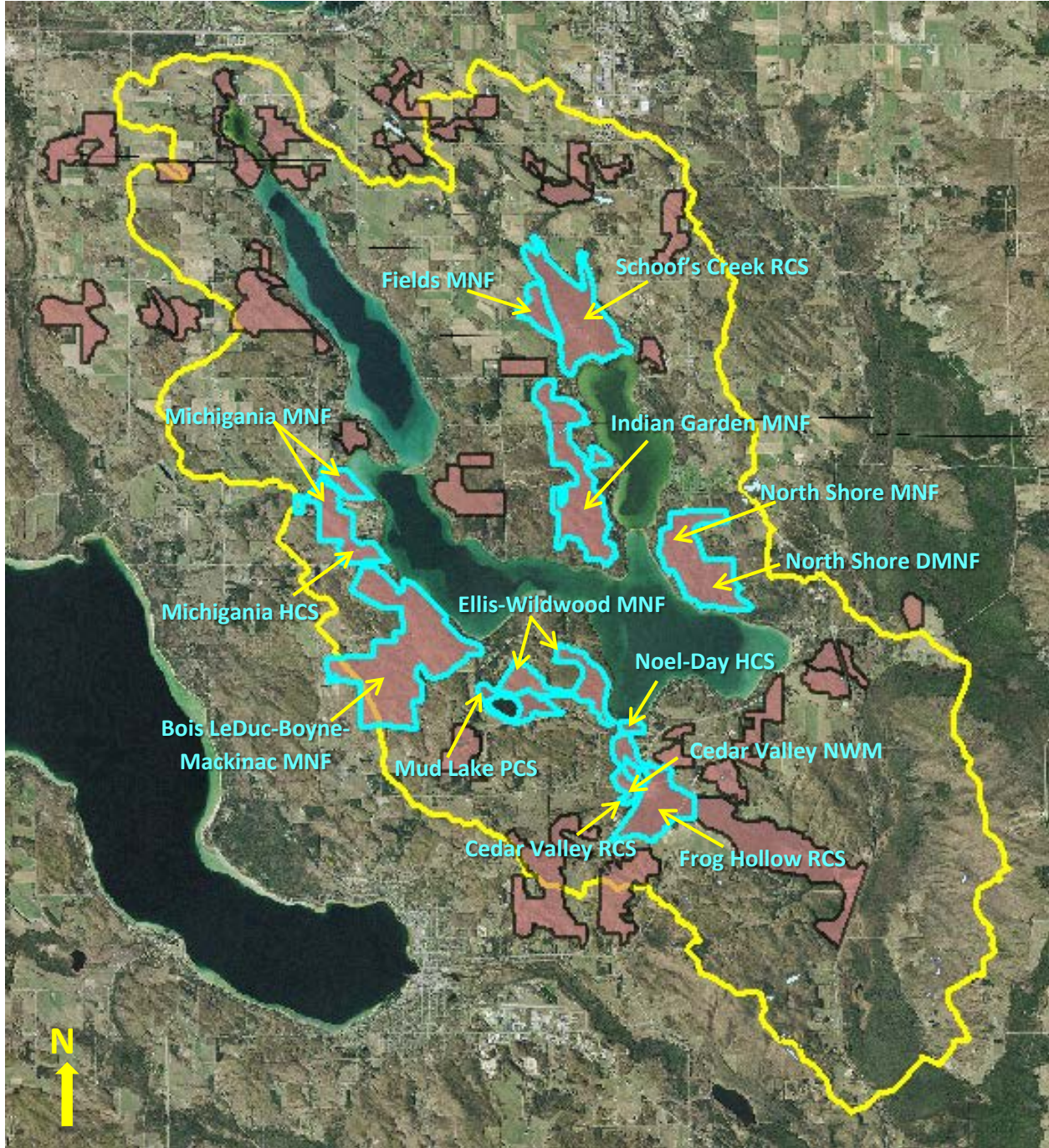


Figure 1. Priority parcels delineated and selected survey sites in Walloon Lake Watershed. Selected survey sites for 2015 are highlighted in blue.

Table 1. Natural communities documented during 2015 surveys.

Site Name	Natural Community Type	Total FQI	Native FQI	Total Species	Native Species	Status*
Schoof's Creek	rich conifer swamp	62.0	62.9	148	141	R, C
Cedar Valley	rich conifer swamp	33.1	34.3	62	58	R
Frog Hollow	rich conifer swamp	51.4	54.4	165	146	R, C
Noel-Day	hardwood conifer-swamp	36.8	39.2	94	83	R
Michigania	hardwood-conifer swamp	26.6	27.5	49	45	R
Wildwood-Mud Lake	poor conifer swamp	36.0	36.0	54	54	R, C
Cedar Valley	northern wet meadow	23.2	23.9	29	27	R
Fields Preserve	mesic northern forest	33.2	35.6	85	72	R, D
Ellis-Wildwood	mesic northern forest	33.7	33.4	56	55	D
Michigania	mesic northern forest	30.5	34.4	91	72	R
Indian Garden	mesic northern forest	49.0	51.8	166	145	R, C
Bois LeDuc-B-M	mesic northern forest	42.0	45.0	121	104	R, C
North Shore	mesic northern forest	42.6	44.8	108	99	R, C
North Shore	dry-mesic northern forest	27.9	29.1	44	40	R

*R=regionally significant; A-D-ranks, evaluated in reference to exemplary occurrences (NatureServe 2010).

From a statewide, historical perspective the forests surveyed at Walloon Lake are comparatively small and occur in a highly fragmented matrix. However they include some of the most representative remaining forests around the Lake and are of high regional significance.

Many of the surveyed sites are sizable, contiguous forests blocks retaining considerable diversity with buffered interior conditions, and subject to many of the natural disturbances that characterized them historically. For these reasons combined with their regional significance, eight

surveyed sites were entered as EOs. They lack the full structural complexity exhibited historically, some key dominants are under-represented and hydrologic alterations have occurred in most of the wetlands. This precludes them from qualifying currently as A- or B-ranked occurrences. They are nevertheless, remarkable sites and primary contributors to the ecological diversity and character of the region. The remaining sites are smaller with more significant alterations, but still provide important ecosystem services. Each site is described further in the Site Summary section.

Vulnerable/Rare Species

No plant or animal species listed as Federal (LE, LT) or State (E, T, SC) endangered, threatened or state special concern, were observed in 2015. However, using these baseline data, 37 future survey targets were identified (Table 2).

Potential rare plants include showy orchis (*Galearis spectabilis*, T), ginseng (*Panax quinquefolius*, T), male fern

(*Dryopteris filix-mas*, SC) goblin moon-wort (*Botrychium mormo*, T) New England sedge (*Carex novae-angliae*, T), and three birds orchid (*Triphora trianthophora*, T). These can be sought in the richest areas of mesic northern forests, particularly along streams and seeps. False violet (*Dalibarda repens*, T) and pine drops (*Pterospora andromedea*) could be targeted in the North Shore dry-

mesic forest and dryer components within the other mesic forests. Limestone oak fern (*Gymnocarpium robertianum*, T), cut-leaf water-parsnip (*Berula erecta*, T), calypso orchid (*Calypso bulbosa*, T), and Ram's head lady's-slipper (*Cypripedium arietinum*, SC) are targets for the rich conifer swamps, while cut-leaved water parsnip could also be sought in hardwood-conifer swamps along with bog bluegrass (*Poa paludigena*, T).

Red-shouldered hawks (*Buteo lineatus*, T) were observed or heard calling at Schoof's Creek rich conifer swamp, Noel-Day hardwood-conifer swamp, Michigan mesic northern forest, and Michigan hardwood-conifer swamp. No nests were observed. Dedicated raptor surveys are recommended so that surveys can be optimally timed, early in the season, with sufficient time allocated to scoping out nest sites. Targets include red-shouldered hawk, northern goshawk (*Accipiter gentilis*, SC), bald eagle (*Haliaeetus leucocephalus*, SC), Osprey (*Pandion Haliaeetus*, SC) and black-backed woodpecker (*Picoides arcticus*, T) in the rich conifer swamps and the mesic forests. Merlin (*Falco columbarius*, T) could also be targeted in the dry-mesic forest.

Two insects, the three horned moth (*Pachypolia atricornis*, SC) and ebony boghaunter (*Williamsonia fletcheri*, SC) have the potential to occur in several natural community types in the watershed, as do Blanding's Turtle (*Emydoidea blandingii*, SC), Wood Turtle (*Glyptemys insculpta*, SC), Eastern Box Turtle (*Terrapene carolina carolina*, SC) and Eastern Massasauga (*Sistrurus catenatus*, SC, Federal candidate).

No currently listed amphibians are likely to be in the region; however, several are proposed for listing as state special concern. These include the Mudpuppy (*Necturus maculosus*), Fowler's Toad (*Anaxyrus [Bufo] fowleri*) and Pickerel Frog (*Lithobates [Rana] palustris*). In addition, there is potential habitat for the woodland vole and two bat species. The little brown bat and northern long-eared bat are proposed for listing due to white nose syndrome.

Finally, there is potential for several rare mussels and snails as shown in the table below. Snails and mussels have been historically undersampled in the state and gathering baseline data will help inform conservation actions.

Table 2. Rare and vulnerable species targets for future surveys in Walloon Lake Watershed.

Scientific Name	Common Name	Natural Communities	Status*
Plants			
<i>Berula erecta</i>	Cut-leaved water parsnip	Rich conifer swamp Hardwood-conifer swamp	T
<i>Botrychium mormo</i>	Goblin moonwort	Mesic northern forest	T
<i>Calypso bulbosa</i>	Calypso orchid/fairy-slipper	Rich conifer swamp	T
<i>Dryopteris filix-mas</i>	Male fern	Mesic northern forest	SC
<i>Carex novae-angliae</i>	New England sedge	Mesic northern forest	T
<i>Cypripedium arietinum</i>	Ram's head lady's-slipper	Rich conifer swamp Hardwood-conifer swamp	SC
<i>Galearis spectabilis</i>	Showy orchis	Mesic northern forest	T
<i>Gymnocarpium robertianum</i>	Limestone oak fern	Rich conifer swamp	T
<i>Mimulus michiganensis</i>	Michigan monkey flower	Rich conifer swamp	LE, E
<i>Panax quinquefolius</i>	American ginseng	Mesic northern forest	T
<i>Poa paludigena</i>	Bog bluegrass	Hardwood-conifer swamp	T

<i>Pterospora andromedea</i>	Pinedrops	Mesic northern forest Dry-mesic northern forest	T
<i>Triphora trianthophora</i>	Nodding pogonia	Mesic northern forest	T
Birds			
<i>Accipiter gentilis</i>	Northern Goshawk	Mesic northern forest Dry conifer swamp Hardwood-conifer swamp	SC
<i>Buteo lineatus</i>	Red-shouldered Hawk	Mesic northern forest Dry-mesic northern forest Hardwood-conifer swamp	T
<i>Falco columbarius</i>	Merlin	Dry-mesic northern forest	T
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Mesic northern forest Dry-mesic northern forest Hardwood-conifer swamp Poor conifer swamp	SC
<i>Pandion haliaeetus</i>	Osprey	Hardwood-conifer swamp	SC
<i>Picoides arcticus</i>	Black-backed Woodpecker	Mesic northern forest Rich conifer swamp	SC
Insects			
<i>Pachypolia atricornis</i>	Three-horned Moth	Mesic northern forest Dry-mesic northern forest Rich conifer swamp Hardwood-conifer swamp	SC
<i>Williamsonia fletcheri</i>	Ebony Boghaunter	Hardwood-conifer swamp	SC
Reptiles			
<i>Emydoidea blandingii</i>	Blanding's Turtle	Emergent marsh Northern wet meadow Rich conifer swamp	SC
<i>Glyptemys insculpta</i>	Wood Turtle	Mesic northern forest Rich conifer swamp Hardwood-conifer swamp Northern shrub-thicket	SC
<i>Sistrurus catenatus</i>	Eastern Massasauga	Mesic northern forest Dry-mesic northern forest Rich conifer swamp Northern shrub-thicket Northern wet meadow	SC Federal Candidate for listing
<i>Terrapene carolina carolina</i>	Eastern Box Turtle	Mesic northern forest Northern shrub-thicket	SC
Amphibians			
<i>Necturus maculosus</i>	Mudpuppy	Aquatic; permanent lakes, ponds, impoundments, streams, and rivers	Proposed for listing as SC
<i>Anaxyrus [Bufo] fowleri</i>	Fowler's Toad	Mesic northern forest Dry-mesic northern forest Hardwood-conifer swamp Northern wet meadow Vernal pools	Proposed for listing as SC

<i>Lithobates [Rana] palustris</i>	Pickereel Frog	Aquatic and wetlands Rich conifer swamp Hardwood-conifer swamp Northern wet meadow Streams, ponds, permanent and temporary pools,	Proposed for listing as SC
Mammals			
<i>Microtus pinetorum</i>	Woodland vole	Mesic northern forest Dry-mesic northern forest	SC
<i>Myotis lucifugus</i>	Little brown bat	Forest cover, water body, and nearby openings	Proposed for listing as T
<i>Myotis septentrionalis</i>	Northern long-eared bat	Forest cover, water body, and nearby openings	LT and proposed for listing as T
Mussels			
<i>Ligumia nasuta</i>	Eastern pondmussel	Ponds and lakes Slow water of rivers, streams	E
<i>Pyganodon lacustris</i>	Lake floater	Inland lakes	SC
Snails			
<i>Stagnicola petoskeyensis</i>	Petoskey pondsnail	Aquatic; small lakes	E
<i>Planorbella smithi</i>	No common name	Aquatic: lake shores	E
<i>Cincinnatia cincinnatiensis</i>	Campeloma spire snail	Aquatic; creeks, streams, rivers, lakes	SC
<i>Fossaria galbana</i>	Boreal fossaria	Aquatic; large rivers, medium to large lakes	SC
<i>Pupilla muscorum</i>	Widespread column	Rich conifer swamp Mesic northern forest	SC
<i>Apalachina sayanus</i>	Spike-lip crater	Mesic northern forest Hardwood-conifer swamp Rich conifer swamp	SC

*LE (Federal Endangered), E (State Endangered), LT (Federal Threatened), T (State Threatened), SC (State Special Concern).

Key Threats to Natural Communities

Substantial, fairly contiguous blocks of natural cover surrounds Walloon Lake, largely on conservancy preserves, state forest lands and adjoining private parcels. These core areas are surrounded primarily by agriculture and rural residences, and there are several utility corridors and roads, that fragment the region and some of the sites themselves. These conditions pose significant threats to ecosystem integrity and function (Table 3). Many of the surveyed

sites remain relatively intact, in spite of the disturbances around them. However, it is important to understand these threats when determining management objectives.

The site summary section includes an overview of each of the natural community types documented during 2015, and presents management considerations for biodiversity and ecosystem integrity for each. As noted earlier, the retention of such a significant area of natural cover around the lake is

remarkable, and contributes substantially to the ecological diversity and character of the region. With attention and care, they can be sustained for the future.

Most notable during surveys was the devastating impact of diseased ash and American beech, both of which are key canopy dominants in most of the natural community types represented at Walloon Lake. The creation of canopy gaps from windthrow is a natural disturbance that allows shade tolerant seedlings in the understory to capture more sunlight and grow to regenerate the canopy. Referred to as gap phase dynamics, this is the key driver for mesic northern forests and is integral to all of the forested natural communities at Walloon Lake.

The loss of these species has created a substantial increase in canopy gaps and significantly more woody debris and snags than in recent history. The high rate and extent of gap formation is a relatively new phenomenon and has altered competitive interactions among species within these forested systems. The altered trajectories of these forests in the face of this new threat are uncertain. It will be important to stay abreast of how species interactions evolve over time.

Maintaining these forests as intact as possible through sustainable forestry practices and monitoring is important for two key reasons. First, intact forests are more likely to ensure the survival of individual disease resistant trees that could inadvertently be removed. Second, allowing the natural processes in these forests to proceed unimpeded will teach us about their natural adaptive pathways. This could be of enormous benefit in the future.

It is important to note that the canopy gaps from mature tree die-offs have created conditions ripe for invasive plant colonization. Some logging practices can also create conditions for plant invasions by compacting the soil, opening up pathways, and spreading seed. Many invasive plants are capable of thriving in disturbed areas, often more so than native species. They can gain a competitive advantage and impact forest regeneration by dominating space and resources. Many invasive plants are already established in the surrounding matrix, but are currently limited or absent within the interior of these forests. Early detection and rapid response will be central to keeping these aggressive species from establishing over time.

Table 3. Key threats to natural communities.

Threat	Impacts
Fragmentation & isolation	Impedes natural disturbances integral to natural communities, reduces species population sizes and genetic exchange that can lead to local extirpation of populations, such as has occurred with yew. Edge effects increase vulnerability of many species to predation, including nest parasitism of forest interior obligates and neo-tropical migrants by brown-headed cowbird. Facilitates the influx of invasive plants.
Loss of structural & species diversity	Changes habitat conditions for species associated with natural communities; even excludes some altogether. Decreases resiliency to change on landscape by the loss of many less well known, but critical functional components of ecosystems, such as fungi and lichens.
High deer pressure and herbivory	Can severely deplete populations of species palatable to deer, even leading to their and often favoring invasive species.

Invasive plants invasions	Displaces native species, alters composition, structure and natural disturbance regimes, thereby fundamentally changing the system and associated species habitats. Can alter soil characteristics, inhibit tree regeneration, and some species act as ecological “traps”, e.g., tricking insects to lay eggs on the invasive species which are toxic to the developing larva. Many non-native species reduce populations of insect specialists that are critical to breeding birds and their young and form the base of the food chain for many species.
Tree pests and disease	Changes composition and structure, altering successional trajectories. Increased canopy gaps increase potential for secondary invasions by invasive and weedy plants.
Logging and associated trails/roads	Can decrease composition and structure, including the diversity of herbaceous vegetation which causes localized changes to hydrology, and enables an influx of invasive plants such as garlic mustard. Some logging practices can compact soil and create potential for erosion, increase fragmentation. Exposure of the canopy also exposes the sub-canopy to the emerald ash borer.
Grazing	Alters species compositional and structural diversity, reducing ecosystem resiliency and habitat quality for some species. It can cause trampling of sensitive species and soil compaction, which can increase erosion.
Hydrologic alteration and stream channelization	Changes water levels and cycles of saturation and inundation; reduces or eliminates stream habitats and their associated species. Can also affect ecosystem services associated with intact wetlands.
Powerlines and pipelines	Alters structure and composition of natural communities, increases fragmentation, impedes natural disturbances, increases edge effects and alters hydrology, creating conditions that favor invasive species.
Agricultural and road runoff	Increases sedimentation and delivery of undesirable nutrients and other chemicals to water bodies, decreasing water quality.
Erosion	Alters soil profiles that can cause species loss and increased competition by invasive plants that are often capable of persisting in a broad range of conditions. Increases run-off of sediments into adjacent communities.
Adjacent land uses	Reduction of large areas of natural cover in adjacent uplands compromises the ability of the wetlands to mitigate agricultural runoff. Adjacent land uses also can increase fragmentation.

Invasive Plants

Upland Forests

In general, invasive plants were minimal within the upland sites; however there are source populations of some key invasive species nearby. These are noted below.

Garlic mustard: Perhaps the most serious concern for the upland forests is garlic mustard (*Alliaria petiolata*). It has not yet

established in the surveyed sites and was rarely observed in the area. However, three adult plants were discovered and pulled along the main trail leading out of Indian Garden preserve and one small patch of seedlings was detected just inside the North Shore Preserve near the main trail entrance by the parking area. One large patch was documented along Resort Pike Road and

two additional patches were found along North Shore Drive. Flowering plants were pulled at the southernmost site on North Shore Drive, filling a 15 gallon bag. Hundreds of seedlings were emerging from contaminated dirt apparently deposited along the road.

It is recommended that all of the garlic mustard infestations be intensively managed with the goal of eradication. The absence of this species in these forests is extraordinary, considering the level of invasion elsewhere in the state, and there is a short window of opportunity to prevent wide scale invasion. A dedicated, vigilant monitoring and response effort, with outreach to the public, is recommended until better control methods are discovered. Regular monitoring for this species during the flowering period, when it is easiest to spot is recommended.

The goal of garlic mustard control is to deplete the seed bank and keep seeds from spreading. Second year flowering plants should be targeted, well before going to seed. Pulled plants can go on to produce seed, so it is critical that they are handled carefully and disposed of in a land-fill. Plants should not be composted or tossed aside, as this will likely result in recolonization and spread. Garlic mustard disposal bins could be stationed along trail heads at critical time periods so that anyone seeing garlic mustard along the trails or elsewhere, could pull and toss it in the bin without having to worry about where to dispose of it.

Landscaping herbs: Many large patches of periwinkle (*Vinca minor*) were observed at the edges of the survey sites, where they border residential areas. Patches of sweet woodruff (*Galium odoratum*) were common as well. Invasion of these species does not occur quickly, however, widespread invasion and displacement of native species has been observed in some areas of the state. Curbing the spread of these species through

education and controlling the leading edges is recommended.

Leafy spurge: A single occurrence of leafy spurge (*Euphorbia esula*) was documented along M-75 at the edge of Frog Hollow swamp. It was not observed in any survey sites during surveys, however, it is likely that it occurs elsewhere in the surrounding matrix and should be watched for. Although not typically a forest invader, it could pose problems if it becomes established along trails or forest openings. It has a notoriously deep, branching root and is extremely difficult to control once established.

Other herbaceous species: Spotted knapweed (*Centaurea stoebe*) is widespread along roads and in old fields in the region. Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*) and sweet clover (*Melilotus* spp.) were observed occasionally, but were not in any upland survey sites.

Woody shrubs and trees: Autumn olive (*Elaeagnus umbellata*), non-native bush honeysuckles (*Lonicera* spp.) and multiflora rose (*Rosa multiflora*) were only occasionally observed along trails and openings, but were virtually absent from the forest interiors. Japanese barberry was observed in wet pockets within upland communities. Common and glossy buckthorn (*Rhamnus cathartica*, *Alnus frangula*) were not observed at any sites. Black locust (*Robinia pseudo-acacia*) was rarely observed but is present in the surrounding matrix. This clonal species can interfere with forestry practices once it is established.

Japanese knotweed: Two occurrences of Japanese knotweed (*Fallopia japonica*) were observed along M-75. It is highly aggressive and extremely difficult to control; particularly after it is cut, as it can reproduce from node fragments. Japanese knotweed is legally prohibited in Michigan and it is illegal to possess or introduce it without a permit. Outreach to inform the community is

recommended. Known infestations should be assessed, treated and monitored after careful study of site conditions and the full range of potential control methods. Qualified and experienced experts should be consulted to avoid the many pitfalls of associated with controlling this species. Long term monitoring and treatment will be required in order to ensure complete kill of the hefty rhizomes. Complete eradications have been rarely documented to date, however recent efforts using newer herbicides show promise under some site conditions.

Weedy species: Species such as common St. John's-wort (*Hypericum perforatum*), hawkweeds (*Hieracium* spp.), timothy grass (*Phleum pretense*), orchard grass (*Dactylis glomerata*) Kentucky and Canada bluegrass (*Poa compressa*, *Poa pratensis*) were observed, mostly along trail openings, but were largely absent from the interior. The exception to this was the recently logged Michiganian mesic northern forest where weedy species were common.

Wetlands

In general, the wetlands at Walloon Lake have experienced more impacts from invasive species, particularly reed canary grass and cat-tails. Fortunately, invasive phragmites (*Phragmites australis* ssp. *australis*) was not observed during surveys.

Cat-tails and grasses: Reed canary grass (*Phalaris arundinacea*) and invasive cat-tails (*Typha angustifolia*, *T. Xglauca*) were locally common in the central portion of Schoof's Creek and along the natural gas

and power lines in Cedar Valley and Frog Hollow Preserves. These species were also prevalent in Noel-Day and Michiganian Hardwood-Conifer Swamps by the roads where hydrologic alterations are the greatest.

Non-native thistles: Eurasian marsh thistle (*Cirsium palustre*) was common, but sparse, in most of the wetland forests. A significant invasion of Canada thistle was noted in the wet meadow portion of the Michiganian swamp and it was observed occasionally at several other sites.

Other herbaceous species: Forget-me-not (*Myosotis scorpioides*), was locally common to abundant along some of the wetland channels and seeps, particularly in Frog Hollow and Noel-Day swamps. Bittersweet nightshade (*Solanum dulcamara*) was locally dominant in several areas within Noel-Day Preserve and observed occasionally in Frog Hollow Preserve. Hoary willow-herb (*Epilobium parviflorum*) was found occasionally in Frog Hollow swamp. This species does not yet have widespread recognition as a serious invader; however, it was recently observed dominating fairly large areas near the Brown Bridge natural area, southeast of Traverse City. The dam was removed recently and hoary willow-herb was displacing native species in some areas. This species should be monitored in the Walloon Lake region to determine whether it will be a problem here.

Table 4 provides a list of all non-native weedy species documented during surveys. The species in bold are commonly agreed to be invasive by the conservation community.

Table 4. Non-native and invasive plants documented in or around surveys sites in Walloon Lake Watershed.

Scientific Name	Common name	Status
<i>Agrostis gigantea</i>	redtop	Occasional along trails
<i>Alliaria petiolata</i> *	garlic mustard	Small infestation along main trail of North Shore; three plant pulled on main trail at Indian Garden Preserve, three larger infestation on perimeter roads
<i>Arctium minus</i>	common burdock	Occasional along trails, rarely in interior
<i>Berberis thunbergii</i>	Japanese barberry	In small wetlands in mesic northern forest of Indian Garden Preserve, several observed in Frog Hollow Preserve
<i>Bromus inermis</i>	smooth brome	At edge of Frog Hollow Preserve along M-75
<i>Centaurea stoebe</i>	spotted knapweed	At edge of Frog Hollow Preserve along M-75
<i>Cerastium fontanum</i>	mouse-ear chickweed	Michiganian mesic northern forest
<i>Cirsium palustre</i>	Eurasian marsh thistle	Common but sparse in all wetland survey sites
<i>Cirsium arvense</i>	Canada thistle	At edge of Frog Hollow Preserve, significant infestation in wet meadow portion of Michiganian hardwood-conifer swamp
<i>Cirsium vulgare</i>	bull thistle	Occasional along trails, rarely in interior
<i>Convolvulus arvensis</i>	field bindweed	Occasional along trails, rarely in interior
<i>Dactylis glomerata</i>	orchard grass	Occasional along trails, rarely in interior
<i>Daucus carota</i>	<i>queen-Anne's-lace</i>	Occasional along trails, rarely in interior
<i>Elaeagnus umbellata</i>	autumn olive	Occasional along trails, rarely in interior; northern edge of Frog Hollow
<i>Elymus repens</i>	quackgrass	Occasional along trails, rarely in interior
<i>Epilobium parviflorum</i>	hoary willowherb	Occasional in Frog Hollow swamp
<i>Epipactis helleborine</i>	helleborine	Sparse at many sites
<i>Euphorbia esula</i>	leafy spurge	Single occurrence along M-75; not observed in survey sites
<i>Fallopia japonica</i>	Japanese honeysuckle	Two occurrences along M-75, not observed in survey sites
<i>Galium odoratum</i>	sweet woodruff	Small monoculture occurrences along residential roads; occasional at trail heads
<i>Hieracium aurantiacum</i>	orange hawkweed	Occasional
<i>Hieracium murorum</i>	hawkweed	Occasional
<i>Hieracium piloselloides</i>	king devil	Occasional
<i>Hypericum perforatum</i>	common St. johns-wort	Occasional on trails, rarely in interior
<i>Lapsana communis</i>	nipplewort	Occasional
<i>Leonurus cardiaca</i>	motherwort	Occasional on trails, rarely in interior
<i>Leucanthemum vulgare</i>	ox-eye daisy	Occasional on trails, rarely in interior
<i>Melilotis alba</i>	white sweet clover	Along M-75 at edge of Frog Hollow

<i>Myosotis scorpioides</i>	forget-me-not	Rich, moist upland forest Trails Wetlands and seeps
<i>Nepeta cataria</i>	catnip	Rare
<i>Lonicera morrowii</i>	Morrow's honeysuckle	Occasional on trails, rarely in interior
<i>Lonicera tatarica</i>	tartarian honeysuckle	Occasional on trails, rarely in interior
<i>Lythrum salicaria</i>	purple loosestrife	Rare, one occurrence at
<i>Nasturtium microphyllum; N. officinale</i>	watercress	Locally dominant in some rivulets in wetlands
<i>Phleum pratense</i>	timothy	Occasional
<i>Poa compressa</i>	Kentucky bluegrass	Locally common, in openings
<i>Poa pratense</i>	Canada bluegrass	Locally common in openings
<i>Phalaris arundinacea</i>	reed canary grass	Occasional in some wetlands; not large infestations noted
<i>Plantago major</i>	common plantain	Occasional along trails
<i>Potentilla recta</i>	rough-fruited cinquefoil	Rare
<i>Ranunculus acris</i>	common buttercup	Occasional
<i>Rosa multiflora</i>	multiflora rose	Noted at Fields Preserve
<i>Rumex crispus</i>	curly dock	Occasional
<i>Rumex obtusifolius</i>	bitter dock	Occasional
<i>Silene vulgaris</i>	bladder campion	Occasional, at edges
<i>Solanum dulcamara</i>	bittersweet nightshade	Sparse to common in most wetlands
<i>Taraxacum officinale</i>	dandelion	Occasional
<i>Trifolium pratense</i>	red clover	Common at Michiganian mesic northern forest
<i>Trifolium repens</i>	white clover	Common at Michiganian mesic northern forest
<i>Typha Xglauca</i>	hybrid cat-tail	Locally dominant at Schoof's Creek, Cedar Valley, Frog Hollow, & Noel-Day Swamps
<i>Typha angustifolia</i>	narrow-leaved cat-tail	Locally dominant at
<i>Veronica officinalis</i>	common speedwell	Occasional
<i>Verbascum thapsis</i>	common mullein	Occasional
<i>Vicia cracca</i>	bird vetch	Occasional
<i>Vinca minor</i>	periwinkle	Many large patches mostly near residences, occasionally migrating into margins of preserves

*Bolded plants are commonly agreed to as invasive.

Vernal Pool Delineation

A total of 95 potential vernal pools were identified and mapped (Figure 2.) These were primarily in forested stands across the entire watershed and in some forested areas adjacent to the watershed. Vernal pools pro-

vide critical breeding habitat for amphibians and invertebrates and habitat for many other plants and animals, including some rare and declining species. They are also important for nutrient cycling, water storage

and infiltration, and groundwater recharge. Vernal pools are vulnerable to climate change and various land use practices, including timber harvesting and development. Yet, little is known about their distribution and abundance, and they are often overlooked during planning efforts. MNFI is currently promoting research and conservation of vernal pools and developing a state-wide monitoring program that engages citizen scientists, including K-12 schools.

Vernal pools are small wetlands that are typically wet in the spring and dry up in the summer. Species that occur there are adapted to this wet-dry cycle. Fairy shrimp are currently known only from vernal pools, and species such as spotted salamanders,

blue spotted salamanders, and wood frogs breed and lay eggs there in the spring and then migrate to the surrounding forested matrix. Some salamanders are long-lived and return to the same pool year after year. Maintaining a forested buffer around the pools is critical for sustaining suitable habitat for these and other species that depend on vernal pools to survive.

Surveys are recommended to confirm the locations of vernal pools in the Walloon Lake watershed. There is also opportunity to engage local citizens in monitoring to contribute to the growing body of knowledge about their distribution, status and trends. Increased awareness may lead to stronger protective measures in the state.



Vernal pool monitoring in northern Michigan. Photo by Yu Man Lee.

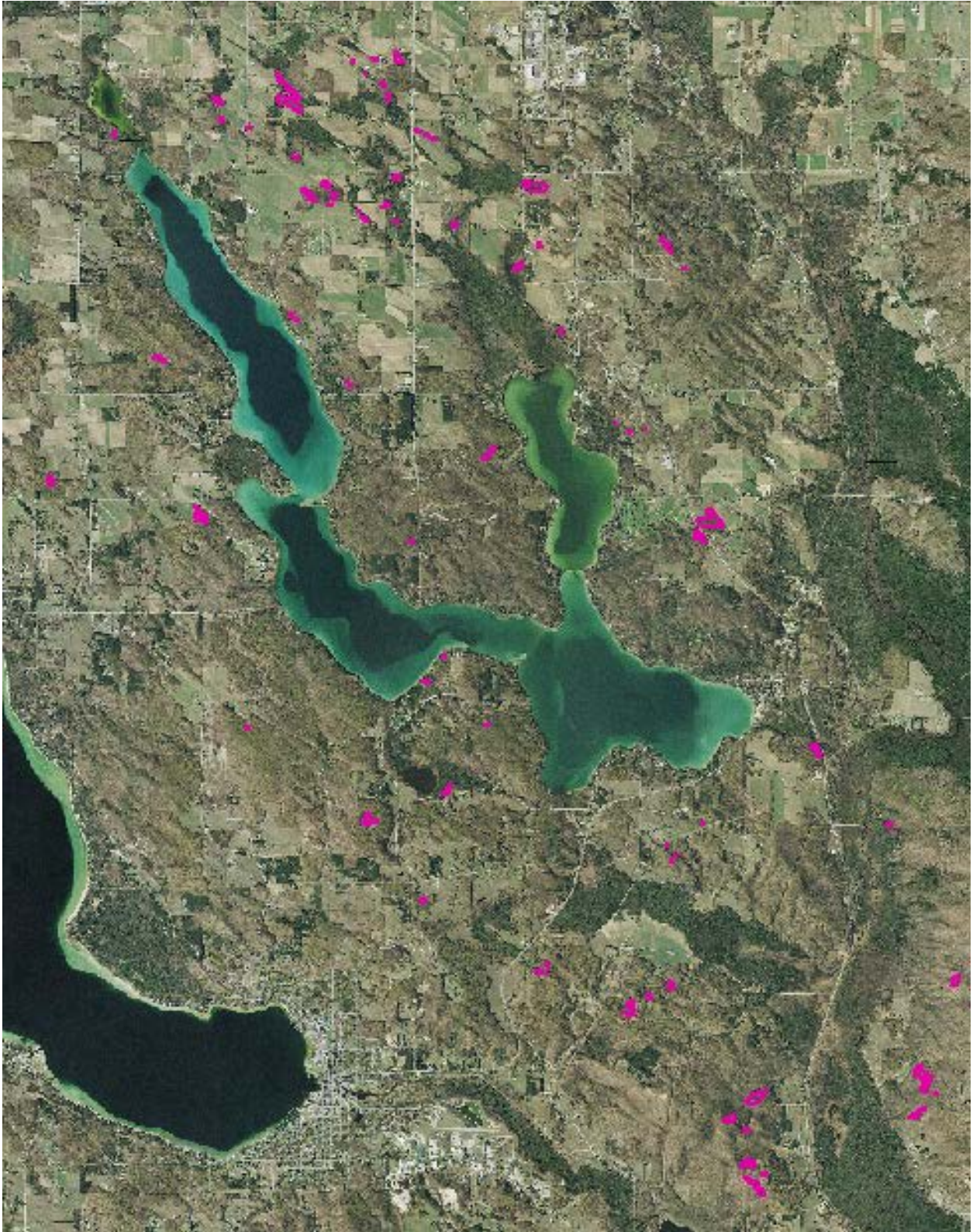


Figure 2. Vernal pools delineated in Walloon Lake Watershed in 2015.

Natural Community Site Summaries

Survey sites are described in the following pages. They are arranged by natural community type, with a short summary of each type and an overview of management considerations for biodiversity and ecosystem integrity at the beginning of each type. These are followed by individual site summaries. The summaries include a site overview, clips of 1938 and 2012 aerial imagery, and descriptions of the vegetation, threats, regional significance and EO status. A floristic quality assessment is provided at the end of each site summary and includes a list of all plant species observed during

surveys. For ease of reading, common plant names are used in the main text, except for species that lack them. Scientific names can be referenced in the associated species lists.

As noted in the Methods Section, size, landscape context, and condition are used to score EO ranks. They range from A-D, where an A-ranked EO is an excellent representation of historical conditions and a D-ranked community is poorly representative of those conditions (NatureServe 2010). Since all of the survey sites lie within the same regional landscape context, the context is described below.

Landscape Context

Much of the surrounding landscape is fragmented by agriculture and rural residences. Expansive portions of contiguous forests exist throughout the area, largely on conservancy preserves, some private lands, and on State Forest land to the east. Some residences retain a substantial amount of natural cover. Upland areas are predominantly mesic or dry-mesic northern forests. Lowlands are complexes of rich conifer to hardwood-conifer swamps with northern shrub thickets and northern wet meadows in areas where beaver flooding has impacted these complexes.

Roads and drainages have altered many of the wetland complexes and many have been logged extensively since the early logging era. Impacts to the remaining upland forests are generally fewer, with recent logging occurring predominantly in certain areas and typically on a smaller scale. This

is likely due, in part, to the steep morainal slopes in the region.

Narrow-leaved and hybrid cat-tail, and reed canary grass are established in the most disturbed portions of wetlands in the region and European swamp thistle is common, though sparse, through-out the wetlands. Many other invasive plants are established in the matrix surrounding the forests wetlands, but are notably infrequent or even absent in the interior of the large forest blocks. The area lacks the level of propagule pressure of many key species that is evident in many other regions of Michigan. But, it is just a matter of time for these seeds or other reproductive parts to grow in number here.

Emerald ash borer and beech bark disease have thrown both mesic northern and wetland forests into flux by large scale die-off of these major canopy dominants. The long-term impacts of this are uncertain.

Rich Conifer Swamp

Rich conifer swamps are forested wetlands that are strongly influenced by mineral-rich groundwater (minerotropic) flowing through organic soils. They are dominated by conifers including northern white cedar, black spruce, balsam fir, white pine and hemlock. In the Lake Walloon region, they occur on coarse- to medium-textured ground moraines and are associated with the lake and streams that are fed by cold groundwater. Cool air from the surroundings causes condensation that creates conditions for an abundance of lichens and bryophytes (mosses, hornwort, and liverworts). Thick layers of moss insulate the soils resulting in a shorter, cooler and more humid growing season, and milder winters with more stable temperatures.

Soils are characterized by varying depths of saturated, coarse woody peat (partly decomposed plants) and are mostly neutral to moderately alkaline, but more strongly acidic in areas where sphagnum mosses dominate.

Seasonal water level fluctuations, beaver flooding, and windthrow are the predominant natural processes in this system. High water conditions create an anaerobic environment resulting in trees that are shallowly rooted and susceptible to windthrow. This creates a complex topography of tip-up mounds, root pits and coarse woody debris that provide microhabitats for a diverse array of plant species. Canopy gaps provide access to sunlight that allows shade tolerant seedlings to thrive, and regenerate the canopy.

Prolonged flooding can cause conversion from forest to non-forested wetlands such as marshes and wet meadows. During extensive droughts, fires may spread through the system killing trees and even sometimes removing the upper layers of organic soil. This can create conditions for increased establishment of conifers, such as white cedar.

Management Considerations for Biodiversity and Ecosystem Integrity

- A major threat to the natural regeneration of cedar in northern rich conifer swamps is the high density of deer, which rely on this species as a main winter food source. Long-term conservation of this system will require a reduction in deer densities across the landscape and allowing natural disturbances such as windthrow and periodic beaver flooding to create the complex structure that provides habitat for late-successional species.
- In the absence of top predators, occasional removal of beaver may be required to promote various stages of succession and prevent conversion to other community types.
- Allowing natural disturbances to occur unimpeded will also increase the chances of retaining disease resistant trees in the system.
- Logging rich conifer swamps during the growing season, especially with heavy equipment, creates ruts that can permanently alter the hydrology. This facilitates conversion of the system to hardwood-conifer swamp, hardwood swamp, aspen, and alder thickets. Single tree removal during the winter has fewer impacts and leaving woody debris on site may expedite the maturation of the system.
- Logging that reduces the diversity of herbaceous vegetation enables an influx

of invasive species and causes localized changes to hydrology.

- Maintaining large areas of natural cover surrounding rich conifer swamp helps mitigate impacts from agricultural runoff and sedimentation, both of which affect water and habitat quality.
- Alterations to hydrology, such as changing stream morphology, impact stream habitat and quality and can diminish ecosystem services associated with intact wetlands.
- Avoiding logging in adjacent lands is ideal in this landscape; however, if logging is desired, using sustainable management practices is essential to minimize sedimentation in the swamps

and maintaining diversity. Winter harvesting can be advantageous.

- The use of natural cover buffer strips in adjacent agricultural operations will help reduce the near-continuous influx of runoff which periodically contains fertilizers and pesticides.
- Invasive species threaten the diversity and community structure of rich conifer swamp. Species of greatest concern include narrow-leaved cat-tail, hybrid cat-tail, reed canary grass, non-native phragmites, European marsh thistle, purple loosestrife and glossy buckthorn. Regular monitoring for these and other invasive species can help prevent widespread invasion.

Rich Conifer Swamps Documented During Surveys

Schoof’s creek.....	19
Cedar Valley	28
Frog Hollow	34



Schoof’s Rich Conifer Swamp. Photo by Jesse M. Lincoln.

Schoof's Creek Rich Conifer Swamp



Photo by Jesse M. Lincoln.

Site Summary

This large forested wetland complex occurs at the northern portion of a lake basin within a morainal landscape in the northern Lower Peninsula. Overall, the complex most closely aligns with the description of rich conifer swamp though there are elements of hardwood conifer swamp, rich tamarack swamp, northern shrub thicket, northern wet meadow, as well as emergent and submergent wetlands. Surveys concentrated within the wetland complex, near the stream, WLTC properties, and properties adjacent to preserves.

The driving forces that shape this system and community variability are nutrient-rich groundwater seeps, saturated soils, periodic

windthrow events, and especially beaver flooding.

Expansive and prolonged flooding and subsequent dam removal drives long cycles of conversion from forested wetland, to open water, emergent wetland, wet meadow, shrub thicket, and eventually back to forested swamp. These phases occur throughout this system with open zones near the main stream channel and expansive zones of tree mortality radiating from Schoof's Creek. These successional stages in combination with localized windthrow and groundwater influence create a structurally variable system and very high plant diversity.

Additionally, sphagnum hummocks and hollows provide micro-site diversity by creating small-scale gradients in soil moisture and chemistry. Soils are saturated, poorly-drained, deep organic mucks with a circumneutral to basic pH. Natural processes are the primary forces driving zonation but historic logging and possible grazing and trail construction have influenced structure and composition.

A particularly unusual habitat occurs along a historic extension of Cemetery Rd which appears to have had an old road or small rail line extending south to the stream channel. Many plants often associated with fens occur along this linear feature, potentially indicating the use of limestone in construction of the road. Small upland inclusions occur throughout but were not surveyed as they were located primarily on private property. They may have important components of intact mesic northern forest.

The stream channel has additional zones of submergent and emergent vegetation but was not thoroughly surveyed. Zones of wet meadow transitioning to conifer swamp at the southern portion of the preserve are particularly beautiful and have an abundance of orchids, expanses of grasses, and support large ant colonies, one of which had been recently excavated by what was likely a black bear.

Bird species observed during surveys include winter wren, red shouldered hawk, swamp sparrow, cedar waxwing, white throated sparrow, gold finch, common yellow throat, blue jay, and woodcock

This is arguably the most important wetland complex in the Walloon Lake watershed as this system provides enormous benefit by filtering, metabolizing, and sequestering pollutants from adjacent agricultural operations; thereby protecting local fisheries and recreational opportunities for the residents of Walloon Lake.

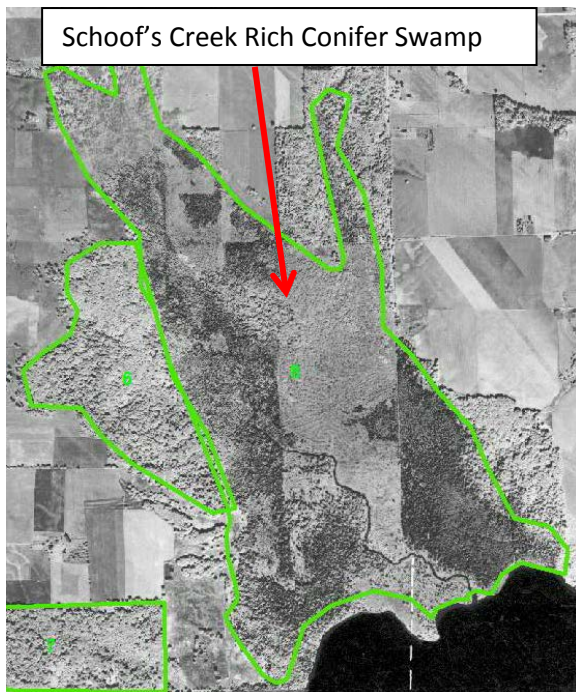


Figure 3. Schoof's Creek 1938 imagery.



Figure 4. Schoof's Creek 2012 imagery.

Vegetation

Total number of species: 148; Native 141. Total FQI 62, Native FQI 62.9.

The system ranges from nearly closed canopy swamp dominated by conifers to meadow/ shrub thicket near the stream where beaver flooding has historically caused prolonged inundation. The rich conifer swamp is characterized by dense sphagnum moss, a species-rich herbaceous layer, a patchy low shrub layer, and a patchy to dense canopy comprised primarily of conifers, including black spruce, balsam fir, white pine, white cedar, and hemlock, with yellow birch, American elm, red maple, green ash, and balsam poplar as occasional constituents in zones that trend towards hardwood-conifer swamp.

Diameters of canopy species typically range from 10-20" with scattered trees over 30" and one cedar was 39 in. Tree size and age range varied considerably from a 39 year old 10" spruce, a 73 year old 20" cedar, 103 year old 13" tamarack, a 160 year old 22" cedar, and a 39" cedar with a rotten center that had 265 years of discernible rings but was estimated to be 450 years old.

Beaver flooding has led to extensive areas with standing dead trees (possibly the majority of the complex). Flooded areas are characterized by very few living canopy trees and pools of standing water. Zones of extremely dense understory of saplings have established following removal of beaver dams.

The subcanopy is dominated by the same species found in the canopy with increased red maple, yellow birch, green ash, as well as mountain maple, northern Juneberry, and paper birch. Shrubs are typically sparse but

locally dense, especially in impenetrable shrub thickets along the creek where speckled alder is dominant. Additional shrubs species are sparse to locally abundant and include gooseberries, hairy honeysuckle, alder-leaved buckthorn, sweet gale, bog rosemary, Labrador tea, wild rose, swamp rose, and velvetleaf blueberry.

The herb layer is extremely diverse, in terms of structure and composition with windthrow, proximity to groundwater seeps, and beaver activities as primary forces influencing micro-site conditions. Ferns are frequently dominant, including: cinnamon fern, royal fern, marsh fern, and wood ferns. Graminoids are common and include fowl manna grass, wood reedgrass, northern shorthusk, fowl meadowgrass, slender wedgrass, *Carex scabrata*, *Carex interior*, and *Carex aurea* as common constituents in the forested areas. Blue-joint, fringed brome, marsh wild Timothy, slender wheatgrass *Carex stricta*, *Carex diandra*, and *Carex flava* are common to dominant in the meadow areas.

Additional herbaceous species were extremely diverse including star flower, goldenrods, small enchanter's nightshade, and marsh marigold. Invasive reed canary grass was locally abundant in the central portion along Schoof's Creek and along Cemetery Rd in the northern portion of the site.

Data from all habitat types were combined for the complete species list, and is reflected in the extremely high FQI for this site.

Threats

Alterations to hydrology, deer herbivory, logging pressure, and invasive species are the primary threats to this system. Invasive species are a problem locally; particularly at

Cemetery Rd. Species of concern include European thistle reed canary grass and narrow leaved and hybrid cat-tail. Glossy buckthorn and invasive phragmites are also

of concern, however they were not observed during surveys. See page 17 for further

discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance:

- *Forest of Regional Significance*
- *C-ranked rich conifer swamp EO*

Despite historic logging (particularly on the Schoof's Creek Preserve), a high probability of agricultural runoff, local alterations to stream morphology, local but serious infestations of invasive species, and widespread tree disease/mortality, this system remains driven primarily by natural processes. This, along with its size, structure, and composition justify its status as a high-quality natural community. Beaver flooding, windthrow, and mineral-rich groundwater create a range of microhabitats that support a great diversity of plant and animal species.

Additionally, this system provides enormous benefit to the larger watershed by filtering, metabolizing, and sequestering pollutants from adjacent agricultural operations; thereby protecting local fisheries and recreational opportunities for the residents of Walloon Lake.

The introduction of Dutch elm disease in the 1980s and emerald ash borer over the past decade have fundamentally altered the structure and composition of the deciduous constituents of the canopy and subcanopy.



Showy lady slipper. Photo by Phyllis J. Higman

Schoof's Creek Rich Conifer Swamp FQA

Total Mean C:	5.1
Native Mean C:	5.3
Total FQI:	62
Native FQI:	62.9
Adjusted FQI:	51.7
% C value 0:	6.8
% C value 1-3:	20.9
% C value 4-6:	45.3
% C value 7-10:	27
Native Tree Mean C:	3.9
Native Shrub Mean C:	6.4
Native Herbaceous Mean C:	5.4

Species Richness:			
Total Species:	148		
Native Species:	141	95.3%	
Non-native Species:	7	4.7%	

Species Wetness:	
Mean Wetness:	-2.7
Native Mean Wetness:	-2.8

Duration Metrics:		
Annual:	3	2.0%
Perennial:	143	96.6%
Biennial:	2	1.4%
Native Annual:	3	2.0%
Native Perennial:	137	92.6%
Native Biennial:	1	0.7%

Physiognomy Metrics:		
Tree:	14	9.5%
Shrub:	17	11.5%
Vine:	3	2.0%
Forb:	65	43.9%
Grass:	14	9.5%
Sedge:	24	16.2%
Rush:	0	0.0%
Fern:	11	7.4%
Bryophyte:	0	0.0%

Documented Species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Abies balsamea</i>	balsam fir	native	3	0	perennial	tree
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Acer spicatum</i>	mountain maple	native	5	3	perennial	tree
<i>Actaea pachypoda</i>	dolls-eyes	native	7	5	perennial	forb
<i>Adiantum pedatum</i>	maidenhair fern	native	6	3	perennial	fern
<i>Alnus incana; a. rugosa</i>	speckled alder	native	5	-3	perennial	shrub
<i>Amelanchier bartramiana</i>	northern juneberry	native	8	0	perennial	shrub
<i>Andromeda glaucophylla</i>	bog-rosemary	native	10	-5	perennial	shrub
<i>Apocynum cannabinum; A. sibiricum</i>	Indian-hemp	native	3	0	perennial	forb
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	forb
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	native	5	0	perennial	forb
<i>Asclepias incarnata</i>	swamp milkweed	native	6	-5	perennial	forb
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Betula papyrifera</i>	paper birch	native	2	3	perennial	tree
<i>Bidens frondosa</i>	common beggar-ticks	native	1	-3	annual	forb
<i>Boehmeria cylindrica</i>	false nettle	native	5	-5	perennial	forb
<i>Brachyelytrum aristosum; B. erectum</i>	northern shorthusk	native	7	5	perennial	grass
<i>Brasenia schreberi</i>	water-shield	native	6	-5	perennial	forb
<i>Bromus ciliatus</i>	fringed brome	native	6	-3	perennial	grass
<i>Calamagrostis canadensis</i>	blue-joint	native	3	-5	perennial	grass
<i>Calopogon tuberosus</i>	grass-pink	native	9	-5	perennial	forb
<i>Caltha palustris</i>	marsh-marigold	native	6	-5	perennial	forb
<i>Campanula aparinoides</i>	marsh bellflower	native	7	-5	perennial	forb

<i>Carex aurea</i>	sedge	native	3	-3	perennial	sedge
<i>Carex bebbii</i>	sedge	native	4	-5	perennial	sedge
<i>Carex diandra</i>	sedge	native	8	-5	perennial	sedge
<i>Carex disperma</i>	sedge	native	10	-5	perennial	sedge
<i>Carex flava</i>	sedge	native	4	-5	perennial	sedge
<i>Carex hystericina</i>	sedge	native	2	-5	perennial	sedge
<i>Carex interior</i>	sedge	native	3	-5	perennial	sedge
<i>Carex intumescens</i>	sedge	native	3	-3	perennial	sedge
<i>Carex lasiocarpa</i>	sedge	native	8	-5	perennial	sedge
<i>Carex leptalea</i>	sedge	native	5	-5	perennial	sedge
<i>Carex pellita</i> ; <i>C. lanuginosa</i>	sedge	native	2	-5	perennial	sedge
<i>Carex pseudo-cyperus</i>	sedge	native	5	-5	perennial	sedge
<i>Carex scabrata</i>	sedge	native	4	-5	perennial	sedge
<i>Carex stipata</i>	sedge	native	1	-5	perennial	sedge
<i>Carex trisperma</i>	sedge	native	9	-5	perennial	sedge
<i>Carex vulpinoidea</i>	sedge	native	1	-5	perennial	sedge
<i>Chrysosplenium americanum</i>	golden saxifrage	native	6	-5	perennial	forb
<i>Cicuta bulbifera</i>	water hemlock	native	5	-5	perennial	forb
<i>Cinna latifolia</i>	wood reedgrass	native	5	-3	perennial	grass
<i>Circaea alpina</i>	small enchanters-nightshade	native	4	-3	perennial	forb
<i>Cirsium muticum</i>	swamp thistle	native	6	-5	biennial	forb
<i>Cirsium palustre</i>	marsh thistle	non-native	0	-3	biennial	forb
<i>Cladium mariscoides</i>	twig-rush	native	10	-5	perennial	sedge
<i>Clematis virginiana</i>	virgins bower	native	4	0	perennial	vine
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	native	5	0	perennial	forb
<i>Cornus sericea</i> ; <i>C. stolonifera</i>	red-osier	native	2	-3	perennial	shrub
<i>Cypripedium parviflorum</i> ; <i>C. calceolus</i>	yellow lady-slipper showy or queens lady-slipper	native	5	0	perennial	forb
<i>Cypripedium reginae</i>	slipper	native	9	-3	perennial	forb
<i>Dactylis glomerata</i>	orchard grass	non-native	0	3	perennial	grass
<i>Dichanthelium lindheimeri</i> ; <i>Panicum l.</i>	panic grass	native	8	-5	perennial	grass
<i>Drosera rotundifolia</i>	round-leaved sundew	native	6	-5	perennial	forb
<i>Dryopteris carthusiana</i>	spinulose woodfern	native	5	-3	perennial	fern
<i>Dryopteris clintoniana</i>	Clintons woodfern	native	8	-3	perennial	fern
<i>Dryopteris intermedia</i>	evergreen woodfern	native	5	0	perennial	fern
<i>Eleocharis intermedia</i>	spike-rush	native	7	-5	annual	sedge
<i>Eleocharis quinqueflora</i> ; <i>E. pauciflora</i>	spike-rush	native	10	-5	perennial	sedge
<i>Elymus trachycaulus</i> ; <i>agropyron t.</i>	slender wheatgrass	native	8	3	perennial	grass
<i>Epigaea repens</i>	trailing-arbutus	native	7	3	perennial	shrub

<i>Epilobium ciliatum</i>	willow-herb	native	3	-3	perennial	forb
<i>Epilobium strictum</i>	downy willow-herb	native	8	-5	perennial	forb
<i>Equisetum arvense</i>	common horsetail	native	0	0	perennial	fern
<i>Equisetum palustre</i>	marsh horsetail	native	8	-3	perennial	fern
<i>Equisetum scirpoides</i>	dwarf scouring rush	native	7	0	perennial	fern
<i>Eriophorum tenellum</i>	cotton-grass	native	10	-5	perennial	sedge
<i>Eriophorum vaginatum</i> ; <i>E. spissum</i>	cotton-grass	native	10	-5	perennial	sedge
<i>Eupatorium perfoliatum</i>	boneset	native	4	-3	perennial	forb
<i>Eutrochium maculatum</i> ; <i>eupatorium m.</i>	Joe-pye-weed	native	4	-5	perennial	forb
<i>Fragaria vesca</i>	woodland strawberry	native	2	3	perennial	forb
<i>Fraxinus nigra</i>	black ash	native	6	-3	perennial	tree
<i>Fraxinus pennsylvanica</i>	red ash	native	2	-3	perennial	tree
<i>Galium boreale</i>	northern bedstraw	native	3	0	perennial	forb
<i>Gaultheria hispidula</i>	creeping-snowberry	native	8	-3	perennial	shrub
<i>Gaultheria procumbens</i>	wintergreen	native	5	3	perennial	shrub
<i>Geranium robertianum</i>	herb robert	native	3	3	annual	forb
<i>Glyceria grandis</i>	reed manna grass	native	6	-5	perennial	grass
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Gymnocarpium dryopteris</i>	oak fern	native	5	3	perennial	fern
<i>Hieracium murorum</i>	hawkweed	non-native	0	5	perennial	forb
<i>Hieracium piloselloides</i>	king devil	non-native	0	5	perennial	forb
<i>Ilex verticillata</i>	Michigan holly	native	5	-3	perennial	shrub
<i>Iris versicolor</i>	wild blue flag	native	5	-5	perennial	forb
<i>Juncus articulatus</i>	jointed rush	native	3	-5	perennial	forb
<i>Juncus effusus</i>	soft-stemmed rush	native	3	-5	perennial	forb
<i>Larix laricina</i>	tamarack	native	5	-3	perennial	tree
<i>Lonicera hirsuta</i>	hairy honeysuckle	native	6	0	perennial	vine
<i>Lycopus uniflorus</i>	northern bugle weed	native	2	-5	perennial	forb
<i>Lysimachia thyrsoiflora</i>	tufted loosestrife	native	6	-5	perennial	forb
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Maianthemum stellatum</i> ; <i>Smilacina s.</i>	starry false solomon-seal	native	5	0	perennial	forb
<i>Mentha canadensis</i> ; <i>M. arvensis</i>	wild mint	native	3	-3	perennial	forb
<i>Menyanthes trifoliata</i>	buckbean	native	8	-5	perennial	forb
<i>Mitella diphylla</i>	bishops-cap	native	8	3	perennial	forb
<i>Muhlenbergia glomerata</i>	marsh wild-timothy	native	10	-5	perennial	grass
<i>Myosotis laxa</i>	small forget-me-not	native	6	-5	perennial	forb
<i>Myrica gale</i>	sweet gale	native	6	-5	perennial	shrub
<i>Myriophyllum heterophyllum</i>	various-leaved water-milfoil	native	6	-5	perennial	forb
<i>Nasturtium microphyllum</i> ; <i>N. officinale</i>	watercress	non-native	0	-5	perennial	forb

<i>Nuphar variegata</i>	yellow pond-lily	native	7	-5	perennial	forb
<i>Nymphaea odorata</i>	sweet-scented waterlily	native	6	-5	perennial	forb
<i>Onoclea sensibilis</i>	sensitive fern	native	2	-3	perennial	fern
<i>Osmunda regalis</i>	royal fern	native	5	-5	perennial	fern
<i>Parnassia palustris</i>	marsh grass-of-Parnassus	native	10	-5	perennial	forb
<i>Peltandra virginica</i>	arrow-arum	native	6	-5	perennial	forb
<i>Phalaris arundinacea</i>	reed canary grass	native	0	-3	perennial	grass
<i>Phragmites australis</i> var. <i>americanus</i>	reed	native	5	-3	perennial	grass
<i>Picea mariana</i>	black spruce	native	6	-3	perennial	tree
<i>Pinus strobus</i>	white pine	native	3	3	perennial	tree
<i>Platanthera psycodes</i> ; <i>habenaria p.</i>	purple fringed orchid	native	7	-3	perennial	forb
<i>Poa palustris</i>	fowl meadow grass	native	3	-3	perennial	grass
<i>Populus balsamifera</i>	balsam poplar	native	2	-3	perennial	tree
<i>Potamogeton epihydrus</i>	ribbon-leaved pondweed	native	8	-5	perennial	forb
<i>Prunella vulgaris</i>	self-heal	native	0	0	perennial	forb
<i>Ranunculus hispidus</i>	swamp buttercup	native	5	0	perennial	forb
<i>Rhamnus alnifolia</i>	alder-leaved buckthorn	native	8	-5	perennial	shrub
<i>Rhododendron</i> <i>groenlandicum</i> ; <i>Ledum g.</i>	Labrador-tea	native	8	-5	perennial	shrub
<i>Rhynchospora alba</i>	beak-rush	native	6	-5	perennial	sedge
<i>Ribes hudsonianum</i>	northern black currant	native	10	-5	perennial	shrub
<i>Ribes triste</i>	swamp red currant	native	6	-5	perennial	shrub
<i>Rosa acicularis</i>	wild rose	native	4	3	perennial	shrub
<i>Rubus hispidus</i>	swamp dewberry	native	4	-3	perennial	shrub
<i>Sagittaria latifolia</i>	common arrowhead	native	4	-5	perennial	forb
<i>Salix candida</i>	hoary willow	native	9	-5	perennial	shrub
<i>Sarracenia purpurea</i>	pitcher-plant	native	10	-5	perennial	forb
<i>Schoenoplectus acutus</i> ; <i>Scirpus a.</i>	hardstem bulrush	native	5	-5	perennial	sedge
<i>Scirpus atrocinctus</i> ; <i>S.</i> <i>cyperinus</i>	wool-grass	native	5	-5	perennial	sedge
<i>Scutellaria galericulata</i>	marsh skullcap	native	5	-5	perennial	forb
<i>Scutellaria lateriflora</i>	mad-dog skullcap	native	5	-5	perennial	forb
<i>Solanum dulcamara</i>	bittersweet nightshade	non-native	0	0	perennial	vine
<i>Solidago patula</i>	swamp goldenrod	native	6	-5	perennial	forb
<i>Solidago rugosa</i>	rough-leaved goldenrod	native	3	0	perennial	forb
<i>Solidago uliginosa</i>	bog goldenrod	native	4	-5	perennial	forb
<i>Sorbus americana</i>	American mountain-ash	native	4	0	perennial	tree
<i>Sparganium emersum</i> ; <i>S.</i> <i>chlorocarpum</i>	green-fruited bur-reed	native	6	-5	perennial	forb
<i>Sphenopholis intermedia</i>	slender wedgegrass	native	4	0	perennial	grass
<i>Stellaria borealis</i> ; <i>S.</i> <i>calycantha</i>	northern stitchwort	native	10	-3	perennial	forb

<i>Symphyotrichum novae-angliae</i> ; <i>Aster n.</i>	New England aster	native	3	-3	perennial	forb
<i>Thelypteris palustris</i>	marsh fern	native	2	-3	perennial	fern
<i>Thuja occidentalis</i>	arbor vitae	native	4	-3	perennial	tree
<i>Trientalis borealis</i>	star-flower	native	5	0	perennial	forb
<i>Tsuga canadensis</i>	hemlock	native	5	3	perennial	tree
<i>Typha angustifolia</i>	narrow-leaved cat-tail	non-native	0	-5	perennial	forb
<i>Typha latifolia</i>	broad-leaved cat-tail	native	1	-5	perennial	forb
<i>Utricularia cornuta</i>	horned bladderwort	native	10	-5	perennial	forb
<i>Vaccinium myrtilloides</i>	Canada blueberry	native	4	-3	perennial	shrub
<i>Valeriana uliginosa</i>	swamp valerian	native	10	-5	perennial	forb



Yellow lady-slipper. Photo by Phyllis J. Higman.

Cedar Valley Rich Conifer Swamp



Photo by Jesse M. Lincoln.

Site Summary

This summary is the result of surveying the forested swamp within the Cedar Valley Preserve which is in the southwest portion of a vast wetland complex. More broadly, this large forested wetland complex occurs at the southern portion of Walloon Lake and this local portion drains via an unnamed creek into Walloon Lake. Schoof's Creek appears to be the only bigger watershed draining into Walloon Lake. The complex extends to the east to merge with the Hay Marsh Creek and the Bear River drainages which empties into Petoskey Harbor.

Large stumps within the swamp indicate this area was historically logged in the late

1800s. The system is currently driven by natural processes that typify this type of system, including beaver flooding, continuously saturated soils, and windthrow. Recent but localized logging, minimal stream channelization, and agricultural runoff have all altered the system but it seems to have retained a structure and flora representative of historic conditions. Catastrophic tree disease and outbreak of non-native insects have also dramatically altered the composition, structure, and trajectory of this system and forests in the region.

A road to the east and powerline maintenance seems to have increased water levels

and mimicked beaver flooding and converted large areas of this previously forested wetland to open wet meadow with minimal occurrence of invasive species typical of such disturbance. This increased water level is leading to tree mortality and a gradual decrease in canopy coverage along the northern portion of the preserve.

Soils are saturated, poorly-drained, deep organic mucks with a basic pH. The high density of the canopy and sub-canopy as well as the stunted nature of the trees seem to be preventing the structural variability

that typically drives structural and species diversity within this system. Systems like this typically have more coarse woody debris and abundant microheterogeneity from tip-ups and windthrow.

This is an important wetland complex for the Walloon Lake watershed as this system provides enormous benefit by filtering, metabolizing, and sequestering pollutants from adjacent agricultural operations; thereby protecting local fisheries and recreational opportunities for the residents of Walloon Lake.

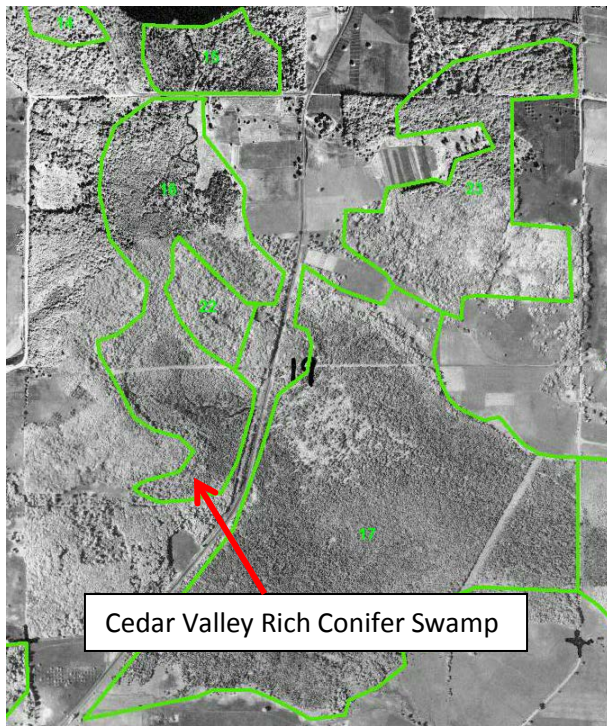


Figure 5. Cedar Valley 1938 imagery.



Figure 6. Cedar Valley 2012 imagery.

Vegetation

Total species, 62; Native 58. Total FQI 33.1; Native FQI 34.3.

This relatively young forest has a canopy dominated by small, coniferous trees that blends into the subcanopy. The effect is a dense stand consisting primarily of cedar (up to 80% in some places), tamarack, white pine, black spruce, green ash, and yellow birch. Tree diameters are typically 10 to 15" with large trees (> 24" and up to 31")

occurring at the margins of the southern lobe. Balsam fir is locally dominant in the sub-canopy/understory. Additional species include spruce, cedar, hemlock, birch, and ash with some red maple.

Shrubs include swamp dewberry, service berry, blueberry, bear berry, Labrador tea, and bunch berry. The herb layer is relatively

sparse as a result of the dense canopy and lack of structural diversity typically associated with older stands. Components of the herb layer include wood fern, golden-rods, sensitive fern, common horsetail, many sedges, star flower, gold thread, violets, bishop's cap, false manna grass, and enchanter's night shade.

Hydrology was likely altered as a result of the road to the east, causing water levels to rise. Additionally, a large set of powerlines are leading to maintenance that requires tree removal. The combined effect is a conversion to wet meadow, mimicking a beaver flooding. The wet meadow extends into the northern margins of this swamp and is described separately.

Threats

Invasive species, high deer densities, altered hydrology are the primary threats to the system. European thistle occurs throughout, but is never dominant. Reed canary grass and narrow leaf cat-tail are somewhat

prevalent along the natural gas line in the eastern portion of this swamp. See page 17 for further discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance

▪ *Forest of Regional Significance*

The small area of the Cedar Valley Preserve does not qualify as high-quality rich conifer swamp EO. The entire complex extends to include several thousand acres to the north and east and large portions may indeed be high-quality and worthy of inclusion to the database. This area was significantly altered by historic logging, road construction, powerline maintenance, con-

struction of a natural gas line, and disease outbreak. Locally, the system is relatively young and lacking structural complexity typical of older systems. Despite these aspects, the system is of regional significance because of its importance for protecting water quality of Walloon Lake. It is also an important system for wildlife and migrating birds.



Diseased trees and woody debris. Photo by Jesse M. Lincoln.

Cedar Valley Rich Conifer Swamp

Conservatism-Based Metrics:	
Total Mean C:	4.2
Native Mean C:	4.5
Total FQI:	33.1
Native FQI:	34.3
Adjusted FQI:	43.5
% C value 0:	12.9
% C value 1-3:	19.4
% C value 4-6:	50
% C value 7-10:	17.7
Native Tree Mean C:	3.9
Native Shrub Mean C:	6.3
Native Herbaceous Mean C:	4.4

Species Richness:	
Total Species:	62
Native Species:	58 93.5%
Non-native Species:	4 6.5%

Species Wetness:	
Mean Wetness:	-1
Native Mean Wetness:	-1.2

Duration Metrics:		
Annual:	0	0%
Perennial:	61	98.4%
Biennial:	1	1.6%
Native Annual:	0	0%
Native Perennial:	58	93.5%
Native Biennial:	0	0%

Physiognomy Metrics:		
Tree:	15	24.2%
Shrub:	6	9.7%
Vine:	0	0.0%
Forb:	23	37.1%
Grass:	7	11.3%
Sedge:	5	8.1%
Rush:	0	0.0%
Fern:	6	9.7%
Bryophyte:	0	0%

Documented Species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Abies balsamea</i>	balsam fir	native	3	0	perennial	tree
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Acer saccharum</i>	sugar maple	native	5	3	perennial	tree
<i>Agrostis scabra; a. hyemalis</i>	ticklegass	native	4	0	perennial	grass
<i>Amelanchier bartramiana</i>	northern juneberry	native	8	0	perennial	shrub
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	forb
<i>Arctostaphylos uva-ursi</i>	bearberry	native	8	5	perennial	shrub
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	native	5	0	perennial	forb
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Betula papyrifera</i>	paper birch	native	2	3	perennial	tree
<i>Brachyelytrum aristosum; B. erectum</i>	northern shorthusk	native	7	5	perennial	grass
<i>Carex gracillima</i>	sedge	native	4	3	perennial	sedge
<i>Carex intumescens</i>	sedge	native	3	-3	perennial	sedge
<i>Carex laxiflora</i>	sedge	native	8	0	perennial	sedge
<i>Carex stricta</i>	sedge	native	4	-5	perennial	sedge
<i>Cicuta bulbifera</i>	water hemlock	native	5	-5	perennial	forb
<i>Cinna latifolia</i>	wood reedgrass	native	5	-3	perennial	grass
<i>Circaea alpine</i>	small enchanters-nightshade	native	4	-3	perennial	forb
<i>Cirsium palustre</i>	marsh thistle	non-native	0	-3	biennial	forb
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	native	5	0	perennial	forb
<i>Coptis trifolia</i>	goldthread	native	5	-3	perennial	forb

<i>Cornus canadensis</i>	bunchberry	native	6	0	perennial	shrub
<i>Cypripedium acaule</i>	pink lady-slipper; moccasin flower	native	5	-3	perennial	forb
<i>Dryopteris carthusiana</i>	spinulose woodfern	native	5	-3	perennial	fern
<i>Elaeagnus angustifolia</i>	Russian-olive	non-native	0	3	perennial	tree
<i>Epipactis helleborine</i>	helleborine	non-native	0	0	perennial	forb
<i>Equisetum arvense</i>	common horsetail	native	0	0	perennial	fern
<i>Fraxinus nigra</i>	black ash	native	6	-3	perennial	tree
<i>Fraxinus pennsylvanica</i>	red ash	native	2	-3	perennial	tree
<i>Galium labradoricum</i>	bog bedstraw	native	8	-5	perennial	forb
<i>Geum rivale</i>	purple avens	native	7	-5	perennial	forb
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Gymnocarpium dryopteris</i>	oak fern	native	5	3	perennial	fern
<i>Hieracium aurantiacum</i>	orange hawkweed	non-native	0	5	perennial	forb
<i>Iris virginica</i>	southern blue flag	native	5	-5	perennial	forb
<i>Larix laricina</i>	tamarack	native	5	-3	perennial	tree
<i>Lycopodiella inundata</i>	bog clubmoss	native	7	-5	perennial	fern
<i>Lycopus uniflorus</i>	northern bugle weed	native	2	-5	perennial	forb
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Mentha canadensis; M. arvensis</i>	wild mint	native	3	-3	perennial	forb
<i>Mitella diphylla</i>	bishops-cap	native	8	3	perennial	forb
<i>Onoclea sensibilis</i>	sensitive fern	native	2	-3	perennial	fern
<i>Osmunda regalis</i>	royal fern	native	5	-5	perennial	fern
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	native	5	3	perennial	tree
<i>Phalaris arundinacea</i>	reed canary grass	native	0	-3	perennial	grass
<i>Picea mariana</i>	black spruce	native	6	-3	perennial	tree
<i>Pinus strobus</i>	white pine	native	3	3	perennial	tree
<i>Piptatherum racemosum; Oryzopsis r.</i>	rice-grass	native	8	5	perennial	grass
<i>Populus tremuloides</i>	quaking aspen	native	1	0	perennial	tree
<i>Prunella vulgaris</i>	self-heal	native	0	0	perennial	forb
<i>Ranunculus abortivus</i>	small-flowered buttercup	native	0	0	perennial	forb
<i>Rhododendron groenlandicum; Ledum g.</i>	Labrador-tea	native	8	-5	perennial	shrub
<i>Rubus hispidus</i>	swamp dewberry	native	4	-3	perennial	shrub
<i>Scirpus atrovirens</i>	bulrush	native	3	-5	perennial	sedge
<i>Scutellaria galericulata</i>	marsh skullcap	native	5	-5	perennial	forb
<i>Solidago rugosa</i>	rough-leaved goldenrod	native	3	0	perennial	forb
<i>Sphenopholis intermedia</i>	slender wedgegrass	native	4	0	perennial	grass
<i>Thuja occidentalis</i>	arbor vitae	native	4	-3	perennial	tree
<i>Trientalis borealis</i>	star-flower	native	5	0	perennial	forb

<i>Tsuga Canadensis</i>	hemlock	native	5	3	perennial	tree
<i>Typha angustifolia</i>	narrow-leaved cat-tail	non-native	0	-5	perennial	forb
<i>Vaccinium myrtilloides</i>	Canada blueberry	native	4	-3	perennial	shrub
<i>Viola cucullata</i>	marsh violet	native	5	-5	perennial	forb



Jack-in-the-pulpit emerging. Photo by Phyllis J. Higman.

Frog Hollow Rich Conifer Swamp



Photo by Phyllis J. Higman

Site Summary

Surveys were conducted in the forested component of the survey site between M-75 and old state road and from the northern forest border to the southern extent of designated property boundaries. Due to time constraints, the wet meadow at the northeast corner was not thoroughly inventoried. This site is an eastward extension of the wetland complex at the southeast end of Walloon Lake, including the Cedar Valley swamp and northern wet meadow. M-75 crosses directly between these two portions of the complex and two utility corridors run through the site. An extensive swamp extends eastward from the site, ultimately merging with the Hay Marsh Creek and

Bear River drainages that empty into Petoskey Harbor.

Natural processes currently drive the system, including continually saturated soils, windthrow and beaver flooding. Although certainly impacted by agricultural run-off from the surrounding fields, the site retains much of the historical flora. Tree disease has resulted in catastrophic die off of ash and elm, altering the overall composition, structure and trajectory of this system. Die-off of trees and conversion to wet meadow is occurring along the northern portion of the site, due to raised water levels from road and powerline maintenance. Soils are saturated, poorly-drained deep organic muck.

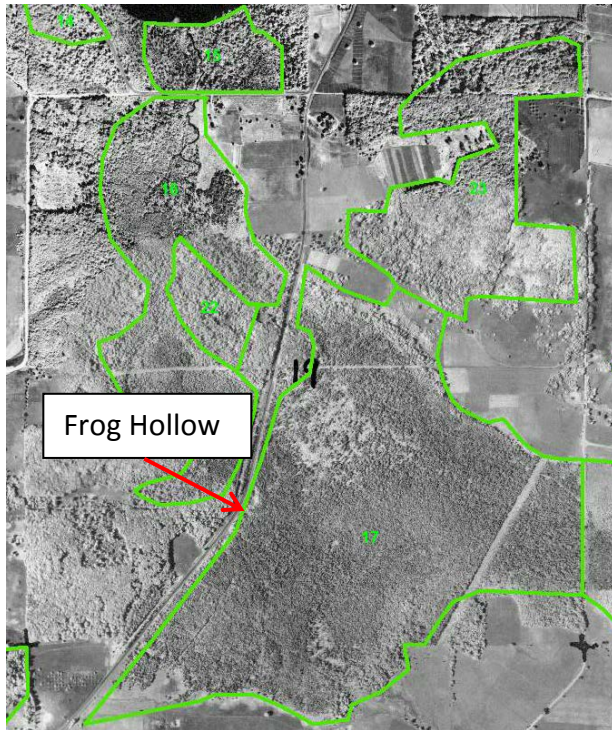


Figure 7. Frog Hollow 1938 imagery.



Figure 8. Frog Hollow 2012 imagery.

Vegetation

Total species 164; Native 146. Total FQI 51.4; Native FQI 54.4

This system is characterized by a sparse supercanopy of 18-24" diameter white pine with a sparse to dense canopy of primarily black spruce and tamarack and occasional white cedar, red maple and white birch, and rarely yellow birch. Spruce and tamarack are occasionally up to 10-14" diameter, but mostly smaller. The understory is similarly sparse to dense with the same species as the canopy and pockets of young black ash. Shrubs include willows, gooseberry, speckled alder, alder-leaved buckthorn, Labrador tea and occasional buffalo berry.

The ground layer is highly diverse, varying with microtopography, light gaps, and hydrology within the site. There are rivulets and open water pockets with abundant wetland sedges, rushes, grasses, forbs and ferns, including *Carex comosa*, *Carex interior*, *Carex leptalea*, *Juncus effusus*, fowl manna grass sensitive fern, royal fern, cinnamon fern, crested shield fern, turtle

head, purple avens and willow-herbs. Perched on the higher mounds are species typical of dry-mesic northern forest such as wild sarsaparilla, twin flower, gay wings, bunch berry, goldthread, soapberry and partridge berry. Sphagnum is only locally dominant at the site.

The swamp merges into wet meadow northward, dominated by *Carex stricta*, Labrador tea and velvet-leaf blueberry, and eventually becomes a near-monoculture of cat-tails. There are some small scattered herbs such as marsh bellflower, water hemlock and touch-me-not in the cat-tail zone.

Weedy forget-me-not and water cress are locally abundant in some of the rivulets. European marsh thistle is scattered throughout but does not dominate. Bittersweet nightshade was observed occasionally as well as reed canary grass, and only rarely Japanese barberry and autumn olive.

Threats

Invasive species, high deer densities, and altered hydrology are the primary threats to the system. Reed canary grass and narrow leaved cat-tail are locally dominant along M-75 and patchily distributed in the utility corridors. European marsh thistle occurs

sparsely throughout, but is not dominant. High deer densities are impacting cedar regeneration, and it seems underrepresented currently. See page 17 for further discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance

- *Forest of Regional Significance*
- *C-ranked rich conifer swamp EO*

Alterations to the hydrology from road construction and clearing under utility lines are the primary anthropogenic disturbances to the system. Stream channelization has been minimal. Impacts are greatest adjacent to M-75, but the interior appears to be buffered, retaining much of the flora characteristic of historic cedar swamps, with the exception of elm and ash. It is mostly driven by natural processes, including beaver flooding and windthrow that typify this natural community type.

Invasive plants are locally dominant in the wet meadow and patchy in the cleared utility line, but they are sparse to absent elsewhere.

This is an important wetland complex for the Walloon Lake region, because of its role in protecting water quality and providing habitat. It is connected to the Cedar Valley rich conifer swamp to the south and the large wetland extending eastward. It qualifies as a C-ranked EO and it could expand with additional surveys.



A rise in Frog Hollow rich Conifer Swamp. Photo by Phyllis J. Higman.

Frog Hollow Rich Conifer Swamp FQA

Conservatism-Based Metrics:	
Total Mean C:	4
Native Mean C:	4.5
Total FQI:	51.4
Native FQI:	54.4
Adjusted FQI:	42.3
% C value 0:	13.9
% C value 1-3:	26.7
% C value 4-6:	45.5
% C value 7-10:	13.9
Native Tree Mean C:	3.9
Native Shrub Mean C:	4.5
Native Herbaceous Mean C:	4.6

Species Richness:		
Total Species:	165	
Native Species:	146	88.5%
Non-native Species:	19	11.5%

Species Wetness:	
Mean Wetness:	-1.7
Native Mean Wetness:	-2.1

Duration Metrics:		
Annual:	4	2.4%
Perennial:	156	94.5%
Biennial:	5	3.0%
Native Annual:	4	2.4%
Native Perennial:	141	85.5%
Native Biennial:	1	0.6%

Physiognomy Metrics:		
Tree:	21	12.7%
Shrub:	25	15.2%
Vine:	3	1.8%
Forb:	71	43.0%
Grass:	11	6.7%
Sedge:	16	9.7%
Rush:	0	0.0%
Fern:	18	10.9%
Bryophyte:	0	0.0%

Documented Species

<i>Scientific Name</i>	Common Name	Native?	C	W	Duration	Physiognomy
<i>Abies balsamea</i>	balsam fir	native	3	0	perennial	tree
<i>Acer pensylvanicum</i>	striped maple	native	5	3	perennial	tree
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Acer saccharum</i>	sugar maple	native	5	3	perennial	tree
<i>Agrostis gigantea</i>	redtop	non-native	0	-3	perennial	grass
<i>Alnus incana; A. rugosa</i>	speckled alder	native	5	-3	perennial	shrub
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	forb
<i>Asclepias incarnata</i>	swamp milkweed	native	6	-5	perennial	forb
<i>Berberis thunbergii</i>	Japanese barberry	non-native	0	3	perennial	shrub
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Betula papyrifera</i>	paper birch	native	2	3	perennial	tree
<i>Bidens cernua</i>	nodding beggar-ticks	native	3	-5	annual	forb
<i>Bidens frondosa</i>	common beggar-ticks	native	1	-3	annual	forb
<i>Brachyelytrum erectum</i>	long-awned wood grass	native	7	5	perennial	grass
<i>Bromus ciliatus</i>	fringed brome	native	6	-3	perennial	grass
<i>Calamagrostis canadensis</i>	blue-joint	native	3	-5	perennial	grass
<i>Caltha palustris</i>	marsh-marigold	native	6	-5	perennial	forb
<i>Campanula aparinoides</i>	marsh bellflower	native	7	-5	perennial	forb
<i>Carex comosa</i>	sedge	native	5	-5	perennial	sedge
<i>Carex disperma</i>	sedge	native	10	-5	perennial	sedge
<i>Carex hystericina</i>	sedge	native	2	-5	perennial	sedge
<i>Carex interior</i>	sedge	native	3	-5	perennial	sedge
<i>Carex lasiocarpa</i>	sedge	native	8	-5	perennial	sedge
<i>Carex leptalea</i>	sedge	native	5	-5	perennial	sedge

<i>Carex pedunculata</i>	sedge	native	5	3	perennial	sedge
<i>Carex pseudo-cyperus</i>	sedge	native	5	-5	perennial	sedge
<i>Carex retrorsa</i>	sedge	native	3	-5	perennial	sedge
<i>Carex scabrata</i>	sedge	native	4	-5	perennial	sedge
<i>Carex stipata</i>	sedge	native	1	-5	perennial	sedge
<i>Carex stricta</i>	sedge	native	4	-5	perennial	sedge
<i>Centaurea stoebe</i> ; <i>C. maculosa</i>	spotted knapweed	non-native	0	5	biennial	forb
<i>Chelone glabra</i>	turtlehead	native	7	-5	perennial	forb
<i>Chimaphila umbellata</i>	pipsissewa	native	8	5	perennial	shrub
<i>Chrysosplenium americanum</i>	golden saxifrage	native	6	-5	perennial	forb
<i>Cicuta bulbifera</i>	water hemlock	native	5	-5	perennial	forb
<i>Cinna latifolia</i>	wood reedgrass	native	5	-3	perennial	grass
<i>Circaea canadensis</i> ; <i>C. lutetiana</i>	enchanters-nightshade	native	2	3	perennial	forb
<i>Cirsium muticum</i>	swamp thistle	native	6	-5	biennial	forb
<i>Cirsium palustre</i>	marsh thistle	non-native	0	-3	biennial	forb
<i>Clematis virginiana</i>	virgins bower	native	4	0	perennial	vine
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	native	5	0	perennial	forb
<i>Coptis trifolia</i>	goldthread	native	5	-3	perennial	forb
<i>Cornus alternifolia</i>	alternate-leaved dogwood	native	5	3	perennial	tree
<i>Cornus canadensis</i>	bunchberry	native	6	0	perennial	shrub
<i>Cornus sericea</i> ; <i>C. stolonifera</i>	red-osier	native	2	-3	perennial	shrub
<i>Cypripedium parviflorum</i> ; <i>C. calceolus</i>	yellow lady-slipper showy or queens lady-slipper	native	5	0	perennial	forb
<i>Cypripedium reginae</i>	slipper	native	9	-3	perennial	forb
<i>Dactylis glomerata</i>	orchard grass	non-native	0	3	perennial	grass
<i>Daucus carota</i>	Queen-Anne's-lace	non-native	0	5	biennial	forb
<i>Diphasiastrum complanatum</i> ; <i>Lycopodium c.</i>	ground-cedar	native	5	3	perennial	fern
<i>Dryopteris carthusiana</i>	spinulose woodfern	native	5	-3	perennial	fern
<i>Dryopteris clintoniana</i>	Clintons woodfern	native	8	-3	perennial	fern
<i>Dryopteris cristata</i>	crested shield fern	native	6	-5	perennial	fern
<i>Elaeagnus umbellata</i>	autumn-olive	non-native	0	3	perennial	shrub
<i>Eleocharis erythropoda</i>	spike-rush	native	4	-5	perennial	sedge
<i>Epigaea repens</i>	trailing-arbutus	native	7	3	perennial	shrub
<i>Epilobium ciliatum</i>	willow-herb	native	3	-3	perennial	forb
<i>Epilobium parviflorum</i>	willow-herb	non-native	0	-5	perennial	forb
<i>Epilobium strictum</i>	downy willow-herb	native	8	-5	perennial	forb
<i>Epipactis helleborine</i>	helleborine	non-native	0	0	perennial	forb
<i>Equisetum arvense</i>	common horsetail	native	0	0	perennial	fern
<i>Equisetum fluviatile</i>	water horsetail	native	7	-5	perennial	fern
<i>Equisetum pratense</i>	meadow horsetail	native	10	-3	perennial	fern

<i>Equisetum sylvaticum</i>	woodland horsetail	native	5	-3	perennial	fern
<i>Eupatorium perfoliatum</i>	boneset	native	4	-3	perennial	forb
<i>Euphorbia virgata; e. esula</i>	leafy spurge	non-native	0	5	perennial	forb
<i>Eutrochium maculatum;</i> <i>Eupatorium m.</i>	Joe-pye-weed	native	4	-5	perennial	forb
<i>Fragaria virginiana</i>	wild strawberry	native	2	3	perennial	forb
<i>Fraxinus nigra</i>	black ash	native	6	-3	perennial	tree
<i>Fraxinus pennsylvanica</i>	red ash	native	2	-3	perennial	tree
<i>Galium labradoricum</i>	bog bedstraw	native	8	-5	perennial	forb
<i>Galium tinctorium</i>	stiff bedstraw	native	5	-5	perennial	forb
<i>Gaultheria hispidula</i>	creeping-snowberry	native	8	-3	perennial	shrub
<i>Geum rivale</i>	purple avens	native	7	-5	perennial	forb
<i>Glyceria grandis</i>	reed manna grass	native	6	-5	perennial	grass
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Gymnocarpium dryopteris</i>	oak fern	native	5	3	perennial	fern
<i>Hieracium piloselloides</i>	king devil	non-native	0	5	perennial	forb
<i>Huperzia lucidula</i>	shining clubmoss	native	5	0	perennial	fern
<i>Ilex verticillata</i>	Michigan holly	native	5	-3	perennial	shrub
<i>Impatiens capensis</i>	spotted touch-me-not	native	2	-3	annual	forb
<i>Iris versicolor</i>	wild blue flag	native	5	-5	perennial	forb
<i>Juncus effusus</i>	soft-stemmed rush	native	3	-5	perennial	forb
<i>Juncus nodosus</i>	joint rush	native	5	-5	perennial	forb
<i>Larix laricina</i>	tamarack	native	5	-3	perennial	tree
<i>Leersia oryzoides</i>	cut grass	native	3	-5	perennial	grass
<i>Linnaea borealis</i>	twinline	native	6	0	perennial	forb
<i>Lonicera dioica</i>	red honeysuckle	native	5	3	perennial	vine
<i>Lonicera tatarica</i>	tartarian honeysuckle	non-native	0	3	perennial	shrub
<i>Lycopus americanus</i>	common water horehound	native	2	-5	perennial	forb
<i>Lycopus uniflorus</i>	northern bugle weed	native	2	-5	perennial	forb
<i>Lysimachia thyrsiflora</i>	tufted loosestrife	native	6	-5	perennial	forb
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Maianthemum trifolium;</i> <i>Smilacina t.</i>	false mayflower	native	10	-5	perennial	forb
<i>Melilotus albus</i>	white sweet-clover	non-native	0	3	biennial	forb
<i>Mentha canadensis; M.</i> <i>arvensis</i>	wild mint	native	3	-3	perennial	forb
<i>Mitchella repens</i>	partridge-berry	native	5	3	perennial	forb
<i>Mitella nuda</i>	naked miterwort	native	8	-3	perennial	forb
<i>Myrica gale</i>	sweet gale	native	6	-5	perennial	shrub
<i>Nasturtium officinale</i>	watercress	native	4	-5	perennial	forb
<i>Onoclea sensibilis</i>	sensitive fern	native	2	-3	perennial	fern
<i>Orthilia secunda</i>	one-sided pyrola	native	7	0	perennial	forb
<i>Osmunda cinnamomea</i>	cinnamon fern	native	5	-3	perennial	fern
<i>Osmunda claytoniana</i>	interrupted fern	native	6	0	perennial	fern
<i>Osmunda regalis</i>	royal fern	native	5	-5	perennial	fern

<i>Persicaria amphibia</i> ;							
<i>Polygonum a.</i>	water smartweed	native	6	-5	perennial	forb	
<i>Phalaris arundinacea</i>	reed canary grass	native	0	-3	perennial	grass	
<i>Picea glauca</i>	white spruce	native	3	3	perennial	tree	
<i>Picea mariana</i>	black spruce	native	6	-3	perennial	tree	
<i>Pilea pumila</i>	clearweed	native	5	-3	annual	forb	
<i>Pinus resinosa</i>	red pine	native	6	3	perennial	tree	
<i>Pinus strobus</i>	white pine	native	3	3	perennial	tree	
<i>Poa palustris</i>	fowl meadow grass	native	3	-3	perennial	grass	
<i>Polygala paucifolia</i>	gay-wings	native	7	3	perennial	forb	
<i>Populus balsamifera</i>	balsam poplar	native	2	-3	perennial	tree	
<i>Populus tremuloides</i>	quaking aspen	native	1	0	perennial	tree	
<i>Prunella vulgaris</i>	self-heal	native	0	0	perennial	forb	
<i>Prunus serotina</i>	wild black cherry	native	2	3	perennial	tree	
<i>Pteridium aquilinum</i>	bracken fern	native	0	3	perennial	fern	
<i>Quercus rubra</i>	red oak	native	5	3	perennial	tree	
<i>Ranunculus acris</i>	tall or common buttercup	non-native	0	0	perennial	forb	
<i>Ranunculus hispidus</i>	swamp buttercup	native	5	0	perennial	forb	
<i>Ranunculus recurvatus</i>	hooked crowfoot	native	5	-3	perennial	forb	
<i>Rhamnus alnifolia</i>	alder-leaved buckthorn	native	8	-5	perennial	shrub	
<i>Rhododendron groenlandicum</i> ;	Labrador-tea	native	8	-5	perennial	shrub	
<i>Ledum g.</i>							
<i>Ribes triste</i>	swamp red currant	native	6	-5	perennial	shrub	
<i>Rosa palustris</i>	swamp rose	native	5	-5	perennial	shrub	
<i>Rubus pubescens</i>	dwarf raspberry	native	4	-3	perennial	shrub	
<i>Rumex obtusifolius</i>	bitter dock	non-native	0	0	perennial	forb	
<i>Rumex orbiculatus</i>	great water dock	native	9	-5	perennial	forb	
<i>Salix bebbiana</i>	Bebbs willow	native	1	-3	perennial	shrub	
<i>Salix discolor</i>	pussy willow	native	1	-3	perennial	shrub	
<i>Salix eriocephala</i>	willow	native	2	-3	perennial	shrub	
<i>Salix exigua</i>	sandbar willow	native	1	-3	perennial	shrub	
<i>Salix lucida</i>	shining willow	native	3	-3	perennial	shrub	
<i>Salix petiolaris</i>	slender willow	native	1	-3	perennial	shrub	
<i>Sambucus canadensis</i>	elderberry	native	3	-3	perennial	shrub	
<i>Scirpus atrovirens</i>	bulrush	native	3	-5	perennial	sedge	
<i>Scirpus cyperinus</i>	wool-grass	native	5	-5	perennial	sedge	
<i>Scutellaria galericulata</i>	marsh skullcap	native	5	-5	perennial	forb	
<i>Silene vulgaris</i>	bladder campion	non-native	0	5	perennial	forb	
<i>Solanum dulcamara</i>	bittersweet nightshade	non-native	0	0	perennial	vine	
<i>Solidago altissima</i>	tall goldenrod	native	1	3	perennial	forb	
<i>Solidago canadensis</i>	Canada goldenrod	native	1	3	perennial	forb	
<i>Solidago gigantea</i>	late goldenrod	native	3	-3	perennial	forb	
<i>Solidago patula</i>	swamp goldenrod	native	6	-5	perennial	forb	
<i>Solidago rugosa</i>	rough-leaved goldenrod	native	3	0	perennial	forb	
<i>Solidago uliginosa</i>	bog goldenrod	native	4	-5	perennial	forb	

<i>Sorbus americana</i>	American mountain-ash	native	4	0	perennial	tree
<i>Spinulum annotinum;</i> <i>Lycopodium a.</i>	stiff clubmoss	native	5	0	perennial	fern
<i>Spiraea alba</i>	meadowsweet	native	4	-3	perennial	shrub
<i>Symphyotrichum firmum;</i> <i>Aster puniceus</i>	smooth swamp aster	native	4	-3	perennial	forb
<i>Symphyotrichum lanceolatum;</i> <i>Aster l.</i>	panicked aster	native	2	-3	perennial	forb
<i>Symphyotrichum puniceum;</i> <i>Aster p.</i>	swamp aster	native	5	-5	perennial	forb
<i>Thalictrum dioicum</i>	early meadow-rue	native	6	3	perennial	forb
<i>Thelypteris palustris</i>	marsh fern	native	2	-3	perennial	fern
<i>Thuja occidentalis</i>	arbor vitae	native	4	-3	perennial	tree
<i>Trientalis borealis</i>	star-flower	native	5	0	perennial	forb
<i>Tsuga canadensis</i>	hemlock	native	5	3	perennial	tree
<i>Typha latifolia</i>	broad-leaved cat-tail	native	1	-5	perennial	forb
<i>Typha Xglauca</i>	hybrid cat-tail	non-native	0	-5	perennial	forb
<i>Vaccinium myrtilloides</i>	Canada blueberry	native	4	-3	perennial	shrub
<i>Veronica officinalis</i>	common speedwell	non-native	0	3	perennial	forb



Frog Hollow rich conifer swamp. Photo by Phyllis J. Higman.

Hardwood-Conifer Swamp

Hardwood-conifer swamp is a forested wetland dominated by a mixture of lowland hardwoods and conifers. In northern Michigan, hemlock is often the canopy dominant. Associated species vary, but may include yellow birch, red maple, black ash, basswood, American elm, balsam poplar, white pine, northern white-cedar, tamarack, balsam fir, and white and/or black spruce. The saturated mineral soils are poorly drained, and overlain with a layer of highly decomposed sapric peat (decaying plant matter). The pH is typically neutral, except at the surface, near accumulations of sphagnum and coniferous needles, where it is acidic. Deep muck is common, especially in seepy areas.

This system only occurs where peat accumulation isolates the rooting zone from the mineral rich ground water.

The primary natural disturbances that drive this system are windthrow and fluctuations and interactions of surface and ground water. Small-scale canopy gaps create a heterogeneous microtopography that seedlings of yellow birch, white pine, white cedar and hemlock take advantage of. They germinate and establish best on hummocks and decaying logs created by windthrow. Here the moisture, texture and more stable hydrology, favor the germination of their small seeds that lack nutrient reserves.

Ground water seepage, rich in calcium and magnesium carbonates, influences species composition, and larger canopy gaps often flood quickly resulting in increased plant diversity. Fire creates conditions that facilitate the establishment of several canopy dominants; however its role in these this system is not clearly known.

Management Considerations for Biodiversity and Ecosystem Integrity

- Regeneration of hardwood-conifer swamp canopy trees, particularly the conifers, relies on the presence of suitable sites for germination and establishment within the stand. Maintaining the natural processes and mature, senescent and dead canopy trees provides a source of large diameter woody debris that creates favored germination sites for, white pine, white cedar, hemlock and yellow birch.
- Regeneration of this system also depends upon maintaining mature seed bearing conifers. Removal of these trees can facilitate the conversion to hardwood dominated stands.
- Expansion of red maple following anthropogenic or other disturbances can limit conifer seedling establishment and recruitment by reducing light levels at the ground level.
- Maintenance of the canopy gap structure is important for sustaining site heterogeneity that results in a diverse ground layer.
- Hydrologic disturbances, including road construction and ditching can drain water or block its flow, thereby altering water tables. This can result in the settling and decomposition of peat, ultimately reconnecting the swamp to groundwater flow and converting the system to something else.
- Maintaining large areas of natural cover surrounding rich conifer swamp helps mitigate potential impacts from agricultural runoff and sedimentation, both of which affect water and habitat quality. Some logging practices can contribute to this.
- Avoiding logging in adjacent lands is ideal in this landscape; however, if

logging is desired, using sustainable management practices is essential to minimize sedimentation in the swamps.

- The use of natural cover buffer strips in adjacent agricultural operations will help reduce the near-continuous influx of runoff which periodically contains fertilizers and pesticides.
- High deer densities increase browse pressure on conifer seedlings and saplings and currently there is poor regeneration of these species in much of the state.

- Deer browse also impacts understory shrubs and herbs which alters the structure and composition of all forest strata.
- Invasive species threaten the diversity and community structure of hardwood-conifer swamp. Species of greatest concern include reed canary grass, non-native phragmites, purple loosestrife, European marsh thistle, autumn olive and glossy buckthorn. Regular monitoring for these and other invasive species can help prevent widespread invasion.

Hardwood-conifer Swamps Documented During Surveys in 2015

Noel-Day.....	44
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Hardwood-conifer swamp. Photo by Jesse M. Lincoln.

Noel-Day Hardwood-Conifer Swamp



Photo by Jesse M. Lincoln.

Site Summary

This large forested wetland complex occurs at the southern portion of the Lake Walloon basin, within a morainal landscape. This portion of the complex most closely aligns with the description of hardwood conifer swamp though there are elements of rich conifer swamp, northern shrub thicket, northern wet meadow, as well as emergent and submergent wetlands throughout other portions of the complex. Small upland inclusions with red oak and beech occur near the lake.

The driving forces that shape this system and community variability are nutrient-rich groundwater seeps, saturated soils, periodic

windthrow events, beaver flooding, emerald ash borer, Dutch elm disease, and altered hydrology from road construction. Sphagnum hummocks and hollows provide micro-site diversity by creating small-scale gradients in soil moisture and chemistry. Soils are saturated, poorly-drained, deep organic mucks with a circumneutral to basic pH.

Natural processes are the primary forces driving zonation but historic logging, road construction, and extensive tree mortality have recently influenced structure and composition. There is abundant coarse woody debris throughout, much of it

doubtlessly from disease, but other downed wood is a result of typical windthrow.

This is an important wetland complex for the Walloon Lake watershed as this system provides enormous benefit by filtering, metabolizing, and sequestering

pollutants from adjacent agricultural operations; thereby protecting local fisheries and recreational opportunities for the residents of Walloon Lake.

A red-shouldered hawk was heard calling during surveys.

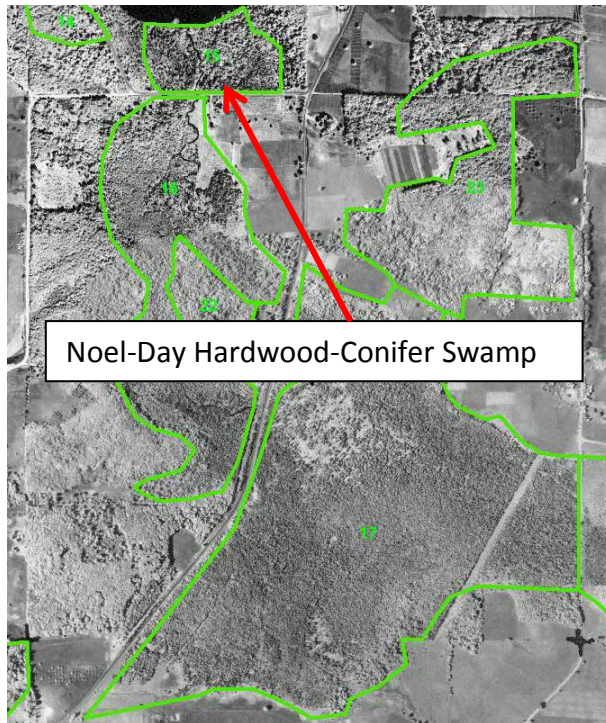


Figure 9. Noel-Day 1938 imagery.



Figure 10. Noel-Day 2012 imagery.

Vegetation

Total species 94, native species 83. Total FQI 36.8, Native FQI 39.2.

The system ranges from a sparse to nearly absent canopy (60 to 15%), though it was likely a closed canopy before successive waves of tree disease. The largest trees were all dead (24" dead yellow birch) and the remaining individuals seem to be less impacted by recent changes such as insect outbreak or hydrologic alterations. Canopy trees had diameters ranging from 10 to 16" and were mostly younger than 80 years old. The swamp is a mix of deciduous and conifer canopy species with ash, elm, tamarack, maple, cedar, and quaking aspen as principal constituents. Abundant tree mortality has been caused by disease and

insect outbreak; potentially the causal factor in hydrologic changes. Additionally, hydrology was likely altered as a result of the road to the south and this also probably negatively influenced tree health.

In the north portion of the site, the subcanopy is typically patchy to sparse but occasionally quite dense with yellow birch, elm, ash, cedar, and fir. The shrub layer is primarily composed of alder and sweet gale and is also sparse to dense with thickets and small zones of wet meadow bordering the small stream.

The herbaceous layer is typically quite dense and diverse, with variations in

groundwater seeps, proximity to the stream, and presence of tip-ups driving variation in composition. It is characterized primarily by several ferns, grasses, and sedges with enormous variation of forbs attributed to microheterogeneity. Ferns are locally dominant, including marsh fern, sensitive fern, royal fern, and Clinton's woodfern. Grasses and sedges include fowl manna grass, reed canary grass, *Carex. tribuloides*,

Carex radiata, *Carex leptalea*, *Carex crinita* and others. *Scirpus atrovirens* is also locally abundant. Forbs include goldenrods, asters, water pennywort, marsh marigold, star flower, willowherb, and others.

South of the road there is an impenetrable thicket of alder and narrow-leaved cat-tail, shifting from forest to shrub zone in response to road construction.

Threats

Invasive species, high deer densities, altered hydrology are the primary threats to the system. European thistle occurs throughout, though is never dominant. Narrow-leaved cat-tail is particularly concerning along the road where hydrologic alterations and potentially road salt are leading to its dominance. Forget-me-not is prevalent along the stream, particularly near

the northern portion where a beaver dam has caused increased water levels. Bittersweet nightshade is also dominant in several areas. Glossy buckthorn and non-native phragmites are also of great concern; however, they were not observed during surveys. See page 42 for further discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance

▪ *Forest of Regional Significance*

The small area around the Noel and Hargreaves Preserves does not qualify as a high-quality hardwood conifer swamp EO. The entire complex extends to include several thousand acres to the south and east and upon survey, large portions may indeed be exemplary and worthy of inclusion. However, this area was significantly altered by road construction and disease outbreak. These factors have led to a significant departure from the characteristic structure of

hardwood conifer swamp and a near-total loss of canopy trees.

Road construction and localized alterations to stream morphology appear to have facilitated a dominance of non-native species, particularly narrow-leaved cat-tail. However, the system does maintain relatively high structural and species diversity and is very important for protecting water quality of Walloon Lake. This is also an important system for migrating birds.

Noel-Day Hardwood Conifer Swamp

Conservatism-Based Metrics:	
Total Mean C:	3.8
Native Mean C:	4.3
Total FQI:	36.8
Native FQI:	39.2
Adjusted FQI:	40.4
% C value 0:	13.8
% C value 1-3:	25.5
% C value 4-6:	47.9
% C value 7-10:	12.8
Native Tree Mean C:	3.5
Native Shrub Mean C:	4.1
Native Herbaceous Mean C:	4.6

Species Richness:		
Total Species:	94	
Native Species:	83	88.3%
Non-native Species:	11	11.7%

Species Wetness:	
Mean Wetness:	-2.2
Native Mean Wetness:	-2.4

Duration Metrics:		
Annual:	2	2.1%
Perennial:	91	96.8%
Biennial:	1	1.1%
Native Annual:	2	2.1%
Native Perennial:	81	86.2%
Native Biennial:	0	0.0%

Physiognomy Metrics:		
Tree:	12	12.8%
Shrub:	11	11.7%
Vine:	6	6.4%
Forb:	43	45.7%
Grass:	6	6.4%
Sedge:	9	9.6%
Rush:	0	0.0%
Fern:	7	7.4%
Bryophyte:	0	0.0%

Documented species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Abies balsamea</i>	balsam fir	native	3	0	perennial	tree
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Alnus incana; A. rugosa</i>	speckled alder	native	5	-3	perennial	shrub
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	forb
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	native	5	0	perennial	forb
<i>Asclepias incarnata</i>	swamp milkweed	native	6	-5	perennial	forb
<i>Athyrium filix-femina</i>	lady fern	native	4	0	perennial	fern
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Betula papyrifera</i>	paper birch	native	2	3	perennial	tree
<i>Caltha palustris</i>	marsh-marigold	native	6	-5	perennial	forb
<i>Campanula aparinoides</i>	marsh bellflower	native	7	-5	perennial	forb
<i>Carex crinita</i>	sedge	native	4	-5	perennial	sedge
<i>Carex gracillima</i>	sedge	native	4	3	perennial	sedge
<i>Carex leptalea</i>	sedge	native	5	-5	perennial	sedge
<i>Carex pseudo-cyperus</i>	sedge	native	5	-5	perennial	sedge
<i>Carex radiata; C. rosea</i>	straight-styled wood sedge	native	2	0	perennial	sedge
<i>Carex stipata</i>	sedge	native	1	-5	perennial	sedge
<i>Carex stricta</i>	sedge	native	4	-5	perennial	sedge
<i>Carex tribuloides</i>	sedge	native	3	-3	perennial	sedge
<i>Cicuta bulbifera</i>	water hemlock	native	5	-5	perennial	forb
<i>Cinna latifolia</i>	wood reedgrass	native	5	-3	perennial	grass
<i>Cirsium palustre</i>	marsh thistle	non-native	0	-3	biennial	forb
<i>Clematis virginiana</i>	virgins bower	native	4	0	perennial	vine
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	native	5	0	perennial	forb

<i>Comarum palustre;</i>							
<i>Potentilla p.</i>	marsh cinquefoil	native	7	-5	perennial	forb	
<i>Convolvulus arvensis</i>	field bindweed	non-native	0	5	perennial	vine	
<i>Coptis trifolia</i>	goldthread	native	5	-3	perennial	forb	
<i>Cornus amomum</i>	silky dogwood	native	2	-3	perennial	shrub	
<i>Cornus sericea;</i> <i>C.</i>							
<i>stolonifera</i>	red-osier dogwood	native	2	-3	perennial	shrub	
<i>Dryopteris carthusiana</i>	spinulose woodfern	native	5	-3	perennial	fern	
<i>Dryopteris clintoniana</i>	Clintons woodfern	native	8	-3	perennial	fern	
<i>Epilobium strictum</i>	downy willow-herb	native	8	-5	perennial	forb	
<i>Epipactis helleborine</i>	helleborine	non-native	0	0	perennial	forb	
<i>Equisetum arvense</i>	common horsetail	native	0	0	perennial	fern	
<i>Eupatorium perfoliatum</i>	boneset	native	4	-3	perennial	forb	
<i>Eutrochium purpureum;</i>	green-stemmed joe-pye-						
<i>Eupatorium p.</i>	weed	native	5	0	perennial	forb	
<i>Fragaria virginiana</i>	wild strawberry	native	2	3	perennial	forb	
<i>Fraxinus nigra</i>	black ash	native	6	-3	perennial	tree	
<i>Fraxinus pennsylvanica</i>	red ash	native	2	-3	perennial	tree	
<i>Galium asprellum</i>	rough bedstraw	native	5	-5	perennial	vine	
<i>Galium labradoricum</i>	bog bedstraw	native	8	-5	perennial	forb	
<i>Geranium robertianum</i>	herb robert	native	3	3	annual	forb	
<i>Geum rivale</i>	purple avens	native	7	-5	perennial	forb	
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass	
<i>Hieracium aurantiacum</i>	orange hawkweed	non-native	0	5	perennial	forb	
<i>Ilex verticillata</i>	Michigan holly	native	5	-3	perennial	shrub	
<i>Impatiens capensis</i>	spotted touch-me-not	native	2	-3	annual	forb	
<i>Iris virginica</i>	southern blue flag	native	5	-5	perennial	forb	
<i>Larix laricina</i>	tamarack	native	5	-3	perennial	tree	
<i>Lemna minor</i>	common duckweed	native	5	-5	perennial	forb	
<i>Lycopus uniflorus</i>	northern bugle weed	native	2	-5	perennial	forb	
<i>Lysimachia thyrsoiflora</i>	tufted loosestrife	native	6	-5	perennial	forb	
<i>Lythrum salicaria</i>	purple loosestrife	non-native	0	-5	perennial	forb	
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb	
<i>Mitella diphylla</i>	bishops-cap	native	8	3	perennial	forb	
<i>Mitella nuda</i>	naked miterwort	native	8	-3	perennial	forb	
<i>Myosotis scorpioides</i>	forget-me-not	non-native	0	-5	perennial	forb	
<i>Myrica gale</i>	sweet gale	native	6	-5	perennial	shrub	
<i>Nasturtium microphyllum;</i>							
<i>N. officinale</i>	watercress	non-native	0	-5	perennial	forb	
<i>Nepeta cataria</i>	catnip	non-native	0	3	perennial	forb	
<i>Nuphar advena</i>	yellow pond-lily	native	8	-5	perennial	forb	
<i>Onoclea sensibilis</i>	sensitive fern	native	2	-3	perennial	fern	
<i>Osmunda cinnamomea</i>	cinnamon fern	native	5	-3	perennial	fern	
<i>Osmunda regalis</i>	royal fern	native	5	-5	perennial	fern	
<i>Parthenocissus quinquefolia</i>	Virginia creeper	native	5	3	perennial	vine	

<i>Phalaris arundinacea</i>	reed canary grass	native	0	-3	perennial	grass
<i>Poa compressa</i>	Canada bluegrass	non-native	0	3	perennial	grass
<i>Poa palustris</i>	fowl meadow grass	native	3	-3	perennial	grass
<i>Populus tremuloides</i>	quaking aspen	native	1	0	perennial	tree
<i>Quercus rubra</i>	red oak	native	5	3	perennial	tree
<i>Rhamnus alnifolia</i>	alder-leaved buckthorn	native	8	-5	perennial	shrub
<i>Ribes triste</i>	swamp red currant	native	6	-5	perennial	shrub
<i>Rosa acicularis</i>	wild rose	native	4	3	perennial	shrub
<i>Rubus hispidus</i>	swamp dewberry	native	4	-3	perennial	shrub
<i>Rubus strigosus</i>	wild red raspberry	native	2	0	perennial	shrub
<i>Rumex orbiculatus</i>	great water dock	native	9	-5	perennial	forb
<i>Sagittaria latifolia</i>	common arrowhead	native	4	-5	perennial	forb
<i>Salix discolor</i>	pussy willow	native	1	-3	perennial	shrub
<i>Scirpus atrovirens</i>	bulrush	native	3	-5	perennial	sedge
<i>Scutellaria galericulata</i>	marsh skullcap	native	5	-5	perennial	forb
<i>Solanum dulcamara</i>	bittersweet nightshade	non-native	0	0	perennial	vine
<i>Solidago gigantea</i>	late goldenrod	native	3	-3	perennial	forb
<i>Solidago rugosa</i>	rough-leaved goldenrod	native	3	0	perennial	forb
<i>Sparganium eurycarpum</i>	common bur-reed	native	5	-5	perennial	forb
<i>Sphenopholis intermedia</i>	slender wedgegrass	native	4	0	perennial	grass
<i>Symphotrichum puniceum</i> ; <i>Aster p.</i>	swamp aster	native	5	-5	perennial	forb
<i>Thuja occidentalis</i>	arbor vitae	native	4	-3	perennial	tree
<i>Tilia americana</i>	basswood	native	5	3	perennial	tree
<i>Toxicodendron radicans</i>	poison-ivy	native	2	0	perennial	vine
<i>Trientalis borealis</i>	star-flower	native	5	0	perennial	forb
<i>Typha angustifolia</i>	narrow-leaved cat-tail	non-native	0	-5	perennial	forb
<i>Typha latifolia</i>	broad-leaved cat-tail	native	1	-5	perennial	forb
<i>Ulmus americana</i>	American elm	native	1	-3	perennial	tree
<i>Viola cucullata</i>	marsh violet	native	5	-5	perennial	forb



Swamp milkweed. Photo by Jesse M. Lincoln.

Michigania Hardwood-Conifer Swamp



Photo by Jesse M. Lincoln.

Site Summary

This small forested wetland complex occurs along the western portion of a lake basin within a morainal landscape in the northern Lower Peninsula. This hardwood-conifer swamp is in relatively good condition with vegetation representative of an intact system. The swamp borders a small stream that runs from west to east and drains into Walloon Lake. The creek was reported to have been used for a lumber mill in the late 1800s and a small road or rail bed runs along the northern portion of the swamp.

The driving forces that shape this system and community variability are historic logging, nutrient-rich groundwater seeps, saturated soils, periodic windthrow events,

emerald ash borer, Dutch elm disease, and altered hydrology from the construction of a logging road.

Sphagnum hummocks and hollows provide micro-site diversity by creating small-scale gradients in soil moisture and chemistry. Soils are saturated, poorly-drained, organic mucks over coarse sands with a circumneutral to basic pH. Natural processes are the primary forces driving zonation but historic logging, road construction, and tree mortality have recently influenced structure and composition. There is abundant coarse woody debris throughout, much of it doubtlessly from disease but other downed wood from typical windthrow.

The system transitions to a somewhat degraded wet meadow near the mouth of the stream. The recent logging activities in adjacent uplands stopped abruptly at the edge of the saturated soils, but sedimen-

tation will likely affect the stream. Fragmentation of the forest will facilitate the spread of invasive species.

A hermit thrush and red shouldered hawk were heard calling during surveys.

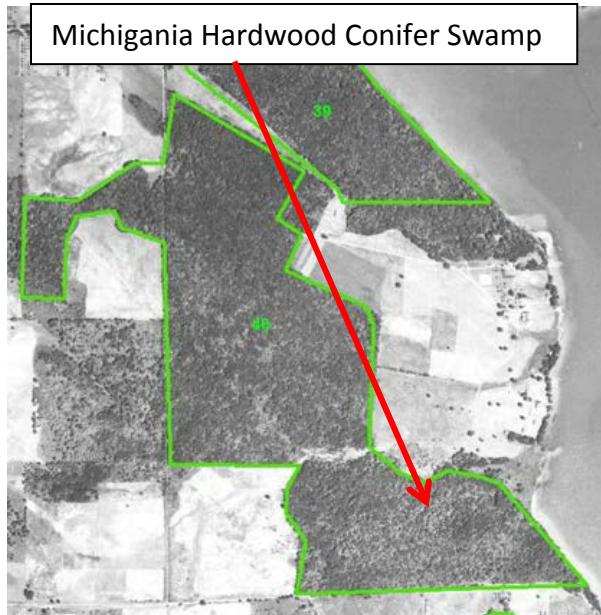


Figure 11. Michiganiana 1938 imagery.



Figure 12. Michiganiana 2012 imagery.

Vegetation

Total Species 49; Native 45. Total FQI 26.6; Native FQI 27.5.

The system ranges from a sparse canopy to a nearly closed canopy (60 to 95%). Canopy tree diameters ranged from 15 to 24" and were mostly older than 100 (estimated by aging a white cedar). The canopy is composed of yellow birch, white cedar, hemlock, red maple, and basswood. The understory is comprised of yellow birch, ash, and maple with ironwood, cedar, and hemlock throughout. The shrub layer is primarily the same species as the canopy.

The herb layer is somewhat diverse, primarily depending on wind throw, canopy density, or degree of saturation. It is characterized primarily by several fern, grass, and sedge species with variation attributed to micro-heterogeneity. Ground cover species include wild sarsaparilla, common trillium, golden ragwort, *Carex scabrata*, swamp buttercup, cinnamon fern, and New York fern, among others.

Threats

Invasive species, high deer densities, and altered hydrology are the primary threats to this system. Invasive plants tend to be most prevalent along the eastern end where an old lumber mill seems to have created a small,

open wet meadow. Species of concern include reed canary grass, hybrid cat-tail, non-native phragmites and European swamp thistle. Canada thistle is also of major concern in the wet meadow portion in the

eastern end (described separately). Glossy buckthorn is also a major concern, however it was not observed during surveys. See page

42 for further discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance

▪ *Forest of Regional Significance*

Although relatively high-quality, this hardwood conifer swamp does not qualify as an EO due to its small size, low species diversity, and adjacent land use. Despite all of these aspects, the system does maintain a

relatively high structural and species diversity and contributes to the water quality of Walloon Lake. This is also an important system for migrating birds because of the evergreen component, primarily hemlock.



A diverse ground flora in Michiganiana hardwood-conifer swamp. Photo by Jesse M. Lincoln.

Michigania Hardwood-Conifer Swamp

Conservatism-Based Metrics:	
Total Mean C:	3.8
Native Mean C:	4.1
Total FQI:	26.6
Native FQI:	27.5
Adjusted FQI:	39.3
% C value 0:	12.2
% C value 1-3:	20.4
% C value 4-6:	63.3
% C value 7-10:	4.1
Native Tree Mean C:	4.3
Native Shrub Mean C:	5
Native Herbaceous Mean C:	4

Species Richness:		
Total Species:	49	
Native Species:	45	91.8%
Non-native Species:	4	8.2%

Species Wetness:	
Mean Wetness:	-1
Native Mean Wetness:	-1

Duration Metrics:		
Annual:	2	4.1%
Perennial:	46	93.9%
Biennial:	1	2.0%
Native Annual:	2	4.1%
Native Perennial:	43	87.8%
Native Biennial:	0	0.0%

Physiognomy Metrics:		
Tree:	9	18.4%
Shrub:	3	6.1%
Vine:	2	4.1%
Forb:	20	40.8%
Grass:	2	4.1%
Sedge:	6	12.2%
Rush:	0	0.0%
Fern:	7	14.3%
Bryophyte:	0	0.0%

Documented Species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Acer rubrum</i>	red maple	native	1	0	perennial	Tree
<i>Adiantum pedatum</i>	maidenhair fern	native	6	3	perennial	Fern
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	Forb
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	native	5	0	perennial	Forb
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	Tree
<i>Boehmeria cylindrica</i>	false nettle	native	5	-5	perennial	Forb
<i>Caltha palustris</i>	marsh-marigold	native	6	-5	perennial	Forb
<i>Cardamine diphylla</i> ; <i>Dentaria d.</i>	two-leaved toothwort	native	5	3	perennial	Forb
<i>Carex bebbii</i>	sedge	native	4	-5	perennial	Sedge
<i>Carex leptonevia</i>	sedge	native	3	0	perennial	Sedge
<i>Carex scabrata</i>	sedge	native	4	-5	perennial	Sedge
<i>Carex stipata</i>	sedge	native	1	-5	perennial	Sedge
<i>Carex vulpinoidea</i>	sedge	native	1	-5	perennial	Sedge
<i>Circaea alpina</i>	small enchanters- nightshade	native	4	-3	perennial	Forb
<i>Cirsium arvense</i>	Canada thistle	non-native	0	3	perennial	Forb
<i>Cirsium palustre</i>	marsh thistle	non-native	0	-3	biennial	Forb
<i>Clematis virginiana</i>	virgins bower	native	4	0	perennial	Vine
<i>Dryopteris carthusiana</i>	spinulose woodfern	native	5	-3	perennial	fern
<i>Equisetum arvense</i>	common horsetail	native	0	0	perennial	fern
<i>Fraxinus nigra</i>	black ash	native	6	-3	perennial	tree
<i>Fraxinus pennsylvanica</i>	red ash	native	2	-3	perennial	tree
<i>Galium asprellum</i>	rough bedstraw	native	5	-5	perennial	vine
<i>Geranium robertianum</i>	herb robert	native	3	3	annual	forb

<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Gymnocarpium dryopteris</i>	oak fern	native	5	3	perennial	fern
<i>Hieracium aurantiacum</i>	orange hawkweed	non-native	0	5	perennial	forb
<i>Impatiens capensis</i>	spotted touch-me-not	native	2	-3	annual	forb
<i>Lonicera morrowii</i>	Morrow honeysuckle	non-native	0	3	perennial	shrub
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Mitella diphylla</i>	bishops-cap	native	8	3	perennial	forb
<i>Osmunda cinnamomea</i>	cinnamon fern	native	5	-3	perennial	fern
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	native	5	3	perennial	tree
<i>Packera aurea; Senecio a.</i>	golden ragwort	native	5	-3	perennial	forb
<i>Populus grandidentata</i>	big-tooth aspen	native	4	3	perennial	tree
<i>Peridium aquilinum</i>	bracken fern	native	0	3	perennial	fern
<i>Ranunculus hispidus</i>	swamp buttercup	native	5	0	perennial	forb
<i>Ribes triste</i>	swamp red currant	native	6	-5	perennial	shrub
<i>Rubus hispidus</i>	swamp dewberry	native	4	-3	perennial	shrub
<i>Scirpus atrovirens</i>	bulrush	native	3	-5	perennial	sedge
<i>Scutellaria lateriflora</i>	mad-dog skullcap	native	5	-5	perennial	forb
<i>Solidago gigantea</i>	late goldenrod	native	3	-3	perennial	forb
<i>Sphenopholis intermedia</i>	slender wedgegrass	native	4	0	perennial	grass
<i>Symphyotrichum urophyllum;</i> <i>Aster sagittifolius</i>	arrow-leaved aster	native	2	5	perennial	forb
<i>Thelypteris noveboracensis</i>	New York fern	native	5	0	perennial	fern
<i>Thuja occidentalis</i>	arbor vitae	native	4	-3	perennial	tree
<i>Tilia americana</i>	basswood	native	5	3	perennial	tree
<i>Trillium grandiflorum</i>	common trillium	native	5	3	perennial	forb
<i>Tsuga canadensis</i>	hemlock	native	5	3	perennial	tree
<i>Viola cucullata</i>	marsh violet	native	5	-5	perennial	forb



Michigan hardwood-conifer swamp. Photo by Jesse M. Lincoln.

Poor Conifer Swamp

Poor conifer swamp is a nutrient-poor, forested peatland characterized by acidic, saturated peat (decomposing plants), with a prevalence of coniferous trees, sphagnum mosses, and acid-loving (ericaceous) shrubs. Black spruce is often dominant and tamarack is a frequent dominant or codominant. Other canopy associates include balsam fir, white pine, jack pine, paper birch and American mountain ash. Labrador tea is usually the most prevalent ericaceous shrub.

The depth and moisture of the peat soils is variable, but the rooting zone is typically quite shallow, typically restricted to the upper six inches. The acidic surface peat and

surface water are cool and contain low nutrient and oxygen levels.

The primary natural disturbances that influence the species composition and structure of this system are fire, beaver flooding, windthrow and insect defoliation. Historically, fire occurred naturally during drought periods and created even-aged, often monospecific, stands of black spruce (*Picea mariana*). Flooding kills canopy trees and converts the system. Trees are not anchored well by the peat soils and the shallow root zone makes them very susceptible windthrow.

Management Considerations for Biodiversity and Ecosystem Integrity

- Because this system is primarily fed by rain water and surface runoff, leaving a large forested buffer on adjacent uplands is important, as logging and agriculture can increase runoff, sedimentation and nutrient inputs.
- Alteration to streams feeding the system or draining into the lake basin will change the hydrology of the site, potentially reconnecting the swamp to ground water and converting it to another type.
- Removal of dead and dying wood can severely diminish site nutrients and productivity, as well as structural heterogeneity. Allowing dead and dying wood to remain within these systems to become snags, stumps, and fallen logs counteracts that.
- Regional biodiversity can be sustained by maintaining swamps in different age-classes and stages of structural development. This can be achieved by leaving large tracts of swamp unharvested and allowing the natural processes to occur unimpeded, which stochastically generates a range of successional states. This is also favorable for many species, including epiphytic lichens and trunk foraging birds that rely on old, large trees.
- Invasive species threaten the diversity, and community structure of poor-conifer swamps. Species of greatest concern include reed canary grass, non-native phragmites, purple loosestrife, European marsh thistle, autumn olive and glossy buckthorn. Currently, invasive species appear to be restricted to the margins of these swamps in Michigan. Regular monitoring for the species noted above can help prevent widespread invasion.

Poor Conifer Swamps Documented During 2015 Surveys:

Wildwood-Mud Lake Poor Conifer Swamp.....	56
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Wildwood-Mud Lake Poor Conifer Swamp



Photo by Jesse M. Lincoln.

Site Summary

This is a poor conifer swamp occurring on the western margins of a lake in a kettle-kame landscape. The hydrology is primarily influenced by rain water and surface water runoff which is maintaining a very low pH and deep sphagnum layer, and there are localized groundwater seeps at the edge. The canopy is dominated by conifers and is patchy with areas of dense canopy and other areas that are sparse. The trees are relatively small, stunted, and slow growing as a result of the severe acidity (~4.5).

The majority of the system was not forested in 1930s based on aerial imagery. This is likely a bog margin that has converted to a poor conifer swamp as part of the normal lake-filling process. It is possible that this was historically forested and logged in the 1800s but no stumps were found in the initial survey. Sometimes bogs were burned or mined for peat and that may explain why this was not forested in the. However, based on the initial survey, this seems like a bog that has transitioned into a

high-quality poor conifer swamp and the condition of the areas surveyed is excellent.

Species diversity is quite low and areas of greatest diversity are concentrated at the margins where cold, mineral rich groundwater seeps are creating zones of variable water chemistry as the neutral groundwater mixes with the acidic system. Along the lake is a floating peat mat which is slowly expanding the system as it is colonized by edge species, then shrubs, then stunted trees. The edges of the system have open pools of stagnant water where surface water from adjacent uplands collects on the saturated soils around groundwater seeps

The community is driven by species tolerant of year round saturation and very low substrate pH. The lake drains to the east and the swamp on the eastern end is characterized by deep sapric mucks and a neutral pH, suggesting that water from a spring feeding the lake is separated from this poor conifer swamp by a lens that segregates water chemistries.

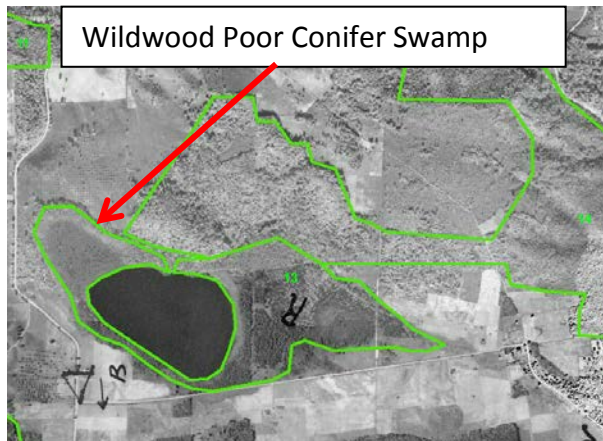


Figure 13. Wildwood 1938 imagery.



Figure 14. Wildwood 2012 imagery.

Vegetation

Total Species: 54; Native 54. Total FQI 36; Native FQI 36

The system is characterized by sparse to dense canopy of pine, spruce, with tamarack, red maple and paper birch as locally

abundant co-dominants. Trees are typically small and stunted with most diameters ranging from 7 to 15" and a few large trees

over 30" diameter. The subcanopy is somewhat dense in places but also locally sparse and consists primarily of the canopy constituents with white pine becoming less dominant in lower strata.

The shrub layer is likewise sparse to dense with thickets of huckleberry and blueberry and Michigan holly, chokeberry, leatherleaf and mountain holly occurring comparatively infrequently. The herbaceous layer is sparse, typically less than 10 % coverage, and is relatively low diversity

The primary threats are changes to hydrology in the lake, alterations to groundwater seeps at the edges, agricultural runoff and changes to adjacent land use that increase surface runoff sedimentation. No invasive plants were documented in the survey area. However, reed canary grass, hybrid cat-tail, European swamp thistle,

with bluebead lily, bracken fern, woodfern, and several sedge species.

There is a continuous mat of sphagnum moss throughout the system, except at the edges where groundwater seeps form pools of water over deep muck. These margins tend to be fairly diverse, in terms of structure and diversity and have a greater presence of deciduous trees in the canopy. The sphagnum is composed of hemic peats to depths greater than 1 m. The bog edge of the lake is dominated by swamp loosestrife and leather leaf.

Threats

autumn olive, Japanese barberry and multiflora rose are in the nearby wetlands. Glossy buckthorn is also a major concern, however, it was not observed during surveys. See page 55 for further discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance

- *Forest of Regional Significance*
- *C-Ranked Poor Conifer Swamp EO*

The majority of the system was not forested in 1930s based on aerial imagery. This is likely a bog margin that has converted to a poor conifer swamp as part of the normal lake filling process. It is possible that this was historically forested and logged in the 1800s but no stumps were found in the initial survey. Sometimes bogs were burned

or mined for peat and that may explain why this was not forested in the 1930s. The condition of the areas surveyed is excellent. It qualifies as a C-rank EO in Michigan's Natural Heritage Database. Its small size and the fragmented landscape surrounding it, preclude it from achieving a higher rank currently.



Photos by Jesse M. Lincoln.



Wildwood poor conifer swamp from the lake. Photo by Jesse M. Lincoln.



Walking on sphagnum! Photo by Jesse M. Lincoln.

Wildwood/Mud Lake Poor Conifer Swamp

Conservatism-Based Metrics:	
Total Mean C:	4.9
Native Mean C:	4.9
Total FQI:	36
Native FQI:	36
Adjusted FQI:	49
% C value 0:	3.7
% C value 1-3:	22.2
% C value 4-6:	48.1
% C value 7-10:	25.9
Native Tree Mean C:	3.6
Native Shrub Mean C:	6.2
Native Herbaceous Mean C:	4.9

Species Richness:			
Total Species:	54		
Native Species:	54	100%	
Non-native Species:	0	0%	

Species Wetness:	
Mean Wetness:	-2
Native Mean Wetness:	-2

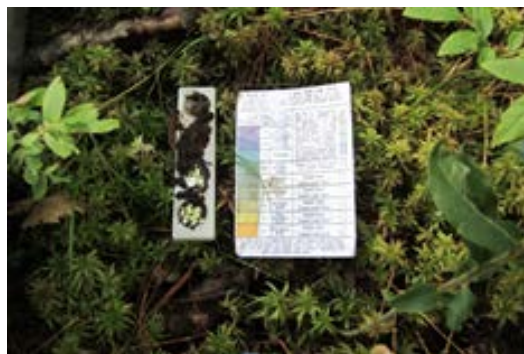
Duration Metrics:			
Annual:	1	1.9%	
Perennial:	53	98.1%	
Biennial:	0	0.0%	
Native Annual:	1	1.9%	
Native Perennial:	53	98.1%	
Native Biennial:	0	0%	

Physiognomy Metrics:		
Tree:	10	18.5%
Shrub:	10	18.5%
Vine:	0	0.0%
Forb:	16	29.6%
Grass:	1	1.9%
Sedge:	10	18.5%
Rush:	0	0.0%
Fern:	7	13.0%
Bryophyte:	0	0%

Documented Species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Caronia prunifolia</i>	chokeberry	native	5	-3	perennial	shrub
<i>Asclepias incarnata</i>	swamp milkweed	native	6	-5	perennial	forb
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Betula papyrifera</i>	paper birch	native	2	3	perennial	tree
<i>Carex bebbii</i>	sedge	native	4	-5	perennial	sedge
<i>Carex crinita</i>	sedge	native	4	-5	perennial	sedge
<i>Carex intumescens</i>	sedge	native	3	-3	perennial	sedge
<i>Carex leptalea</i>	sedge	native	5	-5	perennial	sedge
<i>Carex lupulina</i>	sedge	native	4	-5	perennial	sedge
<i>Carex trisperma</i>	sedge	native	9	-5	perennial	sedge
<i>Carex tuckermanii</i>	sedge	native	8	-5	perennial	sedge
<i>Chamaedaphne calyculata</i>	leatherleaf	native	8	-5	perennial	shrub
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	native	5	0	perennial	forb
<i>Coptis trifolia</i>	goldthread	native	5	-3	perennial	forb
<i>Decodon verticillatus</i>	whorled or swamp loosestrife	native	7	-5	perennial	shrub
<i>Dryopteris carthusiana</i>	spinulose woodfern	native	5	-3	perennial	fern
<i>Dulichium arundinaceum</i>	three-way sedge	native	8	-5	perennial	sedge
<i>Eriophorum gracile</i>	slender cotton-grass	native	10	-5	perennial	sedge
<i>Eutrochium purpureum;</i> <i>Eupatorium p.</i>	green-stemmed joe-pye-weed	native	5	0	perennial	forb
<i>Fagus grandifolia</i>	American beech	native	6	3	perennial	tree
<i>Galium labradoricum</i>	bog bedstraw	native	8	-5	perennial	forb
<i>Gaultheria procumbens</i>	wintergreen	native	5	3	perennial	shrub

<i>Gaylussacia baccata</i>	huckleberry	native	7	3	perennial	shrub
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Ilex mucronata; Nemopanthus m.</i>	mountain holly	native	7	-5	perennial	shrub
<i>Ilex verticillata</i>	Michigan holly	native	5	-3	perennial	shrub
<i>Impatiens capensis</i>	spotted touch-me-not	native	2	-3	annual	forb
<i>Iris virginica</i>	southern blue flag	native	5	-5	perennial	forb
<i>Larix laricina</i>	tamarack	native	5	-3	perennial	tree
<i>Lonicera villosa</i>	mountain fly honeysuckle	native	8	-3	perennial	shrub
<i>Lycopodiella inundata</i>	bog clubmoss	native	7	-5	perennial	fern
<i>Lycopus uniflorus</i>	northern bugle weed	native	2	-5	perennial	forb
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Medeola virginiana</i>	Indian cucumber-root	native	10	3	perennial	forb
<i>Monotropa uniflora</i>	Indian-pipe	native	5	3	perennial	forb
<i>Onoclea sensibilis</i>	sensitive fern	native	2	-3	perennial	fern
<i>Osmunda cinnamomea</i>	cinnamon fern	native	5	-3	perennial	fern
<i>Osmunda regalis</i>	royal fern	native	5	-5	perennial	fern
<i>Picea mariana</i>	black spruce	native	6	-3	perennial	tree
<i>Pinus strobus</i>	white pine	native	3	3	perennial	tree
<i>Plantago rugelii</i>	red-stalked plantain	native	0	0	perennial	forb
<i>Platanthera clavellata; Habenaria c.</i>	small green wood orchid	native	6	-3	perennial	forb
<i>Populus tremuloides</i>	quaking aspen	native	1	0	perennial	tree
<i>Pteridium aquilinum</i>	bracken fern	native	0	3	perennial	fern
<i>Sarracenia purpurea</i>	pitcher-plant	native	10	-5	perennial	forb
<i>Scirpus atrovirens</i>	bulrush	native	3	-5	perennial	sedge
<i>Thelypteris palustris</i>	marsh fern	native	2	-3	perennial	fern
<i>Thuja occidentalis</i>	arbor vitae	native	4	-3	perennial	tree
<i>Trientalis borealis</i>	star-flower	native	5	0	perennial	forb
<i>Typha latifolia</i>	broad-leaved cat-tail	native	1	-5	perennial	forb
<i>Ulmus americana</i>	American elm	native	1	-3	perennial	tree
<i>Vaccinium corymbosum</i>	highbush blueberry	native	6	-3	perennial	shrub
<i>Vaccinium myrtilloides</i>	Canada blueberry	native	4	-3	perennial	shrub



**Determining the pH in sphagnum peat.
Photo by Jesse M. Lincoln.**

Northern Wet Meadow

Northern wet meadow is an open, sedge- and grass-dominated wetland that is influenced-by groundwater. It most often borders streams but also occurs on pond and lake margins above beaver dams where water levels are raised by flooding. Soils are strongly acid to neutral sapric peats (highly decomposed plants). The predominant disturbances that maintain its open condition include seasonal flooding, beaver-induced flooding and fire. It is usually a component of larger wetland complexes lying adjacent to other wetland types.

Soils are typically strongly acid to neutral, well-decomposed sapric peat, but wet meadows can also occur on saturated

mineral soils. It is influenced by seasonally fluctuating groundwater levels that peak in spring and drop in late summer, however, water levels remain near or at the soil surface throughout the year.

Beaver floodings sustain the meadow by raising water levels that kill establishing trees and shrubs and support the influx of shade-tolerant wet meadow species. Fire reduces leaf litter, allowing light to reach the soil and stimulate seed germination, which otherwise is stifled. It also reduces competition by perennials, and creates micro-niches for small species. Without flooding or fire, wet meadows will convert to shrub-thicket and eventually swamp forest.

Management Considerations for Biodiversity and Ecosystem Integrity

- Protection of the hydrology is the most important consideration for maintaining northern wet meadows. It is important to avoid surface water inputs from drainage ditches, agricultural fields and logging operations on adjacent uplands.
- In forested landscapes, establishing no-cut buffers around wet meadows, minimizing road construction and avoiding complete canopy removal in immediately adjacent stands helps protect the hydrologic regime and water quality.
- Invasive species threaten the diversity and community structure of northern wet meadows. Species of greatest concern include reed canary grass, non-native phragmites, purple loosestrife, Canada thistle, common and glossy buckthorn and multiflora rose. Regular monitoring for these and other invasive species can help prevent widespread invasion.

Northern Wet Meadows Documented During Surveys

Schoof's Creek63



Wet meadow sedges. Photo by Jesse M. Lincoln.

Cedar Valley Northern Wet Meadow



Photo by Jesse M. Lincoln.

Site Summary

This portion of the Cedar Valley wetland complex is characterized by a dense graminoid layer that gradually becomes sparser as the water gets deeper near the main channel. These areas have zones of emergent and floating vegetation. The canopy gradually transitions from closed to open along the gradient of increasing water depths. Shrubs become sparse and relegated to small rises within the wetland, likely old tree stumps that are slightly higher than surrounding topography.

The complex extends to the east to merge with the Hay Marsh Creek and the Bear River drainages which empty into

Petoskey Harbor. This is an important wetland complex for the Walloon Lake watershed as this system provides enormous benefit by filtering, metabolizing, and sequestering pollutants from adjacent agricultural operations; thereby protecting local fisheries and recreational opportunities for the residents of Walloon Lake.

A road to the east and powerline maintenance have caused localized and severe tree mortality and increased water levels. This seems to have successfully mimicked beaver flooding and converted large areas of this previously forested wetland to open wet meadow with minimal occurrence of

invasive species typical of such disturbance. There are pockets of reed canary grass and narrow-leaved cat-tail invasion, particularly, north of the channel. This increased water level is causing the tree mortality and

a gradual decrease in canopy coverage along the northern portion of the forested areas. Soils are saturated, poorly-drained, deep organic mucks with a basic pH.

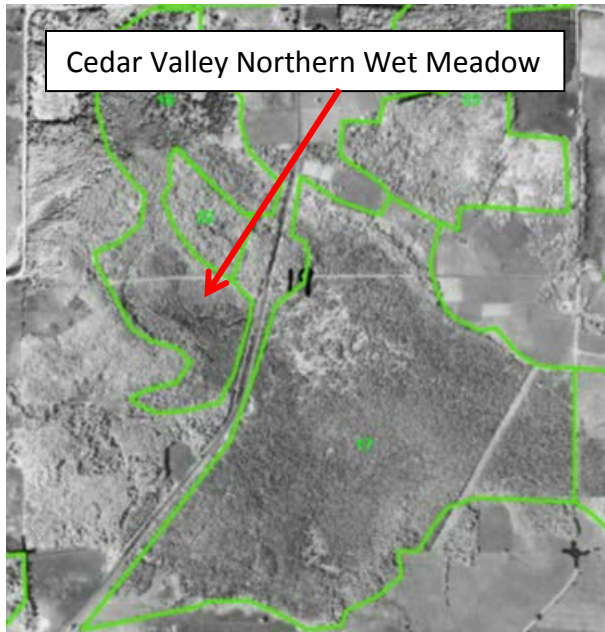


Figure 15. Wildwood 1938 imagery.



Figure 16. Wildwood 2012 imagery.

Vegetation

Total Species 29; Native 27. Total FQI 23.2; Native FQI 23.9.

This is a northern wet meadow that has formed as a result of altered hydrology from the road to the east. Trees were also cleared under the powerline. Dominant herbaceous species include *Carex stricta*, Canada blue joint, native cat-tail, marsh fern, and several additional sedges, including *Carex diandra*, *Carex prairea*, and *Carex lasiocarpa*. Graminoids are dense but become sparser with deeper standing water near the channel of the stream. Narrow-leaved cat-tail is prevalent throughout, especially in areas on

the north side of the stream. Yellow pond lily is common in larger, open pools.

Shrubs include sweet gale, swamp rose, swamp dewberry, and meadowsweet. They are locally abundant, particularly at the drier margins. Scattered and stunted trees remain in the altered system. Young trees cling to small rises within the complex. Tree species include black spruce, balsam fir, white cedar, and tamarack. Common bladderwort occurs in linear channels formed by deer trails.

Threats

Invasive species, deer herbivory and altered hydrology are the primary threats. Hydrologic alterations have been significant. The most worrisome invasive plants include

European swamp thistle, hybrid cat-tail, narrow leaved cat-tail and reed canary grass. The latter two have begun to establish here. Glossy buckthorn is also a major concern,

however it was not observed during surveys. See page 62 for further discussion of

considerations for biodiversity management and ecosystem integrity.

Site Significance

▪ *Wet Meadow of Regional Significance*

This small northern wet meadow within the Cedar Valley Preserve does not qualify as high-quality EO. This specific area was significantly altered by road construction and historic logging during the growing season, and on-going maintenance of the utility corridors result in the clearing of trees throughout the meadow. The meadow is embedded in a much larger wetland complex that extends several thousand acres to the north and east. Large portions of this complex may indeed be determined to be

exemplary of natural conditions, upon further survey.

The wet meadow is important regionally, as it harbors a considerable array of native species that are not as common within the largely forested matrix, and provides habitat for many species. It is a natural community type that has been degraded across much of the state. It is important to consider ways to prevent further expansion of reed canary-grass and non-native cat-tails into the larger wetland complex.



Dying trees in Cedar Valley northern wet meadow. Photo by Jesse M. Lincoln.

Cedar Valley Northern Wet Meadow FQA

Conservatism-Based Metrics:	
Total Mean C:	4.3
Native Mean C:	4.6
Total FQI:	23.2
Native FQI:	23.9
Adjusted FQI:	44.4
% C value 0:	10.3
% C value 1-3:	27.6
% C value 4-6:	41.4
% C value 7-10:	20.7
Native Tree Mean C:	3.8
Native Shrub Mean C:	5
Native Herbaceous Mean C:	4.8

Species Richness:		
Total Species:	29	
Native Species:	27	93.1%
Non-native Species:	2	6.9%

Species Wetness:	
Mean Wetness:	-4
Native Mean Wetness:	-4

Duration Metrics:		
Annual:	0	0%
Perennial:	28	96.6%
Biennial:	1	3.4%
Native Annual:	0	0%
Native Perennial:	27	93.1%
Native Biennial:	0	0%

Physiognomy Metrics:		
Tree:	5	17.20%
Shrub:	6	20.70%
Vine:	1	3.40%
Forb:	7	24.10%
Grass:	2	6.90%
Sedge:	6	20.70%
Rush:	0	0%
Fern:	2	6.90%
Bryophyte:	0	0%

Documented Species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Abies balsamea</i>	balsam fir	native	3	0	perennial	tree
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Andromeda glaucophylla</i>	bog-rosemary	native	10	-5	perennial	shrub
<i>Calamagrostis canadensis</i>	blue-joint	native	3	-5	perennial	grass
<i>Carex diandra</i>	sedge	native	8	-5	perennial	sedge
<i>Carex flava</i>	sedge	native	4	-5	perennial	sedge
<i>Carex lasiocarpa</i>	sedge	native	8	-5	perennial	sedge
<i>Carex prairea</i>	sedge	native	10	-3	perennial	sedge
<i>Carex stricta</i>	sedge	native	4	-5	perennial	sedge
<i>Cirsium palustre</i>	marsh thistle	non-native	0	-3	biennial	forb
<i>Larix laricina</i>	tamarack	native	5	-3	perennial	tree
<i>Lathyrus palustris</i>	marsh pea	native	7	-3	perennial	vine
<i>Myrica gale</i>	sweet gale	native	6	-5	perennial	shrub
<i>Nuphar advena</i>	yellow pond-lily	native	8	-5	perennial	forb
<i>Onoclea sensibilis</i>	sensitive fern	native	2	-3	perennial	fern
<i>Phalaris arundinacea</i>	reed canary grass	native	0	-3	perennial	grass
<i>Picea mariana</i>	black spruce	native	6	-3	perennial	tree
<i>Rosa palustris</i>	swamp rose	native	5	-5	perennial	shrub
<i>Rubus hispidus</i>	swamp dewberry	native	4	-3	perennial	shrub
<i>Salix discolor</i>	pussy willow	native	1	-3	perennial	shrub
<i>Schoenoplectus acutus</i> ;						
<i>Scirpus a.</i>	hardstem bulrush	native	5	-5	perennial	Sedge
<i>Solidago rugosa</i>	rough-leaved goldenrod	native	3	0	perennial	Forb

<i>Spiraea alba</i>	meadowsweet	native	4	-3	perennial	Shrub
<i>Symphotrichum puniceum</i> ; <i>Aster p.</i>	swamp aster	native	5	-5	perennial	Forb
<i>Thelypteris palustris</i>	marsh fern	native	2	-3	perennial	Fern
<i>Thuja occidentalis</i>	arbor vitae	native	4	-3	perennial	Tree
<i>Typha angustifolia</i>	narrow-leaved cat-tail	non-native	0	-5	perennial	Forb
<i>Typha latifolia</i>	broad-leaved cat-tail	native	1	-5	perennial	Forb
<i>Utricularia vulgaris</i>	common bladderwort	native	6	-5	perennial	Forb



Common bladderwort in northern wet meadow. Photo by Jesse M. Lincoln.

Mesic Northern Forests

Mesic northern forests occur on moist to dry-mesic (less moist than mesic northern forest; but not dry) sites lying mostly north of the climatic tension zone. They are dominated by sugar maple and American beech, with hemlock and white pine occurring frequently as important canopy associates. Other common canopy associates include yellow birch, white ash, basswood, red oak, and northern white-cedar. The soils are typically loamy sands to sandy loams of coarse-textured ground and end moraines.

Gap-phase dynamics is the predominant natural disturbance, whereby frequent, small wind-throw gaps allow shade-tolerant seedlings to obtain light and grow to regenerate the canopy. Canopy gaps also create a heterogeneous microtopography that promotes the regeneration of yellow birch, white pine, white cedar and hemlock. These

species have small seeds that lack nutrient reserves. Hummocks and decaying logs created by windthrow provide the conditions of moisture, texture and hydrological stability that favor the germination and establishment of these small seeds.

Infrequent, catastrophic windthrow events also occur, usually with several generations of trees between events. Because these catastrophic events are rare, these forests were multi-generational and dominated huge expanses of the Great Lakes region, historically. Old-growth conditions lasted many centuries and provided critical habitat for many species. Cavity nesters, canopy dwelling species and neotropical migrants such as black-throated warbler, black-throated green warbler and scarlet tanager, thrive in large contiguous tracts of mature mesic northern forest.

Management Considerations for Biodiversity and Ecosystem Integrity

- Maintaining late successional stages of mesic northern forest is important for providing habitat for the full complement of both plant and animal species typical of this forest type. Late successional mesic forests have declined significantly in the state, due to intensive logging practices. Most northern Lower Michigan forests have lower structural, age class, micro-habitat and species diversity than were present historically.
- Sustaining mature stands increases the potential for individual disease-resistant trees to survive on the landscape. Inadvertent removal of resistant trees through some logging practices can prevent such trees from surviving through the intense disease outbreak period.
- Fragmentation of large forested areas by creating roads and openings, decreases suitable habitat for many species including neotropical migrants. It increases forest edge habitat, resulting in increased predation pressure on interior species, including bird nest parasitism by cowbirds. Fragmentation also provides pathways for plant invasions.
- Expanding forested areas at the margins and limiting fragmentation on adjacent properties, where possible, enhances interior forest habitat.
- Many of the mesic northern forests documented at Walloon Lake include a large component of maturing second growth hardwoods and several still have pockets of old growth. They retain varying levels of hemlock, white pine, and/or yellow birch and are moving along a trajectory towards late successional forest. This presents a unique opportunity to allow natural processes to continue unimpeded, ultimately increasing the array of representative

habitats and species for this natural community type.

- Avoiding logging in large contiguous mesic forest blocks in this fragmented landscape is ideal; however, if harvesting is desired, using sustainable management practices and mimicking natural disturbances (gap phase dynamics through windthrow) is optimal for sustaining diversity. It also minimizes sedimentation impacts to adjacent wetlands. Retaining conifers where they persist also provides important habitat.
- Winter harvesting can minimize localized erosion and soil compaction that impacts flora and fauna in the forest itself and in adjacent wetlands.
- Leaving dead and dying trees, particularly large-diameter snags and coarse woody debris, increases structural diversity and habitat for many species. Birds and bats require standing snags and many insects, fungi, and amphibians rely on downed wood as habitat.
- Woody debris also provides nurse logs that are important for promoting the regeneration of species such as hemlock, white pine, white cedar and yellow birch. Decaying logs provide the most suitable conditions for establishment of their small seeds.
- The abundant dead and dying ash and beech, due to emerald ash borer and beech bark disease, are contributing substantially to this habitat structure. Letting these forests adapt naturally to this disturbance, may well be best strategy at present, allowing us to learn from their adaptive Responses.
- Heavy deer browse impacts understory shrubs and herbs which alters the structure and composition of all forest strata. Invasive plants compound this impact, since deer avoid them. This puts greater herbivory pressure on native species, which are already being displaced by the invader. If current levels of deer browse continue, there is concern that over time, some native shrubs and wildflowers will face declines similar to that of yew, which has experienced dramatic reductions and near extirpation, in many areas of the state.
- Promoting predators can help reduce deer densities.
- Hydrologic alterations of wetland seeps, with mesic northern forest alters habitat, and facilitates erosion and invasion.
- Invasive plants threaten the diversity and community structure of mesic northern forests. Garlic mustard has been shown to disrupt soil fungi associated with tree roots (mycorrhizae) and may interfere with tree regeneration. Other species of concern include, multiflora rose, non-native bush honeysuckles, Japanese honey-suckle, swallow-worts, and dame’s rocket. Although not observed during surveys, common and glossy buckthorns are also of huge concern. Regular monitoring for these and other invasive species can help prevent widespread invasion.

Mesic Northern Forest Documented During 2015 Surveys.

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Ellis-Wildwood	77
Michigania	83
Indian Garden.....	90
Bois LeDuc-Boyne-Mackinac	98
North Shore.....	105

Fields Preserve Mesic Northern Forest



Photo by Jesse M. Lincoln.

Site Summary

This relatively large, closed canopy forest occurs on steep, to very steep moraine of variable aspect. Large glacial erratics are relatively frequent and the circumneutral soils are loamy sand with gravel. Seeps occur at the base of steep slopes and form deep organic deposits as groundwater emerges from the hillside. These seeps frequently form small rivulets that feed the expansive swamp to the east. The slope, aspect, and seeps influence community structure and drive diversity.

The majority of the stand is mature second growth forest (around 100 years old) with large, old (probably hemlock) stumps

scattered throughout. A small section of old growth forest persists in the far NE corner where hemlock is the dominant canopy species and most trees are likely over 200 years old. The closed canopy of mature trees offers important habitat to a range of migrating birds, including warblers and raptors. Throughout the stand are areas with pit and mound topography, alluding to historical conditions where gap-phase dynamics were the primary disturbance and contributed to topographical heterogeneity.

The northern third of the site appears to have been grazed (reportedly until 2010) and there are more non-native species and the

herbaceous layer is less diverse. The southern portion appears to have been partially thinned and there are small logging trails throughout, causing localized compaction and soil erosion. The logging operations appear not to have been very intensive and there are few invasive species.

There is abundant coarse woody debris associated with significant regional disease events. Dying trees and standing coarse woody debris serve as important habitat for birds and bats. A myriad of insects, fungi, and amphibians also rely on downed wood

and will likely benefit from the extensive tree mortality. Deer browse is intense throughout and this is likely leading to a shift towards an increased dominance by maple at all community strata. Mature stands like this also increase the potential for individual disease-resistant trees to survive on the landscape. Intensive logging can prevent such trees from surviving through the intense disease outbreak period.

A broad winged hawk was observed at the time of survey.

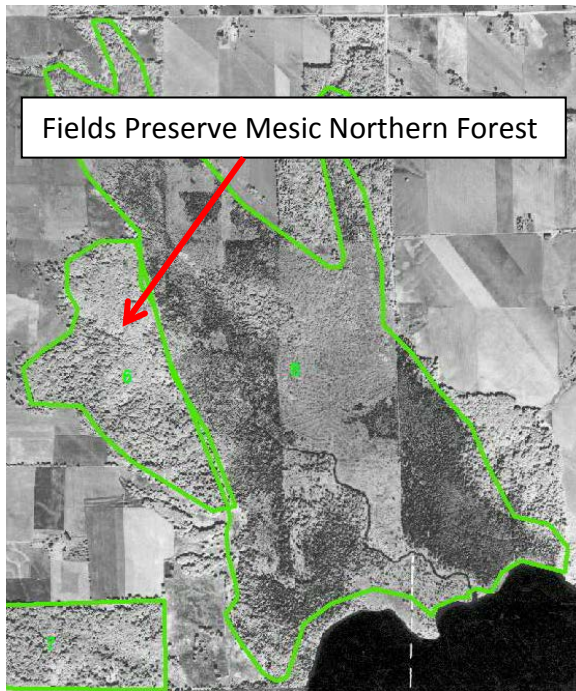


Figure 17. Fields Preserve 1938 imagery.

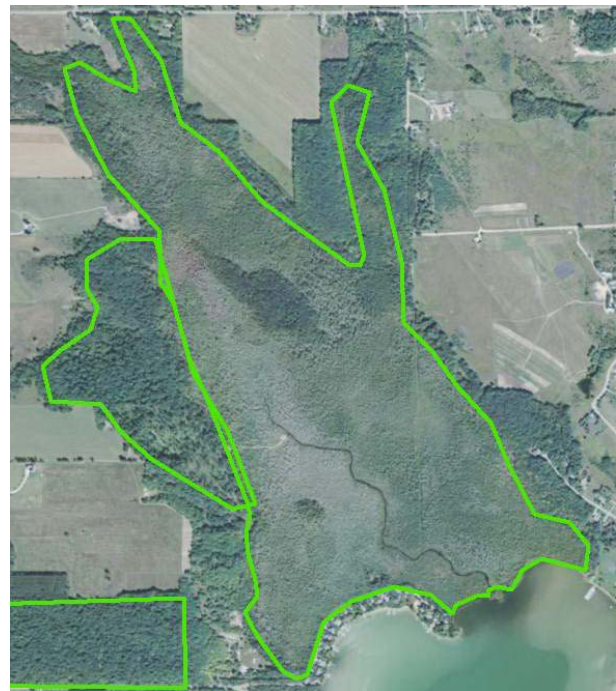


Figure 18. Fields Preserve 2012 imagery.

Vegetation

Total Species: 84; Native 71. Total FQI 33; Native FQI 35.6

The closed canopy is primarily dominated by sugar maple and beech with yellow birch, basswood, and hemlock as important canopy co-dominants. Historically, white ash and American elm were likely dominant or co-dominant. Canopy trees are generally deciduous species and typically range from 16 to 30" with second growth trees around 20" and 100 years old and old-growth over

20" and around 200 years old. A few deciduous trees may be old-growth that were left during historic logging events. Before logging, hemlock was likely a much more dominant species, based on the small patch of old growth in the far northeast portion of the stand. Catastrophic outbreaks of disease and exotic insect have removed principal canopy constituents; elm, ash, and now

beech. These are becoming relegated to the subcanopy but may persist as pathogens become integrated into the ecosystem.

Dominance of canopy and understory species shifts slightly based on topographic position and aspect with hemlock increasing in the subcanopy and understory along north-facing slopes and in wetter areas where ground water forms seeps. Sugar maple is overrepresented in the subcanopy and understory, likely as a result of intense deer pressure, but the other canopy species are important subcanopy/understory constituents along with ironwood and service-berry.

The low shrub layer is primarily composed of tree species found in the canopy, especially sugar maple and occasionally balsam fir. Shrubs are sparse and uncommon with raspberry species and gooseberry as the primary species.

The herbaceous layer ranges from sparse to dense and is characterized by sparse

graminoids, locally dominant ferns, and patchy flowering plants. Sedges and grasses include *Carex albursina*, *Carex plantaginea*, *Carex gracillima*, northern shorthusk, melic grass, and fowl manna grass. Ferns include lady fern, maidenhair fern, spinulose woodfern, rattlesnake fern, and narrow leaved spleen-wort. Common trillium (*Trillium grandiflora*), downy soloman seal, violets, enchanter's nightshade, and Canada mayflower are common forbs.

As with woody species, the distribution and abundance of herbaceous vegetation is influenced by aspect, canopy coverage, and soil moisture with the greatest coverage and diversity of plants around cold, groundwater seeps on steep hillsides. Deer herbivory is impacting many flowering plant species. This creates the potential for regional loss of characteristic species over time, as has occurred with yew across much of northern Lower Michigan.

Threats

The primary threats are intense logging pressure, deer herbivory, fragmentation and invasive species. No major plant invasions were observed; however, Japanese barberry and multiflora rose were documented. Both of these species are significant invaders elsewhere in the state. Japanese barberry is beginning to establish and spread in the watershed, particularly in wetland pockets within mesic forests. It is locally common in wetlands within the nearby Indian Garden mesic northern forest. Several source

populations for garlic mustard were also documented near Indian Garden and North Shore preserves. Other species of concern include autumn olive, multiflora rose, non-native bush honeysuckles and black locust, which were all observed nearby. Common and glossy buckthorns are also a concern, however these were not observed during surveys. See page 68 for further discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance

- *Forest of Regional Significance*
- *D-Ranked Mesic Northern Forest EO*

This is a maturing second growth forest with a history of grazing and logging. It is experiencing intense disruption from tree disease and insect outbreak, high deer

densities, and continuing forest fragmentation in adjacent properties. Despite these factors, it is a relatively large, closed canopy mature second growth forest. It harbors an

area of old-growth and has relatively high plant diversity, minimal lasting consequences from invasive plants currently, and is adjacent to a very large and relatively high-quality swamp complex. This is a regionally important stand, especially as

agriculture expands, logging activities intensify, deer densities increase, and the protracted reduction of top predators continues. It has been entered as a D-ranked occurrence in the Natural Heritage Database.



Yellow birch at Fields Preserve. Photo by Phyllis J. Higman.

Fields Preserve Mesic Northern Forest

Conservatism-Based Metrics:	
Total Mean C:	3.6
Native Mean C:	4.2
Total FQI:	33.2
Native FQI:	35.6
Adjusted FQI:	38.7
% C value 0:	18.8
% C value 1-3:	27.1
% C value 4-6:	41.2
% C value 7-10:	12.9
Native Tree Mean C:	4.6
Native Shrub Mean C:	2.7
Native Herbaceous Mean C:	4.3

Species Richness:			
Total Species:	85		
Native Species:	72	84.7%	
Non-native Species:	13	15.3%	

Species Wetness:			
Mean Wetness:	2.4		
Native Mean Wetness:	2.3		

Duration Metrics:			
Annual:	3	3.5%	
Perennial:	78	91.8%	
Biennial:	4	4.7%	
Native Annual:	2	2.4%	
Native Perennial:	69	81.2%	
Native Biennial:	1	1.2%	

Physiognomy Metrics:		
Tree:	11	12.9%
Shrub:	8	9.4%
Vine:	0	0.0%
Forb:	41	48.2%
Grass:	8	9.4%
Sedge:	11	12.9%
Rush:	0	0.0%
Fern:	6	7.1%
Bryophyte:	0	0.0%

Documented species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Abies balsamea</i>	balsam fir	native	3	0	perennial	tree
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Acer saccharum</i>	sugar maple	native	5	3	perennial	tree
<i>Achillea millefolium</i>	yarrow	native	1	3	perennial	forb
<i>Actaea pachypoda</i>	dolls-eyes	native	7	5	perennial	forb
<i>Actaea rubra</i>	red baneberry	native	7	3	perennial	forb
<i>Adiantum pedatum</i>	maidenhair fern	native	6	3	perennial	fern
<i>Allium tricoccum</i>	wild leek	native	5	3	perennial	forb
<i>Amelanchier arborea</i>	juneberry	native	4	3	perennial	tree
<i>Anaphalis margaritacea</i>	pearly everlasting	native	3	5	perennial	forb
<i>Antennaria parlinii</i>	smooth pussytoes	native	2	5	perennial	forb
<i>Aralia racemosa</i>	spikenard	native	8	3	perennial	forb
<i>Arctium minus</i>	common burdock	non-native	0	3	biennial	forb
<i>Arisaema triphyllum</i>	jack-in-the-pulpit	native	5	0	perennial	forb
<i>Asclepias exaltata</i>	poke milkweed	native	6	5	perennial	forb
<i>Athyrium filix-femina</i>	lady fern	native	4	0	perennial	fern
<i>Berberis thunbergii</i>	Japanese barberry	non-native	0	3	perennial	shrub
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Botrypus virginianus</i>	rattlesnake fern	native	5	3	perennial	fern
<i>Brachyelytrum erectum</i>	long-awned wood grass	native	7	5	perennial	grass
<i>Carex albursina</i>	sedge	native	5	5	perennial	sedge
<i>Carex arctata</i>	sedge	native	3	5	perennial	sedge
<i>Carex castanea</i>	sedge	native	6	-3	perennial	sedge

<i>Carex gracillima</i>	sedge	native	4	3	perennial	sedge
<i>Carex intumescens</i>	sedge	native	3	-3	perennial	sedge
<i>Carex laxiflora</i>	sedge	native	8	0	perennial	sedge
<i>Carex pedunculata</i>	sedge	native	5	3	perennial	sedge
<i>Carex plantaginea</i>	sedge	native	8	5	perennial	sedge
<i>Carex rosea; C. convoluta</i>	curly-styled wood sedge	native	2	5	perennial	sedge
<i>Carex scabrata</i>	sedge	native	4	-5	perennial	sedge
<i>Caulophyllum thalictroides</i>	blue cohosh	native	5	5	perennial	forb
<i>Circaea canadensis; C. lutetiana</i>	enchanters-nightshade	native	2	3	perennial	forb
<i>Cirsium vulgare</i>	bull thistle	non-native	0	3	biennial	forb
<i>Clinopodium vulgare</i>	wild-basil	native	3	5	perennial	forb
<i>Cornus alternifolia</i>	alternate-leaved dogwood	native	5	3	perennial	tree
<i>Dactylis glomerata</i>	orchard grass	non-native	0	3	perennial	grass
<i>Danthonia spicata</i>	poverty grass; oatgrass	native	4	5	perennial	grass
<i>Daucus carota</i>	Queen-Anne's-lace	non-native	0	5	biennial	forb
<i>Dichanthelium implicatum; Panicum i.</i>	panic grass	native	3	0	perennial	grass
<i>Dryopteris carthusiana</i>	spinulose woodfern	native	5	-3	perennial	fern
<i>Elymus hystrix; Hystrix patula</i>	bottlebrush grass	native	5	3	perennial	grass
<i>Epipactis helleborine</i>	helleborine	non-native	0	0	perennial	forb
<i>Erigeron philadelphicus</i>	Philadelphia fleabane	native	2	0	perennial	forb
<i>Fagus grandifolia</i>	American beech	native	6	3	perennial	tree
<i>Fraxinus americana</i>	white ash	native	5	3	perennial	tree
<i>Galium circaezans</i>	white wild licorice	native	4	3	perennial	forb
<i>Gaultheria procumbens</i>	wintergreen	native	5	3	perennial	shrub
<i>Geranium robertianum</i>	herb robert	native	3	3	annual	forb
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Hackelia virginiana</i>	beggars lice	native	1	3	biennial	forb
<i>Hepatica acutiloba</i>	sharp-lobed hepatica	native	8	5	perennial	forb
<i>Hieracium piloselloides</i>	king devil	non-native	0	5	perennial	forb
<i>Homalosorus pycnocarpus</i>	narrow-leaved spleenwort	native	10	0	perennial	fern
<i>Hypericum perforatum</i>	common St. johns-wort	non-native	0	5	perennial	forb
<i>Impatiens capensis</i>	spotted touch-me-not	native	2	-3	annual	forb
<i>Lapsana communis</i>	nipplewort	non-native	0	3	annual	forb
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Maianthemum racemosum; Smilacina r.</i>	false spikenard	native	5	3	perennial	forb
<i>Medeola virginiana</i>	Indian cucumber-root	native	10	3	perennial	forb
<i>Melica smithii</i>	melic grass	native	7	5	perennial	grass
<i>Osmorhiza longistylis</i>	smooth sweet-cicely	native	3	3	perennial	forb
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	native	5	3	perennial	tree
<i>Oxalis stricta; O. fontana</i>	yellow wood-sorrel	native	0	3	perennial	forb
<i>Poa compressa</i>	Canada bluegrass	non-native	0	3	perennial	grass

<i>Polygonatum pubescens</i>	downy solomon seal	native	5	5	perennial	forb
<i>Pteridium aquilinum</i>	bracken fern	native	0	3	perennial	fern
<i>Ranunculus abortivus</i>	small-flowered buttercup	native	0	0	perennial	forb
<i>Ranunculus hispidus</i>	swamp buttercup	native	5	0	perennial	forb
<i>Ribes cynosbati</i>	prickly or wild gooseberry	native	4	3	perennial	shrub
<i>Rosa multiflora</i>	multiflora rose	non-native	0	3	perennial	shrub
<i>Rubus allegheniensis</i>	common blackberry	native	1	3	perennial	shrub
<i>Rubus occidentalis</i>	black raspberry	native	1	5	perennial	shrub
<i>Rubus strigosus</i>	wild red raspberry	native	2	0	perennial	shrub
<i>Rumex crispus</i>	curly dock	non-native	0	0	perennial	forb
<i>Sambucus racemosa</i>	red-berried elder	native	3	3	perennial	shrub
<i>Solidago caesia</i>	bluestem goldenrod	native	6	3	perennial	forb
<i>Symphotrichum urophyllum</i> ; <i>Aster sagittifolius</i>	arrow-leaved aster	native	2	5	perennial	forb
<i>Taraxacum officinale</i>	common dandelion	non-native	0	3	perennial	forb
<i>Tilia americana</i>	basswood	native	5	3	perennial	tree
<i>Trientalis borealis</i>	star-flower	native	5	0	perennial	forb
<i>Trillium grandiflorum</i>	common trillium	native	5	3	perennial	forb
<i>Tsuga canadensis</i>	hemlock	native	5	3	perennial	tree
<i>Viola pubescens</i>	yellow violet	native	4	3	perennial	forb
<i>Viola sororia</i>	common blue violet	native	1	0	perennial	forb



Yellow violet at Fields Preserve. Photo by Phyllis J. Higman.

Ellis-Wildwood Mesic Northern Forest



Photo by Jesse M. Lincoln.

Site Summary

This site is comprised of two polygons of closed canopy forest on steep, to very steep moraine of variable aspect. Within this system, glacial erratics are relatively frequent and the circumneutral soils are loamy sand with gravel. Areas of increased soil moisture occur at the base of steep slopes. The slope, aspect, and soil moisture influence community structure and drive diversity.

The majority of the stand is mature and maturing second growth forest, around 100-115 years old. The closed canopy of mature trees offers important habitat to a range of migrating birds, including warblers and

raptors. Throughout the stand are areas with pit and mound topography, alluding to historical conditions where gap-phase dynamics was the primary disturbance and contributed to topographical heterogeneity. It seems likely that portions have been grazed and portions have been selectively logged. Big toothed aspen is more dominant in areas that were partially logged. South facing slopes and areas that were more recently logged have a much lower herbaceous diversity.

There is abundant coarse woody debris associated with significant regional disease events. Ash was about 20-30% of the

canopy until very recently; most are dead but some are still standing. Dying trees and standing coarse woody debris serve as important habitat for birds and bats. A myriad of insects, fungi, and amphibians also rely on downed wood and will likely benefit from the extensive tree mortality.

Deer browse is intense throughout and this is likely leading to a shift towards an

increased dominance by maple at all community strata. Mature stands like this increase the potential for resistant individuals of tree disease to survive on the landscape. Inadvertent removal of resistant trees by removing them from the forest may prevent them from surviving through the intense disease outbreak period.

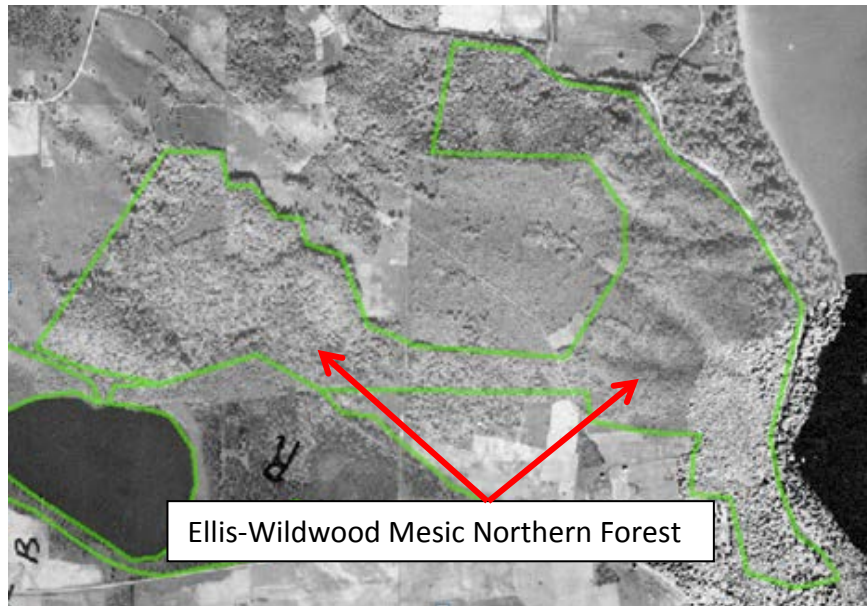


Figure 19. Ellis-Wildwood 1938 imagery.



Figure 20. Ellis-Wildwood 2012 imagery.

Vegetation

Total species: 57, Native 56. Total FQI 34; Native FQI 33.4

The closed canopy is primarily dominated by sugar maple with beech, yellow birch, basswood, and red oak as occasional canopy co-dominants. Historically, white ash and American elm were likely dominant or co-dominant, and some elm remains in the canopy. Canopy trees are generally deciduous species and typically range from 16 to 25" with second growth trees around 20" and 90 to 115 years old. A few deciduous trees may be old-growth trees that were left during historic logging events. Before logging, hemlock was likely a much more dominant species, based on its prevalence in the surrounding areas. White pine, characteristic of this community type was not observed.

Catastrophic outbreaks of disease and exotic insect have removed principal canopy constituents; elm, ash, and now beech. These are becoming relegated to the subcanopy but may persist as pathogens/parasites become integrated into the system over time. Sugar maple is overrepresented in all strata, likely as a result of intense deer pressure, but the other canopy species are important subcanopy/understory constituents along with ironwood, black cherry, hemlock, white pine, and striped maple.

The low shrub layer is primarily composed of tree species found in the canopy, especially sugar maple. Shrubs are sparse and uncommon with gooseberry and

elderberry as the primary shrub species. The herbaceous layer ranges from sparse in younger areas to dense in more intact areas and north-facing slopes.

The herb layer and is characterized by sparse graminoids, locally dominant ferns, and patchy flowering plants. Common sedges included *Carex albursina*, *Carex laxiflora*, *Carex pedunculata*, *Carex plantaginea* and *Carex gracillima*. Grasses include melic grass, rough-leaved rice-grass, wood millet, rice grass, and fowl manna grass. Lady fern, maidenhair fern, rattlesnake fern and narrow-leaved spleenwort were the most common ferns. Flowering plants included trillium, blue cohosh, downy soloman seal, wild sarsaparilla, violets, sweet cicely, wild leek, and enchanter's nightshade, bluestem goldenrod and Canada mayflower.

As with woody species, the distribution and abundance of herbaceous vegetation is influenced by aspect, canopy coverage, and soil moisture, with the greatest coverage and diversity of plants around areas of saturated soil and on steep, particularly north-facing, hillsides. Many of the flowering plants are seriously impacted by deer herbivory. This creates the potential for regional loss of characteristic species over time, as has occurred with yew across much of northern Lower Michigan.

Threats

Key threats at this site include intense logging and grazing, local dumping and high deer herbivory. Currently there are very few invasive plants, having almost no impact. Species of concern in adjacent lands include autumn olive, Japanese barberry, multiflora rose, non-native bush honeysuckles and

black locust, none of which were observed in the forest. Common and glossy buckthorns are also a concern, however these were not observed during surveys. See page 68 for further discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance

- *Forest of Regional Significance*
- *D-Ranked Mesic Northern Forest EO*

This site contains two blocks of mature and maturing second growth forest with a history of grazing and logging. The forest is experiencing intense disruption from tree disease and insect outbreak, high deer densities, and forest fragmentation along the edges. Despite these factors, these two areas form a relatively large, closed-canopy, mostly mature, second-growth forest. It has relatively high plant diversity, minimal invasive plants, and is close to two relatively high-quality forested wetlands along Lake

Evangeline. This qualifies it for EO status as a D-ranked mesic northern forest.

This site is regionally important, due to the abundant habitat it provides for a range of bats and migrating birds, including warblers and raptors, as well as insects, fungi, and amphibians.

Maintaining natural cover on these steep slopes is important for water quality in surrounding wetlands as this area would be a major input of storm water runoff if it were denuded.



Photo by Phyllis J. Higman.

Ellis-Wildwood Mesic Northern Forest

Conservatism-Based Metrics:	
Total Mean C:	4.5
Native Mean C:	4.5
Total FQI:	33.7
Native FQI:	33.4
Adjusted FQI:	44.6
% C value 0:	7.1
% C value 1-3:	17.9
% C value 4-6:	58.9
% C value 7-10:	16.1
Native Tree Mean C:	4.3
Native Shrub Mean C:	3.5
Native Herbaceous Mean C:	4.7

Species Richness:			
Total Species:	56		
Native Species:	55	98.2%	
Non-native Species:	1	1.8%	

Species Wetness:			
Mean Wetness:	2.3		
Native Mean Wetness:	2.4		

Duration Metrics:			
Annual:	1	1.8%	
Perennial:	54	96.4%	
Biennial:	1	1.8%	
Native Annual:	1	1.8%	
Native Perennial:	53	94.6%	
Native Biennial:	1	1.8%	

Physiognomy Metrics:			
Tree:	12	21.4%	
Shrub:	2	3.6%	
Vine:	0	0.0%	
Forb:	25	44.6%	
Grass:	5	8.9%	
Sedge:	6	10.7%	
Rush:	0	0.0%	
Fern:	6	10.7%	
Bryophyte			
:	0	0.0%	

Documented Species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Acer pensylvanicum</i>	striped maple	native	5	3	perennial	tree
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Acer saccharum</i>	sugar maple	native	5	3	perennial	tree
<i>Actaea pachypoda</i>	dolls-eyes				perennial	forb
<i>Adiantum pedatum</i>	maidenhair fern	native	6	3	perennial	fern
<i>Allium tricoccum</i>	wild leek	native	5	3	perennial	forb
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	forb
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	native	5	0	perennial	forb
<i>Athyrium filix-femina</i>	lady fern	native	4	0	perennial	fern
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Botrypus virginianus</i>	rattlesnake fern	native	5	3	perennial	fern
<i>Carex albursina</i>	Sedge	native	5	5	perennial	sedge
<i>Carex cephalophora</i>	Sedge	native	3	3	perennial	sedge
<i>Carex laxiflora</i>	Sedge	native	8	0	perennial	sedge
<i>Carex pedunculata</i>	Sedge	native	5	3	perennial	sedge
<i>Carex pensylvanica</i>	Sedge	native	4	5	perennial	sedge
<i>Carex plantaginea</i>	Sedge	native	8	5	perennial	sedge
<i>Caulophyllum thalictroides</i>	blue cohosh	native	5	5	perennial	forb
<i>Circaea canadensis</i> ; <i>C. lutetiana</i>	enchanters-nightshade	native	2	3	perennial	forb
<i>Dryopteris intermedia</i>	evergreen woodfern	native	5	0	perennial	fern
<i>Epipactis helleborine</i>	Helleborine	non-native	0	0	perennial	forb
<i>Fagus grandifolia</i>	American beech	native	6	3	perennial	tree
<i>Fraxinus americana</i>	white ash	native	5	3	perennial	tree
<i>Galium circaezans</i>	white wild licorice	native	4	3	perennial	forb
<i>Geranium robertianum</i>	herb Robert	native	3	3	annual	forb

<i>Geum canadense</i>	white avens	native	1	0	perennial	forb
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Hackelia virginiana</i>	beggars lice	native	1	3	biennial	forb
<i>Hepatica acutiloba</i>	sharp-lobed hepatica	native	8	5	perennial	forb
<i>Heuchera americana</i>	alum root	native	8	3	perennial	forb
<i>Homalosorus pycnocarpus</i>	narrow-leaved spleenwort	native	10	0	perennial	fern
<i>Laportea canadensis</i>	wood nettle	native	4	-3	perennial	forb
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Maianthemum racemosum</i> ; <i>Smilacina r.</i>	false spikenard	native	5	3	perennial	forb
<i>Melica smithii</i>	melic grass	native	7	5	perennial	grass
<i>Milium effusum</i>	wood millet	native	8	3	perennial	grass
<i>Monotropa uniflora</i>	Indian-pipe	native	5	3	perennial	forb
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	native	6	5	perennial	grass
<i>Osmorhiza claytonii</i>	hairy sweet-cicely	native	4	3	perennial	forb
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	native	5	3	perennial	tree
<i>Piptatherum racemosum</i> ; <i>Oryzopsis r.</i>	rice-grass	native	8	5	perennial	grass
<i>Plantago rugelii</i>	red-stalked plantain	native	0	0	perennial	forb
<i>Polygonatum pubescens</i>	downy solomon seal	native	5	5	perennial	forb
<i>Prunella vulgaris</i>	self-heal	native	0	0	perennial	forb
<i>Prunus serotina</i>	wild black cherry	native	2	3	perennial	tree
<i>Pteridium aquilinum</i>	bracken fern	native	0	3	perennial	fern
<i>Quercus rubra</i>	red oak	native	5	3	perennial	tree
<i>Ribes cynosbati</i>	prickly or wild gooseberry	native	4	3	perennial	shrub
<i>Sambucus racemosa</i>	red-berried elder	native	3	3	perennial	shrub
<i>Solidago caesia</i>	bluestem goldenrod	native	6	3	perennial	forb
<i>Tilia americana</i>	Basswood	native	5	3	perennial	tree
<i>Trillium grandiflorum</i>	common trillium	native	5	3	perennial	forb
<i>Tsuga canadensis</i>	Hemlock	native	5	3	perennial	tree
<i>Ulmus americana</i>	American elm	native	1	-3	perennial	tree
<i>Viola canadensis</i>	Canada violet	native	5	3	perennial	forb
<i>Viola pubescens</i>	yellow violet	native	4	3	perennial	forb
<i>Viola sororia</i>	common blue violet	native	1	0	perennial	forb



Photo by Jesse M. Lincoln.

Michigan Mesic Northern Forest



Photo by Phyllis J. Higman

Site Summary

This relatively large, previously closed canopy forest occurs on steep, to very steep moraine of variable aspect. Large glacial erratics are relatively frequent and the circumneutral soils are loamy sand with gravel. Seeps occur at the base of steep slopes, particularly along the lake. Deep organic deposits form here as groundwater emerges from the hillside. These seeps frequently form small rivulets that run to the lake.

The slope, aspect, and seeps influence community structure and drive diversity. The majority of the stand is mature second or third growth forest with large, old,

probably hemlock stumps scattered throughout.

A small section of old growth forest persists in the far NE corner where hemlock is the dominant canopy species and most trees are likely over 200 years old. Here a 23.5" white cedar along the lake was aged to 251. Typically, the closed canopy would offer important habitat to a range of migrating birds, including warblers and raptors. However, recent logging has significantly reduced the canopy and increased the probability of nest parasitism from brown-headed cowbirds.

Throughout the stand are areas with pit and mound topography, alluding to historical conditions where gap-phase dynamics were the primary disturbance and contributed to topographical heterogeneity. The two large blocks of forest have been partially thinned on multiple occasions and there are small logging trails throughout, causing localized compaction, soil erosion, and avenues for invasion of non-native plants.

The southern block has a relatively nice patch of forest where red maple is more

dominant as a result of wet soils. This area has the best potential for vernal pools, and a red shouldered hawk was observed here.

Throughout, dying trees and standing coarse woody debris serve as important habitat for birds and bats. A myriad of insects, fungi, and amphibians also rely on downed wood and will likely benefit from the extensive tree mortality. Deer browse is intense throughout and this is likely leading to a shift towards an increased dominance by maple at all community strata.

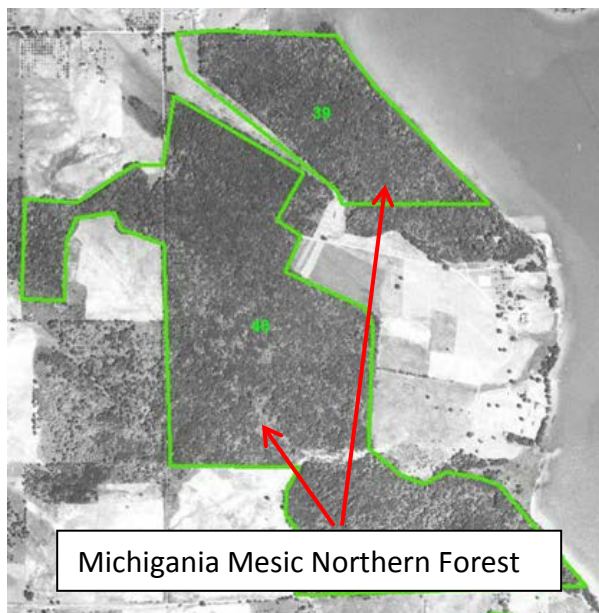


Figure 22. Michiganiana 1938 imagery.



Figure 23. Michiganiana 2012 imagery.

Vegetation

Total species 94, Native 72. Total FQI 30.5, Native FQI 34.8.

Where the forest is intact, the closed canopy is primarily dominated by sugar maple and beech with yellow birch, basswood, and hemlock as important canopy co-dominants. Historically, white ash and American elm were likely dominant or co-dominant. Along the lake, north of the camp, the canopy is characterized by hemlock, white cedar, and yellow birch, with sugar maple and beech increasing. Canopy trees are generally deciduous species and typi-

cally range from 16 to 30" with second growth trees less than 20" and 100 years old and old-growth over 20" and around 200 years old. Before logging, hemlock was likely a much more dominant species. Catastrophic outbreaks of disease and exotic insect have removed principal canopy constituents; elm, ash, and now beech. These are becoming relegated to the subcanopy but may persist as the pathogens integrate into the ecosystem over time.

Dominance of canopy and understory species shifts slightly based on topographic position and aspect with hemlock increasing in the subcanopy and understory along north-facing slopes and in wetter areas where ground water forms seeps. Where recent logging events have occurred, aspen is dominant or at least co-dominant in the canopy. Sugar maple is over-represented in the subcanopy and understory, likely as a result of intense deer pressure, but the other canopy species, beech, yellow birch, basswood and hemlock are important sub-canopy/understory constituents along with ironwood and serviceberry.

The low shrub layer is primarily composed of tree species found in the canopy, especially sugar maple and occasionally balsam fir. Shrubs are sparse and uncom-

Primary threats include deer herbivory, fragmentation and invasive species. The current logging has created increased avenues for invasion by non-native plants. Although mostly weedy species have established thus far, there is an increased likelihood for more serious invasions to occur. Species of concern include garlic mustard, spotted knapweed, autumn olive,

mon, with raspberry species and gooseberry as the primary shrub species. As with woody species, distribution and abundance of herbaceous vegetation is influenced by aspect, canopy coverage, and soil moisture with the greatest coverage and diversity of plants around cold, groundwater seeps on steep hillsides.

Deer herbivory is impacting many flowering plant species. This creates the potential for regional loss of characteristic species over time, as has occurred with yew across much of northern Lower Michigan. Generally, there is very low herbaceous diversity and non-natives are particularly abundant around logged areas, including Kentucky bluegrass, clover, mullein, chickweed, orchard grass, and others.

Threats

Japanese barberry, multiflora rose, non-native bush honeysuckles and black locust, all of which occur in the region. Common and glossy buckthorns are also of concern, however these were not observed during surveys. See page 68 for further discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance

▪ *Forest of Regional Significance*

This is a second or third growth forest that has been repeatedly impacted with selective logging. It is also experiencing intense disruption from tree disease, and high deer herbivory. Currently, it is likely acting as a sink to neotropical migrants due to fragmentation of the canopy. It does not qualify for inclusion in the Natural Heritage Database as an exemplary occurrence of historic mesic northern forest conditions. There is a small area of old-growth along the lake which is more representative of

historical conditions; however, the majority of the forest will have impacts for a long time to come.

Nevertheless, this forest is a significantly large block of contiguous forest that provides habitat for many species, and serves as a buffer to Walloon Lake that helps sustain water quality. It could eventually represent a regionally important natural area in the decades to come if it can be protected from deer herbivory and invasive species.



Disturbance in Michiganian mesic northern forest that would benefit from monitoring for invasive species. Photos by Jesse M. Lincoln.



A pocket of conifers along the Walloon Lake shoreline in Michiganian mesic northern forest. Photo by Jesse M. Lincoln.

Michigania Mesic Northern Forest FQA

Conservatism-Based Metrics:	
Total Mean C:	3.2
Native Mean C:	4.1
Total FQI:	30.5
Native FQI:	34.8
Adjusted FQI:	36.5
% C value 0:	25.3
% C value 1-3:	23.1
% C value 4-6:	42.9
% C value 7-10:	8.8
Native Tree Mean C:	4.5
Native Shrub Mean C:	1.5
Native Herbaceous Mean C:	4.1

Species Richness:		
Total Species:	91	
Native Species:	72	79.1%
Non-native Species:	19	20.9%

Species Wetness:		
Mean Wetness:	1.2	
Native Mean Wetness:	0.8	

Duration Metrics:		
Annual:	2	2.2%
Perennial:	84	92.3%
Biennial:	5	5.5%
Native Annual:	2	2.2%
Native Perennial:	69	75.8%
Native Biennial:	1	1.1%

Physiognomy Metrics:		
Tree:	11	12.1%
Shrub:	2	2.2%
Vine:	2	2.2%
Forb:	42	46.2%
Grass:	12	13.2%
Sedge:	13	14.3%
Rush:	0	0.0%
Fern:	9	9.9%
Bryophyte:	0	0.0%

Documented Species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Acer pensylvanicum</i>	striped maple	native	5	3	perennial	tree
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Acer saccharum</i>	sugar maple	native	5	3	perennial	tree
<i>Adiantum pedatum</i>	maidenhair fern	native	6	3	perennial	fern
<i>Allium tricoccum</i>	wild leek	native	5	3	perennial	forb
<i>Anaphalis margaritacea</i>	pearly everlasting	native	3	5	perennial	forb
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	forb
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	native	5	0	perennial	forb
<i>Asclepias exaltata</i>	poke milkweed	native	6	5	perennial	forb
<i>Asclepias syriaca</i>	common milkweed	native	1	5	perennial	forb
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Carex albursina</i>	sedge	native	5	5	perennial	sedge
<i>Carex arctata</i>	sedge	native	3	5	perennial	sedge
<i>Carex capillaris</i>	sedge	native	9	-3	perennial	sedge
<i>Carex cephaloidea</i>	sedge	native	5	3	perennial	sedge
<i>Carex gracillima</i>	sedge	native	4	3	perennial	sedge
<i>Carex intumescens</i>	sedge	native	3	-3	perennial	sedge
<i>Carex pedunculata</i>	sedge	native	5	3	perennial	sedge
<i>Carex plantaginea</i>	sedge	native	8	5	perennial	sedge
<i>Carex radiata; C. rosea</i>	straight-styled wood sedge	native	2	0	perennial	sedge
<i>Carex scabrata</i>	sedge	native	4	-5	perennial	sedge
<i>Carex sparganioides</i>	sedge	native	5	3	perennial	sedge
<i>Carex stipata</i>	sedge	native	1	-5	perennial	sedge

<i>Carex vulpinoidea</i>	sedge	native	1	-5	perennial	sedge
<i>Caulophyllum thalictroides</i>	blue cohosh	native	5	5	perennial	forb
<i>Centaurea stoebe</i> ; <i>C. maculosa</i>	spotted knapweed	non-native	0	5	biennial	forb
<i>Cerastium fontanum</i>	mouse-ear chickweed	non-native	0	3	perennial	forb
<i>Cinna latifolia</i>	wood reedgrass	native	5	-3	perennial	grass
<i>Circaea alpina</i>	small enchanters-nightshade	native	4	-3	perennial	forb
<i>Circaea canadensis</i> ; <i>C. lutetiana</i>	enchanters-nightshade	native	2	3	perennial	forb
<i>Cirsium palustre</i>	marsh thistle	non-native	0	-3	biennial	forb
<i>Cirsium vulgare</i>	bull thistle	non-native	0	3	biennial	forb
<i>Convolvulus arvensis</i>	field bindweed	non-native	0	5	perennial	vine
<i>Dactylis glomerata</i>	orchard grass	non-native	0	3	perennial	grass
<i>Dichanthelium implicatum</i> ; <i>Panicum i.</i>	panic grass	native	3	0	perennial	grass
<i>Dryopteris carthusiana</i>	spinulose woodfern	native	5	-3	perennial	fern
<i>Elymus repens</i> ; <i>Agropyron r.</i>	quack grass	non-native	0	3	perennial	grass
<i>Epifagus virginiana</i>	beech-drops	native	10	5	annual	forb
<i>Epipactis helleborine</i>	helleborine	non-native	0	0	perennial	forb
<i>Equisetum arvense</i>	common horsetail	native	0	0	perennial	fern
<i>Equisetum scirpoides</i>	dwarf scouring rush	native	7	0	perennial	fern
<i>Fagus grandifolia</i>	American beech	native	6	3	perennial	tree
<i>Fragaria virginiana</i>	wild strawberry	native	2	3	perennial	forb
<i>Fraxinus americana</i>	white ash	native	5	3	perennial	tree
<i>Galium circaezans</i>	white wild licorice	native	4	3	perennial	forb
<i>Geranium robertianum</i>	herb robert	native	3	3	annual	forb
<i>Glyceria grandis</i>	reed manna grass	native	6	-5	perennial	grass
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Gymnocarpium dryopteris</i>	oak fern	native	5	3	perennial	fern
<i>Hackelia virginiana</i>	beggars lice	native	1	3	biennial	forb
<i>Hypericum perforatum</i>	common St. Johns-wort	non-native	0	5	perennial	forb
<i>Iris virginica</i>	southern blue flag	native	5	-5	perennial	forb
<i>Juncus torreyi</i>	Torreys rush	native	4	-3	perennial	forb
<i>Leonurus cardiaca</i>	motherwort	non-native	0	5	perennial	forb
<i>Lycopus uniflorus</i>	northern bugle weed	native	2	-5	perennial	forb
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Melica smithii</i>	melic grass	native	7	5	perennial	grass
<i>Mentha canadensis</i> ; <i>M. arvensis</i>	wild mint	native	3	-3	perennial	forb
<i>Milium effusum</i>	wood millet	native	8	3	perennial	grass
<i>Myosotis scorpioides</i>	forget-me-not	non-native	0	-5	perennial	forb
<i>Onoclea sensibilis</i>	sensitive fern	native	2	-3	perennial	fern
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	native	6	5	perennial	grass
<i>Osmorhiza claytonii</i>	hairy sweet-cicely	native	4	3	perennial	forb
<i>Osmunda cinnamomea</i>	cinnamon fern	native	5	-3	perennial	fern

<i>Osmunda regalis</i>	royal fern	native	5	-5	perennial	fern
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	native	5	3	perennial	tree
<i>Oxalis stricta; o. fontana</i>	yellow wood-sorrel	native	0	3	perennial	forb
<i>Phleum pratense</i>	timothy	non-native	0	3	perennial	grass
<i>Plantago rugelii</i>	red-stalked plantain	native	0	0	perennial	forb
<i>Poa compressa</i>	Canada bluegrass	non-native	0	3	perennial	grass
<i>Populus grandidentata</i>	big-tooth aspen	native	4	3	perennial	tree
<i>Potentilla simplex</i>	old-field cinquefoil	native	2	3	perennial	forb
<i>Prunus serotina</i>	wild black cherry	native	2	3	perennial	tree
<i>Pyrola americana; P. rotundifolia</i>	round-leaved pyrola	native	7	0	perennial	forb
<i>Ranunculus abortivus</i>	small-flowered buttercup	native	0	0	perennial	forb
<i>Rubus occidentalis</i>	black raspberry	native	1	5	perennial	shrub
<i>Rubus strigosus</i>	wild red raspberry	native	2	0	perennial	shrub
<i>Rumex crispus</i>	curly dock	non-native	0	0	perennial	forb
<i>Silene vulgaris</i>	bladder campion	non-native	0	5	perennial	forb
<i>Solanum dulcamara</i>	bittersweet nightshade	non-native	0	0	perennial	vine
<i>Solidago caesia</i>	bluestem goldenrod	native	6	3	perennial	forb
<i>Sphenopholis intermedia</i>	slender wedgegrass	native	4	0	perennial	grass
<i>Symphyotrichum puniceum; Aster p.</i>	swamp aster	native	5	-5	perennial	forb
<i>Thelypteris noveboracensis</i>	New York fern	native	5	0	perennial	fern
<i>Thuja occidentalis</i>	arbor vitae	native	4	-3	perennial	tree
<i>Trifolium pratense</i>	red clover	non-native	0	3	perennial	forb
<i>Trifolium repens</i>	white clover	non-native	0	3	perennial	forb
<i>Trillium grandiflorum</i>	common trillium	native	5	3	perennial	forb
<i>Tsuga canadensis</i>	hemlock	native	5	3	perennial	tree
<i>Typha latifolia</i>	broad-leaved cat-tail	native	1	-5	perennial	forb
<i>Verbascum densiflorum</i>	mullein	non-native	0	5	biennial	forb



Huge ash stump at Michiganian mesic northern forest.

Indian Garden Mesic Northern Forest



Photo by Phyllis J. Higman.

Site Summary

This site occurs on end moraine with steep to very steep slopes and variable aspect, along the eastern portion of the peninsula that forms the two arms of Walloon Lake. It is an elongate band of closed canopy forest that narrows northward, capturing the bulk of the remaining contiguous forest in this area. There is some forest buffer along the perimeter, with lake residences backing up to the eastern border and some fingers of residential development occurring on the west side. In several places, old fields lie directly adjacent to the border.

The majority of the forest is mature or maturing second growth with many large diameter trees including occasional old-

growth trees, primarily beech, maple, hemlock and red oak. Huge, old stumps from the early historical logging era were observed and there was only minor evidence of more recent logging. Soils are circum-neutral loamy sands with gravel; moisture increases towards the base of the slopes. There are scattered wetland pockets and several streams at the bases of the steep slopes.

Pit and mound topography dominate the site, creating topographic heterogeneity that combines with slope, aspect and soil moisture, to influence the array of species and structure of the forest. The closed canopy of mature trees provides important

habitat for a range of migrating birds, including warblers and raptors. The widespread loss of ash and beech has created an unusual amount of canopy gaps. These dead and dying trees contribute to the

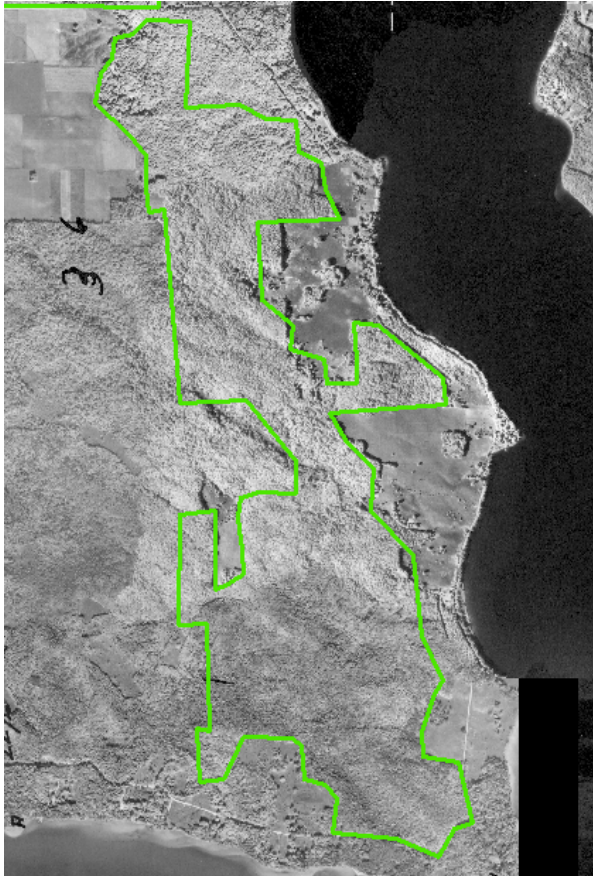


Figure 23. Indian Garden 1938 imagery.

abundant coarse woody debris and snags that are characteristic of this natural community type, and provide critical habitat for many small mammals, insects, fungi and amphibians.



Figure 24. Indian Garden 2012 imagery.

Vegetation

Total species 166; Native 145. Total FQI 40.2; Native FQI 51.8

The canopy is primarily dominated by sugar maple with beech, red oak, basswood hemlock and white pine as occasional co-dominants. Red oak is locally dominant in some areas. Standing dead and downed ash is evidence of its presence as a major canopy dominant prior to invasion by the emerald ash borer. Most beech are still standing, but are diseased and dying. Occasional oak, hemlock, beech and yellow birch are old-growth trees left from historic logging events. The understory is primarily beech,

with some sugar maple, black cherry, ironwood, striped maple, hemlock and yellow birch. Shrubs were encountered infrequently, including prickly gooseberry and red-berried elder.

The herbaceous layer is generally rich, driven by the canopy coverage, soil moisture gradients and aspect. It is characterized by several common sedges, grasses and ferns, and an abundance of forbs. *Carex albursina*, *Carex plantaginea*, and *Carex pedunculata* are locally common. Melic grass, rice grass,

rough-leaved rice grass, wood millet are patchy, but wide-spread. Lady fern, maiden-hair fern, and woodferns are scattered locally. Spring ephemerals include wild leeks, spring beauty, Dutchmans-breeches, squirrel corn, trout-lily, common trillium, downy soloman seal, and Canada, yellow and long-spurred violets. Blue cohosh, doll's eyes, bellflower, sweet cicely, bluestem goldenrod, and Canada mayflower were also common.

Few invasive plants were observed in the forest; however, several garlic mustard plants were pulled along the main trail leading from the parking area, and a source infestation was documented on Resort Pike Road. Periwinkle and forget-me-not are

Primary threats include fragmentation, deer herbivory and invasive species. The few garlic mustard plants observed in 2015, pose what is likely the greatest current threat to this forest. This species has the potential to devastate the rich flora at the site, and impair tree regeneration. Deer preferentially avoid garlic mustard, which puts even greater pressure on the native species because deer browse them instead. Japanese barberry has established in the wet seeps and

slowly creeping into the Indian Garden Preserve near the parking area.

Wetland pockets are sparsely populated by dead black ash, red maple and elm with sedges grasses and ferns dominating the ground layer. These include *Carex prasina*, *Carex scabrata*, fowl manna grass, cinnamon fern, crested shield fern and sensitive fern. Additional forbs included enchanter's nightshade, skullcaps, touch-me-not, willowherb and naked miterwort. Water pennywort and toothwort were common occurrences along the creeks. At least one wetland was invaded by a carpet of forget-me-not and scattered Japanese barberry.

Threats

will spread without treatment. Other species of concern include multiflora rose, non-native bush honeysuckles, autumn olive and black locust, all of which were observed nearby. Common and glossy buckthorns are also of concern, however, these were not observed during surveys. See page 68 for further discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance

- *Forest of Regional Significance*
- *C-ranked mesic northern forest EO*

This maturing second growth forest has a nice representation of community structure and species. There is significant disruption from tree disease and high deer densities, but only minor fragmentation by adjacent land uses. It captures the remaining intact natural forest in this area in one contiguous swath forming a large, closed-canopy forest with significant interior forest habitat.

It is regionally important, contributing to local ecological diversity and the natural

character of the region. The natural cover on the steep slopes is important for sustaining water quality in the region, by preventing significant inputs of storm water runoff.

Site heterogeneity and plant diversity are high, impacts from invasive plants are minimal, and it is largely driven by natural processes. For these reasons combined, it was entered as a C-ranked EO in Michigan's Natural Heritage database.

Indian Garden Mesic Northern Forest FQA

Conservatism-Based Metrics:	
Total Mean C:	3.8
Native Mean C:	4.3
Total FQI:	49
Native FQI:	51.8
Adjusted FQI:	40.2
% C value 0:	15.7
% C value 1-3:	27.7
% C value 4-6:	44.6
% C value 7-10:	12
Native Tree Mean C:	4.2
Native Shrub Mean C:	3.8
Native Herbaceous Mean C:	4.4

Species Richness:		
Total Species:	166	
Native Species:	145	87.3%
Non-native Species:	21	12.7%

Species Wetness:		
Mean Wetness:	1.4	
Native Mean Wetness:	1.1	

Duration Metrics:		
Annual:	6	3.6%
Perennial:	155	93.4%
Biennial:	5	3.0%
Native Annual:	6	3.6%
Native Perennial:	138	83.1%
Native Biennial:	1	0.6%

Physiognomy Metrics:		
Tree:	21	12.7%
Shrub:	13	7.8%
Vine:	3	1.8%
Forb:	84	50.6%
Grass:	9	5.4%
Sedge:	21	12.7%
Rush:	0	0.0%
Fern:	15	9.0%
Bryophyte:	0	0.0%

Documented Species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Abies balsamea</i>	balsam fir	native	3	0	perennial	tree
<i>Acer pensylvanicum</i>	striped maple	native	5	3	perennial	tree
<i>Acer saccharum</i>	sugar maple	native	5	3	perennial	tree
<i>Actaea pachypoda</i>	dolls-eyes	native	7	5	perennial	forb
<i>Actaea rubra</i>	red baneberry	native	7	3	perennial	forb
<i>Adiantum pedatum</i>	maidenhair fern	native	6	3	perennial	fern
<i>Agrimonia gryposepala</i>	tall agrimony	native	2	3	perennial	forb
<i>Alliaria petiolata</i>	garlic mustard	non-native	0	3	biennial	forb
<i>Allium tricoccum</i>	wild leek	native	5	3	perennial	forb
<i>Anaphalis margaritacea</i>	pearly everlasting	native	3	5	perennial	forb
<i>Antennaria parlinii</i>	smooth pussytoes	native	2	5	perennial	forb
<i>Antennaria parvifolia</i>	small-leaved pussytoes	non-native	0	5	perennial	forb
<i>Aquilegia canadensis</i>	wild columbine	native	5	3	perennial	forb
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	forb
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	native	5	0	perennial	forb
<i>Athyrium filix-femina</i>	lady fern	native	4	0	perennial	fern
<i>Berberis thunbergii</i>	Japanese barberry	non-native	0	3	perennial	shrub
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Betula papyrifera</i>	paper birch	native	2	3	perennial	tree
<i>Brachyelytrum erectum</i>	long-awned wood grass	native	7	5	perennial	grass
<i>Cardamine diphylla</i> ; <i>Dentaria d.</i>	two-leaved toothwort	native	5	3	perennial	forb
<i>Carex albursina</i>	sedge	native	5	5	perennial	sedge
<i>Carex arctata</i>	sedge	native	3	5	perennial	sedge
<i>Carex communis</i>	sedge	native	2	5	perennial	sedge

<i>Carex crinita</i>	sedge	native	4	-5	perennial	sedge
<i>Carex deweyana</i>	sedge	native	3	3	perennial	sedge
<i>Carex gracillima</i>	sedge	native	4	3	perennial	sedge
<i>Carex granularis</i>	sedge	native	2	-3	perennial	sedge
<i>Carex intumescens</i>	sedge	native	3	-3	perennial	sedge
<i>Carex lacustris</i>	sedge	native	6	-5	perennial	sedge
<i>Carex leptonevia</i>	sedge	native	3	0	perennial	sedge
<i>Carex lupulina</i>	sedge	native	4	-5	perennial	sedge
<i>Carex pedunculata</i>	sedge	native	5	3	perennial	sedge
<i>Carex pensylvanica</i>	sedge	native	4	5	perennial	sedge
<i>Carex plantaginea</i>	sedge	native	8	5	perennial	sedge
<i>Carex prasina</i>	sedge	native	10	-5	perennial	sedge
<i>Carex radiata; C. rosea</i>	straight-styled wood sedge	native	2	0	perennial	sedge
<i>Carex rosea; C. convoluta</i>	curly-styled wood sedge	native	2	5	perennial	sedge
<i>Carex scabrata</i>	sedge	native	4	-5	perennial	sedge
<i>Carex stipata</i>	sedge	native	1	-5	perennial	sedge
<i>Carpinus caroliniana</i>	blue-beech	native	6	0	perennial	tree
<i>Caulophyllum thalictroides</i>	blue cohosh	native	5	5	perennial	forb
<i>Centaurea stoebe</i>	spotted knapweed	non-native	0	5	perennial	forb
<i>Chrysosplenium americanum</i>	golden saxifrage small enchanters- nightshade	native	6	-5	perennial	forb
<i>Circaea alpina</i>	enchanters-nightshade	native	4	-3	perennial	forb
<i>Circaea canadensis; C. lutetiana</i>	enchanters-nightshade	native	2	3	perennial	forb
<i>Cirsium arvense</i>	Canada thistle	non-native	0	3	perennial	forb
<i>Cirsium vulgare</i>	bull thistle	non-native	0	3	biennial	forb
<i>Claytonia caroliniana</i>	Carolina spring-beauty	native	6	3	perennial	forb
<i>Clinopodium vulgare</i>	wild-basil	native	3	5	perennial	forb
<i>Conopholis americana</i>	squaw-root	native	10	5	perennial	forb
<i>Cornus rugosa</i>	round-leaved dogwood showy or queens lady- slipper	native	6	5	perennial	shrub
<i>Cypripedium reginae</i>	orchard grass	native	9	-3	perennial	forb
<i>Dactylis glomerata</i>	poverty grass; oatgrass	non-native	0	3	perennial	grass
<i>Danthonia spicata</i>	Queen-Anne's-lace	native	4	5	perennial	grass
<i>Daucus carota</i>	ground-pine	non-native	0	5	biennial	forb
<i>Dendrolycopodium obscurum; Lycopodium o.</i>	squirrel-corn	native	5	3	perennial	fern
<i>Dicentra canadensis</i>	Dutchmans-breeches	native	7	5	perennial	forb
<i>Dicentra cucullaria</i>	spinulose woodfern	native	7	5	perennial	forb
<i>Dryopteris carthusiana</i>	crested shield fern	native	5	-3	perennial	fern
<i>Dryopteris cristata</i>	evergreen woodfern	native	6	-5	perennial	fern
<i>Dryopteris intermedia</i>	beechnuts	native	5	0	perennial	fern
<i>Epifagus virginiana</i>	willow-herb	native	10	5	annual	forb
<i>Epilobium ciliatum</i>	cinnamon willow-herb	native	3	-3	perennial	forb
<i>Epilobium coloratum</i>	helleborine	native	3	-5	perennial	forb
<i>Epipactis helleborine</i>		non-native	0	0	perennial	forb

<i>Equisetum arvense</i>	common horsetail	native	0	0	perennial	fern
<i>Equisetum palustre</i>	marsh horsetail	native	8	-3	perennial	fern
<i>Equisetum scirpoides</i>	dwarf scouring rush	native	7	0	perennial	fern
<i>Erechtites hieraciifolius</i>	fireweed	native	2	3	annual	forb
<i>Erythronium albidum</i>	white trout lily	native	7	3	perennial	forb
<i>Fagus grandifolia</i>	American beech	native	6	3	perennial	tree
<i>Fragaria virginiana</i>	wild strawberry	native	2	3	perennial	forb
<i>Fraxinus americana</i>	white ash	native	5	3	perennial	tree
<i>Fraxinus nigra</i>	black ash	native	6	-3	perennial	tree
<i>Fraxinus pennsylvanica</i>	red ash	native	2	-3	perennial	tree
<i>Galium circaezans</i>	white wild licorice	native	4	3	perennial	forb
<i>Galium lanceolatum</i>	yellow wild licorice	native	4	5	perennial	forb
<i>Galium pilosum</i>	hairy bedstraw	native	6	5	perennial	forb
<i>Galium triflorum</i>	fragrant bedstraw	native	4	3	perennial	forb
<i>Geranium robertianum</i>	herb robert	native	3	3	annual	forb
<i>Glyceria melicaria</i>	mannagrass	native	8	-5	perennial	grass
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Gymnocarpium dryopteris</i>	oak fern	native	5	3	perennial	fern
<i>Hepatica acutiloba</i>	sharp-lobed hepatica	native	8	5	perennial	forb
<i>Hypericum perforatum</i>	common St. Johns-wort	non-native	0	5	perennial	forb
<i>Impatiens capensis</i>	spotted touch-me-not	native	2	-3	annual	forb
<i>Juncus tenuis</i>	path rush	native	1	0	perennial	forb
<i>Juniperus communis</i>	common or ground juniper	native	4	3	perennial	shrub
<i>Lactuca canadensis</i>	tall lettuce	native	2	3	biennial	forb
<i>Leucanthemum vulgare;</i> <i>Chrysanthemum</i> <i>leucanthemum</i>	ox-eye daisy	non-native	0	5	perennial	forb
<i>Lonicera tatarica</i>	tartarian honeysuckle	non-native	0	3	perennial	shrub
<i>Lycopodium clavatum</i>	running ground-pine	native	4	0	perennial	fern
<i>Lycopus uniflorus</i>	northern bugle weed	native	2	-5	perennial	forb
<i>Lysimachia nummularia</i>	moneywort	non-native	0	-3	perennial	forb
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Maianthemum racemosum;</i> <i>Smilacina r.</i>	false spikenard	native	5	3	perennial	forb
<i>Medeola virginiana</i>	Indian cucumber-root	native	10	3	perennial	forb
<i>Melica smithii</i>	melic grass	native	7	5	perennial	grass
<i>Mitchella repens</i>	partridge-berry	native	5	3	perennial	forb
<i>Mitella nuda</i>	naked miterwort	native	8	-3	perennial	forb
<i>Monotropa uniflora</i>	Indian-pipe	native	5	3	perennial	forb
<i>Nasturtium officinale</i>	watercress	native	4	-5	perennial	forb
<i>Onoclea sensibilis</i>	sensitive fern	native	2	-3	perennial	fern
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	native	6	5	perennial	grass
<i>Osmorhiza claytonii</i>	hairy sweet-cicely	native	4	3	perennial	forb
<i>Osmunda cinnamomea</i>	cinnamon fern	native	5	-3	perennial	fern
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	native	5	3	perennial	tree

<i>Oxalis stricta</i> ; <i>o. fontana</i>	yellow wood-sorrel	native	0	3	perennial	forb
<i>Parthenocissus inserta</i>	thicket creeper	native	4	3	perennial	vine
<i>Parthenocissus quinquefolia</i>	Virginia creeper	native	5	3	perennial	vine
<i>Persicaria hydropiper</i> ; <i>Polygonum h.</i>	water-pepper	native	1	-5	annual	forb
<i>Phleum pratense</i>	timothy	non-native	0	3	perennial	grass
<i>Pinus resinosa</i>	red pine	native	6	3	perennial	tree
<i>Pinus strobus</i>	white pine	native	3	3	perennial	tree
<i>Poa compressa</i>	Canada bluegrass	non-native	0	3	perennial	grass
<i>Polygonatum pubescens</i>	downy solomon seal	native	5	5	perennial	forb
<i>Populus balsamifera</i>	balsam poplar	native	2	-3	perennial	tree
<i>Populus grandidentata</i>	big-tooth aspen	native	4	3	perennial	tree
<i>Potentilla recta</i>	rough-fruited cinquefoil	non-native	0	5	perennial	forb
<i>Prunella vulgaris</i>	self-heal	native	0	0	perennial	forb
<i>Prunus serotina</i>	wild black cherry	native	2	3	perennial	tree
<i>Prunus virginiana</i>	choke cherry	native	2	3	perennial	shrub
<i>Pteridium aquilinum</i>	bracken fern	native	0	3	perennial	fern
<i>Quercus rubra</i>	red oak	native	5	3	perennial	tree
<i>Ranunculus abortivus</i>	small-flowered buttercup	native	0	0	perennial	forb
<i>Ranunculus hispidus</i>	swamp buttercup	native	5	0	perennial	forb
<i>Ranunculus recurvatus</i>	hooked crowfoot	native	5	-3	perennial	forb
<i>Ranunculus sceleratus</i>	cursed crowfoot	native	1	-5	annual	forb
<i>Ribes cynosbati</i>	prickly or wild gooseberry	native	4	3	perennial	shrub
<i>Ribes triste</i>	swamp red currant	native	6	-5	perennial	shrub
<i>Rubus occidentalis</i>	black raspberry	native	1	5	perennial	shrub
<i>Rubus pubescens</i>	dwarf raspberry	native	4	-3	perennial	shrub
<i>Rubus strigosus</i>	wild red raspberry	native	2	0	perennial	shrub
<i>Rudbeckia hirta</i>	black-eyed Susan	native	1	3	perennial	forb
<i>Rumex obtusifolius</i>	bitter dock	non-native	0	0	perennial	forb
<i>Sambucus racemosa</i>	red-berried elder	native	3	3	perennial	shrub
<i>Scirpus atrovirens</i>	bulrush	native	3	-5	perennial	sedge
<i>Scirpus cyperinus</i>	wool-grass	native	5	-5	perennial	sedge
<i>Scutellaria galericulata</i>	marsh skullcap	native	5	-5	perennial	forb
<i>Scutellaria lateriflora</i>	mad-dog skullcap	native	5	-5	perennial	forb
<i>Solidago caesia</i>	bluestem goldenrod	native	6	3	perennial	forb
<i>Solidago canadensis</i>	Canada goldenrod	native	1	3	perennial	forb
<i>Solidago hispida</i>	hairy goldenrod	native	3	5	perennial	forb
<i>Solidago rugosa</i>	rough-leaved goldenrod	native	3	0	perennial	forb
<i>Sorbus americana</i>	American mountain-ash	native	4	0	perennial	tree
<i>Spiranthes cernua</i>	nodding ladies-tresses	native	4	-3	perennial	forb
<i>Streptopus lanceolatus</i> ; <i>S. roseus</i>	rose twisted-stalk	native	5	3	perennial	forb
<i>Symphotrichum lateriflorum</i> ; <i>Aster l.</i>	calico aster	native	2	0	perennial	forb

<i>Symphotrichum urophyllum</i> ; <i>Aster sagittifolius</i>	arrow-leaved aster	native	2	5	perennial	forb
<i>Thelypteris palustris</i>	marsh fern	native	2	-3	perennial	fern
<i>Tiarella cordifolia</i>	foamflower	native	9	3	perennial	forb
<i>Tilia americana</i>	basswood	native	5	3	perennial	tree
<i>Trifolium pratense</i>	red clover	non-native	0	3	perennial	forb
<i>Trillium grandiflorum</i>	common trillium	native	5	3	perennial	forb
<i>Tsuga canadensis</i>	hemlock	native	5	3	perennial	tree
<i>Ulmus americana</i>	American elm	native	1	-3	perennial	tree
<i>Uvularia grandiflora</i>	bellwort	native	5	5	perennial	forb
<i>Verbascum thapsus</i>	common mullein	non-native	0	5	biennial	forb
<i>Veronica officinalis</i>	common speedwell	non-native	0	3	perennial	forb
<i>Viburnum acerifolium</i>	maple-leaved viburnum	native	6	5	perennial	shrub
<i>Vinca minor</i>	periwinkle	non-native	0	5	perennial	shrub
<i>Viola canadensis</i>	Canada violet	native	5	3	perennial	forb
<i>Viola pubescens</i>	yellow violet	native	4	3	perennial	forb
<i>Viola rostrata</i>	long-spurred violet	native	6	3	perennial	forb
<i>Vitis riparia</i>	river-bank grape	native	3	0	perennial	vine



Wetland pocket invaded by forget-me-not in Indian Garden Preserve. Photo by Phyllis J. Higman.

Bois LeDuc-Boyne-Mackinac Mesic Northern Forest



Photo by Phyllis J. Higman.

Site Summary

This site was the largest, mostly contiguous, closed canopy forest block surveyed in 2015. The site extends north-west from the Wildwood golf course, through Bois LeDuc Preserve, Mackinac state forest and private lands, and west and south from the golf course through Boyne City forest and private forest lands. It occurs on rolling to steep-gradient end moraine with variable aspect and soil moisture. The majority of the site is buffered by forest; however some old clearings occur along one of the several roads that wind through the middle of the site. A utility line also crosses through the southwest portion. These create the only

significant openings within the otherwise closed canopy forest

The northeast portion of the site encompasses old-growth forest with high structural complexity, including multiple age classes and diversity in the forest strata. Here, the dominant canopy trees are likely at least 200 years old. This area is an uneven-aged forest with late successional species, and driven by frequent small-scale wind-throw events. Old growth is rare both regionally and statewide and this area was recommended for designation as an old growth biodiversity stewardship area in 2005.

The old growth lies within a matrix of mature second growth hardwoods, with pit and mound topography and high species diversity throughout. Abundant snags and coarse woody debris also occur throughout, with diseased ash and beech contributing substantially to this.

The site has been variously logged, as evidenced by old logging roads and simplified stand structure in some areas. This is true, particularly in the southwest, where

there are predominantly younger trees with less structural complexity and fewer associated tree dominants. There is active use and expansion of the bicycle trail system in the Boyne City forest.

There are occasional wet swamp pockets at the bases of slopes, including a sizable black ash-dominated swamp near the old growth area. The ash, however, are mostly dead or dying, currently.

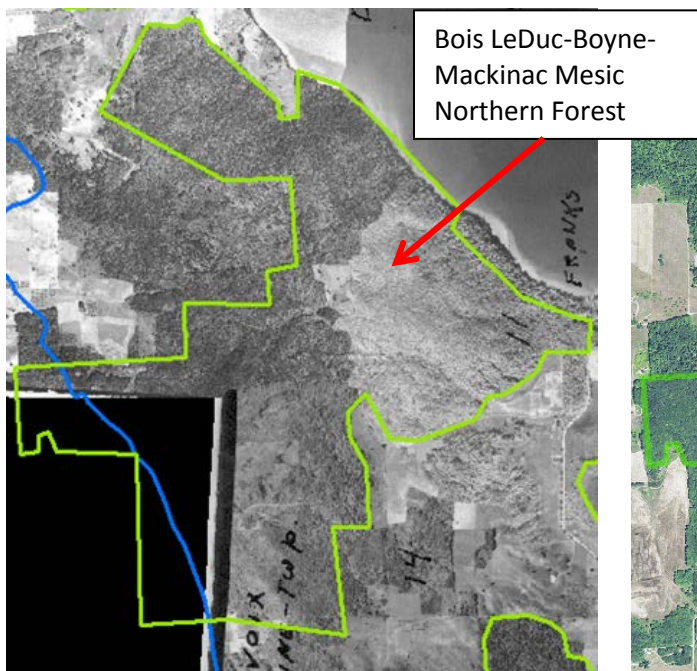


Figure 25. Bois LeDuc 1938 imagery.

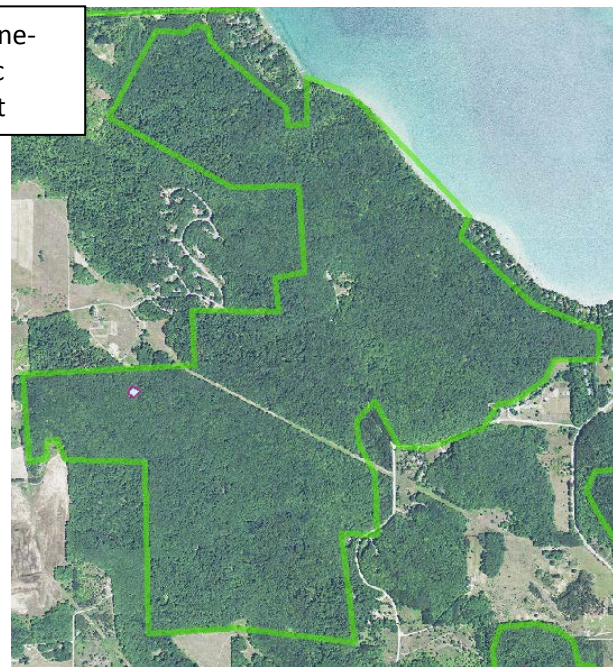


Figure 26. Bois LeDuc 2012 imagery.

Vegetation

Total species 102; Native 104. Total FQI 42; Native FQI 45

Sugar maple, hemlock and beech are the major canopy dominants; however the presence of hemlock is variable across the site. Canopy associates include basswood, white ash and big tooth aspen, and less frequently white birch, yellow birch, trembling aspen and cedar. The subcanopy is similar, but occasionally includes ironwood and black cherry. Much of the white ash is already down and the most beech are standing dead or dying. The understory is

dominated primarily by beech and locally by sugar maple or white ash. There were also pockets of hemlock and striped maple and occasional white pine. Shrubs include prickly gooseberry, Canadian fly-honey-suckle and red-berried elder.

The ground flora includes patches of ferns, scattered grasses and sedges and a diversity of herbs that vary with moisture gradients. The most common ferns are lady fern, spinulose wood fern, and ever-green

fern. Common grasses and sedges include *Carex albursina*, *Carex plantaginea*, *Carex deweyana*, *Carex pedunculata*, wood millet, melic grass, and rough leaved rice grass. Spring flora such as trout-lily, Dutchmans-breeches, spring beauty, common trillium and wild leeks flourish. Later blooming species including doll's eyes, wild sarsaparilla, enchanter's night-shade, several bedstraws, sweet-cicely, and blue-stem

goldenrod are common. Spikenard, Indian cucumber, bloodroot, hepatica, rosy twisted-stalk and bellwort occur occasionally. The swamp pockets are mostly dominated by sedges such as *Carex prasina*, and *Carex scabrata*, and many ferns including sensitive fern, royal fern and cinnamon fern. Willowherbs, purple avens, marsh skullcap and spotted touch-me-not are other common associates.

Threats

Primary threats include erosion, fragmentation, deer herbivory, and invasive plants. Localized erosion was observed on some old logging trails and herbivory is widespread. Fragmentation was minimal, but can be increased by overuse of trails and increased residential development.

include garlic mustard, periwinkle, autumn olive, Japanese barberry, multiflora rose, non-native honeysuckles, and black locust. Common and glossy buckthorns are also of concern, however these were not observed during surveys. See page 68 for further discussion of considerations for biodiversity management and ecosystem integrity.

Few invasive plants are currently impacting the forest. Species of concern

Site Significance

- *Forest of regional significance*
- *C-ranked mesic northern forest EO*

This is a large, mostly contiguous forested complex that is variable in its disturbance history. While some areas are less representative of historical conditions, the site, as delineated, includes as much of the contiguous forest as possible, in order to minimize fragmentation and buffer higher quality areas. Overall, it has a good representation of the historical structure and flora of this type and it captures the most significant old growth area observed during surveys in 2015.

There is currently little impact from invasive species and it provides an expansive, closed canopy forest that sustains quality habitat required by interior forest obligate species. The site heterogeneity provides abundant habitat for a host of other species. The natural cover on the steep slopes helps sustain water quality in the region, by preventing significant inputs of storm water runoff. It is of regional significance, contributing to local ecological diversity and the natural character of the region.

Bois LeDuc-Boyne-Mackinac Mesic Northern Forest FQA

Conservatism-Based Metrics:	
Total Mean C:	3.8
Native Mean C:	4.4
Total FQI:	42
Native FQI:	45
Adjusted FQI:	41
% C value 0:	17
% C value 1-3:	22
% C value 4-6:	49
% C value 7-10:	12
Native Tree Mean C:	3.9
Native Shrub Mean C:	4
Native Herbaceous Mean C:	4.6

Species Richness:		
Total Species:	121	
Native Species:	104	86%
Non-native Species:	17	14%

Species Wetness:	
Mean Wetness:	1.9
Native Mean Wetness:	1.7

Duration Metrics:		
Annual:	6	5%
Perennial:	109	90.1%
Biennial:	6	5.0%
Native Annual:	6	5.0%
Native Perennial:	97	80.2%
Native Biennial:	1	0.8%

Physiognomy Metrics:		
Tree:	19	15.7%
Shrub:	9	7.4%
Vine:	0	0.0%
Forb:	63	52.1%
Grass:	9	7.4%
Sedge:	9	7.4%
Rush:	0	0.0%
Fern:	12	9.9%
Bryophyte:	0	0.0%

Documented Species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Abies balsamea</i>	balsam fir	native	3	0	perennial	tree
<i>Acer pensylvanicum</i>	striped maple	native	5	3	perennial	tree
<i>Acer saccharum</i>	sugar maple	native	5	3	perennial	tree
<i>Actaea pachypoda</i>	dolls-eyes	native	7	5	perennial	forb
<i>Allium tricoccum</i>	wild leek	native	5	3	perennial	forb
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	forb
<i>Aralia racemosa</i>	spikenard	native	8	3	perennial	forb
<i>Arctium minus</i>	Common burdock	non-native	0	3	biennial	forb
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	native	5	0	perennial	forb
<i>Asclepias syriaca</i>	common milkweed	native	1	5	perennial	forb
<i>Athyrium filix-femina</i>	lady fern	native	4	0	perennial	fern
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Betula papyrifera</i>	paper birch	native	2	3	perennial	tree
<i>Botrypus virginianus</i>	rattlesnake fern	native	5	3	perennial	fern
<i>Brachyelytrum erectum</i>	long-awned wood grass	native	7	5	perennial	grass
<i>Bromus inermis</i>	smooth brome	non-native	0	5	perennial	grass
<i>Caltha palustris</i>	marsh-marigold	native	6	-5	perennial	forb
<i>Cardamine diphylla;</i> <i>Dentaria d.</i>	two-leaved toothwort	native	5	3	perennial	forb
<i>Carex albursina</i>	sedge	native	5	5	perennial	sedge
<i>Carex communis</i>	sedge	native	2	5	perennial	sedge
<i>Carex deweyana</i>	sedge	native	3	3	perennial	sedge
<i>Carex lacustris</i>	sedge	native	6	-5	perennial	sedge
<i>Carex leptonevia</i>	sedge	native	3	0	perennial	sedge
<i>Carex pedunculata</i>	sedge	native	5	3	perennial	sedge

<i>Carex pensylvanica</i>	sedge	native	4	5	perennial	sedge
<i>Carex plantaginea</i>	sedge	native	8	5	perennial	sedge
<i>Carex scabrata</i>	sedge	native	4	-5	perennial	sedge
<i>Caulophyllum thalictroides</i>	blue cohosh	native	5	5	perennial	forb
<i>Circaea canadensis</i> ; <i>C. lutetiana</i>	enchanters-nightshade	native	2	3	perennial	forb
<i>Cirsium vulgare</i>	bull thistle	non-native	0	3	biennial	forb
<i>Claytonia caroliniana</i>	carolina spring-beauty	native	6	3	perennial	forb
<i>Conyza canadensis</i>	horseweed	native	0	3	annual	forb
<i>Cornus alternifolia</i>	alternate-leaved dogwood	native	5	3	perennial	tree
<i>Cryptotaenia canadensis</i>	honewort	native	2	0	perennial	forb
<i>Dactylis glomerata</i>	orchard grass	non-native	0	3	perennial	grass
<i>Daucus carota</i>	Queen-Anne's-lace	non-native	0	5	biennial	forb
<i>Dendrolycopodium obscurum</i> ; <i>Lycopodium o.</i>	ground-pine	native	5	3	perennial	fern
<i>Dicentra canadensis</i>	squirrel-corn	native	7	5	perennial	forb
<i>Dicentra cucullaria</i>	Dutchmans-breeches	native	7	5	perennial	forb
<i>Dryopteris carthusiana</i>	spinulose woodfern	native	5	-3	perennial	fern
<i>Dryopteris intermedia</i>	evergreen woodfern	native	5	0	perennial	fern
<i>Epifagus virginiana</i>	beech-drops	native	10	5	annual	forb
<i>Epilobium ciliatum</i>	willow-herb	native	3	-3	perennial	forb
<i>Epipactis helleborine</i>	helleborine	non-native	0	0	perennial	forb
<i>Equisetum sylvaticum</i>	woodland horsetail	native	5	-3	perennial	fern
<i>Erythronium americanum</i>	yellow trout lily	native	5	5	perennial	forb
<i>Fagus grandifolia</i>	American beech	native	6	3	perennial	tree
<i>Fraxinus americana</i>	white ash	native	5	3	perennial	tree
<i>Galium circaezans</i>	white wild licorice	native	4	3	perennial	forb
<i>Galium lanceolatum</i>	yellow wild licorice	native	4	5	perennial	forb
<i>Galium triflorum</i>	fragrant bedstraw	native	4	3	perennial	forb
<i>Geranium robertianum</i>	herb robert	native	3	3	annual	forb
<i>Geum rivale</i>	purple avens	native	7	-5	perennial	forb
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Hepatica acutiloba</i>	sharp-lobed hepatica	native	8	5	perennial	forb
<i>Huperzia lucidula</i>	shining clubmoss	native	5	0	perennial	fern
<i>Hypericum perforatum</i>	common St. Johns-wort	non-native	0	5	perennial	forb
<i>Ilex verticillata</i>	Michigan holly	native	5	-3	perennial	shrub
<i>Impatiens capensis</i>	spotted touch-me-not	native	2	-3	annual	forb
<i>Lactuca canadensis</i>	tall lettuce	native	2	3	biennial	forb
<i>Leonurus cardiaca</i>	motherwort	non-native	0	5	perennial	forb
<i>Lobelia inflata</i>	Indian-tobacco	native	0	3	annual	forb
<i>Lonicera canadensis</i>	Canadian fly honeysuckle	native	5	3	perennial	shrub
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Maianthemum racemosum</i> ; <i>Smilacina r.</i>	false spikenard	native	5	3	perennial	forb

<i>Matteuccia struthiopteris</i>	ostrich fern	native	3	0	perennial	fern
<i>Medeola virginiana</i>	Indian cucumber-root	native	10	3	perennial	forb
<i>Melica smithii</i>	melic grass	native	7	5	perennial	grass
<i>Melilotus albus</i>	white sweet-clover	non-native	0	3	biennial	forb
<i>Milium effusum</i>	wood millet	native	8	3	perennial	grass
<i>Mitchella repens</i>	partridge-berry	native	5	3	perennial	forb
<i>Monotropa uniflora</i>	Indian-pipe	native	5	3	perennial	forb
<i>Onoclea sensibilis</i>	sensitive fern	native	2	-3	perennial	fern
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	native	6	5	perennial	grass
<i>Osmorhiza claytonii</i>	hairy sweet-cicely	native	4	3	perennial	forb
<i>Osmunda regalis</i>	royal fern	native	5	-5	perennial	fern
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	native	5	3	perennial	tree
<i>Phleum pratense</i>	timothy	non-native	0	3	perennial	grass
<i>Pinus banksiana</i>	Jack pine	native	5	3	perennial	tree
<i>Pinus strobus</i>	white pine	native	3	3	perennial	tree
<i>Poa compressa</i>	Canada bluegrass	non-native	0	3	perennial	grass
<i>Polygonatum pubescens</i>	downy solomon seal	native	5	5	perennial	forb
<i>Populus deltoides</i>	cottonwood	native	1	0	perennial	tree
<i>Populus grandidentata</i>	big-tooth aspen	native	4	3	perennial	tree
<i>Populus tremuloides</i>	quaking aspen	native	1	0	perennial	tree
<i>Prunella vulgaris</i>	self-heal	native	0	0	perennial	forb
<i>Prunus serotina</i>	wild black cherry	native	2	3	perennial	tree
<i>Pteridium aquilinum</i>	bracken fern	native	0	3	perennial	fern
<i>Pyrola elliptica</i>	large-leaved shinleaf	native	6	3	perennial	forb
<i>Ranunculus acris</i>	tall or common buttercup	non-native	0	0	perennial	forb
<i>Ribes cynosbati</i>	prickly or wild gooseberry	native	4	3	perennial	shrub
<i>Ribes triste</i>	swamp red currant	native	6	-5	perennial	shrub
<i>Rubus occidentalis</i>	black raspberry	native	1	5	perennial	shrub
<i>Rubus pubescens</i>	dwarf raspberry	native	4	-3	perennial	shrub
<i>Rubus strigosus</i>	wild red raspberry	native	2	0	perennial	shrub
<i>Rumex obtusifolius</i>	bitter dock	non-native	0	0	perennial	forb
<i>Sambucus racemosa</i>	red-berried elder	native	3	3	perennial	shrub
<i>Sanguinaria canadensis</i>	bloodroot	native	5	3	perennial	forb
<i>Silene vulgaris</i>	bladder campion	non-native	0	5	perennial	forb
<i>Solanum ptychanthum</i>	black nightshade	native	1	3	annual	forb
<i>Solidago caesia</i>	bluestem goldenrod	native	6	3	perennial	forb
<i>Solidago rugosa</i>	rough-leaved goldenrod	native	3	0	perennial	forb
<i>Streptopus lanceolatus</i> ; <i>S. roseus</i>	rose twisted-stalk	native	5	3	perennial	forb
<i>Symphyotrichum lanceolatum</i> ; <i>Aster l.</i>	panicled aster	native	2	-3	perennial	forb
<i>Symphyotrichum lateriflorum</i> ; <i>Aster l.</i>	calico aster	native	2	0	perennial	forb
<i>Taraxacum officinale</i>	common dandelion	non-native	0	3	perennial	forb
<i>Thelypteris palustris</i>	marsh fern	native	2	-3	perennial	fern

<i>Thuja occidentalis</i>	arbor vitae	native	4	-3	perennial	tree
<i>Tiarella cordifolia</i>	foamflower	native	9	3	perennial	forb
<i>Tilia americana</i>	basswood	native	5	3	perennial	tree
<i>Trillium grandiflorum</i>	common trillium	native	5	3	perennial	forb
<i>Tsuga canadensis</i>	hemlock	native	5	3	perennial	tree
<i>Ulmus americana</i>	American elm	native	1	-3	perennial	tree
<i>Uvularia grandiflora</i>	bellwort	native	5	5	perennial	forb
<i>Verbascum thapsus</i>	common mullein	non-native	0	5	biennial	forb
<i>Veronica officinalis</i>	common speedwell	non-native	0	3	perennial	forb
<i>Viburnum acerifolium</i>	maple-leaved viburnum	native	6	5	perennial	shrub
<i>Viola blanda</i>	sweet white violet	native	5	-3	perennial	forb
<i>Viola canadensis</i>	Canada violet	native	5	3	perennial	forb
<i>Viola pubescens</i>	yellow violet	native	4	3	perennial	forb
<i>Viola rostrata</i>	long-spurred violet	native	6	3	perennial	forb



**A black ash swamp near old growth forest in Bois Leduc-Boyne-Mackinac mesic northern forest.
Photo by Phyllis J. Higman.**

North Shore Mesic Northern Forest



Photo by Phyllis J. Higman.

Site Summary

This site is a large contiguous block of closed canopy forest on end moraine with steep ravines of variable aspect throughout. It is situated along the north shore of the eastern arm of Walloon Lake with lake residences along the southern border that sustain a high percentage of natural cover. The remainder of the site is buffered by closed canopy forest of varying depth, except for the north and east portions of the site. The north side is flanked by a golfing green with a narrow forest buffer in between, and the southern edge of Postle Farm preserve lies adjacent to agricultural fields. Several roads also run through the forest. The mesic forest transitions south-

ward into dry-mesic northern forest, which is described separately.

The majority of the forest is mature second growth with occasional old growth trees, primarily sugar maple, beech, and hemlock. The white ash component has been dramatically reduced from the canopy due to disease, and beech is not far behind. Both are contributing substantially to the abundant coarse woody debris characterizing the site. Canopy dominance has shifted to sugar maple.

Huge, old stumps from the historic logging were observed and there was evidence of more recent selective logging in

some areas. Soils are circumneutral loamy sands with gravel. Pit and mound topography, resulting from small scale windthrow events, was predominant throughout. Windthrow creates small canopy gaps that allow shade tolerant seedlings to obtain sunlight and regenerate the canopy. These gaps, in conjunction with soil moisture, slope and aspect, create heterogeneous site conditions that allow for high species diversity and shape their distribution.

Wetlands were only observed during surveys in the western portion of Asa Wilson Preserve where sensitive and cinnamon fern were prevalent.

This forest provides abundant habitat for obligate forest interior species such as neotropical migrating birds, as well as a host of insects, fungi, amphibians, and small mammals in the region.

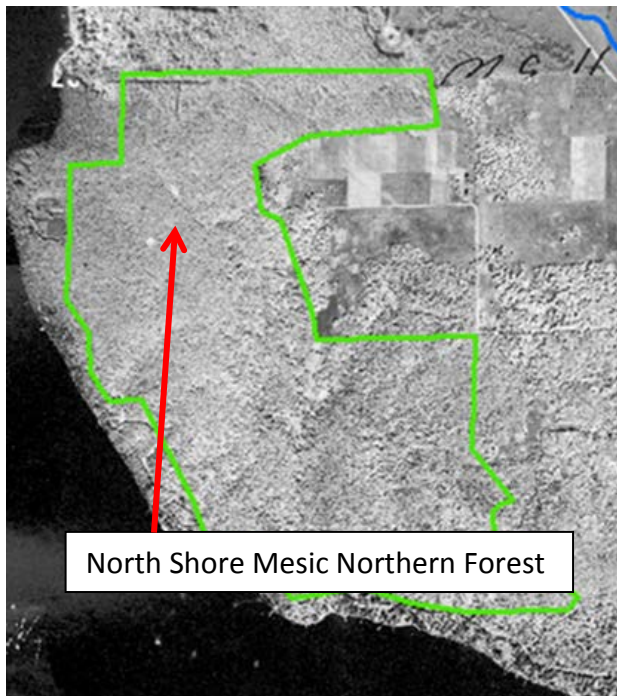


Figure 27. North Shore 1938 imagery.



Figure 28. North Shore 2012 imagery.

Vegetation

Total species 108; Native 99. Total FQI 42.6; Native FQI 44.8

Sugar maple is the dominant canopy species with hemlock, beech, basswood, red oak and big-tooth aspen occurring as localized co-dominants. Due to catastrophic disease, ash and elm are no longer a major component of the canopy and beech is declining rapidly. Beech is the predominant understory species with a scattering of ash, sugar maple and hemlock. Ash seedlings are locally dominant, often surpassing those of sugar maple in the ground layer. Although

not distributed evenly, hemlock was a significant component of both the canopy and understory. Other understory species include ironwood, black cherry, white pine, striped maple and occasional yellow birch. Prickly gooseberry and red-berried elder were occasional shrubs.

There was a rich herb layer throughout most of the forest, including several grasses and sedges, ferns and an abundance of forbs. Among the sedges were *Carex plantaginea*,

Carex albursina, *Carex pedunculata*, *Carex deweyana*, and *Carex gracillima*. Grasses included melic grass, rough-leaved rice grass, and wood millet. Lady fern, maiden-hair fern, rattlesnake fern, and wood ferns were locally common. Spring ephemerals were widespread and abundant, including wild leek, spring beauty, Dutchmans-

breeches, squirrel corn, trout-lily, common trillium, and Canada, yellow and long-spurred violets. Blue cohosh, downy soloman seal, bellflower, sweet cicely, bluestem golden-rod, and Canada mayflower were also common. A barred owl was heard on both occasions this site was visited.

Threats

Primary threats include fragmentation, deer herbivory and invasive plants. Very few invasive plants were observed in the forest; however, a small infestation of garlic mustard was documented near the trail head north of the main North Shore Preserve parking area. Two additional source populations were found on the perimeter road. Garlic mustard poses a huge threat as it is notorious for widespread invasion of mesic forests and displacement of native species. It has also been implicated in the disruption of beneficial soil fungi required

by some trees for regeneration. Other species of concern on adjacent lands include periwinkle forget-me-not, autumn olive, Japanese barberry, multiflora rose, non-native bush honeysuckles, and black locust. These were not yet observed in the interior of the site. Common and glossy buckthorns are also of concern, however these were not observed during surveys. See page 68 for further discussion of considerations for biodiversity management and ecosystem integrity.

Site Significance

- *Forest of Regional Significance*
- *C-ranked mesic northern forest EO*

This maturing second growth mesic northern forest retains much of the flora and some of the structural complexity representative of historical conditions. It is contiguous with the adjacent dry-mesic forest and together they form a large, closed-canopy forest of regional significance. It has high site heterogeneity and plant diversity, and impacts from invasive plants are minimal. The natural cover on the steep slopes is

preventing significant inputs of storm water runoff, helping to sustain water quality in the region.

The site contributes substantially to local ecological diversity and the natural character of the region. This becomes increasingly more important as adjacent and perimeter land use pressures grow. For these reasons, it qualifies for inclusion as a C-ranked EO in the Natural Heritage database.

North Shore Mesic Northern Forest FQA

Conservatism-Based Metrics:	
Total Mean C:	4.1
Native Mean C:	4.5
Total FQI:	42.6
Native FQI:	44.8
Adjusted FQI:	43.1
% C value 0:	10.2
% C value 1-3:	22.2
% C value 4-6:	58.3
% C value 7-10:	9.3
Native Tree Mean C:	4.1
Native Shrub Mean C:	3.6
Native Herbaceous Mean C:	4.7

Species Richness:		
Total Species:	108	
Native Species:	99	91.7%
Non-native Species:	9	8.3%

Species Wetness:		
Mean Wetness:	1.7	
Native Mean Wetness:	1.7	

Duration Metrics:		
Annual:	2	1.9%
Perennial:	106	98.1%
Biennial:	0	0.0%
Native Annual:	2	1.9%
Native Perennial:	97	89.8%
Native Biennial:	0	0.0%

Physiognomy Metrics:		
Tree:	21	19.4%
Shrub:	8	7.4%
Vine:	1	0.9%
Forb:	50	46.3%
Grass:	6	5.6%
Sedge:	12	11.1%
Rush:	0	0.0%
Fern:	10	9.3%
Bryophyte:	0	0.0%

Documented Species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Abies balsamea</i>	balsam fir	native	3	0	perennial	tree
<i>Acer pensylvanicum</i>	striped maple	native	5	3	perennial	tree
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Acer saccharum</i>	sugar maple	native	5	3	perennial	tree
<i>Acer spicatum</i>	mountain maple	native	5	3	perennial	tree
<i>Actaea pachypoda</i>	dolls-eyes	native	7	5	perennial	forb
<i>Allium tricoccum</i>	wild leek	native	5	3	perennial	forb
<i>Apocynum androsaemifolium</i>	spreading dogbane	native	3	5	perennial	forb
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	forb
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	native	5	0	perennial	forb
<i>Betula alleghaniensis</i>	yellow birch	native	7	0	perennial	tree
<i>Betula papyrifera</i>	paper birch	native	2	3	perennial	tree
<i>Botrypus virginianus</i>	rattlesnake fern	native	5	3	perennial	fern
<i>Cardamine diphylla</i> ; <i>Dentaria d.</i>	two-leaved toothwort	native	5	3	perennial	forb
<i>Carex albursina</i>	sedge	native	5	5	perennial	sedge
<i>Carex arctata</i>	sedge	native	3	5	perennial	sedge
<i>Carex deweyana</i>	sedge	native	3	3	perennial	sedge
<i>Carex gracillima</i>	sedge	native	4	3	perennial	sedge
<i>Carex interior</i>	sedge	native	3	-5	perennial	sedge
<i>Carex leptonevia</i>	sedge	native	3	0	perennial	sedge
<i>Carex pedunculata</i>	sedge	native	5	3	perennial	sedge
<i>Carex pensylvanica</i>	sedge	native	4	5	perennial	sedge
<i>Carex plantaginea</i>	sedge	native	8	5	perennial	sedge
<i>Carex radiata</i> ; <i>C. rosea</i>	straight-styled wood sedge	native	2	0	perennial	sedge

<i>Carex rosea</i> ; <i>C. convoluta</i>	curly-styled wood sedge	native	2	5	perennial	sedge
<i>Caulophyllum thalictroides</i>	blue cohosh	native	5	5	perennial	forb
<i>Chrysosplenium americanum</i>	golden saxifrage	native	6	-5	perennial	forb
<i>Circaea canadensis</i> ; <i>C. lutetiana</i>	enchanters-nightshade	native	2	3	perennial	forb
<i>Claytonia caroliniana</i>	Carolina spring-beauty	native	6	3	perennial	forb
<i>Danthonia spicata</i>	poverty grass; oatgrass	native	4	5	perennial	grass
<i>Dendrolycopodium obscurum</i> ; <i>Lycopodium o.</i>	ground-pine	native	5	3	perennial	fern
<i>Dicentra canadensis</i>	squirrel-corn	native	7	5	perennial	forb
<i>Dicentra cucullaria</i>	Dutchmans-breeches	native	7	5	perennial	forb
<i>Dryopteris carthusiana</i>	spinulose woodfern	native	5	-3	perennial	fern
<i>Dryopteris cristata</i>	crested shield fern	native	6	-5	perennial	fern
<i>Dryopteris intermedia</i>	evergreen woodfern	native	5	0	perennial	fern
<i>Epifagus virginiana</i>	beech-drops	native	10	5	annual	forb
<i>Epilobium ciliatum</i>	willow-herb	native	3	-3	perennial	forb
<i>Epilobium parviflorum</i>	willow-herb	non-native	0	-5	perennial	forb
<i>Epipactis helleborine</i>	helleborine	non-native	0	0	perennial	forb
<i>Erythronium americanum</i>	yellow trout lily	native	5	5	perennial	forb
<i>Eutrochium maculatum</i> ; <i>Eupatorium m.</i>	Joe-pye-weed	native	4	-5	perennial	forb
<i>Fagus grandifolia</i>	American beech	native	6	3	perennial	tree
<i>Fraxinus americana</i>	white ash	native	5	3	perennial	tree
<i>Fraxinus nigra</i>	black ash	native	6	-3	perennial	tree
<i>Fraxinus pennsylvanica</i>	red ash	native	2	-3	perennial	tree
<i>Galium lanceolatum</i>	yellow wild licorice	native	4	5	perennial	forb
<i>Galium triflorum</i>	fragrant bedstraw	native	4	3	perennial	forb
<i>Glyceria striata</i>	fowl manna grass	native	4	-5	perennial	grass
<i>Gymnocarpium dryopteris</i>	oak fern	native	5	3	perennial	fern
<i>Hepatica acutiloba</i>	sharp-lobed hepatica	native	8	5	perennial	forb
<i>Huperzia lucidula</i>	shining clubmoss	native	5	0	perennial	fern
<i>Hypopithys monotropa</i> ; <i>Monotropa hypopithys</i>	pinemap	native	6	5	perennial	forb
<i>Impatiens capensis</i>	spotted touch-me-not	native	2	-3	annual	forb
<i>Lemna minor</i>	common duckweed	native	5	-5	perennial	forb
<i>Lonicera canadensis</i>	Canadian fly honeysuckle	native	5	3	perennial	shrub
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Maianthemum racemosum</i> ; <i>Smilacina r.</i>	false spikenard	native	5	3	perennial	forb
<i>Melica smithii</i>	melic grass	native	7	5	perennial	grass
<i>Mitchella repens</i>	partridge-berry	native	5	3	perennial	forb
<i>Monotropa uniflora</i>	Indian-pipe	native	5	3	perennial	forb
<i>Onoclea sensibilis</i>	sensitive fern	native	2	-3	perennial	fern
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	native	6	5	perennial	grass
<i>Osmorhiza claytonii</i>	hairy sweet-cicely	native	4	3	perennial	forb

<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	native	5	3	perennial	tree
<i>Pedicularis canadensis</i>	wood-betony	native	10	3	perennial	forb
<i>Pinus resinosa</i>	red pine	native	6	3	perennial	tree
<i>Pinus strobus</i>	white pine	native	3	3	perennial	tree
<i>Plantago major</i>	common plantain	non-native	0	3	perennial	forb
<i>Poa compressa</i>	Canada bluegrass	non-native	0	3	perennial	grass
<i>Poa pratensis</i>	Kentucky bluegrass	non-native	0	3	perennial	grass
<i>Polygala paucifolia</i>	gay-wings	native	7	3	perennial	forb
<i>Polygonatum pubescens</i>	downy solomon seal	native	5	5	perennial	forb
<i>Populus deltoides</i>	cottonwood	native	1	0	perennial	tree
<i>Populus grandidentata</i>	big-tooth aspen	native	4	3	perennial	tree
<i>Prenanthes alba</i>	white lettuce	native	5	3	perennial	forb
<i>Prunella vulgaris</i>	self-heal	native	0	0	perennial	forb
<i>Pteridium aquilinum</i>	bracken fern	native	0	3	perennial	fern
<i>Pyrola elliptica</i>	large-leaved shinleaf	native	6	3	perennial	forb
<i>Quercus rubra</i>	red oak	native	5	3	perennial	tree
<i>Rubus allegheniensis</i>	common blackberry	native	1	3	perennial	shrub
<i>Rubus strigosus</i>	wild red raspberry	native	2	0	perennial	shrub
<i>Rumex obtusifolius</i>	bitter dock	non-native	0	0	perennial	forb
<i>Sambucus racemosa</i>	red-berried elder	native	3	3	perennial	shrub
<i>Scirpus cyperinus</i>	wool-grass	native	5	-5	perennial	sedge
<i>Solanum dulcamara</i>	bittersweet nightshade	non-native	0	0	perennial	vine
<i>Solidago caesia</i>	bluestem goldenrod	native	6	3	perennial	forb
<i>Solidago rugosa</i>	rough-leaved goldenrod	native	3	0	perennial	forb
<i>Spinulum annotinum;</i> <i>Lycopodium a.</i>	stiff clubmoss	native	5	0	perennial	fern
<i>Streptopus lanceolatus;</i> <i>S.</i> <i>roseus</i>	rose twisted-stalk	native	5	3	perennial	forb
<i>Symphyotrichum firmum;</i> <i>Aster puniceus</i>	smooth swamp aster	native	4	-3	perennial	forb
<i>Symphyotrichum</i> <i>lanceolatum;</i> <i>Aster l.</i>	panicled aster	native	2	-3	perennial	forb
<i>Symphyotrichum</i> <i>lateriflorum;</i> <i>Aster l.</i>	calico aster	native	2	0	perennial	forb
<i>Thuja occidentalis</i>	arbor vitae	native	4	-3	perennial	tree
<i>Tilia americana</i>	basswood	native	5	3	perennial	tree
<i>Trientalis borealis</i>	star-flower	native	5	0	perennial	forb
<i>Trillium cernuum</i>	nodding trillium	native	5	0	perennial	forb
<i>Trillium grandiflorum</i>	common trillium	native	5	3	perennial	forb
<i>Tsuga canadensis</i>	hemlock	native	5	3	perennial	tree
<i>Ulmus americana</i>	American elm	native	1	-3	perennial	tree
<i>Vaccinium angustifolium</i>	low sweet blueberry	native	4	3	perennial	shrub
<i>Vaccinium myrtilloides</i>	Canada blueberry	native	4	-3	perennial	shrub
<i>Veronica officinalis</i>	common speedwell	non-native	0	3	perennial	forb
<i>Viburnum acerifolium</i>	maple-leaved viburnum	native	6	5	perennial	shrub

<i>Vinca minor</i>	periwinkle	non-native	0	5	perennial	shrub
<i>Viola canadensis</i>	Canada violet	native	5	3	perennial	forb
<i>Viola pubescens</i>	yellow violet	native	4	3	perennial	forb
<i>Viola rostrata</i>	long-spurred violet	native	6	3	perennial	forb



Sugar maple (top) and Canada violet (bottom) in North Shore mesic northern forest. Photos by Phyllis J. Higman.

Dry-mesic Northern Forest

Dry-mesic northern forest is a pine or pine-hardwood forest type typically occurring on sandy glacial outwash and lake-plains, and sometimes on coarse-textured moraines, mostly north of the transition zone. Soils are acidic sands or loamy sands. These forests were historically established in the wake of catastrophic fire that occurred infrequently on the landscape. Such fires typically occurred at intervals of 120 to 300

years. More frequent, low-intensity surface fires, occurring at 5-20 year intervals maintained these systems by exposing bare mineral soils required for conifer regeneration and reducing the influx of more mesic species, such as maple, beech and ash by killing them. Other natural disturbances characteristic of this system include windthrow and insect epidemics.

Management Considerations for Biodiversity Ecosystem Integrity

- Prescribed fire is the mechanism that best mimics the historical natural disturbance regime that sustains this system. Fire promotes pine and oak establishment and regeneration, by exposing mineral soil.
- Where appropriate, fire can be mimicked by thinning, mechanically scarifying the soils, and girdling and herbiciding competing vegetation. Under-planting pine seedlings can be used to reestablish pines where a natural seed source is unavailable. This option should be considered carefully, based on site conditions and future condition. Conversion to mesic forest occurs only after very long intervals of fire suppression.
- In fragmented landscapes, monitoring and managing invasive species is important. The conditions that promote pine and oak regeneration also increase risk of invasion by non-native species.

Dry-mesic Northern Forest Documented During 2015 Surveys

North Shore dry-mesic northern forest113



Photo by Phyllis J. Higman.

North Shore Dry-mesic Northern Forest



Photo by Phyllis Higman.

Site Summary

This site comprises the southeastern half of a large contiguous block of closed canopy forest on end moraine. It is characterized by steep ravines of variable aspect throughout. The site is situated along the north shore of the eastern arm of Walloon Lake. Lake residences along the southwestern border generally sustain a high level of natural cover. The remainder of the site is buffered

by closed canopy forest of varying widths. The dry-mesic northern forest transitions to mesic northern forest to the northwest. Soils are well drained, coarse to medium textured acidic sandy loams, with a layer of pine needles and hardwood leaves on the surface. This site is not experiencing the catastrophic die-off of canopy trees characteristic of the mesic forest sites in the region.

Vegetation

Total species 44; Native 40. Total FQI 27.9; Native FQI 29.1

Tree dominance is strikingly different here than at the other forested uplands surveyed in 2015. There is a sparse super-

canopy of white pine, red pine and occasional hemlock. Canopy dominants are red oak, red pine, and big-tooth aspen.

Aspen represents a greater component of the system than historically. The understory is dominated by beech with components of striped maple, white pine, red maple, ironwood and serviceberry and occasionally paper birch and trembling aspen. There are also scattered hemlock groves.

Shrubs are relatively common including Canadian fly-honey-suckle, red honey-suckle, maple-leaved viburnum and low sweet blueberry. The ground layer is sparse including *Carex pensylvanica*, Canada mayflower, big-leaf aster, false spikenard, star flower, wintergreen, gay-wings, downy soloman seal, partridge berry, rough-leaved

rice-grass, and wood betony. Occasionally, ash seedlings are locally dominant, and bracken fern is also common.

Few invasive species were established in the forest. Non-native Kentucky blue grass and common St. John's-wort were noted rarely along the trails, and common speedwell was observed occasionally in the ground layer.

A wetland seep occurs at the southern entry point along North Shore Drive, dominated by *Carex scabrata*, sensitive fern, marsh horsetail, beggar's tick, skull-caps, and spotted touch-me-not.

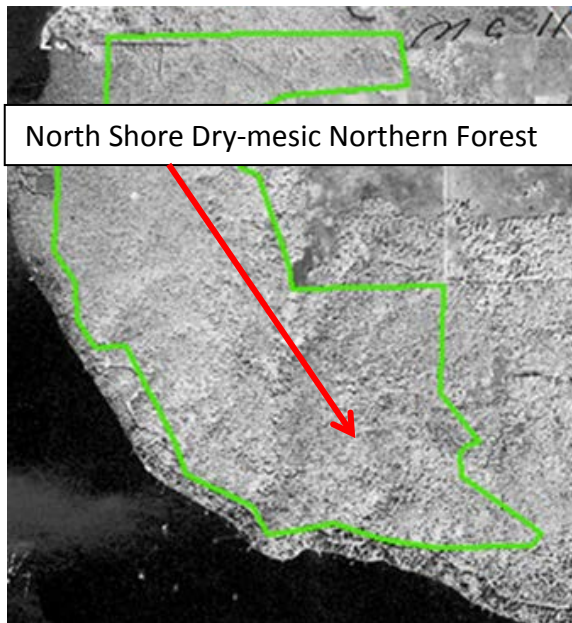


Figure 29. North Shore 1938 imagery.



Figure 30. North Shore 2012 imagery.

Long-term lack of fire, fragmentation and invasive species are the primary threats to this forest. Over extensive time periods, the lack of fire or equivalent disturbance will impede pine and oak regeneration and allow the invasion and maturation of shade-tolerant tree species. This will result in the eventual conversion to mesic forest.

Sources of non-native species are plentiful along the eastern edge of the forest.

Threats

While there is currently little impact from these species, invasion will become more likely, as surrounding lands are opened up by development, especially if the forest becomes more fragmented by trails and pathways. Species of concern include spotted knapweed, common St. John's-wort, hawkweeds, sheep sorrel, garlic mustard, autumn olive non-native bush honeysuckles, multiflora rose and black locust. Common

buckthorn is also a concern, however these were not observed during surveys. See page 112 for further discussion of considerations

for biodiversity management and ecosystem integrity.

Site Significance

▪ *Forest of Regional Significance*

This site retains some of the structure and composition of historical dry-mesic forests, with key dominants and few non-native species. However, the catastrophic and small scale fires that created and sustain this system historically have been long suppressed. This is probably driving the predominance of beech saplings and ash seedlings in the understory. Currently white pine is well represented in the understory; however, red pine is much less so.

It forms a large complex with the mesic northern forest to the northeast and provides

summer nesting habitat for interior forest obligates such as black-throated blue warbler, black-throated green warbler, scarlet tanager, and ovenbird.

This was the only dominant area of dry-mesic northern forest documented during 2015 surveys. Therefore, it is of regional importance, by contributing to ecosystem diversity and providing unique habitat. However, as a relatively small occurrence, it does not currently qualify as an EO. This can be re-evaluated after further surveys are undertaken in the region.



American beech and white pine in the understory of North Shore dry-mesic northern forest. Photo by Phyllis Higman

North Shore Dry-Mesic Northern Forest

Conservatism-Based Metrics:	
Total Mean C:	4.2
Native Mean C:	4.6
Total FQI:	27.9
Native FQI:	29.1
Adjusted FQI:	43.9
% C value 0:	11.4
% C value 1-3:	13.6
% C value 4-6:	68.2
% C value 7-10:	6.8
Native Tree Mean C:	4.1
Native Shrub Mean C:	4.8
Native Herbaceous Mean C:	4.8

Species Richness:		
Total Species:	44	
Native Species:	40	90.9%
Non-native Species:	4	9.1%

Species Wetness:	
Mean Wetness:	2.8
Native Mean Wetness:	2.8

Duration Metrics:		
Annual:	0	0.0%
		100.0
Perennial:	44	%
Biennial:	0	0.0%
Native Annual:	0	0.0%
Native Perennial:	40	90.9%
Native Biennial:	0	0%

Physiognomy Metrics:		
Tree:	13	29.5%
Shrub:	5	11.4%
Vine:	1	2.3%
Forb:	15	34.1%
Grass:	4	9.1%
Sedge:	4	9.1%
Rush:	0	0.0%
Fern:	2	4.5%
Bryophyte:	0	0.0%

Documented species:

Scientific Name	Common Name	Native?	C	W	Duration	Physiognomy
<i>Acer pensylvanicum</i>	striped maple	native	5	3	perennial	tree
<i>Acer rubrum</i>	red maple	native	1	0	perennial	tree
<i>Acer saccharum</i>	sugar maple	native	5	3	perennial	tree
<i>Aquilegia canadensis</i>	wild columbine	native	5	3	perennial	forb
<i>Aralia nudicaulis</i>	wild sarsaparilla	native	5	3	perennial	forb
<i>Betula papyrifera</i>	paper birch	native	2	3	perennial	tree
<i>Carex arctata</i>	sedge	native	3	5	perennial	sedge
<i>Carex deweyana</i>	sedge	native	3	3	perennial	sedge
<i>Carex gracillima</i>	sedge	native	4	3	perennial	sedge
<i>Carex pensylvanica</i>	sedge	native	4	5	perennial	sedge
<i>Dactylis glomerata</i>	orchard grass	non-native	0	3	perennial	grass
<i>Dichanthelium xanthophyllum</i> ;						
<i>Panicum x.</i>	panic grass	native	6	5	perennial	grass
<i>Epipactis helleborine</i>	helleborine	non-native	0	0	perennial	forb
<i>Eurybia macrophylla</i> ; <i>Aster m.</i>	big-leaved aster	native	4	5	perennial	forb
<i>Fagus grandifolia</i>	American beech	native	6	3	perennial	tree
<i>Fraxinus americana</i>	white ash	native	5	3	perennial	tree
<i>Gaultheria procumbens</i>	wintergreen	native	5	3	perennial	shrub
<i>Lonicera canadensis</i>	Canadian fly honeysuckle	native	5	3	perennial	shrub
<i>Lonicera dioica</i>	red honeysuckle	native	5	3	perennial	vine
<i>Lycopodium clavatum</i>	running ground-pine	native	4	0	perennial	fern
<i>Maianthemum canadense</i>	Canada mayflower	native	4	3	perennial	forb
<i>Maianthemum racemosum</i> ;						
<i>Smilacina r.</i>	false spikenard	native	5	3	perennial	forb

<i>Mitchella repens</i>	partridge-berry	native	5	3	perennial	forb
<i>Orthilia secunda</i>	one-sided pyrola	native	7	0	perennial	forb
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	native	6	5	perennial	grass
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	native	5	3	perennial	tree
<i>Pedicularis lanceolata</i>	swamp-betony	native	8	-3	perennial	forb
<i>Pinus resinosa</i>	red pine	native	6	3	perennial	tree
<i>Pinus strobus</i>	white pine	native	3	3	perennial	tree
<i>Poa pratensis</i>	Kentucky bluegrass	non-native	0	3	perennial	grass
<i>Polygala paucifolia</i>	gay-wings	native	7	3	perennial	forb
<i>Polygonatum pubescens</i>	downy solomon seal	native	5	5	perennial	forb
<i>Populus grandidentata</i>	big-tooth aspen	native	4	3	perennial	tree
<i>Populus tremuloides</i>	quaking aspen	native	1	0	perennial	tree
<i>Pteridium aquilinum</i>	bracken fern	native	0	3	perennial	fern
<i>Quercus rubra</i>	red oak	native	5	3	perennial	tree
<i>Ribes cynosbati</i>	prickly or wild gooseberry	native	4	3	perennial	shrub
<i>Solidago caesia</i>	bluestem goldenrod	native	6	3	perennial	forb
<i>Trientalis borealis</i>	star-flower	native	5	0	perennial	forb
<i>Trillium grandiflorum</i>	common trillium	native	5	3	perennial	forb
<i>Tsuga canadensis</i>	hemlock	native	5	3	perennial	tree
<i>Vaccinium angustifolium</i>	low sweet blueberry	native	4	3	perennial	shrub
<i>Veronica officinalis</i>	common speedwell	non-native	0	3	perennial	forb
<i>Viburnum acerifolium</i>	maple-leaved viburnum	native	6	5	perennial	shrub



**White pine in the supercanopy.
Photo by Phyllis J. Higman.**



**Red pine in the subcanopy
Photo by Phyllis Higman.**

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