FOREST STEWARDSHIP PLAN
FOR
ONTONAGON COUNTY FORESTLAND

Landowner: Ontonagon County, Michigan
725 Greenland Road
Ontonagon, Michigan 49953
(906) 884-4255

Property location is depicted on maps included in plan.

Prepared By: Michael F. Schreiber & Rexx A. Janowiak, ACF

Green Timber Consulting Foresters, Inc.
11521 DesRochers Road
Pelkie, Michigan 49958
(906) 353-8584 or (906) 281-4832
gtfc@up.net
www.greentimberforestry.com
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SECTION I- MAPS AND INTRODUCTION

Introduction

This Forest Stewardship Plan is intended to serve as a reference to the Forestry Commission of Ontonagon County. It will also benefit the residents of the county and other individuals who may make use of Ontonagon County Forest property for hunting and other recreational uses. The primary intent of this Forest Stewardship Plan is to describe the current conditions of the forest and related natural resources across the Ontonagon County Forest property and to prescribe forest management activities for a period of twenty years, commencing at the date listed on the front cover of this document. In ten years the property should be reevaluated to check the status of growth and determine if any modifications to the plan and recommended management are necessary. After twenty years, the plan will be considered expired and the property should again be visited by a forester in order to assess the conditions of the forest at that time and to make recommendations for management into the future. At that time, this forest management plan should also undergo an update or complete revision; this decision should be made by the Forestry Commission with recommendations made by the forester. This plan will describe:

- Landowner goals and objectives.
- Current conditions and features of the land.
- Recommended management options to fit the landowner's goals while properly managing the land.

Vocabulary that is commonly used in forest management plans, but may be unfamiliar to the reader is defined in the glossary in Section IV.

Objectives and Goals

This property is owned by Ontonagon County for the primary purpose of timber production. In accordance with the State Statutes of Michigan, no part of the property may be closed to hunting, fishing or other recreational uses. Ontonagon County has no intent to sell or divide this land therefore it is important to maintain the long-term productive capacity of the land to ensure that the county is able to receive periodic revenue from timber sales. In addition to providing money for county projects, the harvesting of timber on this property provides jobs for foresters, loggers, haulers and mill workers.

It is also important for forest management to consider impacts on wildlife, water and soil resources. Many residents of Ontonagon County hunt and fish, and these activities contribute to the quality of life they enjoy. Conducting proper forest management can improve habitat for many species of wildlife, especially game species such as white-tailed deer, ruffed grouse and hares. Forests are crucial to the protection of soil and water quality. Forests intercept rainfall thereby keeping soil erosion to a minimum and reducing the severity of flooding. Preventing soil erosion helps to maintain the long-term productive capacity of the forest so that it can continue to provide the benefits listed above.

Across this ownership, there is a wide network of roads. These roads provide access for hunting, fishing and other uses. The condition of the roads is currently highly variable. Timber harvesting requires roads to be upgraded to facilitate access by logging trucks. Such upgrades will also benefit the other users of the land.

It is also important to consider the visual impacts of forest management on this property. Many areas of the property are found in quite remote locations and therefore are not seen by a large number of people. While visual impacts are important, the primary objective remains forest management, and some of the forest types across this ownership are best suited to clearcut timber harvests. Although a recent clearcut has a negative visual appearance, if it is done properly, in a way that protects soil and water resources, it will rapidly regenerate into a dense forest of young aspen saplings that will provide excellent grouse habitat.

To summarize, the primary objective of management across the Ontonagon County Forest is the sustainable production of merchantable forest products. The term sustainability refers to the long-term ability of the forest to continue producing a range of outputs including forest products, clean water, wildlife and recreational opportunities. If management fails to address any of these outputs, it should not be considered truly sustainable. Sustainable forest management considers the current conditions of the forest and applies the most relevant scientific principles of forestry to ensure that the forest is able to provide "the greatest good for the greatest number for the longest time," as stated by Gifford Pinchot, one of the founders of modern American forestry.

Sustainability has been described as a three-legged stool; if one of the legs is removed, the stool will no longer stand on its own. The "legs" of sustainability are ecological sustainability, economic sustainability and social sustainability. *Ecological sustainability* simply refers to the ability of natural processes, such as tree growth and regeneration, to continue occurring in perpetuity. *Economic sustainability* addresses the cost of management; although it is possible to invest a lot of money into ensuring sustainability for a short time, these investments may exceed the revenues, eventually bankrupting the owner of the land. *Social sustainability* reflects the importance of the stakeholders to resource management. In this particular case, the residents of Ontonagon County, as well as any others who may make use of the Ontonagon County Forest, are all stakeholders. When implementing forest management it is important to consider the needs and concerns of the stakeholders in order to ensure that these stakeholders continue to approve of the management that occurs. Without the approval of the stakeholders, future management will encounter pushback from the public. With this being said, some stakeholders may not be satisfied at all times. It is important to remember that sustainable forest management is always done with the best science in mind, and that there are many stakeholders as well as a host of other considerations that must be taken into account when making management decisions on public forestland. Within this forest management plan, a reasonable effort has been made to explain the science and other reasoning that supports the forest management that will be applied across the Ontonagon County Forest, without being overly technical.

SECTION II- THE LANDOWNERS AND THE LAND

General Property Description

Location

This property consists of approximately 4,670 acres, as determined by the Assessment Roll provided by Ontonagon County. This land is divided among 45 legal parcels; the legal description of each parcel is included in the Appendix of this Forest Stewardship Plan. For the purposes of management, the property has been divided into four separate areas or "blocks." The land is distributed primarily across the eastern half of Ontonagon County. The locations of each parcel of the Ontonagon County Forest are shown on the Overview Map found in Section I of this Forest Stewardship Plan. In addition to the property locations, this map also shows the primary access routes into each parcel of land. When the field inventory and property inspection was conducted in Fall of 2013, a good amount of property line and corner evidence was observed. This evidence is far too varied to describe in detail here, however in general across the entire ownership, the property has been remonumented to the quarter-section level. This means that, generally, survey monuments may be found at one-half mile intervals along section lines. The presence of these monuments, as well as boundary paint on trees, will be useful in establishing harvest boundaries for future timber harvests on the property. This evidence is also useful for individuals recreating on the property for the purposes of navigation and recognition of property boundaries in order to respect private ownership. Foresters are not able to set surveyed property lines, however foresters often use existing evidence to determine timber harvest boundaries. Any property line or corner evidence should only be considered as approximate unless it is known to have been placed by a registered professional surveyor. The existing corner monuments are all quite recent and have been set by a registered professional surveyor, meaning that they are the true and exact corners. Topographic maps or aerial photos would also be very helpful when navigating through this property.

Brief Description

This property has been owned by Ontonagon County since 1951. Information about how Ontonagon County came to own this land is included in the "Land History / Past Land Use" section of this Forest Stewardship Plan. This property is divided among four blocks which have been grouped geographically. The property is comprised of a varied mix of upland and lowland forest types with some scattered non-forested wetlands being present as well. The forest types found on the ownership range from high quality upland hardwood stands consisting of sugar maple, red maple and basswood to lowland conifer stands which include cedar, balsam fir and white spruce. The varying forest types and age classes provide diversity to the ownership offering a wide range of management strategies. These varied forest types and ages also serve as habitat for a diverse range of wildlife species.

The Ontonagon County Forest is located in rural areas with very low human activity. Much of the adjacent properties are also forested. These adjacent parcels of land are virtually all owned by private individuals or forest industry and investment landowners. Some of the adjacent lands are enrolled in Michigan's Commercial Forest Act and are therefore open to public access for hunting, fishing and trapping.

There are no major lakes located on any of the Ontonagon County Forest land however there are many small streams. Additionally, portions of the Flintsteel River are found on and near parts of the Firesteel and Lakeshore Blocks. This ownership also features many areas of wetlands which are crucial to maintaining clean water in lakes and rivers, in addition to ensuring the quality of groundwater reserves. The potential impacts of forest management on water quality are detailed in the "Water and Wetlands" Section of this Forest Stewardship Plan.

Across much of this ownership, soils are generally fine in texture, consisting predominantly of clay, silt and loam-textured materials. These characteristics can have strong impacts on the type of vegetation growing in an area, in addition to impacting forest management activities. The soil characteristics across this ownership are described in further detail later in the "Soils" Section of this Forest Stewardship Plan.

Because of the scattered geographical extent of this ownership, the terrain is highly variable and ranges between completely flat ground and very steep slopes that pose limitations to timber harvesting. Most of the ownership is accessible to timber harvesting equipment; the steepest slopes are found predominantly in the Himanka Hill Block.

Land History/ Past Land Use

Humans have utilized this land and its resources for many years. The forests of Upper Michigan were logged in three phases during the late 19th and early 20th centuries. The first phase consisted of a focused effort to only harvest the highly sought after white pines because lumber from these trees was in high demand at the time. Ontonagon County was once the center of the rush to harvest the white pines. When the seemingly endless supply of pines dwindled, many people left Upper Michigan for the western and southern forests. Those who stayed found opportunities in the hemlock and hardwood forests that remained, transitioning to production of hardwood lumber, railroad ties, mine timbers, charcoal for manufacture of iron, and chemical wood for industrial processes. These new uses created markets for species that were once considered useless, in addition to utilizing a higher percentage of the volume in each tree when compared with the past pine logging. This second phase of logging exerted a much greater influence across this region as it culminated in the great cutover which left many areas completely devoid of trees. The cutover left conditions perfect for large wildfires that were fueled by the logging debris that remained following the first two phases of logging. As the fires subsided, the forests began to naturally regenerate with a diverse and vigorously growing mixture of tree species. The tree species composition and quality of the forests that regenerated were largely determined by the available seed source and soil conditions. Aspen was one of the most common species in this regenerating forest and once again, markets and utilization adapted to the change in forest composition, leading to today's highly mechanized pulp and paper industry, new products like fiberboard and the advent of selective cutting.

This property was purchased from the State of Michigan in 1951 for the price of one dollar. This land was most likely tax delinquent land that had either been abandoned by a lumber company once it was cut over, or else it had been owned by an individual who was no longer able to pay their property taxes during the Great Depression. The state made such land available to local

government bodies in order to promote good forest management, provide wildlife habitat and clean water, give local residents a place to recreate and to serve as a source of jobs for local loggers and mill workers. The only stipulation of this purchase is that the land was to remain under forest management and open for public recreation in perpetuity.

Current Land Use

This land has been managed as a productive forest since being acquired by Ontonagon County in 1951. There is not a lot of information available regarding past timber harvests or management objectives. Ontonagon County has provided records of the dates of the most recent timber harvests, going back nearly 30 years. Although the primary use of this property is forest management and timber production, the residents of the county use this land for a range of other activities. Hunting deer and grouse are probably two of the most common activities occurring on this land. Signs of all-terrain vehicle use were observed when the inventory was conducted in the fall of 2013; it is likely that the property also sees use by snowmobiles during the winter months. No signs of trapping were observed on the property, however there is a significant amount of beaver activity particularly in portions of the Firesteel Block. Residents of Ontonagon County may also engage in silent sports on this ownership, such as snowshoeing, skiing, sightseeing, viewing wildlife, hiking and mountain bike riding. There are currently no developed trails for these activities, however the established logging roads are suitable for most of these uses.

In addition to these active uses of the land, residents of Ontonagon County also are able to obtain some benefits of this land in a passive fashion. Forests help to provide clean air and water which benefits everyone.

Education and Outreach

A portion of the cost of this plan has been paid for by the Forest Stewardship Program. The Forest Stewardship Program is funded by the United States Department of Agriculture Forest Service in order to promote sound forest management. One of the stipulations of this grant is that the plan must serve an educational purpose for stakeholders in the county forest land. All residents of Ontonagon County are stakeholders in the county forest in some way, as are non residents who use the land for hunting or recreation. It is important for stakeholders to understand the science and reasoning behind the different types of management that are recommended and implemented on this ownership. Forestry is an important part of the economy of Ontonagon County, so having the support of all residents is a key part of the success of any management that is implemented. Within this plan, the reader will find descriptions of some of the key aspects of the forest, including soils, water resources, vegetation and timber. The plan will also explain some of the science that supports the management recommendations that are set forth. As stakeholders, the residents of Ontonagon County should feel welcome at county meetings to gain more information on specific management activities as they are planned and implemented.

As an additional source of education, the Green Timber Tree Farm Group will plan and advertise field days on the county forest to view the results of some of the management being implemented. These field days will allow stakeholders to meet with a Green Timber forester at a field site to discuss and view the types of forest management that either has been or will be conducted. These visits will allow stakeholders to gain a better understanding of how these activities will benefit the forest while also protecting soil and water quality and in many cases how they improve wildlife habitat.

To further promote sound forest management among the stakeholders it would be beneficial for the county to develop some signage to be placed in high use areas describing the different forest types present and the style of forest management that has been or will be conducted. A good example of a place where educational signage would be effective is on the parcel located along Lake Shore Drive north of Ontonagon. Since this parcel has county road frontage and also borders Lake Superior it sees a high amount of use from the public. Placing signage in places like this will expose a large number of stakeholders to the benefits of sound forest management.

Lastly, to support education the county should have multiple copies of this Forest Stewardship Plan available to the public. Hard copies of this plan could be kept at the county offices and available to be checked out to interested individuals. To further reach stakeholders there should also be an electronic copy of this plan saved on the Ontonagon County website.

CURRENT LAND CONDITIONS

Figure 1: Small vernal pool, photographed in late spring.

Water/Wetlands

There are no significant lakes found on this ownership, however a portion of the Lakeshore Block is located along the shore of Lake Superior. There are two small inland lakes located on the Himanka Hill Block; these lakes appear to be heavily dependent on rainfall and snowmelt for recharge and due to the low rainfall in recent years, they are smaller than normal. The property also includes frontage on the Flintsteel River and numerous smaller streams, most of which are unnamed. Lake Superior, the Flintsteel River and some of the more significant streams are depicted on the Overview Map for the respective blocks of this ownership. In addition to the streams, there are many wet areas which range from true wetland forests to small vernal pools located within upland hardwood stands. Wetland forests are easily identified by the presence of certain tree and shrub species such as cedar, black ash and tag alder, among others. Vernal pools are small depressions or low-lying areas found within upland forests that may be identified by the presence of standing water in the spring of the year. One example of a vernal pool is shown in Figure 1. These areas may be somewhat wet into summer however they are generally devoid of standing water after springtime.

Lakes, streams, rivers and vernal pools are important for a wide range of reasons. The most obvious reason is that humans depend on clean water for drinking and other uses. Many species of wildlife obtain drinking water from streams and rivers. Streams, rivers, lakes and the land located immediately adjacent to them are known as riparian areas. These riparian areas are crucial habitat for many types of insects, amphibians and reptiles. These species serve important functions in the ecosystem. For example, the insects are a source of food for many species of fish and songbirds. Activities which degrade the quality of riparian habitats can impact populations of songbirds and fish, in addition to decreasing water quality. It is important for forest management activities to identify all riparian areas on the property and take the appropriate steps to protect them. Wetland forests are an important part of the water cycle as well. Wetland forests are located in low-lying areas and are found at or near the level of the water table. The water table, in addition to water which flows across the surface of the soil, keeps these areas wet through most of the year. The vegetation which grows in these areas is adapted to growing in wet soil conditions. Wetlands help to filter contaminants out of water before it flows into streams, rivers and lakes or moves downward into groundwater reserves.

When planning forest management activities on this property it is important that all wetlands, streams, rivers and vernal pools be identified. Properly identifying these features will make it possible to take the appropriate steps to protect them. The protective measures will vary depending on the type of feature encountered. The following paragraphs will address the considerations for each feature.

Wetlands: When the soils are adequately frozen, most types of wetland forests may be harvested. The ice in the soil supports the weight of logging equipment and protects the soils which are otherwise very susceptible to rutting and compaction. It is important that the timber harvesting implemented in wetland forests is well-suited to the timber types present in order to ensure that proper regeneration occurs following the harvest. When preparations are being made to conduct a timber harvest, the area should be properly inspected and if any particularly wet areas are encountered, they should be excluded from the harvest area due to the strong chance that such areas will not freeze completely. Attempting to harvest on wetland soils that are not adequately frozen poses a high risk of rutting and compaction. Severe ruts and compaction can decrease forest productivity in addition to impacting a wetland's ability to provide clean water. Timber harvesting equipment should only be allowed into wetlands if they are considered productive forestland and harvesting them would meet the objectives set forth earlier in this Forest Stewardship Plan. In some situations it may be necessary to cross nonproductive wetlands in order to access productive areas of forestland; if this is to be done, an adequate winter road should be constructed, or if the crossing must take place in the winter, best management practices should be followed to construct a suitable all-season crossing. When timber harvesting is planned adjacent to wetlands, the boundary between these two areas should be clearly delineated so that harvesting equipment does not enter the wetlands.

Vernal Pools: Vernal pools are at times difficult to identify, particularly in the winter and dry periods of summer. If possible, areas of upland forest that are to be harvested should be visited in the spring to identify potential vernal pools. In most cases it is not practical to delineate the boundaries of every single vernal pool, particularly the ones that are less than one-half acre in size. In the case of an individual tree selection timber harvest, the most practical course of action is to avoid marking trees growing in or immediately adjacent to the vernal pools. In the case of a clearcut timber harvest it may be necessary to identify the locations of the pools with tree paint. Clearcut harvests typically occur in the winter months and the soil in these areas would be frozen and much less susceptible to rutting and compaction, so vernal pools are less of a concern at this time. It is still beneficial to maintain a small ring of live trees around larger vernal pools in order to provide shade which helps to keep water temperatures lower. In the event that any timber harvesting occurs in the spring, operation in vernal pools must be avoided because this is the time when they are the most susceptible to rutting and compaction. Also, spring is the time when many of the species which use vernal pools are breeding and are therefore quite vulnerable. In some cases if there are areas of multiple vernal pools clustered near each other, it may be best to create a single larger exclusion from the harvest to protect these areas.

Lakes, Rivers and Streams: Forest management within close proximity to lakes, rivers and streams is guided by Michigan's "Sustainable Soil and Water Quality Practices on Forest Land" manual, also known as Michigan's "Best Management Practices (BMP's)." There are a wide range of guidelines contained in the BMP manual. In general, special guidelines apply within 100 feet of the banks of any body of water with a defined bed and bank. Within this 100 foot wide "buffer strip" at least 70 percent canopy cover must be maintained. This guideline permits individual tree selection harvesting, however it would preclude a complete clearcut. The guidelines include stipulations for increasing the width of buffer strips in areas where steep slopes exist; the width of the buffer increases dependent upon the slope of the landscape. Forested buffer strips, also known as riparian management zones, serve two primary functions.

The first function of a buffer strip is to limit the potential for erosion of soil particles and other material into waterways. The second function is to maintain shade over the waterway in order to mitigate water temperature rises caused by sunlight.

When soil and other materials enter water they can have a range of negative effects. This material can make it harder for fish and other organisms to obtain the oxygen necessary for survival. When a stream is fouled with soil and other material, water temperatures can rise. As the temperature of water increases, its ability to hold dissolved oxygen decreases. Trout in particular are known for their dependence on cool, clear streams with plenty of oxygen, however many other species suffer when water temperatures increase and oxygen levels decrease. As soil and other materials settle out of the water, this material can change the composition of streambeds, making them less suitable for fish spawning habitat. It is important to maintain forest canopy over streams in order to keep them shaded; shade helps to keep the water temperatures cooler which is desirable for trout and other species of fish.

The full list of recommendations provided in the BMP manual is too extensive to include in this Forest Stewardship Plan. The BMP Manual may be viewed in its entirety by visiting the DNR home page, click on the "Forest, Land and Water" tab and then on "Land Management." In the drop-down list under "Land Management", click on "Soil & Water Quality Manual (BMP)."

Wildlife

A large number of the residents of Ontonagon County hunt; in addition many of them enjoy viewing a wide range of wildlife species. The firearm deer season in November is one of the major tourist draws across Ontonagon County. Although the primary focus of wildlife management tends to be on populations of game species to ensure successful hunting seasons, a functioning ecosystem requires all species of wildlife, both game and non-game, as well as the varied sources of food and habitat that these species depend upon. By definition, sustainable forest management considers its impacts on all other parts of the ecosystem, including all species of wildlife.

Wildlife management is a complicated field and specific recommendations regarding improving populations of a certain species are beyond the scope of this forest management plan. In the following paragraphs, some general recommendations will be made that are intended to improve the overall value of the property for wildlife species. More detailed recommendations on improving habitat for specific species are available from the Michigan DNR. The phone number for the DNR Service Center located in Baraga, Michigan is (906) 353-6651.

Given the large acreage that this property covers, and the diverse range of forest types found here, the range of wildlife making use of the property is extremely diverse and includes animals as common as the white tailed deer to more rare species such as the bald eagle. It is possible to conduct wildlife surveys to gain more detailed information about what species are represented and the population sizes, however this practice is generally only conducted over larger areas with a more significant wildlife management program.

Figure 2: Large, live sugar maple on the property with a cavity that was likely created by woodpeckers.

With the exception of logging activity and hunters this ownership sees fairly minimal human usage, and much of it is located away from major roadways and areas of human development. These factors make the property desirable for virtually all species of wildlife, as most are disturbed by human activities. Some species such as deer, raccoons and bear are more tolerant of human activities, and will often seek out bait or garbage left out by people near homes and cabins. Other species like hawks and owls tend to be more elusive; they benefit more from large expanses of undeveloped forest like this property. These parcels of land also include adjacent areas of open wetland, farm field and other non-forested cover types. These areas help to provide increased habitat diversity for wildlife. Fields and other openings in the forest create edge habitat. Edge habitat occurs at the transition between two distinctly different cover types, most often the transition between forests and clearings. In addition to the herbaceous plants which provide a source of forage for many species, the trees growing along the edge of the forest form very dense crowns that extend low on the tree trunk. These dense, extensive crowns provide extra nesting habitat and produce high quantities of seed. Birds of prey, including bald eagles and hawks also take advantage of these open areas for the easy hunting such areas provide.

Ensuring that some large, dead or hollow trees are retained following timber harvests can greatly benefit many wildlife species. Retaining large cull trees, which are live trees with little to no economic value, as well as standing dead “snags” in a forest provides quality habitat for many species of wildlife. These “wildlife trees,” or “den trees,” like the one pictured at right, are low in timber value but they still provide a range of benefits to wildlife. Raptors use these trees as nesting locations, or to perch in and hunt from. Animals such as porcupines, bats, and owls use cavities in these trees as dens. Insect larvae feed on decaying wood and many are eaten by woodpeckers. Those insects that reach maturity are a source of food for songbirds, bats, reptiles and amphibians. Once the trees die and fall over, other animals use the down logs, known as coarse woody debris, for various purposes. Raccoons, foxes and numerous small mammals use down logs as dens. Grouse may use the logs as drumming logs during their mating season. Coarse woody debris retains moisture and provides a crucial refuge for salamanders and other amphibians during hot summer days. When coarse woody debris has decayed to a point where it is no longer usable by most wildlife, it becomes a part of the soil. Snags and coarse woody debris can also harbor disease and insects that may grow to a large enough population to detrimentally affect the live trees on the property, however during the field inspection, no serious concerns were noted. Proper forest management must consider the balance of providing enough snags and coarse woody debris to retain the value of the property for wildlife without posing a threat to the health of the forest. The wildlife trees retained on the property should be carefully

selected to ensure that they are not harboring any serious diseases or pests that may negatively impact the overall health of the forest. Generally speaking, larger wildlife trees are more beneficial because they take longer to decay and have the capacity to support larger wildlife.

The various forest types are used by migrating and non-migrating birds such as:

Black-capped Chickadee	Nuthatches	Warblers
Blue Jay	Ruffed Grouse	Woodcock
Finches	Sparrows	Woodpeckers
Grosbeaks	Thrushes	Wrens

The northern white cedar, mature pine and mature hardwoods offer ideal perching, hunting and nesting opportunities for owls and other raptors such as:

Bald Eagle	Great Horned Owl	Red-Tailed Hawk
Barred Owl	Northern Goshawk	Rough-Legged Hawk
Broad-Winged Hawk	Red Shouldered Hawk	Saw-Whet Owl

The wetlands and streams on the property offer good habitat for wildlife that require large amounts of lowland brush and water to survive. Some of the animals that can be found in these areas of the property are:

Beaver	Frogs	Otter
Bitterns	Herons	Turtles
Fish	Muskrat	Various Waterfowl

There are many terrestrial animals that exist on the property. The vegetation provides a variety of food sources and rotten, hollow trees offer den opportunities. Some examples of the animals that benefit from the habitat of this property and the surrounding area are:

Black Bear	Moose	Salamanders
Bobcat	Pine Marten	Snakes
Chipmunks	Porcupine	Toads
Coyote	Rabbits	Weasel
Fisher	Raccoon	White-tailed Deer
Fox	Red Squirrels	Wolves

Threatened and Endangered Species

During the property inspection, no threatened or endangered plant or animal species were observed. Given the extensive area this property covers, it is quite likely that some endangered or threatened species exist here. The Michigan Natural Features Inventory (MNFI) maintains a record of known sightings of threatened and endangered plant species however the locations of these sightings are intentionally kept vague in order to protect the species. Prior to implementing future timber harvests on this property, the MNFI should be searched for records of threatened and endangered species within the timber harvest area. The MNFI also provides recommendations on the steps that are necessary to protect the species. The Michigan DNR may have to be contacted in order to assist with these searches as they have more specific access to the MNFI records. The specific actions taken will depend entirely upon the type of species encountered and may range from restricting harvest to the winter months to maintaining a non-harvested buffer around a nest site.

Roads and Trails

Well-built and maintained logging roads are necessary for efficient hauling of logs and pulpwood; most of this ownership already has a road network that will facilitate good access. Once a logging road is built, it generally requires little maintenance except during periods of heavy use, such as during a timber harvest. In the event that roads are not built properly, or in cases where the roads see repeated use, they may wash out or develop large ruts and potholes. Since this property is publicly-owned and open for hunting and other uses, it is not practical to close off the roads, nor is it cost-effective to conduct annual maintenance of these roads therefore some of the roads are in poor condition. These areas will have to be repaired prior to future timber harvests; this work usually is done by the loggers. An additional problem was noted in the southern portion of the Firesteel Block. In this area, beaver activity has lead to widespread flooding and a major road is currently inundated by over a foot of standing water. This problem should be addressed by removing the beaver dams and encouraging local trappers to set traps in this area to decrease the beaver population. Prolonged flooding will not only hinder access across this road, but it will also lead to mortality of the standing timber. After an area has been flooded for an extended time period, it often takes years for forest to reestablish.

Forest Health

Forest health is a broad term and may have different meanings to individual landowners as well as to individual forest managers. In this section, specific information is given about threats to forest health and the resilience of the forests growing on this property. Special emphasis is given to "pest" problems in the form of both native and non-native insects and diseases (fungi, etc.) that are most relevant to this property and location.

The forests on this property are generally quite healthy and are not exhibiting strong signs of any particular insect or disease problems. On an ownership of this size, it is not practical to address minor problems that arise, as there are a number of native insects and fungi (also known as diseases) which periodically will appear. These native insects and fungi are generally not a major concern because the forests have evolved with these agents. Some mortality will occur, but there is no cost-effective way to completely prevent such losses on an ownership which spans several thousand acres. The primary concern is non-native insects and fungi. These agents, such as the emerald ash borer (EAB), gypsy moth and oak wilt, have been introduced by human activity and as a result, the forests of Upper Michigan are not able to respond to them in the same fashion they would respond to a native insect.

Most people are familiar with Dutch elm disease, which killed most of the American elm trees in North America during the late 20th century. This disease is caused by a European fungus, which limits the ability of a tree to move water from its roots to its leaves. Elm trees in Europe had developed resistance to the fungus over thousands of years and so the fungus generally only impacted trees that had been weakened by some other factor. In North America, no resistance existed so perfectly healthy trees were killed rapidly by the fungus. Elm trees still exist, however they are much less common than they once were across the landscape, and they generally are infected and killed by Dutch elm disease before they are able to attain their maximum size.

Figure 3: Adult Emerald Ash Borer

The most pressing forest health concern is currently the emerald ash borer (EAB), which is an insect native to Southeast Asia that is believed to have entered the U.S. through shipping materials. All species of ash trees[1] are susceptible to EAB, and once infected, they can be killed by EAB in a matter of a few years. Populations of ash trees in Lower Michigan are being decimated by EAB; in the Upper Peninsula EAB has been documented, however its impacts are minimal thus far. Ontonagon County is currently not part of the quarantine area for EAB however the insect is likely to eventually reach this county as it has been detected in northern Houghton County, and in northwestern Wisconsin. The adult stage of EAB, shown in Figure 3, is virtually harmless to trees, however the juvenile stage of the insect (larvae) feed on the living tissues of the tree just under the bark; this cuts off movement of water, nutrients and energy throughout the tree. Over a period of just a few years, the presence of these larvae will cause enough damage to completely kill the tree. There are a few things to watch for that may be

[1] Species of mountain ash, including American mountain ash and European mountain ash are not impacted by EAB as they are not "true" ash species.

indicative of an EAB infestation. The most obvious signs are death of ash branches progressing from the top downward towards the trunk. As the top branches of the tree are killed, the tree will produce epicormic branches, or suckers, low on the stem in an attempt to continue producing energy. As the top branches die, the bark will begin to slough off and S-shaped tunnels will be seen on the exposed wood. These symptoms would generally be observed in multiple trees; the death of a single ash tree is not necessarily indicative of EAB, it may be a result of some other factor. Ash trees are found throughout the upland hardwood stands on this ownership, although they represent a fairly minor proportion of the total stocking of these stands. When EAB reaches this property, the space occupied by the ash trees will likely be taken over by other tree species found in those stands. On this property, the upland stands would change to a higher proportion of red maple, basswood and sugar maple while lowland stands would change to a higher proportion of red maple and quaking aspen; the wettest lowland sites may be overtaken by tag alder as there are few other tree species that are tolerant of these conditions. Recommended future management, detailed later in this Forest Stewardship Plan, will address the future impacts of EAB.

Oak wilt is a non-native fungus impacting all species of oak, however it is far more deadly to red oak. The oak wilt fungus enters trees through wounds and broken limbs and grows within the vascular tissue of the tree. Eventually the fungus clogs these small vessels that transport energy, nutrients, and water through the tree; once these vessels are clogged the tree quickly dies. The oak wilt fungus has not yet been detected in Ontonagon County however it is spreading throughout southern and eastern Wisconsin, and has been detected along the Michigan-Wisconsin border in Iron and Dickinson Counties. The spread of oak wilt can be slowed by refraining from cutting, pruning or damaging oak trees during the growing season, particularly April, May and June. Within an infected forest, there are procedures that can be applied to help prevent oak wilt from infecting healthy trees, however they are not 100 percent effective.

The gypsy moth is a non-native species which can be considered to have become naturalized, meaning that although trees have not developed resistance to it, a number of natural control mechanisms have been identified. The gypsy moth is an insect from Europe which was introduced in the mid 1800's. This insect is a defoliator, meaning it eats the leaves of trees. The preferred hosts of the gypsy moth are aspen, basswood, oak, maple and fruit trees however there are few species that the gypsy moth will not feed on. Gypsy moths reproduce quite prolifically and in severe cases, an infestation of caterpillars from this species can eat virtually all of the leaves from a fully-grown tree. A single year of defoliation does not usually kill a healthy tree however it can stress it and make it more susceptible to damage by other factors. Additionally, the defoliation can slow a tree's growth rate, which decreases forest productivity. Gypsy moth populations have begun to be kept in check by some native predators such as birds and a few species of insect which prey upon the eggs and larvae; in addition fungal and viral agents are used to kill the insect naturally. The gypsy moth may never be eradicated, however its impact is not as severe as it once was, indicating that there is hope in the fight against non-native forest pathogens.

In addition to these non-native pests, there are a number of native insects and fungi which may be observed on the Ontonagon County Forest. It is beyond the scope of this Forest Stewardship Plan to attempt to list every native forest pest and disease. Experienced foresters are generally

familiar with the most common of these agents and are aware of ways to keep them in check. It is important that forest management always considers the potential impacts of a range of insects, diseases and other damaging agents. Young trees are typically the most resilient to damage by insects and diseases while old trees and larger trees can be at a higher risk of severe damage and mortality. Native insects and diseases are a normal part of a natural forest, helping to remove weak and less vigorous trees. Allowing a forest to grow for an extended time period with no management or natural controls makes it susceptible to more severe outbreaks of disease or insect pests. Managing a forest with regular timber harvests suited to the particular timber type helps to maintain trees that are healthy, vigorous, and are able to respond readily to attack by insects and diseases. Whether a stand is old or young, any abnormal insects or tree conditions should be investigated as soon as possible to ensure they do not pose a significant threat.

Some tree species naturally have longer life spans than others, although there is generally no definite maximum age for any tree species. A wide range of factors can impact the potential maximum age of an individual tree. In a managed forest, tree age is one factor that is considered in determining the point at which financial value stops increasing, and may even begin to decline. For instance, aspen, white birch and balsam fir trees tend to decline and may even die well before reaching the age of 100 years while hemlock, white pine, sugar maple and yellow birch can live to well beyond 200 years. Age is an important factor to consider when prescribing management. It is generally advisable to harvest aspen stands before age 50 because of the marked decline in health and vigor as a stand ages beyond 50 years. On the other hand, depending on stocking levels and site conditions, a sugar maple tree in a mixed-age stand may not reach its maximum economic value until 100 years of age or more.

No exotic or invasive plant species were observed on the property. It is impractical to conduct continual monitoring for invasive species, so it is important for foresters, loggers, hunters and others who use the property to be aware of any unfamiliar plants, particularly ones that may have never been noticed in an area before. If the plant cannot be identified, a forester or botanist should be contacted to identify the plant, determine if it is native or non-native and make recommendations for its removal, if necessary. There are a number of invasive species that have been identified in the Upper Peninsula and these species are often spread when their seeds become attached to a hiker's boots or clothing and then fall off in another location. Timber harvesting equipment is another way that these species spread, so it is important to monitor areas that have been recently harvested. Invasive species can alter the ground flora composition and even interfere with the regeneration of desirable tree species if they are able to enter an area and spread unchecked.

Based on the geographic location of the property and the ecosystems present there is not a high risk of wildfire. Therefore, it is not necessary to conduct specific forest management aimed at reducing the risk of wildfire. However, precautions should be taken to minimize the risk of accidental fires during dry periods when leaf litter and other organic material are extremely dry. Things to consider include parking vehicles with hot exhaust systems on clear areas and not in tall dry grass, the operation of small engines, and outdoor fires. The Michigan DNR provides daily assessments of fire danger throughout snow-free periods of the year. Fire danger can be viewed online by visiting http://tinyurl.com/as6b36j and clicking on the link "Daily Fire Danger - Fire Danger Rating" near the top of the page.

Soils

The word "soil" can be defined as "the product of the *parent material*, influenced by *climate* and *biota*, in a *landform*, over *time*." Each of the five terms listed in italics exerts a specific influence over how a soil forms. These five factors interact in diverse ways resulting in the broad diversity of soils found across the planet, and even on one particular parcel of land. Each factor influencing soil formation is briefly described below.

Parent Material: Parent material is the source of the mineral components of soil. It is typically unweathered rock but can also be recently deposited beach sand, or rocks and gravel deposited by glaciers. Parent material provides the majority of the nutrients used by plants; it also plays a major role in the soil texture.

Climate: The climate includes temperatures, rainfall, wind and other weather phenomena that work to erode the parent material and make it more usable for plant growth. Climate also impacts the types of plants and animals that use soil in an area, which directly impact soil formation.

Biota: Biota are the particular groups of plants and animals that occupy an area. Plants impact soil formation by using particular nutrients, and root growth causes fractures in rock to expand and eventually split. Animals can impact soil formation by mixing and aeration. Insects and earthworms often have a more significant impact on soil formation than larger wildlife like deer and moose.

Landform: Landform affects how soil accumulates and how parent material erodes. Little if any soil will form on steep rock outcrops, while a great deal of sediment and organic matter can gather in low-lying areas, forming soils that are often very high in nutrients, but which may also contain excess amounts of water.

Time: Time is crucial to the development of soils. The longer a soil is allowed to develop, the stronger the impacts of the other four factors can become. A soil that has existed for thousands or tens of thousands of years may have a finer texture and more nutrients available for plant growth than a soil that began to form a few hundred years ago.

Soil maps are labeled with **mapping unit symbols.** A mapping unit symbol is a number and letter combination that refers to a unique soil type, found across the landscape on a particular slope class. The number indicates a unique soil series, determined by factors such as texture, color, moisture and acidity. The letter in the mapping unit symbol corresponds to the slope of the soil. An area listed as "A" slope is generally flat or very gently sloping, while an area listed as "F" slope is extremely steep. The letters from B to E indicate intervals along the gradient from mostly flat to extremely steep. These areas are mapped separately and given unique mapping unit symbols to allow considerations to be made for the slopes. In forest management, the slope of a soil can impact the ability to safely conduct timber harvesting in an area, as well as increasing the potential for erosion following a timber harvest. Soil descriptions also provide information about drainage characteristics and available water capacity. Drainage is a measure of how rapidly excess water moves through the soil and can range from excessively drained to

very poorly drained. If a soil is poorly drained, excess water is retained for a longer period of time; this can result in stagnant conditions where oxygen, necessary for root growth, is limited. Available water capacity is essentially a measure of the water available for plant growth after all excess water has drained out following a precipitation event. It can be visualized by considering the soil as a sponge, which has become saturated in a bowl of water. When the sponge is removed from the bowl, excess water drains out. At a certain point, no more water drips out of the sponge, however it is still possible to extract water from the sponge by wringing it out. The water that can be wrung out of the sponge may be thought of as its available water capacity. Moderate available water capacity is usually tolerable for the growth of most upland trees and other forest plants except during times of extreme droughts. During droughts, trees and other plants are often unable to obtain adequate amounts of water for proper growth; it is during these times that they can be at an increased risk of attack by insects and diseases. Maintaining at least partial forest cover and preventing soil compaction can help to preserve a soil's ability to retain water, thereby protecting against unnecessary drought stresses. Keeping partial forest cover helps to keep the soil cooler, which limits evaporation; preventing compaction maintains the structure of the small spaces between soil particles, which are crucial in the retention of water. Available water capacity ranges from very low to very high; a soil with very low available water capacity can limit plant growth by causing moisture stress; moisture stress can also make plants more susceptible to insect damage or disease.

Several of the mapping units identified on this property consist of more than one unique soil type; these areas are known as **complexes**. A soil complex consists of two or more distinctive soil types that are arranged across the landscape in a fashion that made it difficult to map them separately when the original soil surveys were conducted. When a soil complex is named, the first soil listed in the name is the most common and the second soil listed is the second most common. There are often other soils that are not identified in the name; these are listed in the soil description as "minor components." A minor component is any soil that makes up less than ten percent of the area of a mapping unit. The varying soil types that comprise a soil complex may have differing impacts on plant growth and forest management; where these differences exist they will be noted.

Figure 4 shows the chart used to determine the specific texture of a soil, with modifiers such as "fine" reflecting the specific size of particles within the soil. The texture of a soil is one of its most important characteristics for a number of reasons. Texture impacts how rapidly water moves downward through the soil, the amount of water held in the soil following precipitation and the length of time for which it is held there, the availability of nutrients and the stability of trees in high winds, as well as many other characteristics. The three primary soil textures are sand, silt and clay, with sand being the coarsest and clay being the finest. The size of soil particles impacts how closely together they

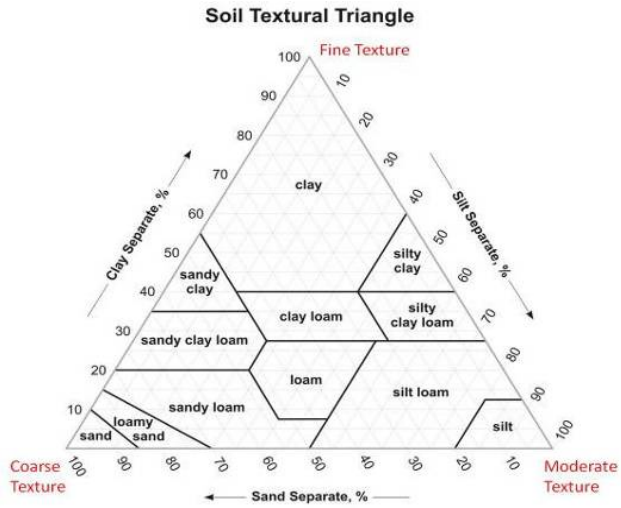


Figure 4: USDA Soil Textural Triangle.
Source: http://soils.usda.gov/education/resources/lessons/texture/textural_tri_hi.jpg

occupy the space of the soil. Smaller soil particles are able to pack together more tightly. The tightly packed soil particles of a silt or clay give it a higher surface area per unit of mass than a comparable volume of sand. This extra surface area means that silt and clay are able to retain more water than sand. Nutrients needed for plant growth are dissolved in the water that occupies this space in the soil. On the other end of the spectrum, when a soil becomes packed too densely together, for instance after being compacted by improper logging operations, its ability to retain small pockets of oxygen in the "pore spaces" between soil particles is decreased. This limits root growth because roots require oxygen to conduct respiration. Sandy soils are less susceptible to compaction than clays or silts.

From the perspective of soil formation, the ownership may be broken up into two subsections, divided by a line running from Lake Mine through Mass City and Victoria, westward towards White Pine. To the north of this line lie the Firesteel and Lakeshore Blocks; to the south, the Himanka Hill and Ewen Blocks. Within these two subsections there are some similarities in soil formation, although there are also many differences. Soils found within the Firesteel and Lakeshore Blocks have formed on what is known as a till-floored lake plain. As the glaciers melted over 10,000 years ago, an ice dam located near present-day Duluth, Minnesota held the water back; this water created what is known as Lake Duluth. When the dam broke and the water flowed out, the sediment that was left behind became the parent material of the soils in these areas. The Ewen Block is situated on what is known as a till plain, consisting of material that was mixed in with glacial snow and ice. As the glaciers retreated, a large sheet of ice remained trapped by the Trap Hills to the north; this material was deposited on the surface of the Earth as the ice melted. The hilly terrain of the Himanka Hill block exists because of a disintegration moraine. Glaciers have a bulldozer effect, pushing large amounts of rock and soil at their leading edge as they move across the landscape. When a glacier retreats, this leading edge is left behind as a fairly uniform hill across the landscape known as a terminal moraine; just behind this hill where the rock is less uniformly mixed with the ice exists the disintegration moraine where material has been deposited very erratically. This is the reason for the steep variable terrain on the Himanka Hill Block.

Across the entire ownership, the most common soil texture is loam. The Lakeshore and Firesteel Blocks may be characterized as containing predominantly loam-textured soils, the Ewen Block consists of a mix of clay and loam soils, and the Himanka Hill block consists of loams and loamy sand. These minor differences are a result of varied local features, however the vast majority of the ownership is suitable for the growth of most upland tree and plant species. Loam is an intermediate soil texture consisting of varied but mostly equal amounts of sand, silt and clay. Because of this mix of textures, loam soils are generally the most suitable for the growth of most upland plant species. The sand in loam helps to allow water to move downward through the soil and maintain pore space for root growth, while the clay and silt provide nutrients and a surface for water, thereby improving the available water capacity of the soil.

The Lakeshore Block has been impacted very heavily by the eroding action of the Flintsteel River and its tributaries. As a result, this area and the western portions of the Firesteel Block, are heavily dissected, or marked by the presence of drainages that are at times rather deep and steep. As water moves across the landscape, it erodes the fine textured soil materials and causes the formation of these drainages. Some drainages can be harvested, while others are simply too steep to harvest without risking severe erosion, or possible damage to harvesting equipment.

The fine textured clay and moderately fine textured silt loam soils found on the Ewen Block are well-suited to the growth of aspen. Past management, consisting of periodic clearcut harvests, has perpetuated the presence of the aspen forest type, however if left unmanaged, this area of the property would gradually develop into a forest consisting of a mix of maples, ash, oak, hemlock and white pine.

The well-drained loamy sand soils of the Himanka Hill Block are also very well-suited for northern hardwoods. Mixed with the more typical northern hardwood species (maple, birch, hemlock, basswood and ash) is a significant amount of red oak as well as bigtooth aspen; these species are well-adapted to somewhat dry conditions and are often found at and near the tops of the hills where moisture stress may occur during dry periods.

In addition to the upland soils found across most of the ownership, there are a number of small isolated wetlands scattered across the ownership. Wetland soils differ from upland soils due to the presence of a high water table for most or all of the year. This wetness leads to the accumulation of organic matter, which eventually develops into muck and peat textured material. These soils typically originate in stagnant water where plants such as sphagnum moss grow. Over time, as the moss and other plants die, the processes of decomposition use up the oxygen in the water, causing acidic, nutrient poor conditions where decomposition occurs at an extremely slow rate. Plants that grow on muck and peat soils typically grow very slowly and are able to tolerate acidic soil conditions. Operation of harvesting equipment and construction of roads on wetland soils must be avoided whenever possible because of the severe soil compaction and rutting that can result. Rutting and compaction can result in long-term decreases in productivity of the soil, in addition to reducing the quality of surface and groundwater. Most of these areas are fairly small and do not contain a significant volume of timber. Because of the poor stocking of timber in these areas of the property, it would be advisable to avoid timber harvesting entirely.

Although the soil maps and information included in this plan are very useful in identifying potential forest productivity and potential limitations to harvesting timber, they are no substitute for diligent work when preparing for timber harvests. If possible, timber harvest layout and marking should occur when soils are not frozen in order to allow wet areas to be identified. Loggers should be notified of these wet spots and given clear instructions on how to mitigate any potential rutting or compaction that their equipment may cause. It is also important to take adequate precautions when constructing roads and operating on steep slopes in order to prevent soil erosion. In addition to damaging water bodies as described earlier in this Forest Stewardship Plan, severe soil erosion can lead to long-lasting losses in soil productivity.

The soil maps included in Section I of this Forest Stewardship Plan depict the approximate locations of each individual soil mapping unit. More information about each individual soil type is available on the internet through the Web Soil Survey tool provided by the Natural Resource Conservation Service (NRCS). The internet address for the Web Soil Survey is http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. Web Soil Survey is capable of providing a wealth of soil information for the entire United States, in addition to generating custom maps and soil suitability reports. In addition, the full text of the original printed Ontonagon County Soil Survey is available online at http://tinyurl.com/lu4zkt2. Further soils information may be obtained from the NRCS Baraga Field Office at (906) 226-8871.

SECTION III- VEGETATION AND MANAGEMENT RECOMMENDATIONS

VEGETATION

Methods

In the fall of 2013, a forest inventory was conducted on this property. Variable radius inventory plots were randomly placed and measured across the productive portions of the ownership. Forest measurements that were taken at each plot included tree species, DBH and merchantable heights for both sawtimber and pulpwood. Prior to this visit, preliminary stand lines were delineated on aerial photographs of the property. These lines were also loaded onto a field GPS receiver to allow the forester to navigate throughout the property and visit each stand. Within each stand, basic observations were made. These observations include:

- Tree Species Composition
- Tree Quality and Health
- Tree Size Class (Qualitative)
- Tree Stocking (Basal Area)
- Regeneration Stocking
- Logging History and Future Potential
- Ground Vegetation and Exotic Species
- Soil Conditions
- Wildlife and Endangered Species

In addition to making these observations, the forester verified the preliminary stand lines and corrected them where necessary. These stand lines are then used to determine stand acreage. Within each stand, a timber type and habitat type are identified. Timber types are determined by the examining the tree species composition, size class and stocking density of the forest within each unique stand. Habitat types are determined by examining the soils, topography, tree species, and ground flora found within the stand. Knowledge of habitat types is useful to estimate tree productivity and determine potential equipment limitations of a forest stand. This information is then used to develop the management recommendations set forth later in this section.

For the purpose of categorizing different vegetation size classes in the stand descriptions below, trees are divided into overstory, understory and regeneration size classes. The overstory tree size class is any tree five inches or greater in diameter at breast height (DBH). DBH is measured at four and one half feet up from the soil surface. The understory tree size class is any tree two to five inches in DBH. Additionally, the regeneration size class is any tree one inch tall up to two inches in DBH.

Habitat Types

The system of habitat typing has been developed as an aid to forest management decision making on upland sites. It is based on the observation that forest plants, both trees and herbaceous vegetation, grow in relatively consistent associated groups. Past impacts on the stand such as timber harvests and natural disturbances can cause variation in the tree species present on a particular habitat type, however the understory plants generally remain consistent and predictable. An understanding of the habitat types and how forest cover progresses over time on the habitat types is crucial to being able to conduct forest management that cooperates with natural processes. Doing so greatly increases the effectiveness of particular management strategies and minimizes the need for inputs such as site preparation and planting.

Awareness of habitat types found on a particular site also provides insights into the potential productivity of certain tree species and the likely outcomes of particular management strategies. Habitat types are named after three or four significant indicator plants, one or two of which are typically trees. The frequency of numerous other plants determines the actual habitat type. Three habitat types were identified on the property. A brief description of these habitat types and the associated understory plants, are listed below:

***Acer saccharum – Tsuga canadensis / Dryopteris spinulosa - Caulophyllum thalictroides* phase — (Sugar Maple – Hemlock / Shield Fern - Blue Cohosh phase) – ATD-Ca:** The ATD-Ca habitat type is a very high quality and highly productive northern hardwood habitat type, in fact it is the most productive of the common habitat types found in Ontonagon County. Areas identified as the ATD-Ca habitat type usually have very diverse and dense ground vegetation with a fairly sparse shrub and understory layer and a well-developed forest understory. On this ownership, the ATD-Ca habitat type is most commonly found on the Lakeshore and Firesteel Blocks. This habitat type may be easily identified by the high productivity of northern hardwoods, particularly sugar maple, white ash and basswood. Although sugar maple dominates in most northern hardwood stands on the ATD-Ca habitat type, basswood and white ash are typically very common. Regeneration is often comprised predominantly of shade tolerant sugar maple with other species being more common in canopy gaps or clearcuts. Common ground vegetation in the ATD-Ca habitat type includes the following:

Spinulose shield fern	Jack-in-the-pulpit	Sweet cicely
Blue cohosh	Grasses and Sedges	Hairy Solomon's seal
Baneberry	Canada mayflower	False Solomon's seal
Oak fern	Ash seedlings	Sugar maple seedlings

***Acer saccharum – Tsuga canadensis / Dryopteris spinulosa* – (Sugar Maple – Hemlock / Shield Fern) – ATD:** The ATD habitat type often occurs on well-drained sandy and loam textured soils; on this property it supports the growth of most of the upland forests across the entire Himanka Hill Block. The primary tree species found on the ATD habitat type in a well-developed forest community is sugar maple, although all species associated with northern hardwoods may grow on an ATD site. The ATD habitat type is generally very productive, although not quite as productive as the AOCa habitat type described above. Forest stands growing on the ATD habitat type can be expected to produce good quality sawtimber, however it is important that timber harvesting equipment operators take care to limit rutting and compaction which can severely degrade the potential of these sites. Common ground vegetation found on the ATD habitat type includes the following:

Spinulose shield fern	Sedges	Twisted stalk
Elderberry	Starflower	Hairy Solomon's seal
Canada mayflower	Lady fern	

***Acer saccharum –Acer rubrum / Aster macrophyllus* - (Sugar maple – Red maple / Large-leaved aster) – AArAst:** The AArAst habitat type often occurs on soils with a thin surface layer of sandy loam overlying clay. The clay subsurface layers help to increase the available water capacity of these areas. Much of the Ewen Block may be classified as the ATM-O habitat type. Due to past management, this area of the ownership is currently stocked with young aspen poletimber, however in the absence of forest management, this area would gradually progress to a forest dominated by sugar maple, hemlock and yellow birch. The soil conditions are also well-suited to continued production of aspen provided that timber harvesting does not severely rut or compact the soil as this can lead to decreases in productivity. Common understory vegetation found on the ATM habitat type includes the following:

Large-leaved aster	False Solomon's seal	Wild lily-of-the-valley
Hairy Solomon's seal	Club mosses	Shield fern
Sweet cicely	Trillium	Hooked crowfoot

Currently, no proven method exists for describing habitat types in wetlands. Although the soil survey information lists habitat types for the wetland soils found on this ownership, these habitat types are outdated and were based on incomplete information. Management on wetland soils should consider the tree species present and desired future condition of the forest while taking all necessary steps to maintain soil and water quality into the future.

MANAGEMENT RECOMMENDATIONS

Proper land management must take many factors into account such as past land use, current land use, desired land use, conditions of the land and the potential of the land. Because nature does not consider property lines, land management must consider the landscape as a whole (landscape management). The options recommended in this plan consider the parcel of land being discussed and how it fits into the surrounding landscape. Management of this parcel is designed to benefit the land being managed, without negatively impacting the adjacent and surrounding natural ecosystems.

Recommended dates for forest management provided later in this plan are the dates recommended for initiating the implementation of the forest management practice prescribed by contacting your consulting forester. These dates are determined by considering the current conditions of the forest and its anticipated growth rates. However timber markets, weather conditions and many other factors may impact the date in which a timber harvest actually occurs. It is important to note that in many cases, the time frame from when a landowner contacts a consulting forester until the time when the first tree is cut is often one to two years due to the time it takes to schedule and implement the timber harvest layout, conduct any prescribed timber marking and sign a contract with a logger. Additionally, once a contract is signed with a logger it will take them time to mobilize their harvesting equipment and begin the cutting. In most situations, a time frame of approximately three years is considered acceptable for the implementation of any recommended practice.

Pre-Treatment Activity
Prior to the implementation of any treatment, the following details should be considered:

- Property boundaries should be checked or established if needed. This should be done either by or with the aid of a knowledgeable professional.

- Roads should be properly established or at least marked. This should be done either by or with the aid of a knowledgeable professional. If any roadwork near drainages or wet areas is required, the Department of Environmental Quality (DEQ) should be contacted at (906) 346-8300. The condition of roads should be documented, preferably with photographs, so that there is recourse if the roads are left in unacceptable condition following the completion of logging.

- Prescription implementation should be conducted either by or with the aid of a knowledgeable professional. If the prescription involves timber management, an experienced consulting forester should be involved.

- If treatment is implemented and income tax assistance is needed, Jim Burns with Burns Forestry Consultants (906) 364-3238 or Susan Metcalfe with Metcalfe Forestry (989) 348-3596 can be contacted. More tax information can be seen in the Appendix of this plan.

Stand Descriptions
The section below describes the various forest types found across the Ontonagon County ownership and the management techniques that should be implemented within them. The geographical location of each forest type and individual stand is depicted on the Management Unit Maps found in Section I of this management plan. In addition, the Management Unit maps also depict the timing that forest management is recommended to occur within each individual stand. There are four separate Management Unit Maps for this ownership, one for each block of the property. The four different blocks of property include the Lakeshore Block, the Firesteel Road Block, the Himanka Hill Block and the Ewen Block. Within each block of the ownership the property is further broken down into Management Units. Each Management Unit coincides with the year of entry for each recommended timber sale. For example, Management Unit 1 coincides with the area of the property that is recommended for harvest between 2014 and 2016. Management Unit 2 coincides with the area of the property that is recommended for harvest between 2016 and 2018 and so on. For future organizational purposes each individual stand is labeled on each Management Unit Map. The labeling scheme uses the following format. The first number of each individual stand coincides with the management unit it is found in. The second number is the unique stand number assigned to each individual stand found in its corresponding management unit. The last series of letters and numbers refers to the forest type

and stocking level of each individual stand. For example stand 3:7:M6 is Stand 7, found in Management Unit 3. It is comprised of a well stocked poletimber stand of northern hardwoods. The type of forest management (individual tree selection, modified clearcut, patch clearcut, etc.) conducted in each stand is depicted on a separate Activities Map. There is one Activities Map for each unique block of the property.

Forest Type:	**A (Aspen)**
Acres:	**874**
Tree Quality and Potential:	**Good Quality with Good Potential**
Site Index:	**63 Feet Tall at Age 50**
Site Index Species:	**Aspen**
Management Objective:	**Maintain the aspen forest type while producing income from timber sales and improving wildlife habitat.**
Prescribed Management:	**Modified Clearcut**

Forest Type Description:
The aspen forest type comprises a significant portion of the total acreage of the Ontonagon County ownership. This forest type consists of stands with varying stocking levels and size classes ranging from dense young regeneration to well stocked stands of mature timber. The typical mix of tree species found within the aspen forest type consists of the following:

Dominant		**Co-Dominant**	
Quaking Aspen	Red Maple	White Spruce	White Pine
Balsam Fir		White Ash	Sugar Maple
		White Birch	Big-toothed Aspen
		Basswood	Black Ash

Quaking aspen is by far the most common tree species found within the aspen forest type. The vast majority of the quaking aspen trees found within this forest type are healthy and vigorously growing. However, in the mature stands the quaking aspen trees present are displaying poor growth rates and in some cases are beginning to show signs of decline due to old age. Commonly mixed with quaking aspen is a good component of red maple. The red maples are generally healthy however their growth rates and timber quality is somewhat low due to the soil conditions present throughout most of the aspen forest type. Balsam fir is another common associate within the aspen forest type. Many of the balsam fir trees present are found in the sapling and small poletimber size classes ranging from roughly two to six inches in DBH. They are typically healthy and in many situations providing good cover for wildlife. Other tree species commonly noted within the aspen forest type but at much lower frequencies can be seen in the list of co-dominant species above.

Recommended Management:
The management objective for the aspen forest type is to maintain aspen as the predominant cover type while producing income through the implementation of timber sales and improving wildlife habitat. To meet this objective the aspen forest types found across the Ontonagon County ownership should be treated with a modified clearcut harvest when the individual stands range from 45 to 60 years of age. The recommended timing of harvest in each individual stand

can be seen on the Management Unit Map included in Section I of this management plan. The modified clearcut harvest recommended will consist of cutting all hardwood trees two inches in DBH and greater and all conifer trees five inches in DBH and greater with a few exceptions. Any white pine, red pine, hemlock, cedar, red oak or American elm encountered within the harvest areas should be retained. Following these harvest guidelines will fully open the canopy and stimulate the cut aspen trees to regenerate from root sprouts. The resulting root sprouts will provide an excellent source of food and cover for many wildlife species, especially ruffed grouse and white tailed deer. When possible, the modified clearcut harvests conducted within the aspen forest type should be conducted during the winter. Conducting a winter harvest when the aspen trees are storing their energy and nutrients in their root systems will provide the resulting root sprouts with boost in the spring when they begin to grow. This boost will maximize the growth rates of the resulting root sprouts.

To improve wildlife habitat it is recommended that for every ten acres of harvest area, roughly one acre be reserved. These reserve areas should be irregularly shaped and range from one half to two acres in size. They should be located in areas of the harvested stand that are currently providing good conifer cover. Retaining these areas will increase the diversity of the harvested stand making it more suitable to a wider range of wildlife species.

Another aspect to consider when managing the aspen forest type is the diversification of age classes. Having multiple age classes of aspen in close proximity to each other is very beneficial to a number of wildlife species, especially the ruffed grouse. Ruffed grouse use different age classes of aspen as cover and a food source during various times of the year. Maintaining a number of age classes in a small area will provide the ruffed grouse with suitable habitat year around. In situations where there is a large contiguous acreage of aspen in one age class it will be beneficial to create multiple age classes by conducting a few timber sales over a number of years. Each timber sale should consist of a minimum of 20 acres to ensure it is economically feasible to harvest. The minimum acreage of the timber sale will increase as expenses such as road building and culvert installation are encountered. When possible it would be most beneficial to create at least three separate age classes of aspen by conducting timber sales roughly ten years apart in an area. Within a stand this can be done by harvesting the first third at roughly age 40, the second third at age 50 with the final cut coming when the parent stand is roughly 60 years old.

Another important aspect to consider when implementing the modified clearcuts is the use of riparian buffers. Clearcutting can have a dramatic impact on surface water features due to the increase in sunlight and potential for runoff and erosion. Maintaining buffers along these surface water features will help sustain the quality of the habitat they provide. The minimum width of a buffer should be 100 feet from the water's edge on flat ground. In areas where terrain is a factor the width of the buffer should be increased. A table relating buffer width to slope can be found in the "Sustainable Soil and Water Quality Practices on Forest Land" manual, also known as Michigan's "Best Management Practices (BMP's)." Any time forest management is conducted near riparian areas all of the guidelines in the BMP manual should be followed.

Forest Type:	**Am (Aspen-Northern Hardwoods)**
Acres:	**559**
Tree Quality and Potential:	**Average Quality with Good Potential**
Site Index:	**63 Feet Tall at Age 50**
Site Index Species:	**Aspen**
Management Objective:	**Maintain the aspen forest type while producing income from timber sales and improving wildlife habitat.**
Prescribed Management:	**Modified Clearcut**

Forest Type Description:
The aspen-northern hardwood forest type in very similar is composition to the aspen forest type previously described. The primary difference is the presence of a relatively significant northern hardwood component. The presence of the northern hardwood component in this forest type could be a result of either site conditions or past forest management. The majority of the acreage found in the aspen-northern hardwood forest type consists of young regeneration and small pole sized trees. However, there are a few individual stands where more mature trees are present. Tree species commonly observed in the aspen-northern hardwood forest type include:

Dominant		**Co-Dominant**	
Quaking Aspen	Red Maple	Big-toothed Aspen	White Ash
Sugar Maple		Yellow Birch	Black Ash
		American Elm	Balsam Fir

Quaking aspen was by far the most common tree species observed in the aspen-northern hardwood forest type. Other common tree species noted include red maple and sugar maple. Typically the quality of the quaking aspen trees in the forest type is good and they have the potential to produce quality future timber products. The maples however are typically displaying poor growth rates and timber quality. This is often because the soil conditions present are not suitable to grow high quality hardwoods. Other tree species observed in the aspen-northern hardwood forest type, but at rather low frequencies include big-toothed aspen, white ash, black ash, yellow birch, American elm and balsam fir. The big-toothed aspen trees present are commonly found in small groups or “clones” scattered throughout this forest type. Like the quaking aspens they are displaying desirable growth rates and timber quality. Like the maples the yellow birch trees present, they are displaying poor growth rates and timber quality. The ashes and American elms present are typically in somewhat better condition than the maples and yellow birches, however they too are not reaching their maximum potential due to site conditions. Balsam fir is the most common conifer tree species found in this forest type. The majority of the balsam firs are sapling size, ranging from 2-4 inches in DBH. Other conifers present but not common in this forest type include white spruce, white pine and hemlock.

Recommended Management:
The management objective for the aspen-northern hardwood forest type is to maintain the aspen cover type while improving wildlife habitat and producing income from timber sales. To meet this objective, the aspen-northern hardwood forest type should be treated with a modified clearcut when the aspen trees in the individual stands range from 45 to 60 years of age. The management guidelines to follow in the aspen-northern hardwood forest type are identical to those described for the aspen forest type above. For more information on these guidelines see the “Recommended Management” section for the aspen forest type on the previous page.

Forest Type:	**Af (Aspen-Fir)**
Acres:	**6**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**60 Feet Tall at Age 50**
Site Index Species:	**Aspen**
Management Objective:	**Maintain the aspen forest type while producing income from timber sales and improving wildlife habitat.**
Prescribed Management:	**Modified Clearcut**

Forest Type Description:
The aspen-fir forest type is only found in one stand on the Ontonagon County property. This forest type consists primarily of aspen with significant component of balsam fir. Common tree species noted in the aspen-fir forest type include the following:

Dominant		**Co-Dominant**	
Quaking Aspen	Balsam Fir	White Spruce	Red Maple

Quaking aspen is the most common tree species observed in the aspen-fir forest type. The vast majority of the quaking aspens present are in the sapling size class ranging from two to four inches in DBH. A few scattered larger aspen trees are present however they only comprise a very small component of the stand. Like the quaking aspen, balsam fir trees are rather plentiful. Most of the balsam fir trees are found in the either the sapling or small pole timber size class ranging up to about seven inches in DBH. Mixed with the aspen and fir are lesser amounts of white spruce and red maple. Like the firs, the spruces are noted in both the sapling and small poletimber size class. The red maples present are concentrated in the sapling size class.

Recommended Management:
The management objective for the aspen-fir forest type is to maintain the aspen cover type while improving wildlife habitat and producing income from timber sales. To meet this objective, the aspen-fir forest type should be treated with a modified clearcut when the aspen trees in the individual stands range from 45 to 60 years of age. The management guidelines to follow in the aspen-fir forest type are identical to those described for the aspen forest type above. For more information on these guidelines see the “Recommended Management” section for the aspen forest type on page 33-34.

Forest Type:	**E (Lowland Hardwood)**
Acres:	**23**
Tree Quality and Potential:	**Poor Quality with Low Potential**
Site Index:	**55 Feet Tall at Age 50**
Site Index Species:	**Black Ash**
Management Objective:	**Maintain soil and water quality while implementing forest management where possible.**
Prescribed Management:	**Patch Clearcut**

Forest Type Description:
The lowland hardwood forest type exists in three separate stands spread across the Ontonagon County ownership. This forest type is found on wet mineral or muck soils that are very sensitive to rutting and compaction. Due to the wet soils present, only one of the three stands is suitable for forest management. Common tree species noted in the lowland hardwood forest type include the following:

Dominant		**Co-Dominant**	
Black Ash	White Ash	Basswood	Red Maple
		Hemlock	Balsam Fir

Black ash is the most common tree species present in the lowland hardwood forest type. Along with black ash is a decent component of white ash. The majority of the black ash trees are found in the wettest portions of the stand while the white ash trees are typically found along the fringes of the stand and in localizes high spots where the soils are not as wet. Both ash species are displaying poor to average growth and timber quality. Mixed with the ash trees are varying amounts of basswood, red maple, hemlock and balsam fir. Nearly all of the basswood and red maple trees present are displaying very poor growth and timber quality due to the wet soils. The hemlocks and balsam firs however, are displaying average growth and quality since they are slightly better suited to the wet soils present. Nearly all of the trees present in this forest type are found in the sapling and poletimber size class ranging from two to ten inches in DBH.

Recommended Management:
The management objective for the lowland hardwood forest type is to protect soil and water quality and where possible implement forest management to improve tree quality and growth. To meet this objective two of the three lowland hardwood stands should be omitted from timber management. The soils in these two stands are extremely wet and very sensitive to rutting and compaction. Furthermore, the low value timber that is present does not warrant risking potential soil and water degradation.

The other stand that is operable for forest management activities should be managed using the patch clearcut harvest technique. The goal of the patch clearcut harvest technique will be to harvest roughly one third of the stands overall acreage. The harvest patches should be irregularly shaped and roughly one to three acres in size. Within the patches all merchantable trees should be harvested except for any red oak, American elm, white pine, hemlock or cedar encountered. Harvesting in this fashion will fully open the canopy in the cut patches thus encouraging natural

regeneration of the forest from seeds blown into the cut patches from the surrounding non-harvest areas. Where possible, the harvest patches should be located in areas that are already displaying desirable regeneration.

To maintain water and soil quality all timber harvesting that takes place in the lowland hardwood stands should be limited to winter, when the ground is frozen and protected by snow. This will help mitigate the potential for soil rutting and compaction. Furthermore, all harvest patches should be at least 100 feet from any surface water body. This well help maintain water quality by minimize the risk of soil particles and other contaminants eroding into the surface water body.

Forest Type:	**F (Spruce-Fir)**
Acres:	**6**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**50 Feet Tall at Age 50**
Site Index Species:	**Balsam Fir**
Management Objective:	**Utilize degrading forest products.**
Prescribed Management:	**Species Removal**

Forest Type Description:
The spruce-fir forest type comprises a very small portion of the total acreage of the Ontonagon County forest. This forest type is made up of primarily upland conifer and hardwood tree species. Common Tree species noted in the spruce-fir forest type include the following:

Dominant		**Co-Dominant**	
Balsam Fir	White Spruce	Red Maple	Hemlock
		Red Oak	Basswood

The most common tree species noted in the spruce-fir forest type is balsam fir. The balsam fir trees are found ranging from young seedlings and saplings to small pole sized trees roughly eight inches in DBH. Since balsam fir is a relatively short lived tree, many of them found in the pole sized class are nearing maturity with some individuals already displaying signs of decline. Mixed with the balsam fir is a good representation of white spruce. Like the firs, the spruces are found in all size classes. They are slightly longer lived than the firs and therefore are generally displaying better health. However, they can be expected to begin declining once they reach an age of roughly 65 years old. Less common associates within the spruce-fir forest type include red maple, hemlock, red oak and basswood. The red maples and basswoods are generally not well suited to grow on the sites that currently make up the spruce-fir forest type and therefore they are displaying poor growth rates and low timber quality. The hemlocks and red oaks present are better suited to the site conditions and they are displaying reasonable productivity and quality.

Recommended Management:
The management objective for the spruce-fir forest type is to utilize the high risk timber products present before they begin to degrade. To meet this objective the spruce-fir forest type should be treated with a species removal timber harvest. The species removal timber harvest will focus on

harvesting all merchantable spruce, fir, red maple and basswood trees that are present. Conducting a species removal harvest will allow the landowner to utilize the spruce and fir trees before they begin to decline in quality and value. It will also create conditions favorable for natural regeneration of the species best suited to the site conditions, primarily red oak, balsam fir and white spruce. If possible, any harvesting in the spruce-fir forest type should be conducted during the summer and the loggers should be instructed to scarify the ground with their logging equipment. Scarifying the soils will provide a mineral soil seedbed that will increase the probability of successful germination of desirable tree species, primarily red oak.

Forest Type:	**H (Hemlock)**
Acres:	**169**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**55 Feet Tall at Age 50**
Site Index Species:	**Red Maple**
Management Objective:	**Maintain and promote hemlock for wildlife habitat.**
Prescribed Management:	**Individual Tree Selection/Species Removal**

Forest Type Description:
The hemlock forest type is found primarily on productive lowland sites. The terrain throughout most of the hemlock forest type is flat. It is commonly heavily stocked with a diverse mixture of hardwood and conifer tree species. Common tree species noted in the hemlock forest type include the following:

Dominant		**Co-Dominant**	
Hemlock	Cedar	White Spruce	Balsam Fir
Red Maple		Yellow Birch	Red Oak

Hemlock is the most common tree species found in the hemlock forest type. Along with the hemlocks is a good representation of both cedar and red maple. The majority of the hemlock and cedar trees present are healthy, however many of them are displaying poor timber quality traits. The red maples are also generally healthy, however due to the wet soil conditions they are not growing at their maximum potential and therefore the timber quality they are displaying is poor to average. Also found within the hemlock forest type with some consistency are white spruce and balsam fir. Many of the merchantable white spruce and balsam fir trees found in this forest type are near maturity with some individuals already showing signs of decline. Tree species that are present but relatively uncommon include yellow birch and red oak. Like the red maples, the yellow birches are not well suited to the wet soil conditions and are therefore displaying poor timber quality. The red oaks are very uncommon and found only in small localized dry portions of the forest type.

Due to the intense shade cast by the dense canopy, this forest type is lacking a well-represented understory or regeneration layer. Tree species that were observed in the understory and regeneration layer include primarily hemlock and red maple.

Recommended Management:
The management objective for the hemlock forest type is to maintain and promote wildlife habitat. Hemlock and other conifers growing in densely stocked conditions provide excellent winter habitat for many species of wildlife, especially white tailed deer. Therefore forest management should be aimed at promoting the growth of hemlock. To do this the hemlock forest type should be treated with a combination of an individual tree selection and species removal harvest. The individual tree selection harvest should focus on releasing the best quality hemlocks on the site while allowing for smooth operability of timber harvesting equipment. Trees to be harvested should be designated by a forester adhering to the following order of removals:

1. Risk - Cut high risk trees that are likely to die or significantly decline in product grade between harvests. This includes diseased trees that are at risk of declining in value in the next 15 years.
2. Release dominant hemlocks - Cut poorer quality competitors to provide crown growing space in order to promote growth and quality development.
3. Vigor - Cut low vigor trees, based on crown size and condition, crown class, and potential stem decay.
4. Stem form and quality - Cut poorly formed stems, based on usable log length and potential decay.
5. Undesirable species - Cut tree species that interfere with management objectives of landowner and species that interfere with growth of more desired species.
6. Improve Spacing - Create more uniform spacing between the healthiest trees to distribute growth more evenly throughout the stand.

Using an order of removals helps to ensure uniform tree selection throughout the stand. This will help the stand continue to grow in a relatively predictable fashion while providing a range of other benefits, including wildlife habitat, water quality preservation and carbon sequestration.

In addition to the individual tree selection harvest described above a number of tree species should be designated for harvest, they include red maple, white spruce and balsam fir. Removing these tree species will create more growing space for hemlock and also release some of the hemlock regeneration that is already established within this forest type.

All timber harvesting operations conducted in the hemlock forest types should take place during the winter when the ground is frozen and capable of supporting the heavy logging equipment. Harvesting during the winter will help to minimize the potential for soil damage and help maintain water quality.

Forest Type:	**Hm (Hemlock-Northern Hardwoods)**
Acres:	**231**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**55 Feet Tall at Age 50**
Site Index Species:	**Red Maple**
Management Objective:	**Maintain and promote hemlock for wildlife habitat.**
Prescribed Management:	**Individual Tree Selection/Species Removal**

Forest Type Description:

The hemlock-northern hardwood forest type is found in a number of locations across the Ontonagon County ownership. This is a very diverse forest type that occurs on a number of different soil types with varying terrain. In some areas of this forest type the soils are slightly wet and found on flat terrain. Other areas the soils are drier but found on excessively steep terrain often times leading down to a small stream. This steep terrain along with a number of small streams nearby will inhibit future forest management in some areas. The tree species composition of this forest type is also very diverse consisting of the following tree species:

Dominant		**Co-Dominant**	
Hemlock	Red Maple	Sugar Maple	Yellow Birch
		Basswood	White Ash
		Balsam Fir	White Spruce
		White Pine	

Hemlock and red maple are the two most common tree species found in the hemlock-northern hardwood forest type. The hemlocks are found in the poletimber and sawtimber size classes ranging from roughly 6 to 20 inches in DBH. The dominant hemlocks are typically healthy however they are generally displaying poor timber quality due to the high frequency of frost cracks. The red maples present are commonly found in the poletimber and small sawtimber size class ranging from 5 to 14 inches in DBH. Most are healthy and displaying average timber quality. Other hardwood species observed less frequently in this forest type include sugar maple, yellow birch, basswood and white ash. These species generally display the same size and quality characteristics as the red maples. Adding to the conifer component of this forest type is balsam fir, white spruce and white pine. Balsam fir and white spruce are relatively common with most of their stems found in the saplings and poletimber size class. White pines are a somewhat infrequent occurrence however they are present commonly as large scattered individual trees.

Recommended Management:
The management objective for the hemlock-northern hardwood forest type is to maintain and promote the hemlock component to improve habitat for wildlife. It will also be important to protect soil and water quality. To meet this objective the operable areas of this forest type should be treated with a combination of an individual tree selection and species removal timber harvest identical to that prescribed for the hemlock forest type. For more information on the details of conducting an individual tree selection species removal timber harvest see the details outlined on page 40 of this plan. Before conducting a timber harvest within the individual stands of this forest type the soils will have to be evaluated to determine if they can support a summer harvest or if harvesting will have to be restricted to winter only.

A number of the hemlock-northern hardwood stands across this ownership are found on steep terrain leading down to numerous small creeks and streams. These areas should be omitted from the timber harvest described above for two reasons, the primary reason being soil and water protection. Harvesting on steep slopes near surface water bodies creates a great risk of soil erosion. If erosion occurs and sedimentation is allowed to enter the adjacent creek or stream it will degrade the quality of the aquatic habitat that the creek or stream provides. Furthermore, operation logging equipment on steep slopes can be extremely hazardous to the loggers and in extreme conditions should be avoided.

Forest Type:	**M (Northern Hardwoods)**
Acres:	**2,051**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**60 Feet Tall at Age 50**
Site Index Species:	**Sugar Maple**
Management Objective:	**Promote tree quality, growth, diversity and health while improving wildlife habitat and conserving soil and water quality**
Prescribed Management:	**Individual Tree Selection/Patch Clearcut/Overstory Removal**

Forest Type Description:
The northern hardwood forest type is found across a large area of the property. This is a very diverse forest type that has been influenced by a significant amount of past forest management. The northern hardwood forest type ranges from young stands stocked with scattered poletimber and thick regeneration to mature stands of sawtimber with a dense canopy and little regeneration present. Because of the diversity of this forest type a number of management techniques will be implemented to meet the needs of each individual stand. The species composition of this forest type is rather diverse and consists of the following tree species:

Dominant		**Co-Dominant**	
Sugar Maple	Red Maple	Basswood	White Ash
		Yellow Birch	Red Oak
		Quaking Aspen	Balsam Fir
		White Spruce	Hemlock
		White Pine	

Sugar maple and red maple are by far the most common tree species observed in the northern hardwood forest type. Other hardwood species frequently observed include basswood and white ash. Yellow birch, red oak and quaking aspen are present but not common. The quaking aspens are generally found in small groups or clones ranging from roughly one quarter to one half acre in size. The hardwood species found in most of the individual stands that make up the northern hardwood forest type are commonly in good health and displaying good timber quality, especially the maples. However, a small number of individual stands are displaying a significant amount of top dieback. Mixed with the hardwoods at rather low frequencies are balsam fir, white spruce, hemlock and white pine. The balsam fir and white spruce trees are typically found

in the sapling and poletimber size class. In some individual stands balsam fir comprises a significant portion of the seedlings and saplings present. Hemlock and white pine are typically found as scattered individual trees, many ranging from 10 to 20 inches in DBH.

Within the northern hardwood forest type is varying degrees of terrain. A large portion of the terrain within this forest type is flat to gently rolling and easily harvestable with modern logging equipment. However, there are instances where the terrain is rather steep and will limit logging operability. Additionally, a number of streams dissect the northern hardwood forest type. The proximity of these streams to individual stands will also play a role in selecting the type of management implemented.

Recommended Management:
The management objective for the northern hardwood forest type is to promote tree quality, growth, diversity and health while improving wildlife habitat and conserving soil and water quality. To meet this objective the majority of the northern hardwood forest type should be treated with an individual tree selection harvest. Individual tree selection harvests in northern hardwoods help to accelerate the natural process of thinning, freeing up space for the most desirable trees in the stand and generating revenue for the landowner. Thinning hardwood stands also helps to create conditions more conducive to the establishment and growth of regeneration, thereby ensuring continued growth of the forest into the future. Foregoing timber harvests eventually leads to natural mortality of trees as they compete for space and other limited resources. Trees to be harvested should be designated by a forester adhering to the following order of removals:

1. Risk - Cut high risk trees that are likely to die or significantly decline in product grade between harvests. This includes diseased trees and those with tight “V” shaped forks that have a high risk of splitting and large trees with significant economic value that are at risk of declining in value in the next 15 years.
2. Reduce overall stocking of ash to no more than 10 square feet per acre in order to minimize the future impact of emerald ash borer.
3. Release crop trees - Cut poorer quality competitors to provide crown growing space around 40-60 crop trees per acre promoting growth and quality development. Apply two-sided release in sawtimber sized trees and full release in pole and sapling sized trees.
4. Vigor - Cut low vigor trees, based on crown size and condition, crown class, and potential stem decay.
5. Stem form and quality - Cut poorly formed stems, based on usable log length and potential decay.
6. Undesirable species - Cut tree species that interfere with management objectives of landowner and species that interfere with growth of more desired species.
7. Improve Spacing - Create more uniform spacing between the healthiest trees to distribute growth more evenly throughout the stand.

Using an order of removals helps to ensure uniform tree selection throughout the forest. This will help the forest continue to grow in a relatively predictable fashion while providing a range of other benefits, including wildlife habitat, water quality preservation and carbon sequestration. Following the timber harvest, the average basal area should be approximately 80 to 90 square

feet per acre. This stocking level allows adequate amounts of sunlight to reach the forest floor to stimulate the growth of regeneration, and recruitment of established regeneration into the poletimber size class. This stocking level also maintains enough overstory trees to prevent windthrow and loss of large limbs. The shade cast by the residual overstory will also help to limit the growth of brush that can outcompete regeneration of desirable tree species. All aspen and white birch should be harvested, and all hemlocks, white pine and red oak should be retained. Large snags and cull trees should be retained, unless they appear to be harboring some significant insect or disease problem. The benefits of snags and culls are detailed in the wildlife section of this Forest Management Plan.

Northern hardwood stands have an excellent capacity for natural regeneration, especially of the more shade-tolerant species such as sugar maple, red maple, balsam fir, and hemlock. This characteristic makes it possible to conduct periodic timber harvests which remove the low quality and high risk trees and open up space for the better quality trees. Provided that harvesting is done properly and no severe disturbances occur, this process can be repeated every 10 to 20 years without the need to completely clearcut the stand.

If any clusters, or clones, of aspen trees are encountered they may be managed by installing small patch clearcuts. Within the patch clearcuts all merchantable trees should be harvested. These patch clearcuts should range from one-half to one acre in size depending on the extent of the aspen clone. Installation of the patch clearcuts should only be considered if the residual stocking of hardwoods would be less than 50 square feet of basal area after removing all aspen trees.

Patch clearcuts could also be utilized in areas where hardwood timber quality is very low. In these situations patch clearcuts ranging from one-half to one acre in size would be installed to salvage the low quality timber present and encourage new hardwood regeneration to become established. The establishment of dense hardwood regeneration will create structural diversity within the stand and also provide a source of food and cover for wildlife. Additionally, the regeneration that results from the patch clearcut will likely develop into healthier more productive trees than the low quality timber that was present prior to the harvest.

Additionally, patch clearcuts should be used to improve species diversity by encouraging the regeneration of mid shade tolerant tree species such as yellow birch, American elm, red oak and white pine. Following a strict individual tree selection harvest favors shade tolerant trees, especially sugar maple. Implementing this type of thinning over the course of two or three entries will create a situation in which sugar maple begins to occupy a higher percentage of the stand's overall species composition. It is important to maintain species diversity for wildlife needs and also for the overall health of the forest. To encourage species diversity patch clearcuts ranging from one quarter to one acre in size should be installed. These patch clearcuts should be placed either where mid shade tolerant trees species are currently regenerating or in areas nearby a reliable seed source of a mid tolerant tree species. Within the patch clearcuts nearly all merchantable trees should be removed. Trees to retain within the patch clearcuts should consist of roughly five to ten mid shade tolerant individuals that will be retained to provide a seed source to help regenerate the harvested patch. Furthermore, to encourage mid shade tolerant regeneration, the loggers should be instructed to scarify the soils of the harvested patches to the

best of their ability with their logging equipment. Scarifying the soils will expose a bare mineral soil seedbed that is required for the successful germination of most mid shade tolerant tree species.

Some on the individual stands within the northern hardwood forest type are experiencing severe levels of top dieback. Due to the extensive top dieback present they should be treated with an overstory removal harvest. Conducting an overstory removal consists of cutting all trees within a stand that are ten inches in DBH and larger. This will allow the landowner to capture the value of the overstory trees now before they decline further or die as a result of top dieback. Conducting the overstory removal will also open the canopy and allow sunlight to reach the regeneration layer of the stand, which in many cases is already thick and vigorously growing. This will accelerate the growth of the regeneration allowing it to recruit into the overstory of the stand.

The upland soils found in should only be operated on with heavy logging equipment during dry periods of the summer and fall or during the winter. If harvesting occurs during summer or fall, care should be taken to keep soil rutting and compaction to an absolute minimum. Prior to the commencement of harvesting, access points for equipment and log trucks will need to be identified. Any new roads or skid trails constructed should be excluded from areas where hardwood regeneration is well established.

Forest Type:	**Ma (Northern Hardwoods-Aspen)**
Acres:	**108**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**55 Feet Tall at Age 50**
Site Index Species:	**Sugar Maple**
Management Objective:	**Promote tree quality, growth and health while improving wildlife habitat and conserving soil and water quality**
Prescribed Management:	**Individual Tree Selection/Species Removal**

Forest Type Description:
The northern hardwood-aspen forest type is relatively common across the Ontonagon County forest. Typically this forest type is capable of producing good quality hardwood timber products however it is not the most productive site for hardwood growth. Common tree species observed in the northern hardwood-aspen forest type include the following:

Dominant		**Co-Dominant**	
Red Maple	Sugar Maple	Basswood	White Ash
Quaking Aspen		Yellow Birch	White Birch
		Balsam Fir	White Spruce
		White Pine	

The most common tree species observed in the northern hardwood-aspen forest type are red maple, sugar maple and quaking aspen. The maples are generally in fair to good condition and can be expected to produce quality future timber products. They are currently found primarily in

the poletimber size class ranging from five to ten inches in DBH. Mixed with the maples is a significant amount of quaking aspen. Like the maples, the quaking aspens are found in the poletimber size class and are generally healthy. The aspens are found in this forest type both as scatted individual and as small groups or clones. Other hardwood tree species present but less common include basswood, white ash, yellow birch and white birch. Like the maples, the majority of these tree species are found in the poletimber size class and are capable of producing good quality future timber products. The conifer component of this forest type is rather sparse consisting primarily of balsam fir, white spruce and white pine. Balsam fir, white spruce and white pines are all found in the understory of this forest type as scattered seedlings and saplings. Some larger scattered individual white spruce and white pines are also present. Red maple and sugar maples seedlings and saplings are also present.

Recommended Management:
The management objective for the northern hardwood-aspen forest type is to promote the quality, growth and health of the forest while improving wildlife habitat and conserving soil and water quality. To meet this objective this forest type should be harvested by means of a combination of an individual tree selection and species removal harvest. The details of the individual tree selection harvest should follow the same guidelines described in the "Recommended Management" section for the northern hardwood forest type found on pages 44 and 45.

In addition to those management guidelines all merchantable aspen trees should be harvested from this forest type. Thinning the hardwoods and removing the aspen will discourage the cut aspen trees from regenerating thus pushing this forest type to a more typical northern hardwood mix. If any clusters, or clones, of aspen trees are encountered they may be managed by installing small patch clearcuts. Within the patch clearcuts all merchantable trees should be harvested. These patch clearcuts should range from one-half to one acre in size depending on the extent of the aspen clone. Installation of the patch clearcuts should only be considered if the residual stocking of hardwoods would be less than 50 square feet of basal area after removing all aspen trees.

Forest Type:	**Mh (Northern Hardwoods-Hemlock)**
Acres:	**20**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**55 Feet Tall at Age 50**
Site Index Species:	**Sugar Maple**
Management Objective:	**Promote hemlock cover for wildlife and overall tree quality, growth and health while conserving soil and water quality**
Prescribed Management:	**Individual Tree Selection**

Forest Type Description:
The northern hardwood-hemlock forest type is found as scattered small stands across the ownership. This forest type is found on varying terrain ranging from gently rolling to steep and inoperable. Many of the individual stands that make up this forest type are associated with a small stream or creek. Common tree species observed in this forest type include the following:

Dominant		**Co-Dominant**	
Sugar Maple	Red Maple	Basswood	White Ash
Hemlock		Red Oak	White Birch
		White Spruce	Balsam Fir

The most common tree species found in the northern hardwood-hemlock forest type is sugar maple, red maple and hemlock. The maples are generally found in the poletimber and small sawtimber size class ranging from 6 to 14 inches in DBH. They are generally healthy and displaying average timber quality characteristics. The hemlocks found in this forest type are represented by both poletimber and sawtimber sized trees ranging from 8 to 20 inches in DBH. The majority of the hemlocks are healthy however most are displaying poor timber quality due to frost cracking. Other hardwood species commonly observed in this forest type but at lower frequencies include basswood and white ash. Like the maples these species are commonly found in the poletimber and small sawtimber size classes. White birch and red oaks are present however they are not very common. Helping to add to the conifer component of this forest type is the presence of white spruce and balsam fir. White spruce and balsam fir are not very common overstory species in this forest type. They are more typically found in the seedling and sapling size classes.

Recommended Management:
The management objective for the northern hardwood-hemlock forest type is to promote hemlock cover for wildlife while improving overall tree quality, health and growth, and conserving soil and water quality. To meet this objective the operable stands found in this forest type should be treated with an individual tree selection harvest. The details of the individual tree selection harvest should follow the same guidelines described in the “Recommended Management” section for the northern hardwood forest type found on pages 44 and 45. The overall goal of the individual tree selection harvest will be to retain as much hemlock as possible while thinning primarily the hardwoods.

A number of the northern hardwood-hemlock stands across this ownership are found on steep terrain leading down to numerous small creeks and streams. These areas should be omitted from the timber harvest described above for two reasons, the primary reason being soil and water protection. Harvesting on steep slopes near surface water bodies creates a great risk of soil erosion. If erosion occurs and sedimentation is allowed to enter the adjacent creek or stream it will degrade the quality of the aquatic habitat that the creek or stream provides. Furthermore, operation of logging equipment on steep slopes can be extremely hazardous to the loggers and in such extreme conditions it should be avoided.

Forest Type:	**Mb (Northern Hardwoods-white birch)**
Acres:	**11**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**55 Feet Tall at Age 50**
Site Index Species:	**Sugar Maple**
Management Objective:	**Promote white birch regeneration to maintain forest diversity**
Prescribed Management:	**Modified Clearcut**

Forest Type Description:
The northern hardwood-white birch forest type is found in one stand on the Ontonagon County property. This forest type is comprised of a mixture of upland hardwood trees species with some scattered conifers. Common tree species found in this forest type include the following:

Dominant		**Co-Dominant**	
Red Maple	White Birch	Balsam Fir	White Spruce
		Yellow Birch	

Red maple and white birch are the most common tree species found in this forest type. Most of the red maple and white birch trees are in the poletimber and small sawtimber size class ranging from 6 to 14 inches in DBH. They are generally healthy, however the white birch trees are nearing maturity and can be expected to begin showing signs of decline relatively soon. Mixed with the red maple and white birch are lesser amounts of balsam fir, white spruce and yellow birch. These species are also found primarily in the poletimber size class.

The overall stocking of this forest type is very dense which has resulted in a closed canopy that casts a lot of shade on the forest floor. This shade is inhibiting the establishment of regeneration and therefore the regeneration layer of this forest type is very sparse.

Recommended Management:
The management objective for the northern hardwood-white birch forest type is to promote the regeneration of white birch to maintain forest diversity. To meet this objective this forest type should be treated with a modified clearcut. The modified clearcut harvest recommended will consist of cutting all hardwood trees two inches in DBH and greater and all conifer trees five inches in DBH and greater, with a few exceptions. Any white pine, hemlock, cedar, red oak or American elm encountered within the harvest areas should be retained. If possible the harvest should be scheduled to occur during snow free conditions and the loggers should be instructed to

scarify the soil with logging equipment. Scarifying the soil will prepare a mineral soil seed bed which is required for successful germination of white birch seeds. Following these harvest guidelines will fully open the canopy and create conditions favorable for the reestablishment of white birch regeneration. In addition to white birch it can be expected that some red maple, balsam fir and white spruce will also naturally regenerate thus leading to future forest conditions similar to what is currently being displayed.

Forest Type:	**Mf (Northern Hardwoods-Balsam Fir)**
Acres:	**69**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**55 Feet Tall at Age 50**
Site Index Species:	**Sugar Maple**
Management Objective:	**Promote a healthy forest and create early successional wildlife habitat.**
Prescribed Management:	**Modified Clearcut**

Forest Type Description:
The northern hardwood-balsam fir forest type comprises a rather small percentage of the overall Ontonagon County ownership. This forest type is made up of a mixture of upland hardwood and conifer tree species which include the following:

Dominant		**Co-Dominant**	
Red Maple	Balsam Fir	White Birch	Sugar Maple
White Spruce		White Pine	Black Spruce

The northern hardwood-balsam fir forest type is commonly found in areas where site conditions are somewhat marginal for the growth of hardwoods but generally fairly well suited for the growth of other tree species such as balsam fir and aspen. These sites are often slightly too dry to grow high quality hardwoods. Therefore the hardwood species present, especially red and sugar maple are generally displaying poor growth rates and timber quality. The quality of the conifer trees present is typically better than that of the hardwoods.

The regeneration layer of this forest type is often comprised primarily of balsam fir and white spruce seedlings and saplings. However, red maple is also somewhat well represented. In some portions of this forest type aspen regeneration is thick. This aspen regeneration is the result of root sprouts from trees that were cut roughly three years ago. In many places the growth and productivity of the aspen regeneration is being inhibited by the scattered hardwood and fir overstory.

Recommended Management:
The management objective for the northern hardwood-fir forest type is to promote the growth of the trees present that are best suited to the site while creating early successional wildlife habitat. To meet this objective this forest type should undergo a modified clearcut harvest when the fir trees present reach an age of 40 to 50 years old. At that time all hardwood trees two inches in DBH and all conifers five inches in DBH or greater should be cut, with a few exceptions. Any white pine, hemlock, cedar or red oak encountered should be retained to maintain diversity and

improve wildlife habitat. Conducting a modified clearcut harvest in this forest type will fully open the canopy and encourage species suited to the site conditions such as balsam fir, white spruce and white pine to regenerate. Furthermore, any aspen regeneration that is present will be released by the harvest thus accelerating its growth rate and its potential to develop into a usable future forest product. Following the harvest it can be expected that some red maple and sugar maple will also regenerate, however it will likely be a smaller component of the future forest.

Forest Type:	**Q (Lowland Conifer)**
Acres:	**35**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**55 Feet Tall at Age 50**
Site Index Species:	**White Spruce**
Management Objective:	**Promote a healthy forest and create early successional wildlife habitat while conserving soil and water quality.**
Prescribed Management:	**Patch Clearcut**

Forest Type Description:
The lowland conifer forest type is found in three separate stands ranging from roughly five to fifteen acres in size. This forest type is found on wet soils that are very susceptible to rutting and compaction if operated on with heavy logging equipment. In some portions of this forest type, these wet soils are inhibiting quality tree growth. This forest type is dominated by lowland conifer tree species that include the following:

Dominant		**Co-Dominant**	
Hemlock	Cedar	Black Spruce	Tamarack
		Red Maple	Black Ash
		White Pine	

Hemlock and cedar are the two most common tree species found within this forest type, however combined they make up less than 40 percent of the overall stocking. Mixed with the hemlock and cedar at a slightly lower frequency are black spruce, tamarack, red maple and black ash. White pines are present but only as scattered individual trees. Overall most of the trees in this forest type are healthy however they are not achieving their maximum growth potential due to the wet soils present. In some portions of this forest type the soils are so wet that they are inhibiting the development of marketable timber.

Recommended Management:
The management objective for the lowland conifer forest type is to promote a healthy forest while creating early successional wildlife habitat and conserving soil and water quality. To meet this objective the productive portions of this forest type should be treated with the patch clearcut harvest method. The goal of the patch clearcut harvest method will be to harvest roughly one-third to one-half of a stand's overall acreage. The harvest patches should be irregularly shaped and roughly one to three acres in size. Within the patches all merchantable trees should be harvested except for any hemlock, cedar or white pine encountered. Harvesting in this fashion will fully open the canopy in the cut patches thus encouraging natural regeneration of the forest

from seeds blown into the cut patches from the surrounding non-harvest areas. Where possible, the harvest patches should be located in areas that have a low density of hemlock and cedar.

To maintain water and soil quality all timber harvesting that takes place in the lowland conifer stands should be limited to the winter months when the ground is frozen and protected by snow. This will help mitigate the potential for soil rutting and compaction. Furthermore, all harvest patches should be placed a minimum of 100 feet from any surface water body. This well help maintain water quality by minimizing the risk of soil particles and other contaminants from eroding into the surface water body.

Forest Type:	**Qe (Lowland Conifer-Lowland Hardwood)**
Acres:	**13**
Tree Quality and Potential:	**Poor Quality with Poor Potential**
Site Index:	**45 Feet Tall at Age 50**
Site Index Species:	**Black Ash**
Management Objective:	**Maintain soil and water quality**
Prescribed Management:	**No Active Management**

Forest Type Description:
The lowland conifer-lowland hardwood forest type is found in two separate areas of the Ontonagon County forest comprising only about 12 acres. This forest type is found on excessively wet soils with flat terrain. These excessively wet soils are prohibiting the growth of productive timber in most areas of this forest type. Common tree species observed in the lowland conifer-lowland hardwood forest type include the following:

Dominant		**Co-Dominant**	
Cedar	Black Ash	Red Maple	Hemlock
		Balsam Fir	White Spruce
		Black Spruce	Tamarack

All of the tree species observed growing in this forest type are stunted by the excessively wet soils. In some places the cedars and hemlocks are displaying average growth but not enough to warrant harvesting. The conifer cover found on this forest type is thick in spots and currently provides good winter wildlife habitat. In parts of this forest type tag alder is rather thick.

Recommended Management:
The management objective for the lowland conifer-lowland hardwood forest type is to protect soil and water quality while maintaining wildlife habitat. To meet this objective there should not be any active timber management conducted within this forest type. The poorly productive timber in this forest type will not support a commercial timber harvest. Furthermore, the excessively wet soils are also extremely susceptible to damage such as rutting and compaction if operated on with heavy logging equipment. Therefore, to protect soil and water quality no active forest management should occur in this forest type. Due to its low productivity, it is likely that this forest type will not change much over the next 20 years., thus preserving the wildlife habitat this forest type currently provides.

Forest Type:	**T (Swamp Conifer)**
Acres:	**17**
Tree Quality and Potential:	**Average Quality with Average Potential**
Site Index:	**50 Feet Tall at Age 50**
Site Index Species:	**Tamarack**
Management Objective:	**Utilize mature timber products while encouraging natural regeneration**
Prescribed Management:	**Modified Clearcut**

Forest Type Description:
The swamp conifer forest type is found in one stand encompassing roughly 16 acres. This forest type is found on wet, somewhat mucky soils with flat terrain. The tree species found growing in this forest type are very well adapted to wet and nutrient poor soils and include the following:

Dominant		**Co-Dominant**	
Tamarack	Black Spruce	Cedar	White Pine
		Red Maple	Balsam Fir

Tamarack and black spruce are the two most common tree species found in the swamp conifer forest type. These tree species are very well suited to grow on the wet nutrient poor soil conditions that exist and therefore they are displaying reasonable growth rates and timber quality. The vast majority of the tamarack and black spruce trees present are found in the poletimber size class ranging from five to ten inches in DBH. Both tamarack and black spruce are relatively short-lived tree species and while they are primarily healthy now, they can be expected to begin declining in the near future. Mixed with the tamaracks and black spruce are lesser amounts of cedar, white pine, red maple and balsam fir. Like the tamaracks and black spruce these species are also concentrated in the poletimber size class. However, they are all displaying poor timber quality and growth rates due to the wet nutrient poor soils. The regeneration layer of this stand is rather sparse and consists primarily of balsam fir and tag alder.

Recommended Management:
The management objective for the swamp conifer forest type is to utilize the maturing timber while naturally regenerating the forest. To meet this objective the swamp conifer forest type should be treated with a modified clearcut. The modified clearcut will focus on removing all merchantable trees within the forest type except for white pine and cedar. Following these harvest instructions will fully open the forest canopy allowing sunlight to reach the forest floor. This added sunlight will stimulate the regeneration of the forest which will likely consist of thick tamarack seedlings within two to three years following the harvest. Black spruce can also be expected to regenerate however it is not likely to have as large of a presence in the future stand as tamarack will.

To protect soil and water quality any harvesting conducted in the swamp conifer forest type should be restricted to winter when the ground is frozen and protected by snow. Restricting harvesting operation to winter will help mitigate the potential for soil rutting and compaction.

Forest Type:	**Tf (Swamp Conifer-Balsam Fir)**
Acres:	**24**
Tree Quality and Potential:	**Poor Quality with Poor Potential**
Site Index:	**40 Feet Tall at Age 50**
Site Index Species:	**Balsam Fir**
Management Objective:	**Protect soil and water quality while retaining wildlife habitat and cover**
Prescribed Management:	**No Active Management**

Forest Type Description:
The swamp conifer forest type is found in one stand encompassing roughly 16 acres. This forest type is found on wet, somewhat mucky soils with flat terrain. The tree species found growing in this forest type are very well adapted to wet and nutrient poor soils, they include the following:

Dominant		**Co-Dominant**	
Tamarack	Cedar	Balsam Fir	Tag Alder

On this property, tamarack is the most common tree species found in the swamp conifer forest type; black spruce is a common associate of tamarack although it was not observed on this property. Balsam fir and cedar were observed growing with the tamarack, although at lesser frequencies. These tree species are very well suited to growing on the wet and nutrient poor soil conditions that exist and therefore they are displaying reasonable growth rates and timber quality. The vast majority of the tamarack and cedar trees present are found in the sawtimber size class ranging from 11 to 18 inches in DBH. In addition, a poorly stocked understory of cedar and balsam fir exists; these trees range from four to six inches in DBH. Tamarack and balsam fir are relatively short lived tree species and while they are primarily healthy now, they can be expected to begin declining in the near future. The cedars are mixed throughout the stand, however they are most common around the perimeter, in the transitional area between hardwoods and tamarack. The overstory in this stand is fairly sparse and consists predominantly of scattered tag alder and some balsam fir regeneration.

Recommended Management:
The wet soils in these areas of the property pose a severe limitation to the operation of timber harvesting equipment. In addition, the presence of cedar growing here provides an excellent source of cover for wildlife, particularly deer. For these reasons, timber harvesting is not recommended on this forest type. Without active management, it is likely that over time, as the tamarack in the overstory begin to decline and die, the balsam fir and cedar will move in and colonize these areas as a part of the natural succession of this forest type. Although balsam fir is somewhat tolerant of growing in shade under an established forest canopy, cedar is fairly intolerant and therefore requires openings in the canopy for successful regeneration. These openings will be a result of natural mortality of tamarack, and in some cases, damage caused by windstorms. When these areas progress to a cedar-dominated forest, the cedar will likely persist for a very long time as cedar has a very long life span. Avoiding timber harvesting in these two small areas of the property will help to protect water quality in addition to maintaining the value of the cedars growing here for wildlife habitat.

Forest Type:	**XL (Lowland Brush)**
Acres:	**416**
Tree Quality and Potential:	**N/A**
Site Index:	**N/A**
Site Index Species:	**N/A**
Management Objective:	**Preserve to maintain water quality**
Prescribed Management:	**No Active Management**

Forest Type Description:
The lowland brush forest type occurs on some of the wettest soils on this property and includes a unique and diverse range of tree and shrub species. This forest type is found in low-lying sites of varying sizes across the entire ownership and totals 416 acres. Generally speaking these areas have one feature in common: they are located in close proximity to surface water bodies, or in areas where the water table is located at or very near the surface of the soil. These areas generally prohibit the growth of all upland tree species, and in many instances they are too wet to support significant growth of even wetland tree species like black spruce and tamarack. In the absence of a forest canopy, brush and herbaceous vegetation often dominate in these areas. Some areas of lowland brush exist due to beaver activity; these areas may be found on the Lakeshore and Firesteel Blocks. When beavers construct a dam, the subsequent flooding eventually kills trees growing in the flooded areas and may even kill those trees growing in close proximity due to the saturated soils. In an unmanaged forest, this is a natural occurrence however in a managed forest where the primary objective is timber production, this activity represents a long-term loss in productivity and potential revenue. Tree species observed in the lowland brush forest type consist mainly of scattered, poor quality tamarack, black spruce, black ash, balsam fir and white cedar.

Interspersed throughout some areas of the lowland brush forest type are some small lakes and flooded areas. The wet soils in this stand will not support significant stocking of merchantable tree species in the near future. When adjacent stands are harvested, logging equipment should be excluded from areas of lowland brush in order to limit the chances of soil rutting and compaction. Areas of lowland brush are important to maintaining water quality as they help to filter impurities and nutrients out of the water as it flows across the landscape into streams and other bodies of water.

Management Recommendations:
No active forest management is recommended in the lowland brush forest type. During harvest operations in adjacent stands, the wetland boundaries should be clearly delineated and designated as equipment-free areas. These areas of the property should be reevaluated in 2024 in order to ensure that they have not been drastically impacted by any disease or invasive species.

Forest Type:	**XW (Water)**
Acres:	**8**
Tree Quality and Potential:	**N/A**
Site Index:	**N/A**
Site Index Species:	**N/A**
Management Objective:	**Preserve to maintain water quality**
Prescribed Management:	**No Active Management**

Forest Type Description:
The surface water features found on this ownership consist primarily of small streams and beaver ponds. Portions of the property also border Lake Superior and the Flintsteel River. A detailed description of the water features found on this property is located in the Water/Wetlands sections of this plan found on page 14.

Management Recommendations:
The management objective for the surface water features found on this property is to maintain their quality and the unique habitat they provide. To accomplish this objective all recommendations found in the in the "Sustainable Soil and Water Quality Practices on Forest Land" manual, also known as Michigan's "Best Management Practices (BMP's)" should be followed. This manual provides recommendations on road building and stream crossings to help prevent soil erosion and sedimentation from entering surface water bodies. Furthermore it provides information on harvesting buffers that should be used to protect water quality. Proper implementation of the recommendations found in this manual will ensure that water quality is maintained.

Forest Type:	**O (Open)**
Acres:	**12**
Tree Quality and Potential:	**N/A**
Site Index:	**N/A**
Site Index Species:	**N/A**
Management Objective:	**Maintain these unique areas for future forest management and wildlife habitat**
Prescribed Management:	**No Active Management**

Forest Type Description:
The open areas of this ownership consist primarily of old log landings and the capped dump found on the Himanka Hill block. The majority of these forest openings are smaller than one acre in size. The largest opening consists of the old dump which totals roughly seven acres. These small openings provide areas of unique habitat within a larger area that is heavily forested. The unique habitat provided by these areas is used by a number of wildlife species, especially song birds.

Management Recommendations:
There is no active management recommended for this forest type. Instead it should be allowed to develop naturally and when needed, utilized again to facilitate forest management practices. Utilizing the old landings for future timber sales will minimize future forest and soil disturbance while also maintaining the areas as openings. Maintaining the openings in this fashion will also help preserve the unique habitat they provide.

Forest Type:	**ROW (Right-of-Way)**
Acres:	**18**
Tree Quality and Potential:	**N/A**
Site Index:	**N/A**
Site Index Species:	**N/A**
Management Objective:	**Allow the owners of the ROW to maintain the area as needed for their purposes.**
Prescribed Management:	**No Active Management**

Forest Type Description:
The utility Right-of-Way (ROW) found on this property is located running east and west through the middle of the Firesteel Road Block. It consists of a strip of land that has been cleared and maintained by the owner of the ROW. This area is not managed or maintained by Ontonagon County.

Management Recommendations:
There is no recommended forest management required for this forest type. In lieu of forest management the County should allow the owners of the ROW to continue to maintain the ROW to suit their needs. Furthermore, when forest management is being conducted adjacent to the ROW the forester overseeing the management should take precautions to ensure the ROW and the utilities it provides are not damaged. This typically involves making sure that trees designated for harvest do not threaten power lines. Also, the forester should check to ensure that there are not any buried utilities that might be damaged by operating heavy logging equipment within the ROW. If these buried utilities exist, precautions such as designating crossing areas and bringing in fill or skid mats to lessen the impact from the harvesting equipment might be necessary.

Volume by Forest Stratum

During the process of developing this forest management plan, a strata level inventory was conducted to obtain an idea of forest stocking levels for similar forest types occurring on the property. Through this process stands of similar forest types were joined together, forming forest strata. The following table lists each forest stratum found on the Ontonagon County ownership along with the acreage and total volume associated with each of them.

Forest Strata	Forest Type Abbreviation	Acreage	Basal Area Per acre	MBF		Cords	
				Per Acre	Total	Per Acre	Total
Aspen Dominant	A4, A5, A6, Af3-4, Am4-3, Am5, Am6	692.5	101	0.6	416	20	14,000
Northern Hardwoods: High Stocking	M6, M8, M9, Mh9, Ma6, Mb6	1,315.1	130	2.5	3,300	28	36,000
Northern Hardwoods: Medium-Low Stocking	M4, M4-3, M5, M5-2, Ma4-3, Ma5, Mf5-2	944.7	96	1.1	1,000	18	17,000
Hemlock Dominant		399.9	187	0.6	252	44	17,000
Lowland Conifer & Hardwoods	Q6, Qe6, T5, Tf9-3, F5, E5, E6	116.3	137	0.7	90	33	4,000
Pre-Merch.		747.1	NA	NA	NA	NA	NA
Non-Forested	Open, ROW, XL, XW	454.4	NA	NA	NA	NA	NA
	All Forest Types	4,670.0	NA	NA	NA	NA	NA

Recommended Treatment Schedule

The following tables summarize each management unit and the year in which a recommended timber harvest is to take place. Additionally, the total acres to harvest and the acres within each forest type to harvest are listed by Management Unit. **All recommended management should be reevaluated in 2024 and updated if necessary to reflect ecological or economical changes that would affect forest management.**

Management Unit	Treatment Year	Total Acres
1	2014-2016	434
Forest Type	Prescribed Management	Acres
A	Modified Clear Cut	34
Hm	ITS/Species Removal	35
M	ITS	375
Mb	Modified Clearcut	11

Management Unit	Treatment Year	Total Acres
2	2016-2018	336
Forest Type	Prescribed Management	Acres
A	Modified Clearcut	6
M	ITS	260
Mf	Modified Clearcut	56
Q	Patch Clearcut	14

Management Unit	Treatment Year	Total Acres
3	2018-2020	459
Forest Type	Prescribed Management	Acres
Am	Modified Clearcut	30
H	ITS/Species Removal	135
Hm	ITS/Species Removal	29
M	ITS	227
T	Modified Clearcut	17

Recommended Treatment Schedule, continued

Management Unit	Treatment Year	Total Acres
4	2020-2022	352
Forest Type	Prescribed Management	Acres
Am	Modified Clearcut	65
H	ITS/Species Removal	35
M	ITS/Patch Clearcut	185
Ma	ITS/Species Removal	51
Q	Patch Clearcut	16

Management Unit	Treatment Year	Total Acres
5	2022-2024	277
Forest Type	Prescribed Management	Acres
A	Modified Clearcut	16
Am	Modified Clearcut	178
M	ITS	67
Ma	ITS/Species Removal	16

Management Unit	Treatment Year	Total Acres
6	2024-2026	505
Forest Type	Prescribed Management	Acres
Am	Modified Clearcut	133
E	Patch Clearcut	17
M	ITS/Patch Clearcut	355

Management Unit	Treatment Year	Total Acres
7	2026-2028	228
Forest Type	Prescribed Management	Acres
A	Modified Clearcut	31
Am	Modified Clearcut	12
M	ITS	175
Mf	Modified Clearcut	10

Recommended Treatment Schedule, continued

Management Unit	Treatment Year	Total Acres
8	2034+	303
Forest Type	Prescribed Management	Acres
A	Modified Clearcut	7
Af	Modified Clearcut	6
F	Species Removal	4
M	ITS	248
Ma	ITS/Species Removal	38

Management Unit	Treatment Year	Total Acres
9	To Be Determined	1776
Forest Type	Prescribed Management	Acres
A	Modified Clearcut	781
Am	Modified Clearcut	142
E	To Be Determined	6
F	To Be Determined	1
Hm	ITS/Species Removal	166
M	ITS	160
Ma	ITS/Species Removal	4
Mf	ITS/Patch Clearcut	2
Mh	ITS/Species Removal	20
Q	To Be Determined	5
Qe	To Be Determined	12
Tf	To Be Determined	24
XL	No Active Management	415
XW	No Active Management	8
Open	No Active Management	12
ROW	No Active Management	18

Recorded Treatment Activity

The following table shows each stand located on this property. Actual treatment activity should be recorded as it takes place over time.

Treatment Year	Stand #	Timber Type	Activity	Total Acres

Recorded Treatment Activity, continued

Treatment Year	Stand #	Timber Type	Activity	Total Acres

SECTION IV- DEFINITIONS/APPENDIX

GLOSSARY

Basal Area- Measurement taken to evaluate forest density. Units expressed in square feet/acre. Represents the cross-sectional area of trees in the forest.

Canopy- The cover of branches and foliage formed collectively by the crowns of adjacent trees.

Co-dominant- Trees that are also in the overstory, usually right below the dominant trees.

Clay Soil- Soil class based on the size of mineral fragments (less than or equal to 0.002 millimeters in diameter). Clay soils are very fine and poorly drained. This means that they hold excessive water during wet times of the year.

Crop Trees- Upper-crown residual trees of higher quality that will eventually form the final tree community at the time of stand maturity.

DBH- Diameter of individual trees measured at breast height (4.5 feet from the ground).

Dendrochronology- The study of past forest fires using the scars and other evidence found in the current forest.

Ecosystem- The living and non-living components of an area that make up an environment.

Habitat Type- Particular ecosystem, which is classified based on soil type, forest type, and ground flora. Habitat types are used to help determine site management potential, limitations, and concerns.

Landscape Management- Consideration of the all the ecosystems within an area.

Loam- Soil that is made up of a mix of clay, silt and less than 50 percent sand particles.

Mature- The period of time that trees are fully developed and at their highest quality. The sized of the tree varies by species and site index.

Merchantable- Trees that are of a size and quality that can be harvested and sold.

Muck Soil- Soil type that is dark in color and fine in texture. It contains primarily well-decomposed organic material. It is poorly to very

poorly drained and holds water throughout the year. This soil can be associated with wetlands.

Northern Hardwoods- A forest type including sugar maple, red maple, American basswood, yellow birch and white ash.

Old growth- An age class of a forest. Referring to a forest that is very old and unchanged by humans.

Over-mature- Trees that have grown beyond maturity and are beginning to decay.

Overstory- Trees within the forest forming the uppermost canopy layer.

Pole-sized tree- Usually immature or suppressed trees 6-12 inches in diameter (dbh).

Pre-Merchantable- Trees that are not of a size or quality to be harvested or sold

Pulp/Cord- A merchantable forest product measured in cords. One cord equals 128 cubic feet. Pulp logs are cut 100 inches long and must have a diameter of 4 inches or greater. They also must be reasonable straight and sound.

Regeneration- The smaller trees that establish on the forest floor

Release- Allow individual trees more room to expand their crowns. This increases tree production, health and vigor.

Residual- Forest volume or density after a timber harvest.

Sawlog-sized tree- Larger, usually older trees 12 + inches in diameter (dbh). These trees meet the minimum diameter specs. for sawlog products.

Sawtimber/MBF- A merchantable forest product measured in MBF (thousand board feet. One board foot equals 1ft by 1 ft by 1 inch).

Sandy Loam Soil- Soil class that is a little finer in texture than sand, containing some silt and clay mixed with sand.

Sandy Soil- Soil class based on the size of mineral fragments (0.05 - 2.0 millimeters in diameter). Sandy soils are considered to be coarse and well-drained.

Sapling- Small and young trees, 1 – 4 inches in diameter (dbh) and 6 – 20 feet tall.

Scarification- Lightly disturb forest floor to expose bare soil. Generally for the purpose of creating a seedbed for desired tree species that require such conditions.

Seedling- Small and young trees, less than 1 inch in diameter (dbh) and less than 5 feet tall.

Silt Soil- Soil class based on the size of mineral fragments (0.05 - 0.002 millimeters in diameter). Silt soils are considered to be fine but not as fine as clay. They are fair to poorly drained, meaning that they hold water during wet times of the year.

Site Index- A measure of productiveness based on the height of the dominant trees in a stand at a base age. Largely influenced by the soil composition and climate.

Stand- Land areas grouped together based on their forest and vegetative species structure, site quality, and current conditions. Stands are usually greater than 2 acres in size.

Succession- Refers to the natural evolution of a forest over time and can be measured by the species composition of the forest.

Tree Stocking- Term used to express the density of the trees in a forest.

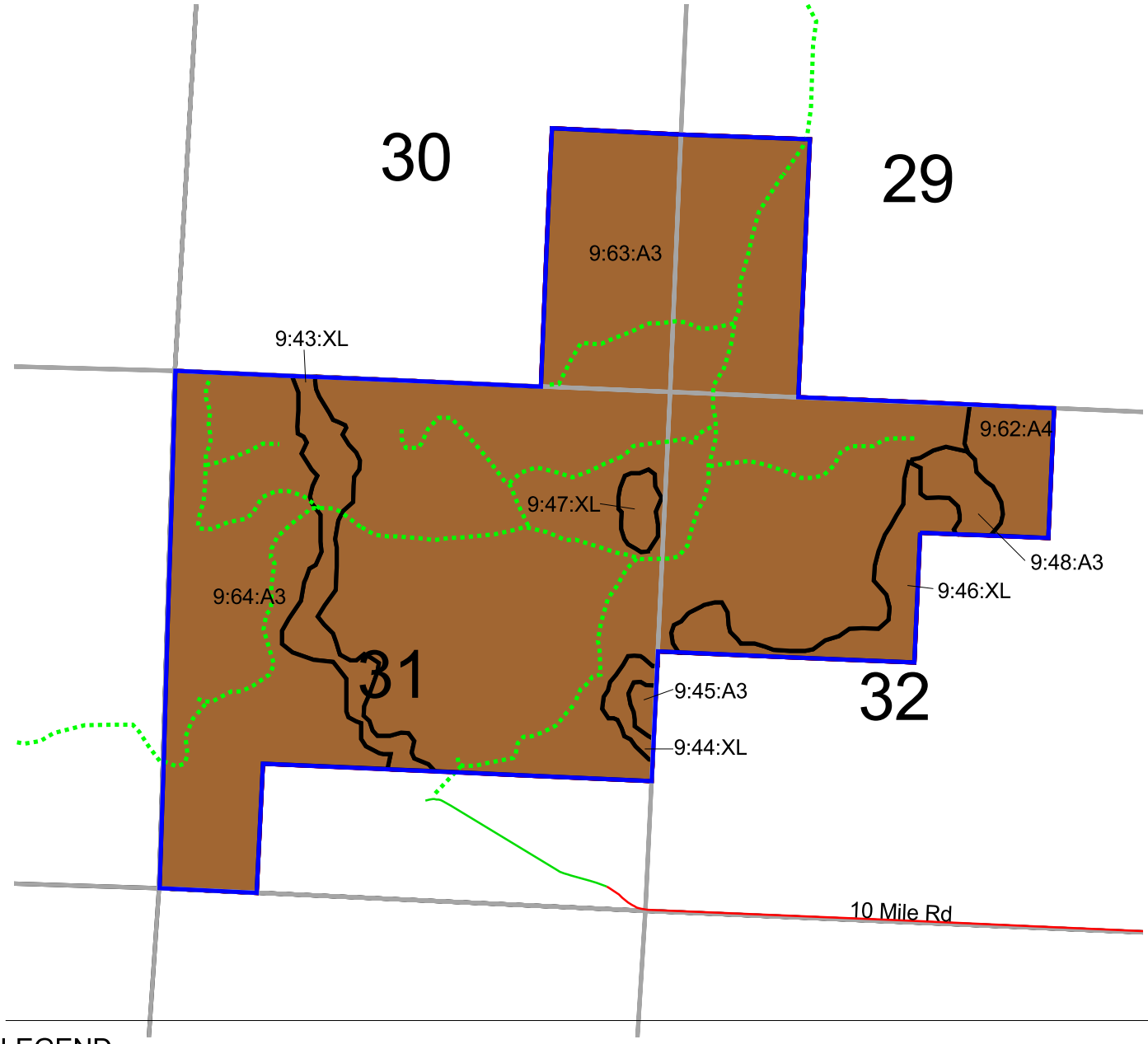
Understory- Trees within the forest growing beneath the overstory.

Vernal Ponds- Pools of water that form in the forest during the wet seasons

APPENDIX

1. Tree Farm Group Invitation
2. Timber Tax Information

ONTONAGON COUNTY FOREST PROPERTY
Ewen Block Management Unit Map
T. 48 N. - R. 40 W
Ontonagon County, Michigan



LEGEND

- Property Boundary
- Town / Range
- Section
- Stand Boundary
- County Road
- Woods Road

Management Unit Entry Years and Acres

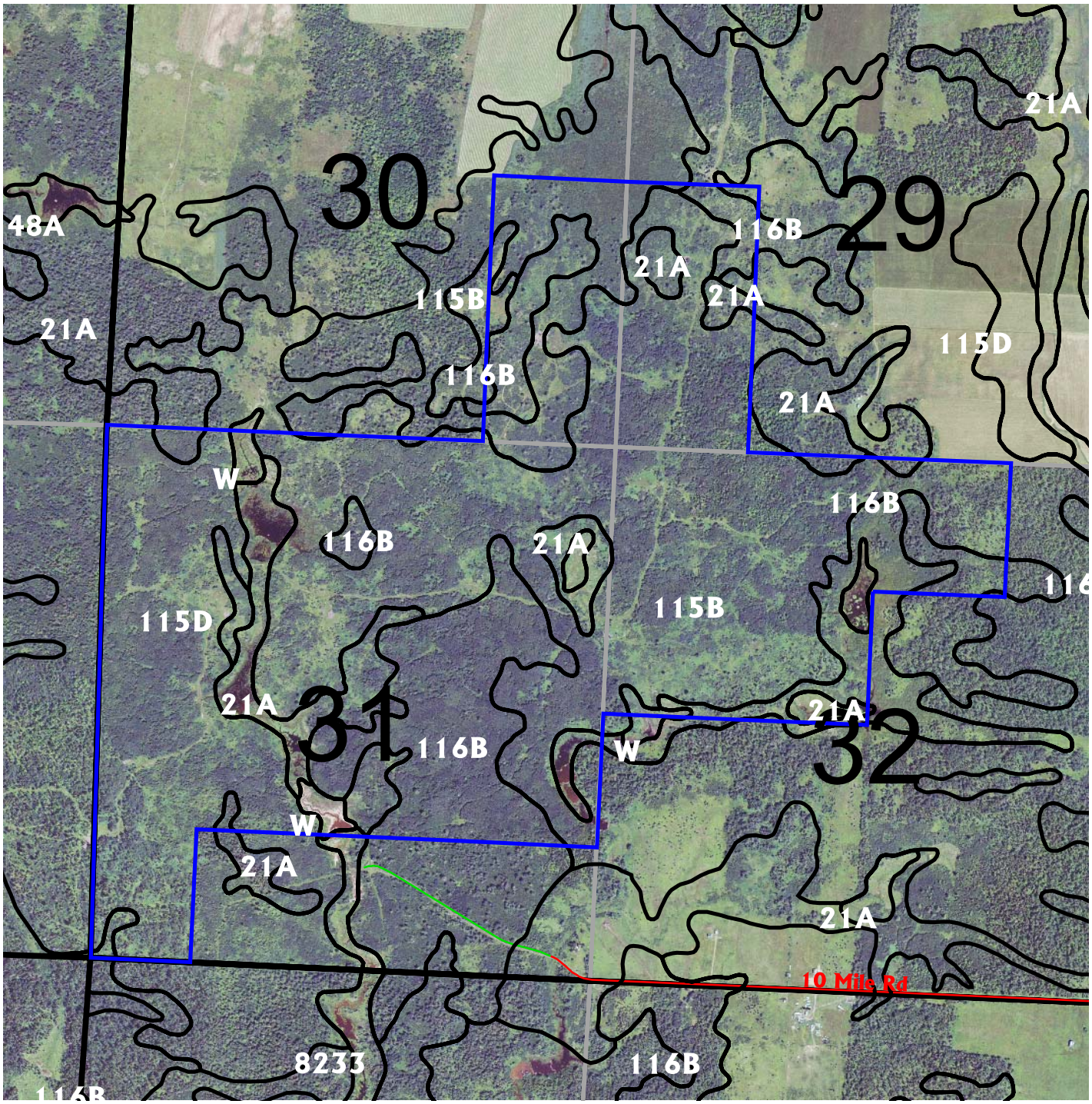
- MU 1: 2014-16 = 0 acres
- MU 2: 2016-18 = 0 acres
- MU 3: 2018-20 = 0 acres
- MU 4: 2020-22 = 0 acres
- MU 5: 2022-24 = 0 acres
- MU 6: 2024-26 = 0 acres
- MU 7: 2026-28 = 0 acres
- MU 8: 2034+ = 0 acres
- MU 9: NA = 840 acres

N

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY FOREST PROPERTY
Ewen Block Soils Overview
T. 48 N. - R. 40 W
Ontonagon County, Michigan



LEGEND

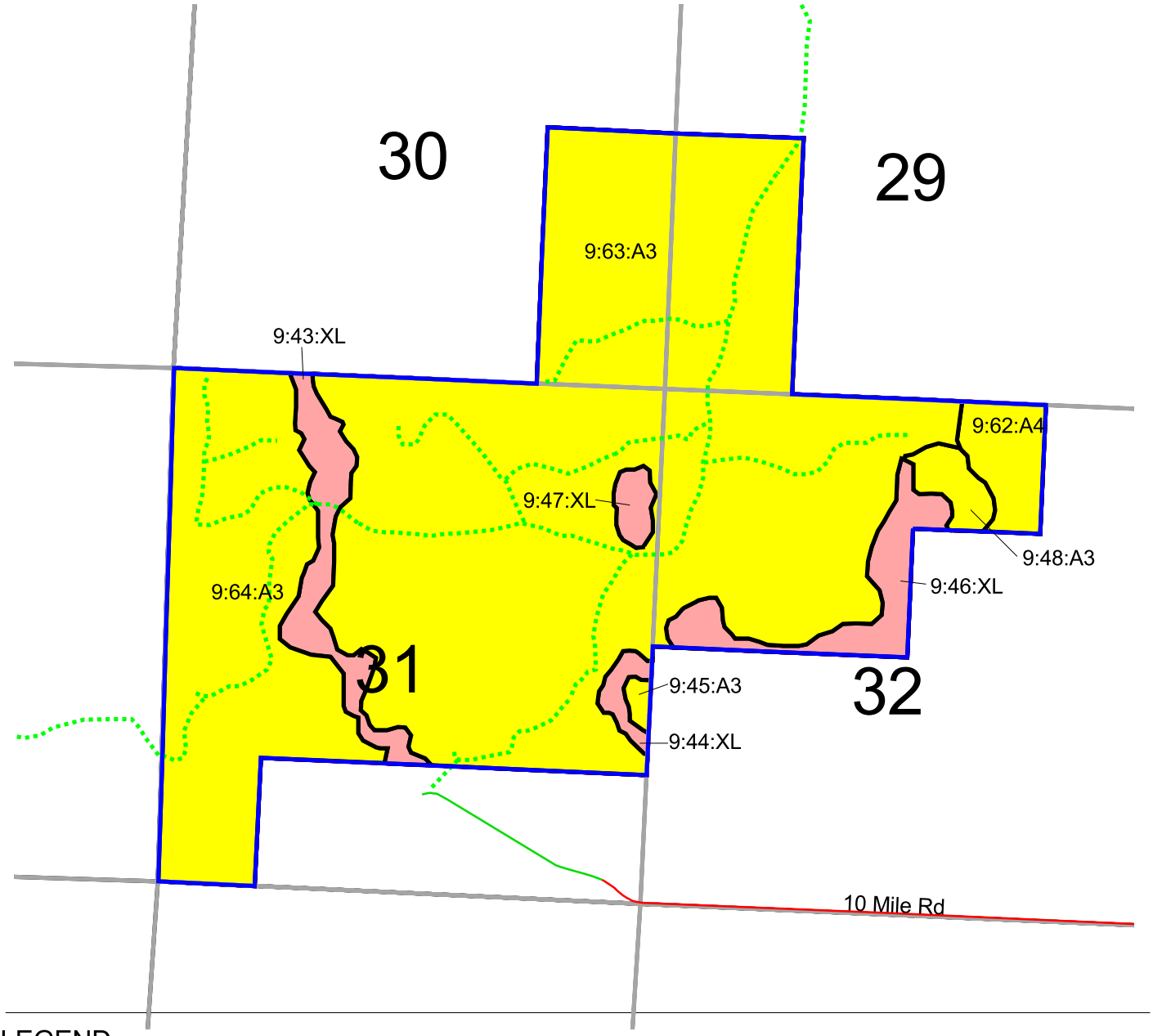
- Ontonagon County Property
- Soils Boundary
- Section
- Town / Range

N

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY FOREST PROPERTY
Ewen Block - Activities Map
T. 48 N. - R. 40 W
Ontonagon County, Michigan



LEGEND

- Property Boundary
- Town / Range
- Section
- Stand Boundary
- County Road
- Woods Road

Management Activities

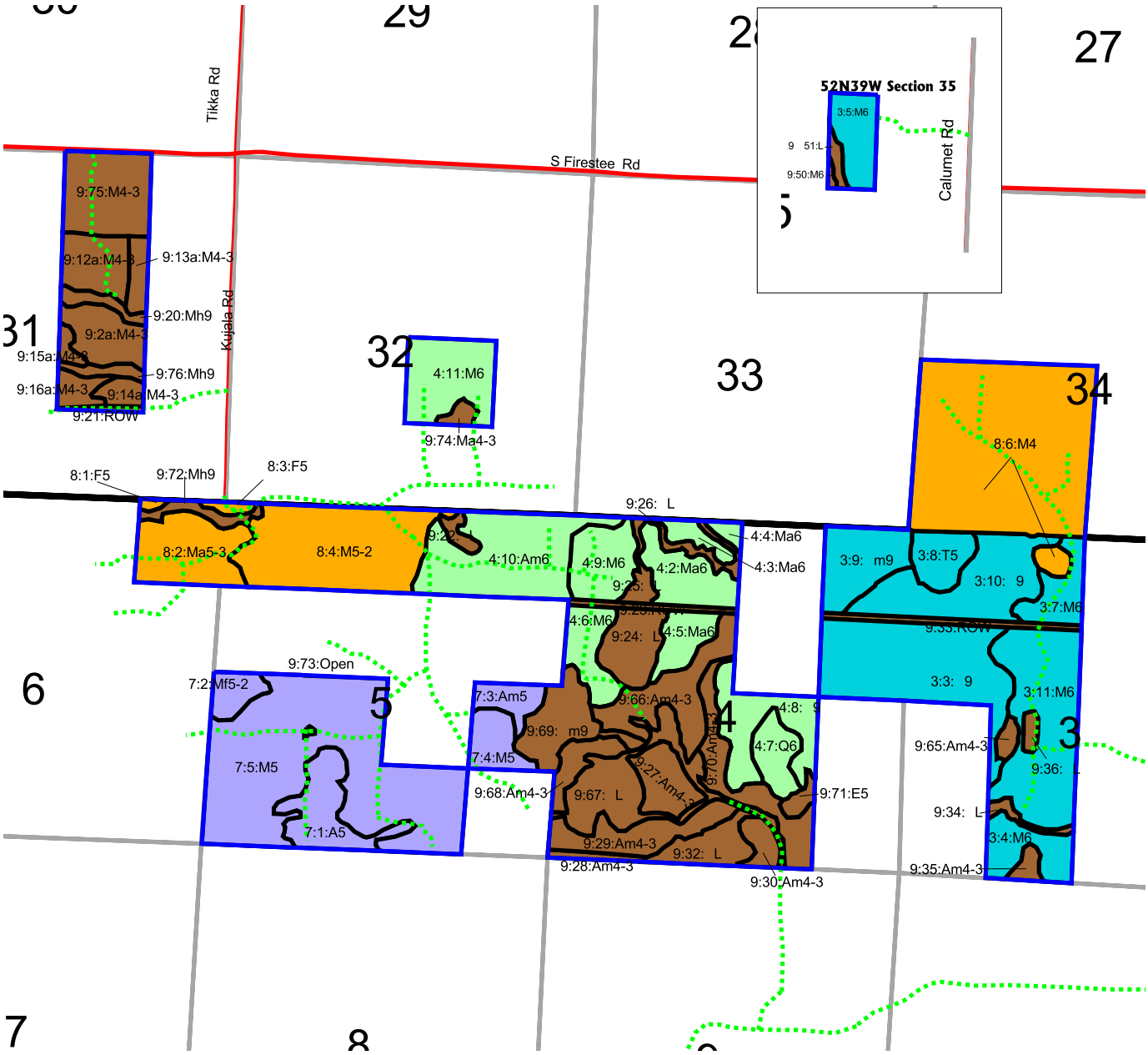
- ndividuaTree Selection (ITS) = 0 acres
- ITS/Patch Clearcut = 0 acres
- ITS/Species Removal = 0 acres
- Overstory Removal = 0 acres
- Clearcut = 768 acres
- Patch Clearcut = 0 acres
- Species Removal = 0 acres
- No Active Management = 72 acres

N

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY FOREST PROPERTY
Firesteel Road Block - Management Unit Map
T. 51&52 N. - R. 39 W
Ontonagon County, Michigan



LEGEND

- Property Boundary
- Town / Range
- Section
- Stand Boundary
- County Road
- Woods Road

N

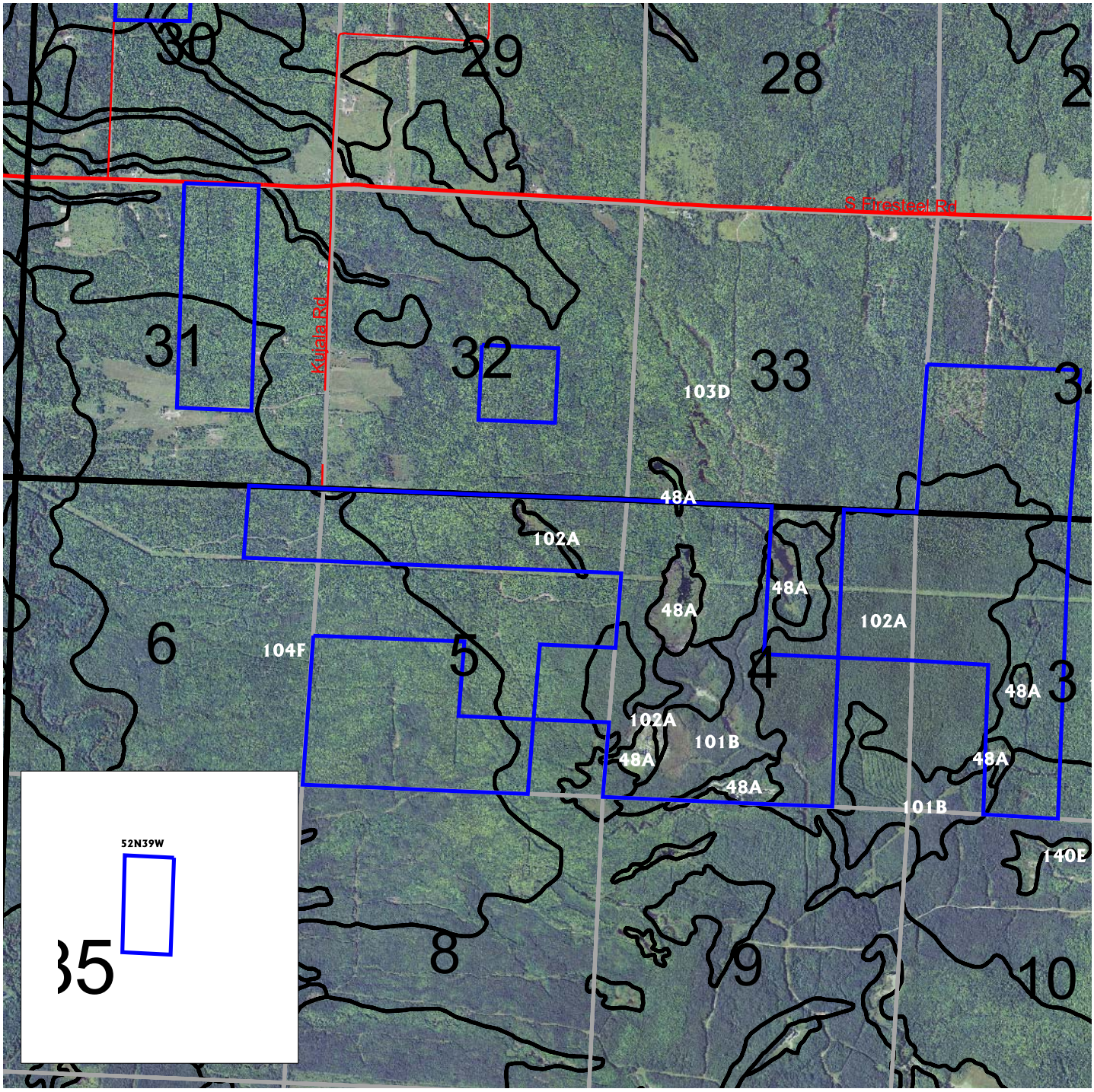
Management Unit Entry Years and Acres

- MU 1: 2014-16 = 0 acres
- MU 2: 2016-18 = 0 acres
- MU 3: 2018-20 = 310 acres
- MU 4: 2020-22 = 248 acres
- MU 5: 2022-24 = 0 acres
- MU 6: 2024-26 = 0 acres
- MU 7: 2026-28 = 228 acres
- MU 8: 2034+ = 290 acres
- MU 9: NA = 422 acres

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY FOREST PROPERTY
Firesteel Road Block Soils Overview
T. 51&52 N. - R. 39 W
Ontonagon County, Michigan



LEGEND

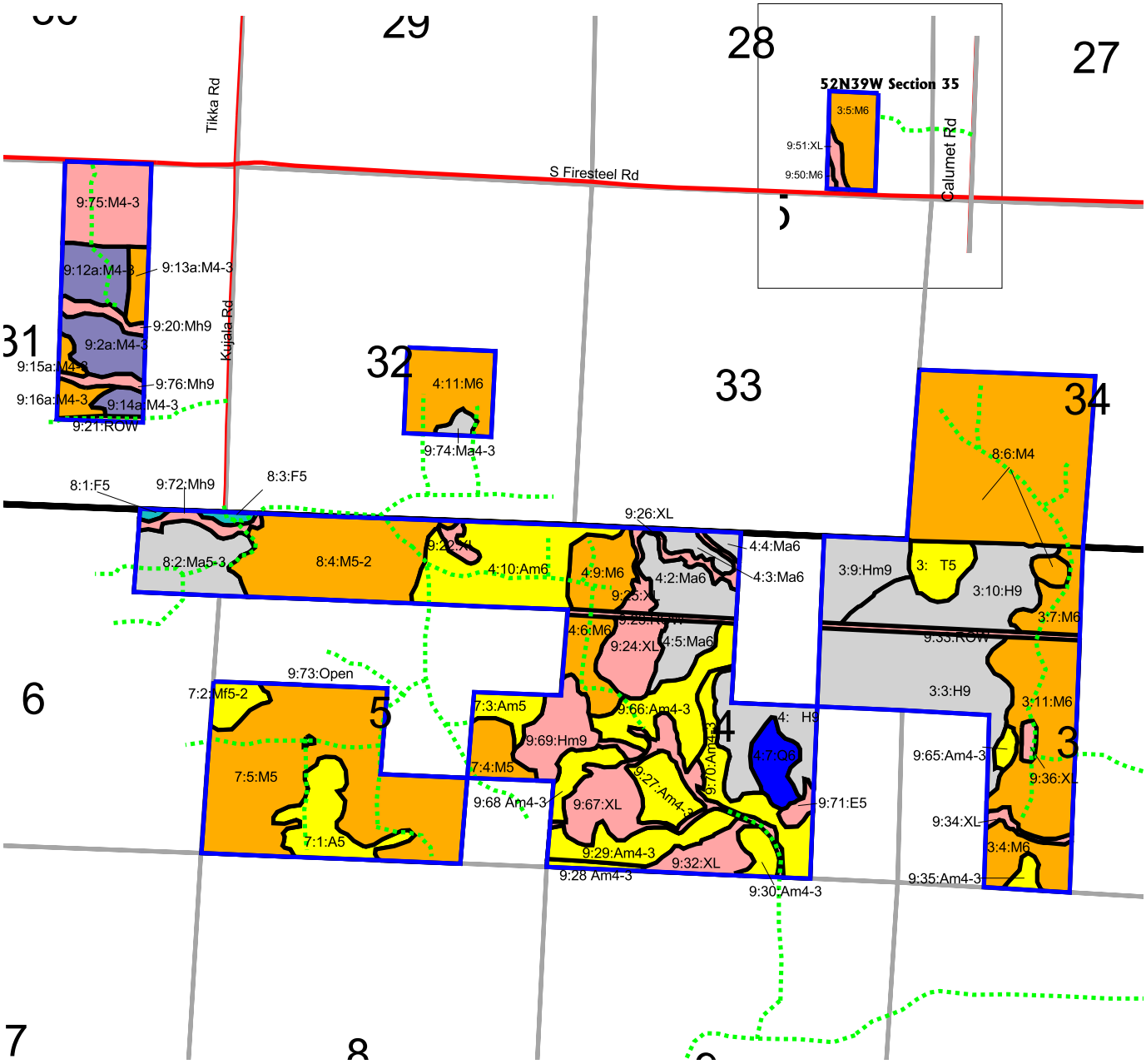
- Ontonagon County Property
- Soils Boundary
- Section
- Town / Range

N

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY FOREST PROPERTY
Firesteel Road Block - Activities Map
T. 51&52 N. - R. 39 W
Ontonagon County, Michigan



LEGEND

- Property Boundary
- Town / Range
- Section
- Stand Boundary
- County Road
- Woods Road

s

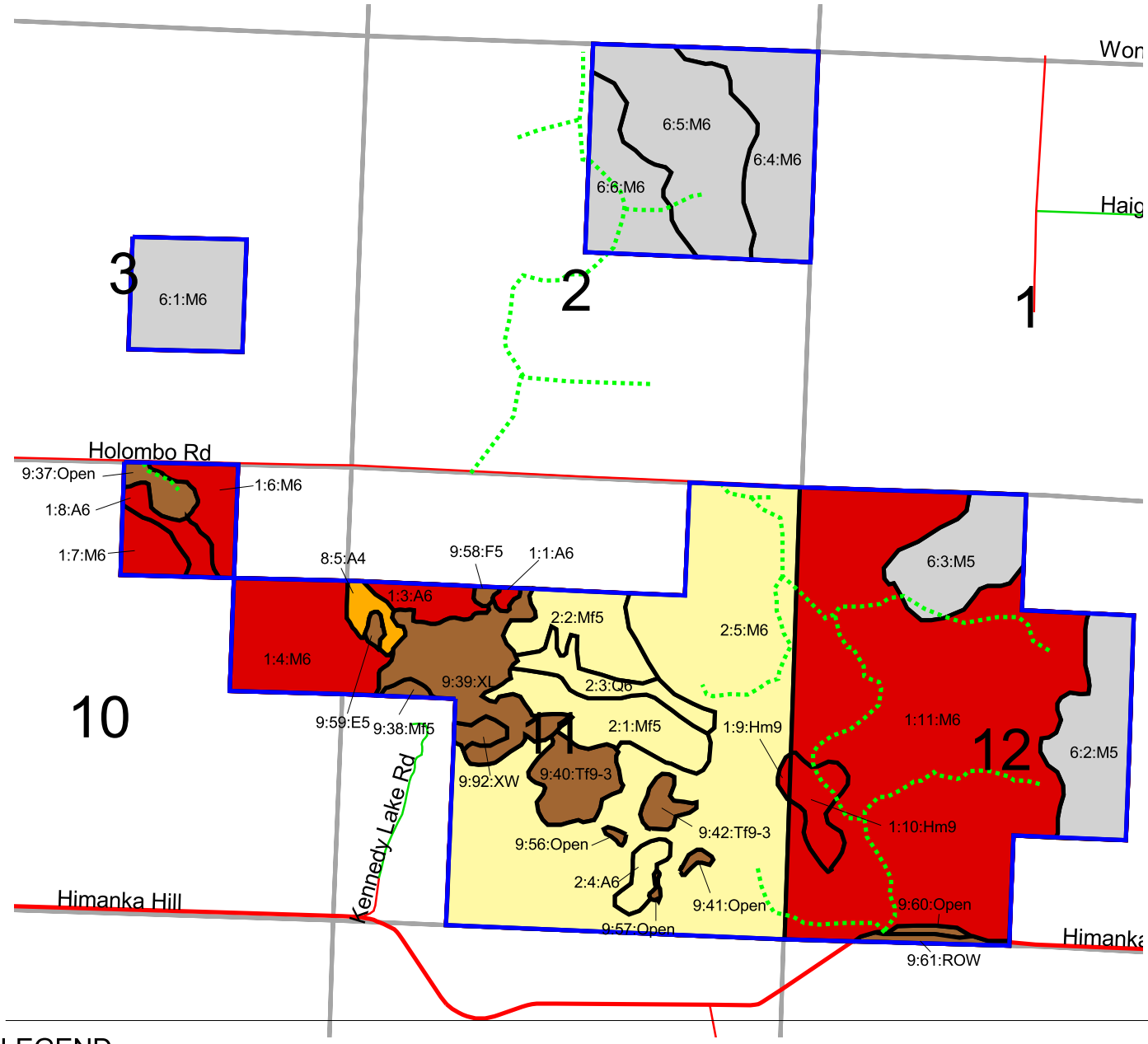
- Individual Tree Selection (ITS) = 653 acres
- ITS/Patch Clearcut = 0 acres
- ITS/Species Removal = 291 acres
- Overstory Removal = 49 acres
- Clearcut = 274 acres
- Patch Clearcut = 16 acres
- Species Removal = 4 acres
- No Active Management = 212 acres

N

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY FOREST PROPERTY
Himanka Hill Block Management Unit Map
T. 47 N. - R. 39 W
Ontonagon County, Michigan



LEGEND

- Property Boundary
- Town / Range
- Section
- Stand Boundary
- County Road
- Woods Road

N

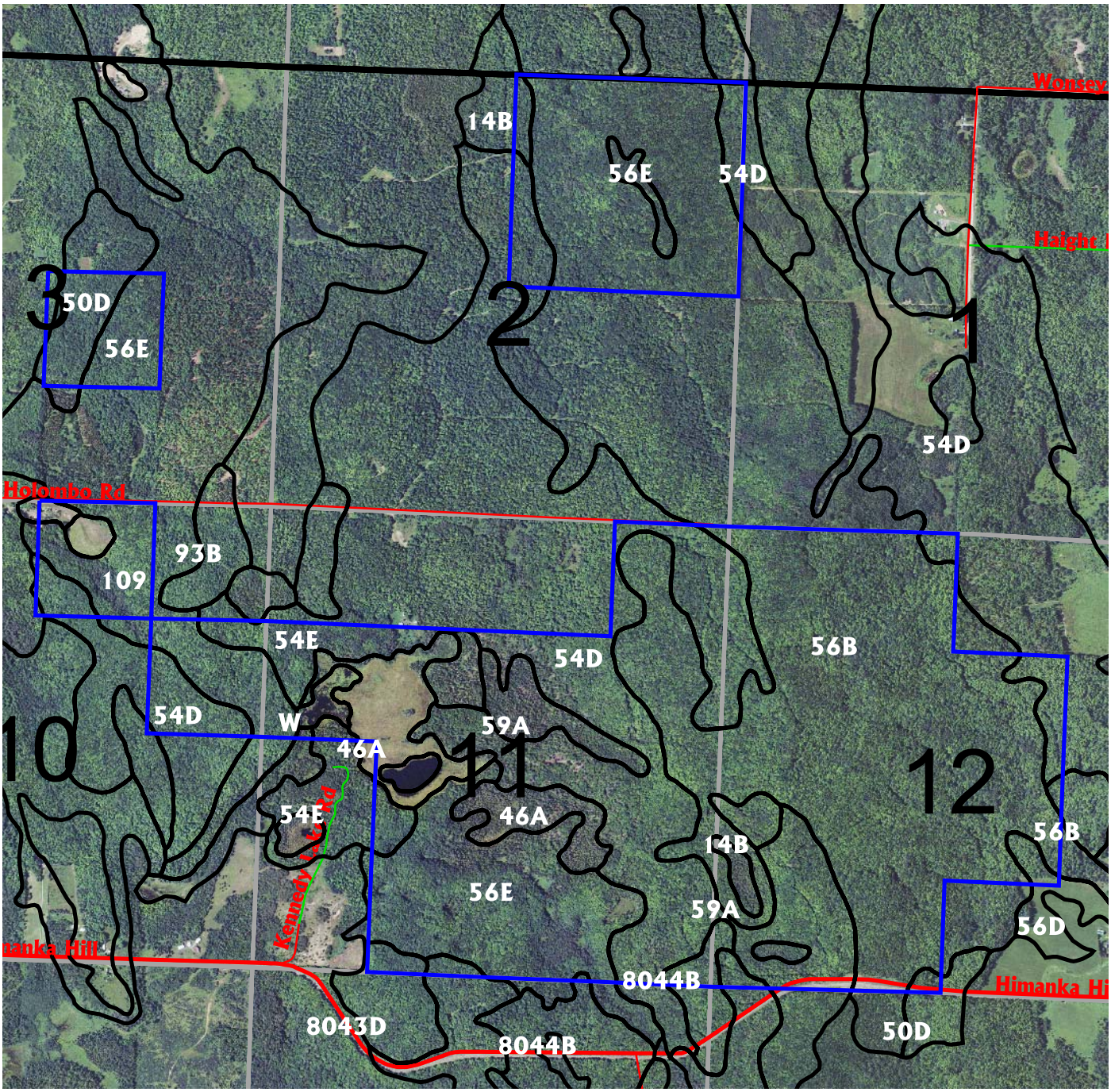
Management Unit Entry Years and Acres

- MU 1: 2014-16 = 407 acres
- MU 2: 2016-18 = 336 acres
- MU 3: 2018-20 = 0 acres
- MU 4: 2020-22 = 0 acres
- MU 5: 2022-24 = 0 acres
- MU 6: 2024-26 = 268 acres
- MU 7: 2026-28 = 0 acres
- MU 8: 2034+ = 6 acres
- MU 9: NA = 89 acres

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY FOREST PROPERTY
Himanka Hill Block Soils Overview
T. 47 N. - R. 39 W
Ontonagon County, Michigan



LEGEND

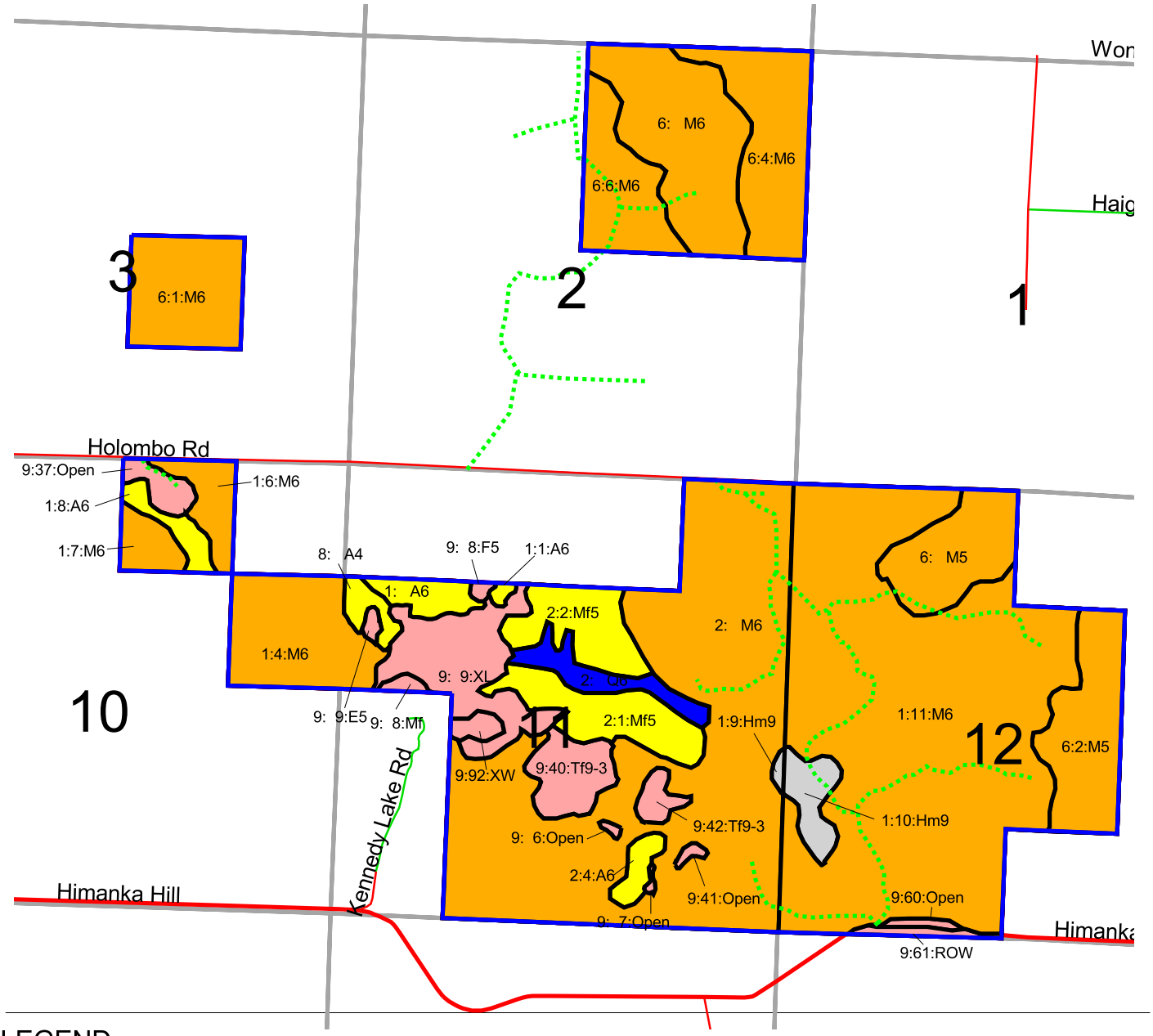
- Ontonagon County Property
- Soils Boundary
- Section
- Town / Range

N

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY PROPERTY
Himanka Hil Block - Activities Map
T. 47 N. - R. 9 W
Ontonagon County, Michigan



LEGEND

- Property Boundary
- Town / Range
- Section
- Stand Boundary
- County Road
- Woods Road

s

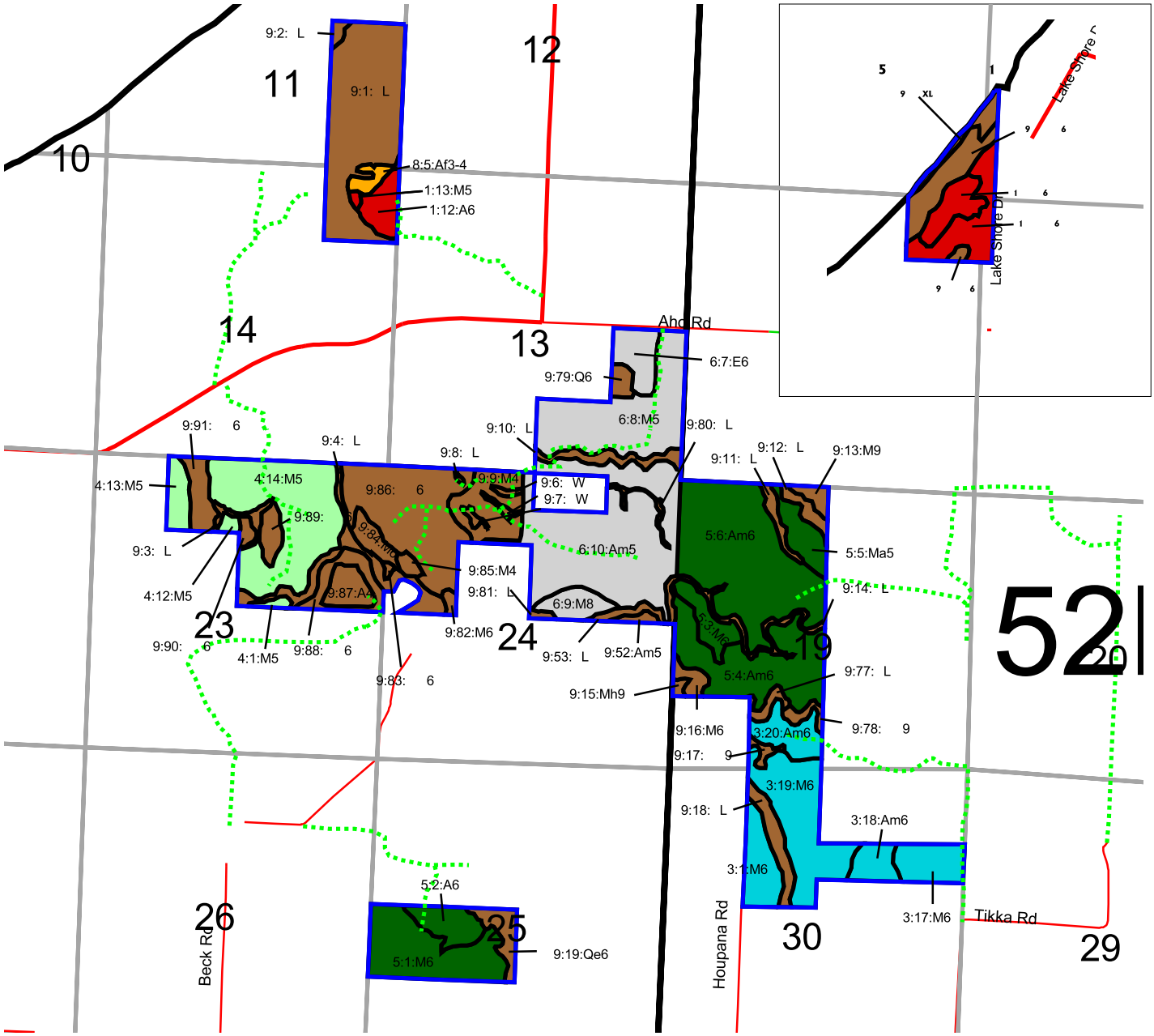
- Individual Tree Selection (ITS) = 948 acres
- ITS/Patch Clearcut = 0 acres
- ITS/Species Removal = 14 acres
- Overstory Removal = 0 acres
- Clearcut = 42 acres
- Patch Clearcut = 14 acres
- Species Removal = 0 acres
- No Active Management = 89 acres

N

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY FOREST PROPERTY
Lakeshore Block Management Unit Map
T. 52 N. - R. 38 & 39 W
Ontonagon County, Michigan



LEGEND

- Property Boundary
- Town / Range
- Section
- Stand Boundary
- County Road
- Woods Road

N

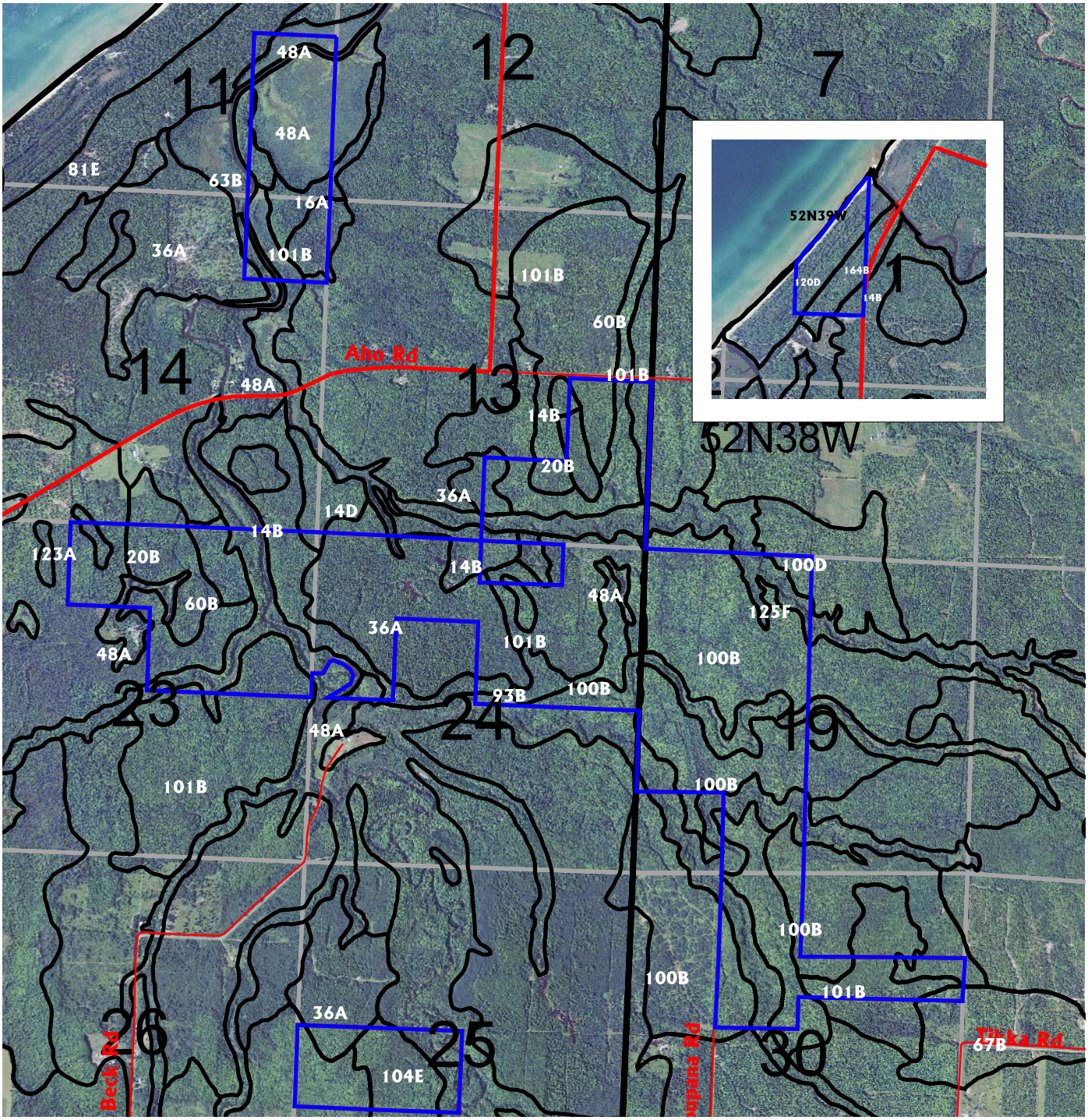
Management Unit Entry Years and Acres

- MU 1: 2014-16 = 47 acres
- MU 2: 2016-18 = 0 acres
- MU 3: 2018-20 = 129 acres
- MU 4: 2020-22 = 104 acres
- MU 5: 2022-24 = 278 acres
- MU 6: 2024-26 = 237 acres
- MU 7: 2026-28 = 0 acres
- MU 8: 2034+ = 6 acres
- MU 9: NA = 424 acres

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY FOREST PROPERTY
Lakeshore Drive Block Soils Overview
T. 52 N. - R. 38 & 39 W
Ontonagon County, Michigan



LEGEND

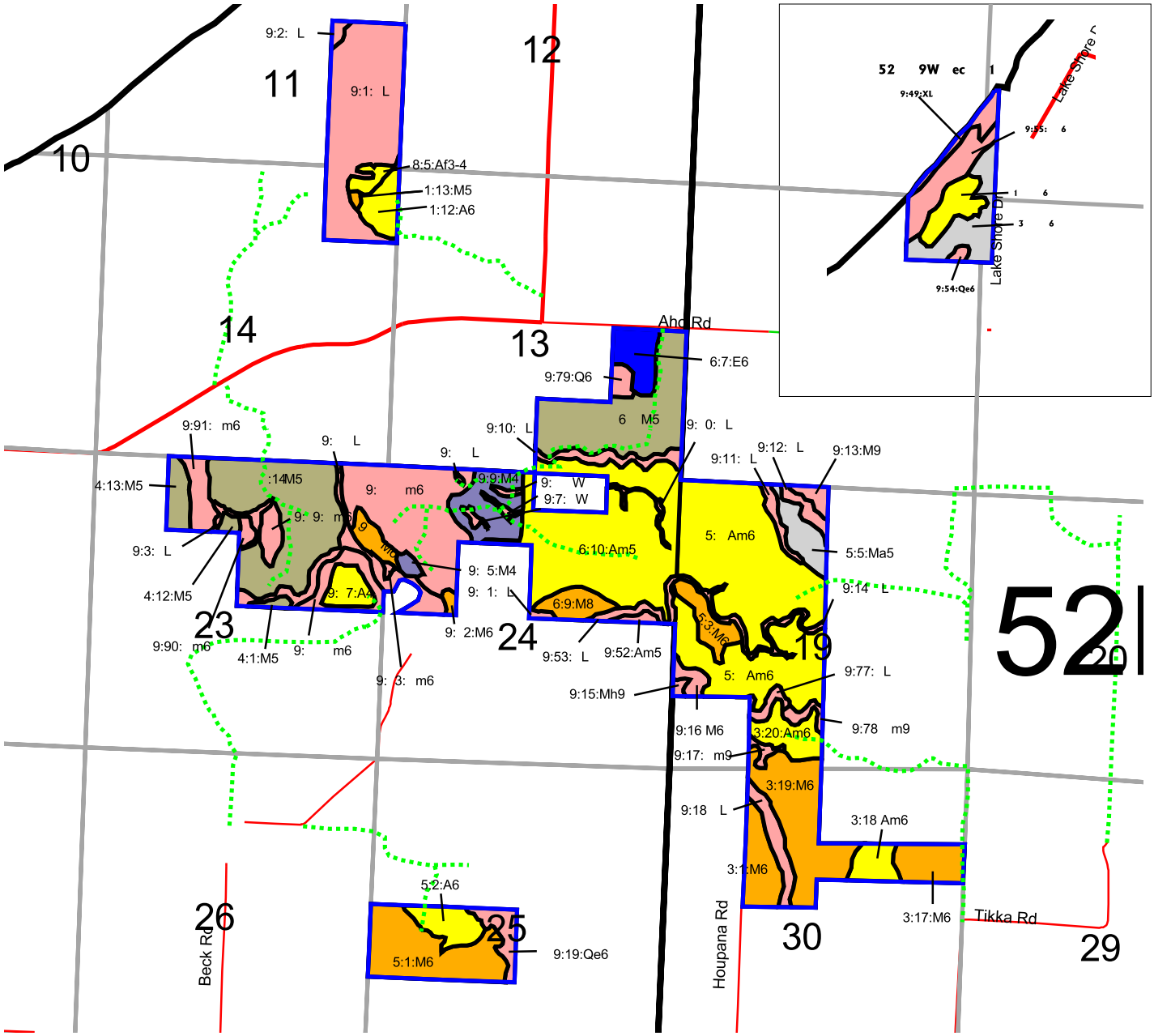
- Ontonagon County Property
- Soil Boundary
- Section
- Town / Range

N

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.

ONTONAGON COUNTY FOREST PROPERTY
Lakeshore Block Activities Map
T. 52 N. - R. 38 & 39 W
Ontonagon County, Michigan



LEGEND

- Property Boundary
- Town / Range
- Section
- Stand Boundary
- County Road
- Woods Road

S

- Individual Tree Selection (ITS) = 191 acres
- ITS/Patch Clearcut = 177 acres
- ITS/Species Removal = 36 acres
- Overstory Removal = 30 acres
- Clearcut = 01 acres
- Patch Clearcut = 17 acres
- Species Removal = 0 acres
- No Active Management = 371 acres

N

660 0 660 1320 Feet

Green Timber Consulting Foresters, Inc.