Forest Stewardship Plan for 45th Parallel Park

Prepared for Suttons Bay Township by:

Linda Thomasma, Ph.D.
Two by Two Wildlife Consulting, LLC
(twobytwowildlife@gmail.com)

Plan Start Date: July 2017
Plan Duration: 20 years (July, 2037)

Landowner Contact Information	Plan Writer Contact Information
Name: Suttons Bay Township Parks and Recreation William Drozdalski (contact)	Name: Linda Thomasma, Ph.D. Two by Two Wildlife Consulting LLC
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Property Information				
Total Acres: Approximately 40	Forested Acres: Approximately 40		Acres in Plan: Approximately 40	Tax ID:
Town: 30N	Range: 11W	Section: 16	Township: Suttons Bay	County: Leelanau

Property Legal Description:
SW1/4 of the SE1/4 of Section 16; T30N R11W; Suttons Bay Township; Leelanau County

How to Find Property from Nearest Town:
The parking area for 45th Parallel Park is located approximately 1.5 miles north of the intersection of M22 and 204 in Suttons Bay or approximately 0.25 miles north of Dumas Road. It is a MDOT pull off on the bay side of M22. The Park boundary is approximately 800 feet due west of the parking area.

Participation in Related Forestry Programs

__ I intend to enroll this parcel in the Qualified Forest Program (QF). [www.Michigan.gov/QFP]
__ I intend to enroll this parcel in the Commercial Forest Program (CF). [www.Michigan.gov/Commercial Forest]
__ I intend to enroll this parcel in the American Tree Farm System. [www.TreeFarmSystem.org]
__ I intend to apply to the NRCS for financial assistance. [www.nrcs.usda.gov]

Michigan's Stewardship Ethic

Stewardship is an ethic recognizing that the land and its natural inhabitants have an inherent worth and that we have a responsibility to consider the land as we protect, manage, utilize, and enjoy the forest. Stewardship guides us to conduct our activities to the utmost of our abilities, to insure the future health, productivity, diversity, and well-being of the land, its natural communities and species, and to provide opportunities to our successors that are at least equal to ours to use and enjoy the land and its resources.

Signatures of Approval from the Landowner, Plan Writer, and DNR Service Forester

Landowner: William Drozdalski Suttons Bay Township Parks and Recreation	Date: 6/21/2017
Plan Writer: Linda Thomasma	Date: 6/21/2017
DNR Service Forester: Mikell Smallegan	Date: 6/21/2017

After review and approval by the Landowner, the Plan Writer will submit the entire Plan to the nearest DNR Service Forester for their review. Electronic submission of the Plan is encouraged by emailing a Word document or pdf file to the Service Forester. The DNR Service Forester will return a hard copy or pdf of the final signature page to the Plan Writer after approval.

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Introduction

Goals for 45th Parallel Park

The Township has four primary goals for 45th Parallel Park; 1) determine if revenue could be generated through active timber management 2), increase recreational opportunities, 3) evaluate potential threats associated with hazard trees and 4) retain/enhance local biodiversity, including the promotion of wildlife corridors within the landscape.

Specifically, the township would like to evaluate the possibility of placing a hiking trail, picnic sites, and a single-track mountain bike trail within the Park boundary. The area which encompasses the Park has been logged in the past and the township would like to determine if logging is a viable financial option and if so, develop a schedule for logging operations. Emerald Ash Borer, Beech-Bark Disease, and Oak Wilt have left dead and dying trees throughout the region. Standing dead trees pose potential safety threats to park visitors. This threat will need to be addressed as recreational opportunities increase within the Park. The land use/land cover of the neighborhood encompassing the park is diverse. Do the habitats that comprise the Park contribute to the local diversity and are these habitats well connected? This report will address the Township's objectives and the management recommendations required to meet those objectives.

General Property Description

The 45th Parallel Park comprises approximately 40 acres of inherently diverse forested sites. The Park is located in Leelanau County approximately 1.5 miles north of the village of Suttons Bay (Figure 1). The watershed that incorporates the Park drains directly into Suttons Bay (Lake Michigan Watershed, 04060200) (Figure 2).

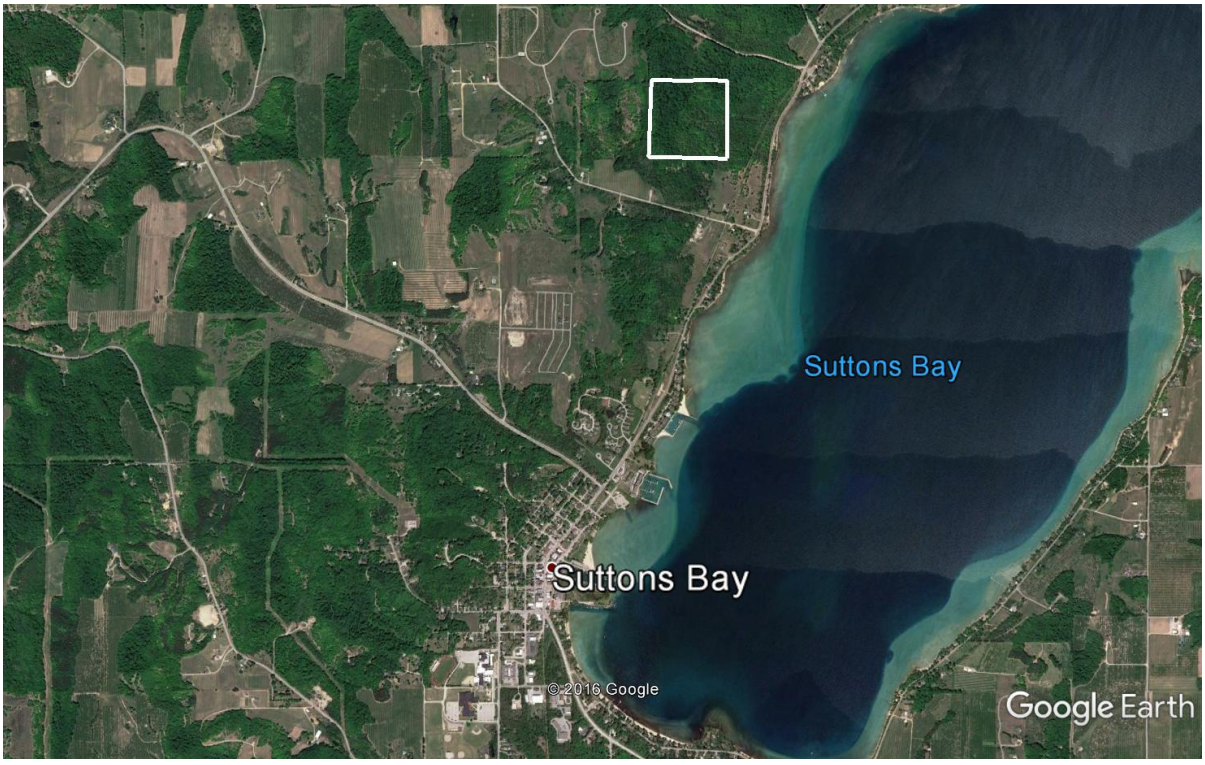

Figure 1. The 45th Parallel Park is located north of Suttons Bay, MI.

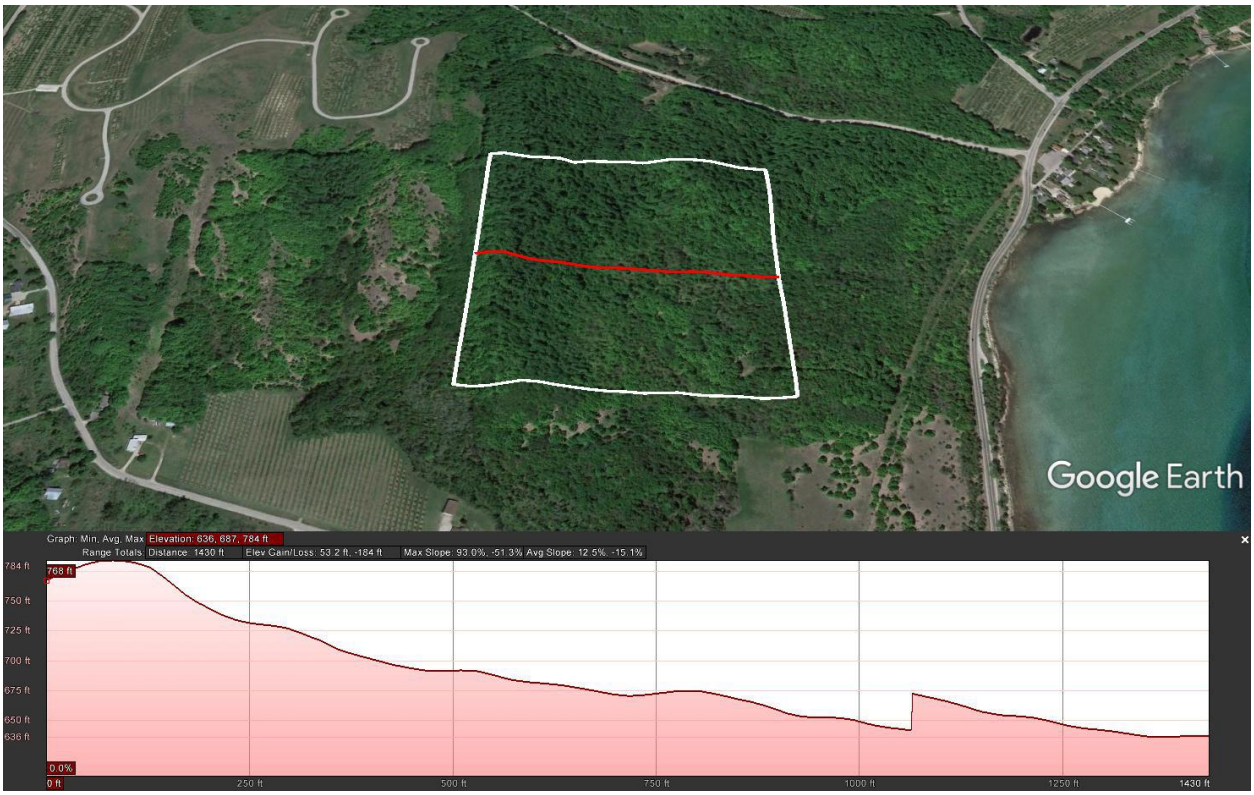

Figure 2. Elevation change on a west to east transect through 45th Parallel Park.

Planning Process

Representatives of the Township met with the Plan Writer during the Winter of 2016-2017. A proposal, including a schedule, was submitted and accepted in late winter 2017. Multiple field visits in late winter and spring were conducted by the Plan Writer. A draft plan was submitted to the Township for their review prior to submission to the MDNR. Upon the Township's approval, the plan was then submitted to the MDNR for their review and approval.

Stand Assessment Method

The Plan Writer first compiled information on property boundaries, soil types, and vegetative cover types. Basic field assessment data was collected by visual and quantitative surveys on multiple occasions in the winter and spring. Winter sampling was necessary to address the presence or absence of winter deer yards. Winter sampling had the additional advantage of allowing the Plan Writer to determine if other wildlife species were present based upon tracks left in the snow. Vegetative sampling was conducted during the spring to sample both over and understory species. In addition, other wildlife such as songbirds were identified in the spring. Point and fixed area plots were used to gain a rough estimate of forest density, vegetative species composition, diameter distribution, and dead down woody debris. Other observational data included: insect and disease issues, presence or absence of invasive species, and occurrence of wildlife trees. These sampling efforts were not a formal forest inventory as this entails more expensive data collection and analysis and should be completed in preparation for a timber sale.

Resource Descriptions

Geology

The Park lies within an area known as the Leelanau Drumlin Field. The landforms comprising the Park are Pleistocene glacial deposits. The steep hills found predominantly in the western and northern portions of the Park are ground moraines and the lowland areas to the south and east lie in the glaciolacustrine plain.

Soils

The three primary soil types found within the 45th Parallel Park are the Emmet-Omena sandy loams on 25-50% slopes, the Kalkaska-East Lake loamy sands on 0-6% slopes, and the Lupton-Markey mucks (Table 1, Figure 3). For a complete description of each Soil Type see Appendix 1. The Emmet-Omena sandy loams and the Kalkaska-East Lake loamy sands are associated with the ground moraines while the Lupton-Markey mucks are associated with the glaciolacustrine plain.

Table 1. Soil types found in the Area of Interest (AOI) which includes 45th Parallel Park, Suttons Bay Township (Soil Survey Staff, Natural Resources Conservation Service, and United States Department of Agriculture. Web Soil Survey. Available online at https://websoilsurvey.sc.egov.usda.gov/).

Map Unit Symbol	Map Unit Name	Percent Slope	Acres in AOI*	Percent of AOI*
ArA	Alcona-Richter sandy loams	0-2%	0.2	0.4%
EsD	Emmet-Omena sandy loams	12-18%	0.5	1.2%
EsF	Emmet-Omena sandy loams	25-50%	24.2	51.7%
KeB	Kalkaska-East Lake loamy sands	0-6%	2.7	5.7%
LlF	Leelanau-East Lake loamy sands	25-45%	0.1	0.1%
Lm	Lupton-Markey mucks	-----	19.1	40.8%
MdB	Mancelona sandy loam	0-6%	<0.1	<0.1%
WlD	Wind eroded land	steep	0.1	0.2%
Totals for Area of Interest			**46.8**	**100.0%**

Figure 3. Soils map of the Area of Interest which encompasses 45th Parallel Park, Suttons Bay Township (Soil Survey Staff, Natural Resources Conservation Service, and United States Department of Agriculture. Web Soil Survey. Available online at https://websoilsurvey.sc.egov.usda.gov/).

Forest Cover Types

There are two mixed forest cover types comprising the Park; Northern Hardwood Forest and Bottomland Mixed Forest (Figure 4). The Northern Hardwood Forest type is associated with the loamy sands and sandy loams of the ground moraine while the Bottomland Mixed Forest type is found on the poorly drained mucks of the glaciolacustrine plain.

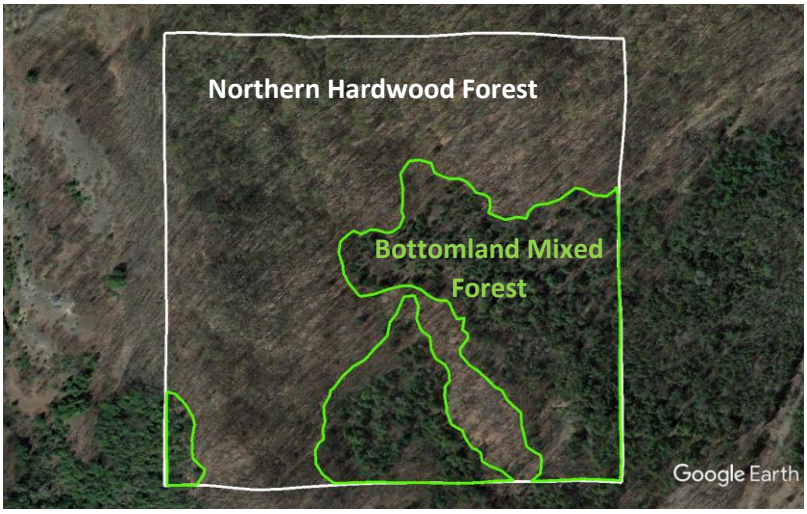

Figure 4: The forest cover types comprising 45th Parallel Park.

The Northern Hardwood Forest is comprised predominantly of deciduous tree species including; maple (Sugar and Red), American Beech, American Basswood, Yellow Birch, White Ash, Aspen, Northern Red Oak, and Hophornbeam (Figure 5). Almost all of the White Ash trees were already on the ground having succumbed to Emerald Ash Borer. There was very little Beech Bark Disease scale on the American Beech trees within the Park. They appear to be quite healthy and vigorous. Northern Red Oaks were only observed on the ridges and did not appear to have oak wilt, however, they had not yet leafed-out when the surveys were conducted.

Figure 5. Northern Hardwood Forest of 45th Parallel Park.

The Bottomland Mixed Forest is comprised predominantly of Northern White Cedar and Eastern Hemlock. Deciduous species include; Red Maple, Birch, Black Ash, Boxelder, Balsam Poplar, and Willow (Figure 6). As in the hardwood stand, most of the ash was already dead and on the ground.

Figure 6. Bottomland Mixed Forest in 45th Parallel Park.

Water

There are numerous flowing wells along the Suttons Bay shoreline and 45th Parallel Park is no exception. A spring can be found along the base of the slope (Figure 7). This spring results in a small creek that flows through the Bottomland Mixed Forest stand. The springs are the result of subsurface clay lenses that confine the aquifer (https://pubs.usgs.gov/of/2007/1236/pdf/OFR2007-1236.pdf).

Figure 7. The headwaters of the small creek that flows near the southeast corner of 45th Parallel Park.

Wetlands

The Michigan Department of Environmental Quality (DEQ) Wetlands Map Viewer (www.mcgi.stte.mi.us/wetlands), indicates that much of the Bottomland Mixed Forested stands in 45th Parallel Park are designated wetland according to state and federal definitions (Figure 8). A permit is not required for typical forest management activities in a wetland, but a permit is required for filling, dredging, draining, or development. A DEQ permit is also required for a stream crossing (culvert or bridge). See www.Michigan.gov/DEQWetlands for more information about wetlands. Any management activity in the Park should follow the "Sustainable Soil and Water Quality Practices on Forest Land" (Best Management Practices – www.michgan.gov/dnr).

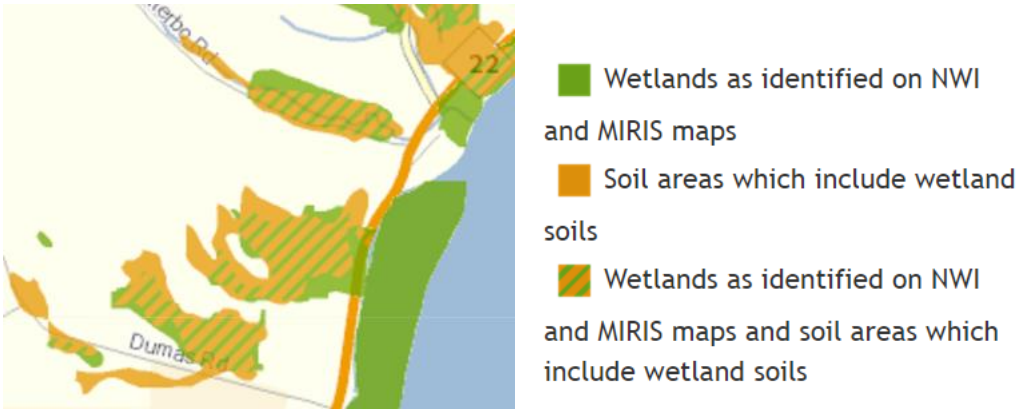

Figure 8. Wetland designation for 45th Parallel Park as determined from Michigan DEQ Wetlands Map Viewer (www.mcgi.stte.mi.us/wetlands).

Threatened and Endangered Species

The Michigan Department of Natural Resources (MDNR) and the Michigan Natural Features Inventory (MNFI) report that the Common Loon (*Gavia immer*) (Threatened, legally protected; last observed in 1989), the Little Brown Bat (*Myotis lucifugus*) (Species of Special Concern; Rare or status uncertain; not legally protected; last observed in 1921), and Furrowed Flax (*Linum sulcatum*) (Species of Special Concern' Rare or status uncertain; not legally protected; last observed in 1953) were found in

the general vicinity of the Park. The Common Loon is associated with large water bodies. Relatively undisturbed inland lakes are used for breeding and the bays and the open waters of the Great Lakes are used by nonbreeding birds and for staging during migration. Suitable habitat for loons is not found within or immediately adjacent to the Park. The Little Brown Bat is associated with forests near water where they forage for insects. Roosts commonly used by active bats include buildings, tree hollows, and log and rock piles. Suitable roost trees for bats are found within the Park. Unless they pose a significant threat, trees with hollows will be retained during active management. Furrowed Flax is associated with exposed mineral soil within oak barrens and dry prairie remnants, none of which exist in the Park.

Wildlife Habitat

Of the 399 vertebrate wildlife species found in Michigan, 300 are found in Leelanau County. Of this, the Park provides habitat for 153 species; 43 in Northern Hardwoods, 45 in Bottomland Mixed, and 65 in both (MIWILD analysis, Appendix 2). Both forest types are inherently diverse and provide potential habitat for the Red-shouldered Hawk, a State Threatened species. The Park contains a variety of structural habitat features which contribute to the overall quality of the habitat for wildlife. These include; the springs and creek, significant dead down woody debris, snags, living cavity trees (Figure 9), a large tree component, canopy gap openings, and mast producing species (Northern Red Oak and American Beech).

Figure 9. A living cavity tree. This butt hollow in a large diameter American Beech is used as a den site by a porcupine.

Archeological, Cultural, or Unique Natural Sites

The MDNR reports that the archeological database does not show any concerns for historical sites in this section of the Township. Standard Seven of the American Tree Farm System is Protect Special Sites – "Special sites are managed in ways that recognized their unique historical, archeological, cultural, geological, biological or ecological characteristics." The Park is located within a Forest of Recognized Importance (FORI). The FORI in Michigan include Great Lakes coastline, riparian corridors along Wild and Scenic or Natural Rivers, rare forest types, or forests that provide required habitat for threatened or endangered species. Forests within a mile of the Great Lakes are globally rare and should be managed to maintain forest cover near Great Lakes shorelines.

The Northern Hardwoods Forest type within the Park falls within the Michigan Natural Features Inventory definition of Mesic Northern Forest while portions of the Bottomland Mixed Forest type fall within the Rich Conifer Swamp classification (for a complete discussion of each, go to www.mnfi.anr.msu.edu/communities/index.cfm). The state element ranking for Mesic Northern Forest and Rich Conifer Swamp is S3. The S3 ranking is defined as "Vulnerable in the state due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation."

Invasive Species

Small populations of non-native invasive species were found within the Park. They include; Japanese Barberry, Garlic Mustard, Autumn Olive, and possibly Marsh Thistle (Figure 10). A patch of Phragmites was also found but it is unknown whether or not it is the native or non-native species. The Japanese Barberry, Garlic Mustard, and Autumn Olive were typically found in proximity to the old skid trails and haul roads within the Northern Hardwoods while the Marsh Thistle was in the wet areas within the Bottomland Mixed Forest. The Invasive Species Specialist from the Leelanau Conservation District should be contacted and directed to the sites. Population control of these invasive species should be conducted as soon as possible to prevent the further spread and encroachment on native species.

Figure 10. Invasive species found to occur within 45th Parallel Park. Japanese Barberry, Garlic Mustard, Autumn Olive, and Marsh Thistle.

Aesthetic Quality

People respond positively to trees and other vegetation. Research indicates a direct link between visual quality and human health. Enhancing the visual quality of forested land for recreational users may result in a healthier community and local economy. People respond positively to natural versus urban landscapes. Within forested landscapes, they tend to prefer more open forest conditions with scattered large trees. Negative features include; many small trees, large amounts of dead and down woody debris, and a thick shrub understory. At times, human perceptions of visual quality may be at odds with the ecological value of the stand. For instance, dead down woody debris is of significant value to wildlife and important in carbon retention and nutrient cycling. Once people are made aware of the positive ecological benefits of those "undesirable" features they may modify their opinion. The same is true for timber harvesting. Initially, harvesting may result in a negative visual perception, yet in the long term produce a more visibly desirable stand. Efforts should be made to educate the public on the differences between visual and ecological quality of their forests as well as the transitory effects of timber management.

The Park has good visual quality with a variety of forms, colors, and textures. The Northern Hardwood stand provides significant visual diversity with each season. From the open canopy of winter

and spring to the closed canopy of summer and fall. In spring, sunlight can reach the forest floor, resulting in a bloom of spring ephemeral wildflowers. With summer the stand darkens under a closed green canopy. With autumn the canopy slowly begins to open as the deciduous trees drop their colorful foliage. The changes within the Bottomland Mixed Forested stand may be less dramatic as the season's progress but the perpetual cover provided by the conifer trees is dramatic. Within stand features that contribute to visual quality are the variety of tree species and sizes including a large tree component, canopy gap openings, and water features. During the winter and spring there is a dramatic view of the bay from the top of the ridge along the western boundary of the Park. Even though the Park is set back from the road, the hillside is visible from M-22. The distance from the road contributes to the relative quiet and solitude of 45th Parallel Park.

Management Recommendations

Site Considerations

In general, meeting the goals and objectives of the Township for 45th Parallel Park are dependent on site factors. For instance, soil type and percent slope will determine management options and potential expense associated with activities and development (Table 2).

Table 2. Potential limitations associated with the soil types found within 45th Parallel Park and the Township's goals (Soil Survey Staff, Natural Resources Conservation Service, and United States Department of Agriculture. Web Soil Survey. Available online at https://websoilsurvey.sc.egov.usda.gov/).

Township's Goals	EsF 25-50% slope	KeB 0-6% slope	Lm
Timber Production			
Erosion Hazard (Road and Trail)[a]	Severe	Slight	Slight
Suitability for Haul Roads[b]	Poorly Suited	Well Suited	Poorly Suited
Suitability for Log Landings[c]	Poorly Suited	Well Suited	Poorly Suited
Construction Limitations for Haul Roads and Log Landings[d]	Severe	Slight	Severe
Harvest Equipment Operability[e]	Poorly Suited	Well Suited	Poorly Suited
Potential for Wind-throw[f]	Slight	Slight	Severe
Recreation Development			
Erosion Hazard (Off Road and Off Trail)[g]	Severe	Slight	Slight
Paths and Trails[h]	Very Limited	Somewhat Limited	Very Limited
Camp Areas[i]	Very Limited	Somewhat Limited	Very Limited

[a] "Slight" indicates that little or no erosion is likely. "Severe" indicates that significant erosion is expected, that the roads or trails require frequent maintenance, and that costly erosion-control measures are needed.

[b] "Well suited" indicates that few or no restrictions affect construction activities. "Poorly suited" indicates that one or more limitations make the construction of haul roads very difficult or costly.

[c] "Well suited" indicates that the soil has features that are favorable for log landings and has no limitations. Good performance can be expected, and little or no maintenance is needed. "Poorly suited" indicates that the soil has one or more properties that are unfavorable for log landings. Overcoming the unfavorable properties requires special design, extra maintenance, and costly alteration.

[d] "Slight" indicates that no significant limitations affect construction activities. "Severe" indicates that one or more limitations can make construction very difficult or very costly.

[e] "Well suited" indicates that the soil has features that are favorable and there are no limitations. Good performance can be expected, and little or no maintenance is needed. "Poorly suited" indicates that the soil has one or more properties that are unfavorable and that overcoming them requires special design, extra maintenance, and costly alteration.

[f] Wind-throw hazard is the likelihood that trees will be uprooted (tipped over) by the wind. It can occur if the soil is not deep enough to provide adequate root anchorage. "Severe" alerts the forestland manager to the possibility of wind-throw. Special care is needed in planning cutting areas to minimize the danger of wind-throw.

[g] "Slight" indicates that erosion is unlikely under ordinary climatic conditions. "Severe" indicates that erosion is very likely and that erosion-control measures, including re-vegetation of bare areas, are advised.

h and i "Somewhat limited" indicates that the soil has features that are moderately favorable. Limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable. Limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Best Management Practices

Poor land management practices can degrade surface and ground water quality by increasing sedimentation, nutrient and chemical input, heat, and debris. Forest landowners and their agents and contractors are responsible for any damage to streams, lakes, and wetlands. Any land management activity in the Park should follow "Sustainable Soil and Water Quality Practices on Forest Land" (Best Management Practices – http://www.michigan.gov/dnr/0,4570,7-153-31154_31261---,00.html). The purpose of the manual is to provide specific guidance to the forest landowner on how to protect water quality, critical habitat, and aquatic resources when conducting forest management activities. Following these practices results in healthy forests and watersheds by preventing erosion, sedimentation, and soil compaction.

Timber Management

Northern Hardwood Forest - The Northern Hardwood stand was harvested in the past. Based upon Google Earth imagery, the stand was most likely harvested around 1999 (18 years ago) (Figure 11). Uneven-age silvicultural systems (single-tree and group selection) are typically used to regenerate Northern Hardwoods on a 15 to 20 year rotation. The basal area and diameter distribution of the overstory is variable throughout the stand. In a cursory survey, basal area of the overstory ranged from 50 to 120 sqft/acre (average 80 sqft/ac; Sugar Maple 45 sqft/acre, Red Maple 17.5 sqft/acre, Hophornbeam 10.0 sqft/ac, and American Beech 7.5 sqft/ac). Overstory diameter ranged from 6 to 18 inches with a medial diameter of 10 inches. Basal area, overstory diameter, and species composition varied in part with slope position (ridge top, ravine, side, and toe) and aspect. Slope position and aspect effect nutrient and light availability as well as ease of access during the last harvest.

April 1993 April 1999

Figure 11. Leaf-off black and white imagery of 45th Parallel Park from April 1993 and April 1999. Note the presence of skid trails, haul roads, and landings in the 1999 image. The main haul road exits the Park near the south east corner and travels south along the old railroad grade.

Sugar and Red Maple were the most abundant overstory species and Hophornbeam and Maple the most predominant understory species in the stand. White Ash was found to be the most predominant dead down woody tree species in the cursory inventory. The vast majority of the ash tree species in both the upland and lowland areas have been lost to Emerald Ash Borer. American Beech is present but scattered throughout the stand. At present, there was little evidence of Beech-bark disease within the stand. Aspen is present but found in scattered groupings on the margins of the stand. The aspen is typically associated with favorable aspect and moist soil conditions. Northern Red Oak was limited to scattered trees along the ridge-tops.

The timber harvest issues associated with the Northern Hardwood stand include; steep slopes with potentially unstable soils, saturated soils along the haul road, restricted access for logging equipment, and potential conflicts with recreational goals. There are existing skid trails and a main haul road that were used in the last harvest. Today, most are vegetated and stable with no significant sources of erosion. Many of these trails could be used again, however, the saturated soil sites would need to be addressed. Invasive plant species were noted in the vicinity of the haul road and skid trails and should be treated. Logging equipment should be cleaned prior to operating in the Park to reduce the introduction and spread of invasive species. As access to the Park for logging equipment is limited, co-operative efforts with the adjoining landowners may be required for a timber harvest. Recreational activities can exist within a managed stand. However, during and immediately after logging, all public access should be restricted for safety reasons. In addition, the public should be informed of the purpose and intent of timber harvesting. Including temporary impacts to the visual quality of the stand which, with unevenaged silvicultural techniques, usually last about 4 years post-harvest. An additional measure that can be taken to reduce the visual impact is to lop the tops of all trees felled within 50 feet of the trail. The timber harvest plan should provide a comprehensive inventory, address issues relating to soils, invasive species, visual quality, and wildlife as well as provide specific instructions to loggers.

Based upon the cursory inventory, the basal area of the stand was approximately 80 sqft/acre. For unevenaged management of Northern Hardwoods in the Lake States, optimal growth is between 70-90 sqft/acre and the recommended medial dbh before harvest is 14 to 16 inches (http://www.michiganforesters.com/Northern%20Hardwood%20Management%20-%20MSU.pdf). It is recommended that a harvest be delayed until the basal area and medial diameter come within the recommended range for unevenaged management. The results from the inventory were cursory and a more intensive inventory should be conducted prior to any harvest activities.

Bottomland Mixed Forest – Due in part to saturated soils, wind-throw potential, the presence of springs and a watercourse, and the overall ecological importance of this type, there are no timber harvest recommendations for the Bottomland Mixed Forested stand.

Landscape Considerations in Forest Management – The 45th Parallel Park exists in a landscape that is fragmented with approximately 50% forested and 50% nonforested (Figure 12). The Park resides within one of the largest and most connected patches of forest remaining in the neighborhood. The reduction of forest cover within this landscape would result in a loss of biodiversity. The lowland coniferous forests are highly fragmented and connectivity between these stands is even more reduced (Figure 12). The Park plays an important role in sustaining the biodiversity of the neighborhood. The degree of forest fragmentation can limit silvicultural options. Within these fragmented landscapes, those

silvicultural systems such as unevenaged systems (single-tree and group selection systems) that retain an existing canopy are encouraged.

Figure 12. The neighborhood containing 45th Parallel Park. Note the amount of forests available within this landscape and their connectivity with other forested stands. The Park is unique in that it is still forested and connected. The lowland conifer forests, like the Bottomland Mixed Forest within the Park are more highly fragmented and detached from similar stands.

Recreation Management

Trails and Picnic Areas – Many of the same restrictions that apply to timber management also apply to the development of trails for recreational activities. The placement and maintenance of trails needs to consider the potential for soil impacts. Those sites that are not too steep within the Northern Hardwood stand are more conducive to recreational development then the Bottomland Mixed Stand with its saturated soils. The existing haul road and skid trails that are well vegetated and stable could potentially be used for trail development. Because they are relatively flat and open, some of the old log landings may be used for small picnic areas. Dead or dying trees that pose a safety issue to hikers, bikers, or campers should be felled. The treatment of invasive species should be incorporated into any recreational development plan.

Nature Observation and Hunting – Because of its inherent diversity, the Park is a great place to view both plants and animals. Habitat for numerous wildlife species is present within the Park and birding opportunities are good. Multiple deer blinds were found in and around the margins of the Park. Even though the Park has deer, there is still White Cedar regeneration within the Bottomland Mixed Forest. By keeping the deer population in check, hunting may help with the perpetuation of White Cedar as well as Eastern Hemlock, Aspen, and Sugar Maple within the stands. Other game species found within the Park include Ruffed Grouse and Black Bear. The grouse population benefits from the Hophornbeam, a critical winter food for wintering Ruffed Grouse. Black Bear tracks were observed within the Park during the winter. A bear den was located within a large windthrow in the Bottomland Mixed Forested stand.

Biodiversity and Wildlife Corridors

With a mix of upland and lowland forested habitat types as well as variable stand structure, 45th Parallel Park makes a significant contribution to local biodiversity. At a large spatial scale, the Park provides contiguous forested habitat that is still connected with adjoining stands. At a fine within stand scale, there is significant structural complexity due various site factors and disturbance events (e.g.

wind-throws). At both the large and small spatial scales 45th Parallel Park plays a significant role in sustaining the local biodiversity.

Summary of Management Recommendations

Invasive Species Inventory
Contact Rebecca S. Koteskey (Communication Specialist, NW Michigan Invasive Species Network at 231.941.0960 x17) to discuss funding sources as well as a formal inventory and evaluation of invasive species within the Park. Invasive species inventories should be conducted on an annual basis at the floristically appropriate time of the year.

Trail and Picnic Area Design
Investigate potential sources of funding including, but not limited to:
Mark Mandenberg
MDNR Parks & Recreation Division
517.284.6114
mandenbergm@michigan.gov

Grand Traverse Band of Ottawa and Chippewa Indians 2% Grant http://www.grandtraverse.org/218/2-Percent-Applications---GT-Band

American Trails http://www.americantrails.org/resources/funding/

Federal Highway Administration https://www.fhwa.dot.gov/Environment/recreational_trails/

People for Bikes http://www.peopleforbikes.org/pages/community-grants

Michigan Trails and Greenway Alliance http://michigantrails.org/resources/trail-toolkit/funding/

Once funding is secured, work with the appropriate agencies to insure compliance and follow Best Management Practices in trail and picnic area development http://www.michigan.gov/dnr/0,4570,7-153-31154_31261---,00.html

Join the American Tree Farm System
Consider joining the American Tree Farm System. Information can be found at:
https://www.treefarmsystem.org/get-started-american-tree-farm

Forest Health
Forest health is an issue of concern with Emerald Ash Borer already present within the stands. The stands should be monitored annually (during different seasons) for changes that may indicate additional insect or disease problems. The "Forest Health Highlights" publication on forest insects and diseases is updated annually and available at www.Michigan.gov/ForestHealth. An additional source of information is www.Michigan.gov/ExoticPests.

Timber Harvest
With an abundance of commercially desirably trees, such as Sugar Maple, the Northern Hardwood stand is a high quality forest from an economic and timber perspective. Sustainable timber production is

compatible with other goals. It is possible to conduct a conservative timber harvest while keeping aesthetics, biodiversity, wildlife habitat, and recreation as equal priorities. The stand is not immediately ready for harvest and a formal inventory should be conducted in about 5 years. During this time, it is recommended that that the Township enter into discussion with surrounding landowners regarding a shared forest inventory, harvest, and access. Working in conjunction with the surrounding owners would be beneficial to all. The Township should contract with a qualified Forester to conduct the inventory, mark the stand, and carry-out the timber sale (advertising, negotiating, sale administration, and post-harvest sampling).

Summary Chart

Stand	Activity	Dates		Cost Share	Cost/Income
		Planned	Completed		
Entire Park	Invasive Species Inventory	Annual* Beginning in 2017			
Entire Park	Invasive Species Removal	Annual* Beginning in 2017			
Entire Park	Trail & Picnic Area Design and Development	Beginning in 2017			
Entire Park	Consider Joining the American Tree Farm System	2017			
Entire Park	Monitor Forest Health	Annual* Beginning in 2018			
Northern Hardwood Stand	Talk with adjoining landowners regarding a future harvest	Beginning in 2018			
Northern Hardwood Stand	Timber Inventory*	2022			
Northern Hardwood Stand	Commercial Timber Sale[+]	2023-2024			

* Funding dependent

[+] Dependent on timber inventory and adjoining landowners

Monitoring

The successful implementation of this Forest Stewardship Plan is dependent upon frequent monitoring by the Township. The Township (or their agent) should walk the entire Park at least annually to inspect the forests for changes and to evaluate the success of earlier management activities. All Forest Stewardship Plans should be adaptable and flexible enough to accommodate changes in landowner goals or forest resources over the 20 year planning period. Please use the following table to record notes and make modifications to this plan as needed.

Updates and Modifications

Appendix 1. Soil Map Unit descriptions for soils found in 45th Parallel Park, Suttons Bay Township, Leelanau County.

ArA—Alcona-Richter sandy loams, 0 to 2 percent slopes

Map Unit Setting

- *National map unit symbol:* 6dj3
- *Elevation:* 600 to 1,600 feet
- *Mean annual precipitation:* 27 to 34 inches
- *Mean annual air temperature:* 39 to 46 degrees F
- *Frost-free period:* 70 to 150 days
- *Farmland classification:* Prime farmland if drained

Map Unit Composition

- *Alcona and similar soils:* 55 percent
- *Richter and similar soils:* 30 percent
- *Minor components:* 15 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Alcona

Setting

- *Landform:* Outwash plains, lake plains, moraines
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Stratified sandy and loamy glaciofluvial deposits and/or glaciolacustrine deposits

Typical profile

- *H1 - 0 to 8 inches:* sandy loam
- *H2 - 8 to 12 inches:* loamy fine sand
- *H3 - 12 to 18 inches:* loamy sand
- *H4 - 18 to 24 inches:* sandy loam
- *H5 - 24 to 60 inches:* stratified loamy sand to sandy loam

Properties and qualities

- *Slope:* 0 to 2 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Moderately well drained
- *Runoff class:* Low
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* About 30 to 72 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water storage in profile:* Moderate (about 8.6 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 2s

- *Hydrologic Soil Group:* B
- *Hydric soil rating:* No

Description of Richter

Setting

- *Landform:* Drainageways, lake plains, moraines
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* 25 to 40 inches of sandy and/or loamy material over stratified, calcareous sandy and silty glaciofluvial deposits

Typical profile

- *H1 - 0 to 8 inches:* sandy loam
- *H2 - 8 to 27 inches:* fine sandy loam
- *H3 - 27 to 60 inches:* stratified loamy fine sand to sandy loam

Properties and qualities

- *Slope:* 0 to 2 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Somewhat poorly drained
- *Runoff class:* Very low
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* About 6 to 18 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 20 percent
- *Available water storage in profile:* Moderate (about 7.4 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 2w
- *Hydrologic Soil Group:* B/D
- *Hydric soil rating:* No

Minor Components

Hettinger

- *Percent of map unit:* 15 percent
- *Landform:* Depressions on lake plains
- *Landform position (three-dimensional):* Talf
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* Yes

EsD—Emmet-Omena sandy loams, 12 to 18 percent slopes

Map Unit Setting

- *National map unit symbol:* 6dk2
- *Elevation:* 600 to 1,400 feet
- *Mean annual precipitation:* 27 to 32 inches
- *Mean annual air temperature:* 41 to 46 degrees F
- *Frost-free period:* 90 to 150 days
- *Farmland classification:* Farmland of local importance

Map Unit Composition

- *Emmet and similar soils:* 50 percent
- *Omena and similar soils:* 45 percent
- *Minor components:* 5 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Emmet

Setting

- *Landform:* Drumlins, moraines, till plains
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, side slope, base slope, nose slope, crest
- *Down-slope shape:* Linear, convex
- *Across-slope shape:* Convex, concave
- *Parent material:* 24 to 50 inches of loamy material over calcareous loamy till

Typical profile

- *H1 - 0 to 8 inches:* sandy loam
- *H2 - 8 to 26 inches:* sandy loam
- *H3 - 26 to 32 inches:* sandy clay loam
- *H4 - 32 to 60 inches:* sandy loam

Properties and qualities

- *Slope:* 12 to 18 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Runoff class:* Low
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 30 percent
- *Available water storage in profile:* Moderate (about 7.4 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 4e
- *Hydrologic Soil Group:* B
- *Hydric soil rating:* No

Description of Omena

Setting

- *Landform:* Drumlins, moraines
- *Landform position (two-dimensional):* Summit, shoulder, toeslope, backslope, footslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Parent material:* Loamy till

Typical profile

- *H1 - 0 to 8 inches:* sandy loam
- *H2 - 8 to 14 inches:* sandy loam
- *H3 - 14 to 60 inches:* sandy loam

Properties and qualities

- *Slope:* 12 to 18 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Runoff class:* Medium
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 30 percent
- *Available water storage in profile:* Moderate (about 6.4 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 4e
- *Hydrologic Soil Group:* B
- *Hydric soil rating:* No

Minor Components

Leelanau

- *Percent of map unit:* 2 percent
- *Landform:* Till plains, drumlins, moraines
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Hydric soil rating:* No

Kiva

- *Percent of map unit:* 2 percent
- *Landform:* Outwash plains, lake plains, moraines
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope

- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Linear
- *Across-slope shape:* Concave, convex
- *Hydric soil rating:* No

Nester

- *Percent of map unit:* 1 percent
- *Landform:* Moraines, till plains
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Hydric soil rating:* No

EsF—Emmet-Omena sandy loams, 25 to 50 percent slopes

Map Unit Setting

- *National map unit symbol:* 6dk4
- *Elevation:* 600 to 1,400 feet
- *Mean annual precipitation:* 27 to 32 inches
- *Mean annual air temperature:* 41 to 46 degrees F
- *Frost-free period:* 90 to 150 days
- *Farmland classification:* Not prime farmland

Map Unit Composition

- *Emmet and similar soils:* 50 percent
- *Omena and similar soils:* 45 percent
- *Minor components:* 5 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Emmet

Setting

- *Landform:* Drumlins, moraines, till plains
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, side slope, base slope, nose slope, crest
- *Down-slope shape:* Linear, convex
- *Across-slope shape:* Convex, concave
- *Parent material:* 24 to 50 inches of loamy material over calcareous loamy till

Typical profile

- *H1 - 0 to 8 inches:* sandy loam
- *H2 - 8 to 26 inches:* sandy loam
- *H3 - 26 to 32 inches:* sandy clay loam
- *H4 - 32 to 60 inches:* sandy loam

Properties and qualities

- *Slope:* 25 to 50 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Runoff class:* Medium
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 30 percent
- *Available water storage in profile:* Moderate (about 7.4 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 7e
- *Hydrologic Soil Group:* B
- *Hydric soil rating:* No

Description of Omena

Setting

- *Landform:* Drumlins, moraines
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Parent material:* Loamy till

Typical profile

- *H1 - 0 to 8 inches:* sandy loam
- *H2 - 8 to 14 inches:* sandy loam
- *H3 - 14 to 60 inches:* sandy loam

Properties and qualities

- *Slope:* 25 to 50 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Runoff class:* High
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 30 percent
- *Available water storage in profile:* Moderate (about 6.4 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 7e
- *Hydrologic Soil Group:* B
- *Hydric soil rating:* No

Minor Components

Leelanau

- *Percent of map unit:* 2 percent
- *Landform:* Drumlins, moraines, till plains
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Hydric soil rating:* No

Kiva

- *Percent of map unit:* 2 percent
- *Landform:* Outwash plains, lake plains, moraines
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope

- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Linear
- *Across-slope shape:* Concave, convex
- *Hydric soil rating:* No

Nester

- *Percent of map unit:* 1 percent
- *Landform:* Till plains, moraines
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Hydric soil rating:* No

KeB—Kalkaska-East Lake loamy sands, 0 to 6 percent slopes

Map Unit Setting

- *National map unit symbol:* 6dkg
- *Elevation:* 600 to 1,900 feet
- *Mean annual precipitation:* 27 to 34 inches
- *Mean annual air temperature:* 39 to 46 degrees F
- *Frost-free period:* 70 to 150 days
- *Farmland classification:* Not prime farmland

Map Unit Composition

- *Kalkaska and similar soils:* 55 percent
- *East lake and similar soils:* 35 percent
- *Minor components:* 10 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Kalkaska

Setting

- *Landform:* Outwash plains, moraines
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Sandy glaciofluvial deposits

Typical profile

- *H1 - 0 to 7 inches:* loamy sand
- *H2 - 7 to 15 inches:* sand
- *H3 - 15 to 32 inches:* sand
- *H4 - 32 to 60 inches:* sand

Properties and qualities

- *Slope:* 0 to 6 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Somewhat excessively drained
- *Runoff class:* Negligible
- *Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water storage in profile:* Low (about 3.9 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 4s
- *Hydrologic Soil Group:* A
- *Hydric soil rating:* No

Description of East Lake

Setting

- *Landform:* Outwash plains, moraines

- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* 20 to 40 inches of sandy material over calcareous, sandy and gravelly glaciofluvial deposits

Typical profile

- *H1 - 0 to 8 inches:* loamy sand
- *H2 - 8 to 26 inches:* loamy sand
- *H3 - 26 to 60 inches:* gravelly coarse sand

Properties and qualities

- *Slope:* 0 to 6 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Somewhat excessively drained
- *Runoff class:* Negligible
- *Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 25 percent
- *Available water storage in profile:* Low (about 3.9 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 4s
- *Hydrologic Soil Group:* A
- *Hydric soil rating:* No

Minor Components

Leelanau

- *Percent of map unit:* 2 percent
- *Landform:* Moraines, till plains, drumlins
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* No

Leelanau

- *Percent of map unit:* 2 percent
- *Landform:* Drumlins, moraines, till plains
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* No

Richter

- *Percent of map unit:* 2 percent
- *Landform:* Lake plains, moraines, drainageways

- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* No

Mancelona

- *Percent of map unit:* 2 percent
- *Landform:* Valley trains, lake plains, moraines, beach ridges, outwash plains
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* No

Alcona

- *Percent of map unit:* 2 percent
- *Landform:* Outwash plains, lake plains, moraines
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* No

LlF—Leelanau-East Lake loamy sands, 25 to 45 percent slopes

Map Unit Setting

- *National map unit symbol:* 6dkt
- *Elevation:* 600 to 1,900 feet
- *Mean annual precipitation:* 27 to 36 inches
- *Mean annual air temperature:* 39 to 50 degrees F
- *Frost-free period:* 70 to 180 days
- *Farmland classification:* Not prime farmland

Map Unit Composition

- *Leelanau and similar soils:* 50 percent
- *East lake and similar soils:* 35 percent
- *Minor components:* 15 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Leelanau

Setting

- *Landform:* Moraines, till plains, drumlins
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Parent material:* 20 to 52 inches of sandy and loamy material over calcareous sandy glaciofluvial deposits

Typical profile

- *H1 - 0 to 8 inches:* loamy sand
- *H2 - 8 to 28 inches:* loamy sand
- *H3 - 28 to 36 inches:* sandy loam
- *H4 - 36 to 60 inches:* loamy sand

Properties and qualities

- *Slope:* 25 to 45 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Well drained
- *Runoff class:* Low
- *Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 30 percent
- *Available water storage in profile:* Low (about 5.0 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 7e
- *Hydrologic Soil Group:* A
- *Hydric soil rating:* No

Description of East Lake

Setting

- *Landform:* Outwash plains, moraines
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Parent material:* 20 to 40 inches of sandy material over calcareous, sandy and gravelly glaciofluvial deposits

Typical profile

- *H1 - 0 to 8 inches:* loamy sand
- *H2 - 8 to 26 inches:* loamy sand
- *H3 - 26 to 60 inches:* gravelly coarse sand

Properties and qualities

- *Slope:* 25 to 45 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Somewhat excessively drained
- *Runoff class:* Low
- *Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 25 percent
- *Available water storage in profile:* Low (about 3.9 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 7s
- *Hydrologic Soil Group:* A
- *Hydric soil rating:* No

Minor Components

Kalkaska

- *Percent of map unit:* 3 percent
- *Landform:* Outwash plains, moraines
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Hydric soil rating:* No

Mancelona

- *Percent of map unit:* 3 percent
- *Landform:* Beach ridges, outwash plains, valley trains, lake plains, moraines

- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Hydric soil rating:* No

Nester

- *Percent of map unit:* 3 percent
- *Landform:* Till plains, moraines
- *Landform position (two-dimensional):* Summit, shoulder, backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope, crest
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Concave, convex
- *Hydric soil rating:* No

Wind eroded land

- *Percent of map unit:* 3 percent
- *Hydric soil rating:* Unranked

Alcona

- *Percent of map unit:* 3 percent
- *Landform:* Outwash plains, lake plains, moraines
- *Landform position (two-dimensional):* Backslope, footslope, toeslope
- *Landform position (three-dimensional):* Interfluve, nose slope, side slope, base slope
- *Down-slope shape:* Linear
- *Across-slope shape:* Convex, linear
- *Hydric soil rating:* No

Lm—Lupton-Markey mucks

Map Unit Setting

- *National map unit symbol:* 6dkv
- *Elevation:* 600 to 1,500 feet
- *Mean annual precipitation:* 19 to 44 inches
- *Mean annual air temperature:* 36 to 46 degrees F
- *Frost-free period:* 60 to 172 days
- *Farmland classification:* Not prime farmland

Map Unit Composition

- *Lupton and similar soils:* 60 percent
- *Markey and similar soils:* 30 percent
- *Minor components:* 10 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Lupton

Setting

- *Landform:* Depressions, depressions, depressions, lake terraces, moraines, till plains
- *Landform position (three-dimensional):* Dip
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Greater than 51 inches of organic material

Typical profile

- *Oa1 - 0 to 10 inches:* muck
- *Oa2 - 10 to 60 inches:* muck

Properties and qualities

- *Slope:* 0 to 2 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Very poorly drained
- *Runoff class:* Very low
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.20 to 5.95 in/hr)
- *Depth to water table:* About 0 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* Frequent
- *Available water storage in profile:* Very high (about 23.9 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 6w
- *Hydrologic Soil Group:* A/D
- *Hydric soil rating:* Yes

Description of Markey

Setting

- *Landform:* Depressions on moraines, depressions on outwash plains, depressions on lake plains
- *Landform position (three-dimensional):* Dip
- *Down-slope shape:* Linear

- *Across-slope shape:* Linear
- *Parent material:* 16 to 51 inches of organic material over sandy glaciofluvial deposits

Typical profile

- *Oa - 0 to 20 inches:* muck
- *2C - 20 to 60 inches:* sand

Properties and qualities

- *Slope:* 0 to 2 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Very poorly drained
- *Runoff class:* Very low
- *Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.20 to 5.95 in/hr)
- *Depth to water table:* About 0 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* Frequent
- *Calcium carbonate, maximum in profile:* 5 percent
- *Available water storage in profile:* High (about 10.4 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 5w
- *Hydrologic Soil Group:* A/D
- *Hydric soil rating:* Yes

Minor Components

Edwards

- *Percent of map unit:* 5 percent
- *Landform:* Depressions on outwash plains, depressions on moraines
- *Landform position (three-dimensional):* Dip
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* Yes

Roscommon

- *Percent of map unit:* 5 percent
- *Landform:* Depressions on lake plains, depressions on outwash plains
- *Landform position (three-dimensional):* Talf
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* Yes

MdB—Mancelona sandy loam, 0 to 6 percent slopes

Map Unit Setting

- *National map unit symbol:* 6dkw
- *Elevation:* 600 to 1,400 feet
- *Mean annual precipitation:* 27 to 32 inches
- *Mean annual air temperature:* 41 to 46 degrees F
- *Frost-free period:* 100 to 150 days
- *Farmland classification:* Not prime farmland

Map Unit Composition

- *Mancelona and similar soils:* 90 percent
- *Minor components:* 10 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Mancelona

Setting

- *Landform:* Valley trains, lake plains, moraines, beach ridges, outwash plains
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* 18 to 40 inches of sandy and/or gravelly material over calcareous sandy and gravelly glaciofluvial deposits

Typical profile

- *H1 - 0 to 8 inches:* sandy loam
- *H2 - 8 to 25 inches:* loamy sand
- *H3 - 25 to 30 inches:* gravelly sandy loam
- *H4 - 30 to 60 inches:* very gravelly coarse sand

Properties and qualities

- *Slope:* 0 to 6 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Somewhat excessively drained
- *Runoff class:* Very low
- *Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum in profile:* 25 percent
- *Available water storage in profile:* Low (about 3.9 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 3s
- *Hydrologic Soil Group:* A
- *Hydric soil rating:* No

Minor Components

East lake

- *Percent of map unit:* 4 percent

- *Landform:* Outwash plains, moraines
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* No

Nester

- *Percent of map unit:* 3 percent
- *Landform:* Moraines, till plains
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* No

Kiva

- *Percent of map unit:* 3 percent
- *Landform:* Outwash plains, lake plains, moraines
- *Landform position (three-dimensional):* Rise
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* No

WlD—Wind eroded land, steep

Map Unit Setting

- *National map unit symbol:* 6dln
- *Elevation:* 600 to 1,000 feet
- *Mean annual precipitation:* 28 to 36 inches
- *Mean annual air temperature:* 39 to 50 degrees F
- *Frost-free period:* 100 to 180 days
- *Farmland classification:* Not prime farmland

Map Unit Composition

- *Wind eroded land:* 100 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Wind Eroded Land

Typical profile

- *H1 - 0 to 60 inches:* sand

Appendix 2. Wildlife species associated with the various size classes of Northern Hardwood and Bottomland Mixed Forests in Leelanau County, MI.

Species	Latin	Northern Hardwood Forest	Bottomland Mixed Forest
Blue-spotted Salamander	*Ambystoma laterale*	LX	LX
Spotted Salamander	*Ambystoma maculatum*	LX	-
Tiger Salamander	*Ambystoma tigrinum*	SPLX	SPLX
Four-toed Salamander	*Hemidactylium scutatum*	LX	LX
Eastern Redback Salamander	*Plethodon cinereus*	PLX	PLX
Eastern Newt	*Notophthalmus viridescens*	LX	LX
American Toad	*Bufo americanus*	SPLX	SPLX
Fowler's Toad	*Bufo fowleri*	LX	-
Gray Treefrog	*Hyla versicolor*	LX	LX
Western Chorus Frog	*Pseudacris triseriata*	-	PLX
Spring Peeper	*Pseudacris crucifer*	PLX	PLX
Green Frog	*Rana clamitans*	-	SPLX
Wood Frog	*Rana sylvatica*	LX	LX
Double-crested Cormorant	*Phalacrocorax auritus*	-	LX
Great Blue Heron	*Ardea herodias*	-	PLX
Green Heron	*Butorides virescens*	-	SPLX
Wood Duck	*Aix sponsa*	-	LX
American Black Duck	*Anas rubripes*	-	RSPLX
Mallard	*Anas platyrhynchos*	-	RSPLX
Hooded Merganser	*Lophodytes cucullatus*	-	LX
Common Merganser	*Mergus merganser*	-	LX
Turkey Vulture	*Cathartes aura*	LX	-
Osprey	*Pandion haliaetus*	-	LX
Bald Eagle	*Haliaeetus leucocephalus*	-	LX
Sharp-shinned Hawk	*Accipiter striatus*	PLX	-
Cooper's Hawk	*Accipiter cooperii*	LX	-
Northern Goshawk	*Accipiter gentillis*	LX	-
Red-shouldered Hawk*	*Buteo lineatus*	LX	LX
Broad-winged Hawk	*Buteo platypterus*	LX	LX
Red-tailed Hawk	*Buteo jamaicensis*	RLX	-
Ruffed Grouse	*Bonasa umbellus*	SPLX	-
Wild Turkey	*Meleagris gallopavo*	LX	-
Solitary Sandpiper	*Tringa solitaria*	-	PLX
Yellow-billed Cuckoo	*Coccyzus americanus*	-	R
Great Horned Owl	*Bubo virginianus*	RLX	RLX
Northern Hawk Owl	*Surnia ulula*	-	RPLX
Barred Owl	*Strix varia*	LX	LX
Northern Saw-whet Owl	*Aegolius acadicus*	-	PLX
Whip-poor-will	*Caprimulgus vociferus*	PLX	-
Ruby-throated Hummingbird	*Archilochus colubris*	LX	LX

Species	Latin	Northern Hardwood Forest	Bottomland Mixed Forest
Red-headed Woodpecker	*Melanerpes erythrocephalus*	LX	-
Red-bellied Woodpecker	*Melanerpes carolinus*	LX	-
Yellow-bellied Sapsucker	*Sphyrapicus varius*	LX	-
Downy Woodpecker	*Picoides pubescens*	PLX	PLX
Hairy Woodpecker	*Picoides villosus*	LX	LX
Northern Flicker	*Colaptes auratus*	RLX	-
Pileated Woodpecker	*Dryocopus pileatus*	LX	-
Olive-sided Flycatcher	*Contopus cooperi*	-	PLX
Eastern Wood-pewee	*Contopus virens*	LX	-
Least Flycatcher	*Empidonax minimus*	PLX	-
Eastern Phoebe	*Sayornis phoebe*	PLX	-
Great Crested Flycatcher	*Myiarchus crinitus*	PLX	-
Blue Jay	*Cyanocitta cristata*	PLX	-
American Crow	*Corvus brachyrhynchos*	RPLX	-
Common Raven	*Corvus corax*	RLX	RLX
Black-capped Chickadee	*Poecile atricapillus*	PLX	PLX
Tufted Titmouse	*Baeolophus bicolor*	PLX	PLX
Red-breasted Nuthatch	*Sitta canadensis*	-	PLX
White-breasted Nuthatch	*Sitta carolinensis*	PLX	-
Brown Creeper	*Certhia americana*	LX	LX
House Wren	*Troglodytes aedon*	-	SPLX
Winter Wren	*Troglodytes troglodytes*	-	LX
Ruby-crowned Kinglet	*Regulus calendula*	-	PLX
Blue-gray Gnatcatcher	*Polioptila caerulea*	LX	-
Veery	*Catharus fuscescens*	SPLX	SPLX
Gray-cheeked Thrush	*Catharus minimus*	LX	LX
Swainson's Thrush	*Catharus ustulatus*	-	PLX
Hermit Thrush	*Catharus guttatus*	-	PLX
Wood Thrush	*Hylocichla mustelina*	LX	LX
American Robin	*Turdus migratorius*	RSPLX	RSPLX
Cedar Waxwing	*Bombycilla cedrorum*	RSPLX	RSPLX
Blue-headed Vireo	*Vireo solitarius*	LX	LX
Yellow-throated Vireo	*Vireo flavifrons*	LX	-
Warbling Vireo	*Vireo gilvus*	PLX	PLX
Red-eyed Vireo	*Vireo olivaceus*	PLX	-
Nashville Warbler	*Vermivora ruficapilla*	SLX	SLX
Northern Parula	*Parula americana*	-	LX
Chestnut-sided Warbler	*Dendroica pensylvanica*	S	S
Magnolia Warbler	*Dendroica magnolia*	-	SLX
Yellow-rumped Warbler	*Dendroica coronata*	-	PLX
Black-throated Blue Warbler	*Dendroica caerulescens*	LX	-
Black-throated Green Warbler	*Dendroica virens*	PLX	PLX
Blackburnian Warbler	*Dendroica fusca*	-	PLX

Species	Latin	Northern Hardwood Forest	Bottomland Mixed Forest
Blackpoll Warbler	*Dendroica striata*	PLX	PLX
Black-and-white Warbler	*Mniotilta varia*	LX	LX
American Redstart	*Setophaga ruticilla*	LX	S
Ovenbird	*Seiurus aurocapillus*	PLX	-
Northern Waterthrush	*Seiurus noveboracensis*	-	LX
Mourning Warbler	*Oporornis philadelphia*	S	S
Canada Warbler	*Wilsonia canadensis*	LX	-
Scarlet Tanager	*Piranga olivacea*	LX	-
Northern Cardinal	*Cardinalis cardinalis*	SPLX	SPLX
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	PLX	PLX
Indigo Bunting	*Passerina cyanea*	RSPLX	RSPLX
White-throated Sparrow	*Zonotrichia albicollis*	-	S
Common Grackle	*Quiscalus quiscula*	-	SPLX
Brown-headed Cowbird	*Molothrus ater*	RSPLX	-
Baltimore Oriole	*Icterus galbula*	LX	LX
Pine Grosbeak	*Pinicola enucleator*	-	PLX
Purple Finch	*Carpodacus purpureus*	-	PLX
Pine Siskin	*Carduelis pinus*	-	PLX
Virginia Opossum	*Didelphis virginiana*	PLX	PLX
Masked Shrew	*Sorex cinereus*	RSPLX	RSPLX
Water Shrew	*Sorex palustris*	-	PLX
Northern Short-tailed Shrew	*Blarina brevicauda*	RSPLX	RSPLX
Eastern Mole	*Scalopus aquaticus*	SPLX	-
Star-nosed Mole	*Condylura cristata*	-	PLX
Little Brown Myotis	*Myotis lucifugus*	LX	LX
Northern Myotis	*Myotis septentrionalis*	LX	LX
Silver-haired Bat	*Lasionycteris noctivagans*	LX	LX
Big Brown Bat	*Eptesicus fuscus*	RSPLX	RSPLX
Eastern Red Bat	*Lasiurus borealis*	LX	LX
Hoary Bat	*Lasiurus cinereus*	LX	LX
Snowshoe Hare	*Lepus americanus*	-	SPLX
Eastern Chipmunk	*Tamias striatus*	SPLX	-
Eastern Gray Squirrel	*Sciurus carolinensis*	LX	-
Eastern Fox Squirrel	*Sciurus niger*	LX	-
Red Squirrel	*Tamiasciurus hudsonicus*	LX	PLX
Southern Flying Squirrel	*Glaucomys volans*	LX	-
Northern Flying Squirrel	*Glaucomys sabrinus*	-	LX
Deer Mouse	*Peromyscus maniculatus*	SPLX	SPLX
White-footed Mouse	*Peromyscus leucopus*	SPLX	-
Southern Red-backed Vole	*Clethrionomys gapperi*	SPLX	SPLX
Woodland Vole	*Microtus pinetorum*	LX	-
Southern Bog Lemming	*Synaptomys cooperi*	LX	LX
Woodland Jumping Mouse	*Napaeozapus insignis*	-	SPLX

Species	Latin	Northern Hardwood Forest	Bottomland Mixed Forest
Common Porcupine	*Erethizon dorsatum*	PLX	PLX
Coyote	*Canis latrans*	RPLX	PLX
Red Fox	*Vulpes vulpes*	PLX	PLX
Common Gray Fox	*Urocyon cinereoargenteus*	LX	-
Black Bear	*Ursus americanus*	RSPLX	PLX
Common Raccoon	*Procyon lotor*	LX	LX
American Marten	*Martes americana*	-	PLX
Ermine	*Mustela erminea*	SPLX	SPLX
Long-tailed Weasel	*Mustela frenata*	SPLX	SPLX
Mink	*Mustela vison*	-	SPLX
Striped Skunk	*Mephitis mephitis*	SPLX	SPLX
Northern River Otter	*Lutra canadensis*	-	SPLX
Bobcat	*Lynx rufus*	SPLX	SPLX
White-tailed Deer	*Odocoileus virginianus*	RS	S
Spotted Turtle	*Clemmys guttata*	-	SPLX
Wood Turtle	*Clemmys insculpta*	SPLX	SPLX
Blanding's Turtle	*Emydoidea blandingii*	-	SPLX
Common Box Turtle	*Terrapene carolina*	LX	LX
Five-lined Skink	*Eumeces fasciatus*	LX	-
Ringneck Snake	*Diadophis punctatus*	LX	LX
Eastern Hognose Snake	*Heterodon platirhinos*	SPLX	-
Milk Snake	*Lampropeltis triangulum*	SPLX	-
Northern Water Snake	*Nerodia sipedon*	-	SPLX
Brown Snake	*Storeria dekayi*	SPLX	SPLX
Redbelly Snake	*Storeria occipitomaculata*	SPLX	-
Common Garter Snake	*Thamnophis sirtalis*	SPLX	SPLX
Eastern Massasauga	*Sistrurus catenatus*	-	SPLX

R – Regeneration
S – Sapling
P – Pole
L – Small Saw
X – Large Saw
* Michigan State Threatened Species