Marquette County Forest Management Plan

Approved by the Marquette County Forestry Commission April 5, 2017

Abstract

The Marquette County Forestry Commission manages forest resources on County owned lands. Their primary guidance to accomplish this task is the Forest Management Plan. This document is the latest in a series of management plans dating back to the 1950s, exemplifying commitment to scientific management of forest resources by the County.

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Executive Summary

The Marquette County Forestry Commission manages forest resources on County owned lands. Their primary guidance to accomplish this task is the Forest Management Plan. This document is the latest in a series of management plans dating back to the 1950s, exemplifying commitment to scientific management of forest resources by the County.

The most significant forested property the county owns is the County Forest. The forest is comprised of approximately 9,300 acres in Sands and Forsyth Township near Sawyer. The County Forest is managed for multi-use. A variety of management prescriptions are used to govern the manner in which individual tracts of land are used. These prescriptions range from intensive forestry efforts such as plantations where the focus is primarily growing trees much like a crop to areas that are preserved for fish and wildlife habitat.

Most of the County Forest is an outwash plain created by the retreat of the last glacier that covered this area. The sandy soil left behind is a poor habitat for most tree species but well suited for jack pine. As a result, 72% of the tree cover in the forest is jack pine.

Jack pine grows best in even aged stands in full sunlight reaching maturity in about 50 years. Mother Nature maintains this condition primarily by fire which eliminates the old stand and facilitates germination of seeds and establishment of a young vigorous stand. Man has interceded in this process by clearcut harvests and reforestation creating the ability to approximate this cycle and use the timber resource. In the County Forest, jack pine stands are clearcut when mature and seedlings are planted the following year.

A smaller component of County forestry is the growing of red pine where sites are suitable. Red pine can be managed in plantations and is a longer lived species offering incremental thinning cuts before a final harvest takes place. These harvests can be spread over a 100 years or more. Benefits of growing red pine include aesthetics (fewer clear cuts), higher resistance to insects and disease, diversification of wildlife habitat, and an ability to generate more revenue over time on a given site versus jack pine.

An abundance of recreational opportunities exist on County forestlands. Activities include hiking, horseback riding, biking, cross country skiing, snowshoeing, snowmobiling, ORV riding, fishing, hunting, canoeing, kayaking, swimming, picnicking, berry picking, bird watching (including the endangered Kirtland's warbler), and camping.

The ability to generate revenue through sale of timber on the County Forest is extremely important. Sale proceeds are deposited in the Forest Recreation Fund and used for reforestation, wildlife enhancement projects, and recreation-related activities. County sponsored recreation extends beyond the Forest boundary and includes Perkins Park Campground, Big Bay Harbor of Refuge, Little Trout Lake and Sugarloaf Mountain Natural Area. The Forest Recreation Fund supplements operational shortfalls at these sites as well as provides local matching funds for state and federal grants for capital improvement projects at these locations.

The greatest challenge in managing the County Forest results from most of the jack pine being of similar age. Ideally, with a 50 year "crop" like jack pine, 1/50th of the trees should be mature for harvest annually. This concept is called area regulation. This is a goal which will take decades to achieve in the County Forest.

Since area regulation has not been attained there will be a period of time in which little if any mature jack pine are available to harvest. That period of time is expected to be approximately 15 years and begins now. Thinnings of red pine plantations and other species will generate smaller amounts of revenue during the next decade and a half. During this period, it will be necessary to fund County recreation facilities from revenue they generate and from reserves of the County Forestry Fund. Aware of this approaching period, staff have been implementing strategies to increase revenue and decrease expenditures at the county recreation facilities as well as identify new harvest opportunities within the forest through the completion of a partial forest inventory in 2015.

In anticipation of this period, the Forestry Commission implemented measures to minimize the impact of reduced timber sale revenue such as additional timber sales through red pine thinnings and the implementation of the 2015 inventory. These measures coupled with recent high sales prices have had a positive impact on the shrinking Fund balance. Additional efforts to reduce expenditures and increase revenue of the County's recreational facilities will continue to be implemented.

Successful management of the County Forest provides many benefits to residents and visitors of Marquette County. Many hours of enjoyment are derived from recreational pursuits on these lands and at other facilities these lands support. Additionally, the economy of the County benefits from the jobs created by the forest industry and spin off employment that results.

This Plan provides the guidance necessary for decision making regarding the County Forest now and into the future, specifically through the year 2039.

INTRODUCTION

The forest products industry, and related forest-based tourism and recreation, contributes over 150,000 jobs and $12 billion annually to the State's economy[1]. Marquette County forest resources and businesses contribute to this total. Census Bureau 2014 County Business Patterns data indicates there are 14 logging companies and 2 sawmills in the County[2]. Add to that the wood manufacturing businesses (furniture, trusses, flooring), transportation (trucking, railroad), and retail businesses that sell products made with wood and the local significance of the industry becomes more apparent.

Management of the County Forest has been carried on, in some form, for over 65 years. The entity currently charged with this responsibility is the Marquette County Forestry Commission. The Forestry Commission was created by resolution of the Marquette County Board of Commissioners on November 1, 1994. It is a sub-committee of the Marquette County Planning Commission and consists of three members. Concurrent with this appointment, the Forest Recreation Fund was created within the County budget. Revenues generated from timber sales as-well-as money derived from fees at Perkins Park Campground and the Big Bay Harbor of Refuge are combined to finance forest management operations and support County-owned recreation facilities.

This effort reflects over 60 years of scientific management of the County Forest. John J. Barnaks performed a forest inventory in 1954 which provided the basis for planning sustainable forest resources from this land. The 2011 Forest Management Plan, and subsequent 2016 update, though broader in scope and supporting a multiple use forest principle, carries on the tradition and responsibility for utilizing while preserving this public resource.

The primary focus of this Plan is the land commonly known as the County Forest. The County Forest is comprised of approximately 9,300 acres in Sands and Forsyth Townships 15 miles south of the City of Marquette in the proximity of Sawyer. This area is managed as a multi-use forest producing forest products and providing recreational opportunities for residents and visitors.

This document will provide valuable assistance for future decision making regarding County owned forest lands.

PURPOSE

The purpose of this Plan is to provide a framework for decision making in order to help County Forest lands yield sustainable levels of commodities and amenities, in a multi-use environment while maintaining the quality of the resource into the future.

AUTHORITY

Authority for development of this Plan is granted pursuant to Section 7 of the Michigan Planning Enabling Act (P.A. 33 of 2008) and Part 527, Municipal Forests, of Public Act 451 of 1994, the Natural Resources and Environmental Protection Act.

MISSION STATEMENT

The Marquette County Forest consists of a variety of natural resources that provide for the social, economic, and ecological needs of present and future generations. The mission of Marquette County, through the actions of the Marquette County Forestry Commission, is to manage and protect these resources on a sustainable basis while maximizing public benefit from these lands.

[1] http://michiganforest.com/resources/economic-overview

[2] http://censtats.census.gov/cbpnaic/cbpnaic.shtml

DESCRIPTION OF COUNTY FOREST

PHYSICAL GEOGRAPHY

The Marquette County Forest begins approximately 15 miles south of the City of Marquette and in close proximity to the community of Sawyer. It occupies portions of both Forsyth and Sands Townships and includes almost 9,300 acres.

GEOLOGY AND SOILS

Bedrock in the location of the County Forest is from the Paleozoic Era and is typically undifferentiated Cambrian formations. These Cambrian deposits are varieties of sandstones.

Surficial geology is the area of unconsolidated soil and rock materials that lie above the bedrock. It is believed that glaciers passed over this region as many as four times scouring away most of the loose surface material. As the glaciers retreated, the water released by the melting resulted in an outwash plain of stratified sand and gravel.

The County Forest consists primarily of an outwash plain of sandy soils resulting from early glacial activity. Significant areas of Grayling and Rubicon sand are present. These soils are known for their rapid permeability and low capacity for water retention. These droughty soils are well suited for jack pine. Other areas of the forest are influenced by a shallow depth to bedrock or rock outcroppings. These areas have soils with higher gravel content and forest cover tends to be red or white pine. The East Branch of the Escanaba River runs through the western portion of the forest depositing and mixing soils providing opportunities for even greater forest diversity.

TOPOGRAPHY

A large portion of the County Forest is in an area locally known as the Sands Plains. The term plain typically refers to a flat, treeless expanse. Though perhaps accurate when originally named, the area is now completely forested. The topographic component of the definition remains accurate though with a change of only about 40 feet over the distance of 5 or 6 miles. Some sections have only one contour line on a 10 foot increment scale. Altitude in the forest ranges from a maximum of 1,212 feet to a low of 1,072 feet. Most of the deviation from a flat landscape are the result of hydrologic forces such as the East Branch of the Escanaba River and several creeks and streams.

CLIMATE

Marquette County is classified as a humid continental climate. This classification is known for its large seasonal temperature differences. The mean annual temperature is 39.975 degrees Fahrenheit (Fº). The warmest months are July and August with mean monthly temperatures of 65.5 ºF and 63.7 ºF respectively. The record high temperature was 108ºF recorded in 1901. The record low was -49ºF in February of 1899.

Climate normals recorded from 1981-2010 at the NWS Marquette show that annual precipitation averages 35.67 inches. While average annual snowfall (snow, sleet, hail) is 204 inches. A record snowfall in the winter of 2001-2002 deposited 319.8 inches of snow, almost 27 feet. Distribution of precipitation throughout the county is affected by proximity to Lake Superior and elevation.

BIOLOGICAL COMMUNITY

In the recent past, 50 years or so, much of the county forest would fall into the biological community know as Pine Barrens. This community is generally found in cooler climates in the Great Lakes region. Pine Barrens are found on outwash plains, sand lake plains, and sandy riverine terraces. Topography is typically flat or gently rolling with long expanses capable of carrying wildfires with few natural fire breaks. The soils of this community are sandy, acidic, droughty, and relatively infertile.

The natural process by which these barrens are perpetuated, principally fire, maintain open areas by limiting long-term growth of woody species. The natural process is impacted by man through fire suppression and reforestation efforts, consistent with how the County Forest is managed. County forest lands now more closely resemble a jack pine forest community.

FLORA

The county forest is dominated by jack pine. There are numerous plants and trees that are associated with a jack pine ecosystem, listed in Table 1. Fire is a common natural occurrence in these areas and thus so is open areas and few large or old trees. Through human intervention, there are fewer fires, but, open areas are still prevalent as a result of timber harvests.

Though jack pine is the predominant cover type, the remainder of the county forest is made up of a variety of tree species. Forest inventories have identified the following tree species: aspen, balsam fir, red pine, spruce, tamarack, white birch, and white pine.

Table 1 Jack Pine Ecosystem Flora

Trees	Other Plants	
Aspen	Alleghany Plum	Hoary Puccoon
Black Cherry	Big Bluestem	Lichens
Jack Pine	Blueberry	Little Bluestem
Oak	Bracken Fern	Pale Agoseris
Red Pine	Harebells	Rough Fescue
White Birch	Hill's Thistle	Stinkhorn Fungas
		Sweet Fern

Source: RM/D and MDNR

FAUNA

The presence of the Escanaba River and some inland waterbodies produce areas of other habitat. Animals may also take advantage of their mobility and use several habitats as availability of food, water, and shelter may vary on a seasonal basis. The primary characteristics related to the emergence of a particular habitat are soil type and availability of water. These factors determine the plant life that will emerge followed by the animals that depend on them. Table 2 lists animals expected to inhabit the county forest.

Of particular note is the presence of Kirtland's warbler. Kirtland's warblers were once only known to nest in Michigan. As populations have grown and dispersed, recent surveys have found small populations in Wisconsin and Ontario. The Kirtland's warbler is federally listed as an endangered species. The 2015 census results estimates a population of 2,365 singing males, up from 1,733 in 2010[3].

The warblers are ground nesters and select trees from 5 to 20 feet high with live branches reaching the ground. These young jack pine stands were once typically produced by fire. Trees growing in burned areas are often more densely stocked with intermittent open patches which the birds prefer. In 2009, partnering with the U.S. Fish and Wildlife Service, the County developed a site of approximately 75 acres as wildlife habitat specifically designed for Kirtland warblers.

Table 2 County Forest Fauna

Beaver	Pine Snake
Black Bear	Porcupine
Black-Backed Woodpecker	Raven
Bluebird	Red-headed Woodpecker
Blue jay	Red Squirrel
Brown headed Cowbird	Red-tailed hawk
Canadian Jay	Ruffed Grouse
Chick-a-dee	Skunk
Coyote	Snowshoe Hare
Crow	Spruce Grouse
Eastern Chipmunk	Upland sandpiper
Fritillary	White-tailed deer
Garter Snake	Woodcock
Green Snake	
Kirtland's Warbler	

Source: RM/D

[3] https://www.fws.gov/midwest/endangered/birds/Kirtland/Kwpop.html

LAND OWNERSHIP

Excluding right of ways, the Marquette County Forest consists of 9,297 acres located in Forsyth and Sands Townships. The county holds title to this land under the three mechanisms: fee simple, PA 223, and PA 217.

Table 3 Land Ownership

TYPE	ACRES	% OF FOREST
Fee Simple	3,516	**38%**
PA 223	296	**3%**
PA217	5,485	**59%**
Total	**9,297**	**100%**

Source: RM/D

FEE SIMPLE

Approximately 3,516 acres (38%) of county forestland is held by the County Board in fee simple. Generally, this means the county has absolute possession. There may be exceptions where easements have been granted or other limitations such as reservation of mineral rights by other parties have occurred.

PA 223 LANDS

Public Act 223 of 1909 provided a mechanism whereby the State of Michigan could transfer "surplus" tax reverted land to local units of government. The county holds 296 acres within the County Forest. This comprises 3% of forest holdings. A reverter clause is contained within the deeds that if the property is no longer used for public purpose it will be returned to the State.

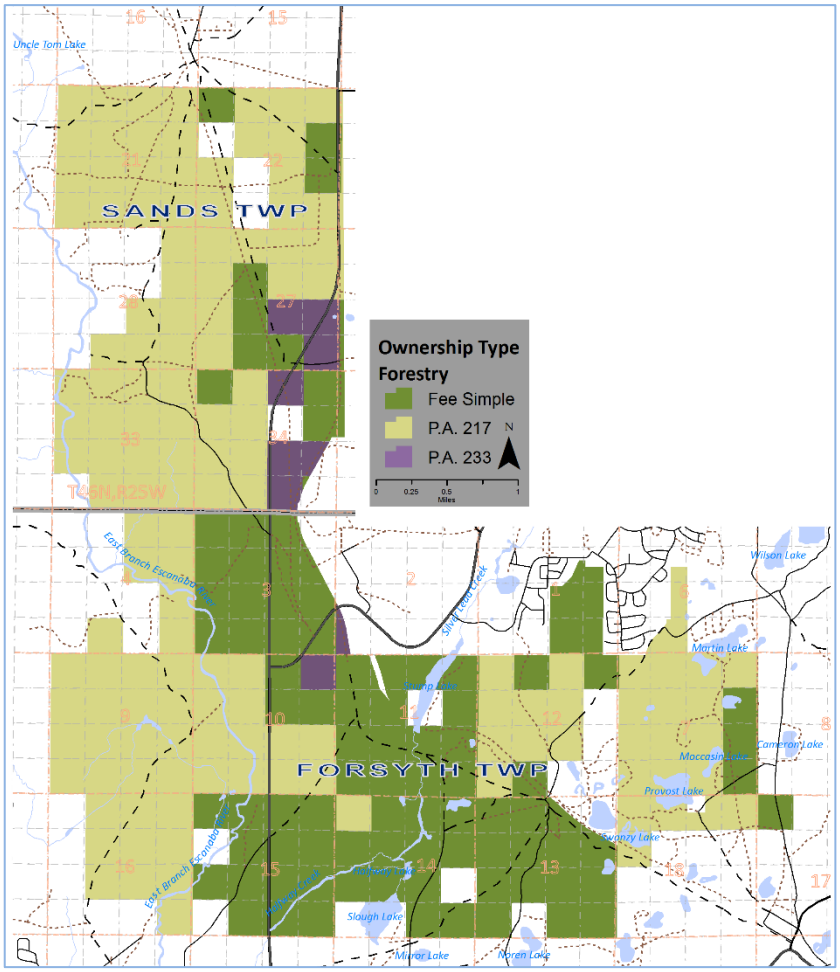


Figure 1 Land Ownership

PA 217 LANDS

Public Act 217 of 1931, the Municipal Forest Act, provided the source by which most county forest land was obtained. Approximately 5,485 acres or 59% of the forest came from this source. Act 217 has since been recodified under the Natural Resources and Environmental Protection Act, Act 451 of 1994, Part 527 Municipal Forests. This property contains a reverter requiring it to be returned to the State if it is no longer used for forestry purposes. The Act not only provided land but also the statutory authority for a municipality, in this case the County, to appoint a forestry commission to manage forest properties. A stipulation of the Act also requires that the forestry commission, townships and school districts in which the forest lies by agreement shall determine a formula under which the forestry commission makes payments to the townships and school districts in lieu of general property taxes which would otherwise be levied against the land and forests comprising the municipal forest.

The Forestry Commission maintains an interest in acquiring additional forestlands. The primary mission related to land acquisition is to acquire private holdings that are within the county forest boundary and also acquire lands immediately adjacent to the forest as they become available.

ROAD NETWORK

The county forest can be accessed from numerous roads. Figure 2 is a map of the road network within and adjacent to the county forest. The most prominent road feature is M-553, a state trunkline that divides the forest into east and west components of approximately 4,160 and 5,140 acres respectively. This is a class A all season road; a feature that makes county forest timber sales attractive to bidders because no spring weight restrictions are placed on this road class. Weight restrictions (60% of axel weight) are placed on roads typically anywhere from mid-March to mid-May resulting in a period of no hauling or hauling of reduced loads. State Highway M-94 cuts through a small portion of the county forest providing only limited access to county properties.

A network of county local roads are used to access areas of the forest. With exception to a few, most of these roads are considered seasonal and are not plowed in the winter. Roads that are not classified likely developed as access to harvest areas or recreation spots. The road network is also used extensively by all-terrain vehicles and snowmobiles.

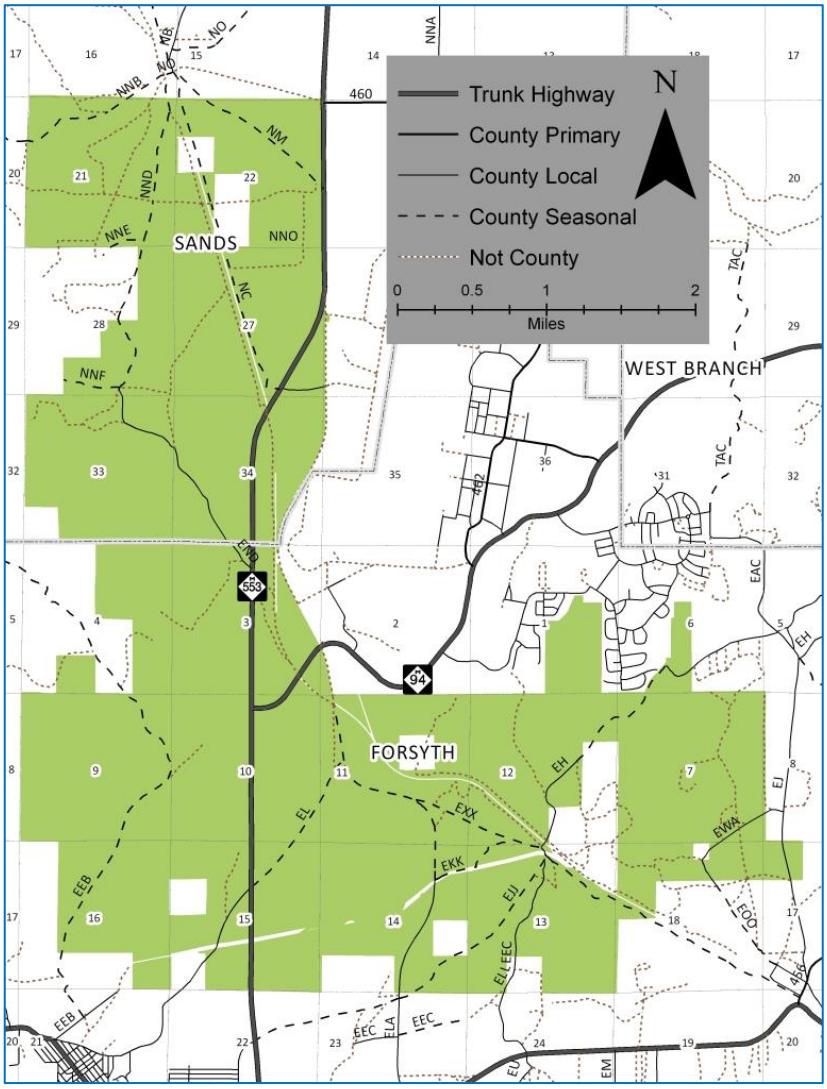


Figure 2 Road Network

Table 4 County Forest Road System

Road Name	Type	Length
Co Rd NNB	Seasonal	0.78
Co Rd NNE	Seasonal	0.23
Co Rd NNF	Seasonal	0.42
Co Rd	Seasonal	3.41
Co Rd NM	Seasonal	0.97
Co Rd NNO	Seasonal	0.51
Co Rd NC	Seasonal	1.62
Pohlman Dr	Seasonal	2.12
Southgate Dr	Year Round	0.55
Southgate Dr	Seasonal	1.08
Marshall Dr	Seasonal	2.30
Co Rd EKK	Seasonal	0.33
Co Rd EXX	Seasonal	0.88
Slough Lake Rd	Seasonal	1.21
Noren Lake Dr	Seasonal	0.03
Swanzy Lake Rd	Seasonal	0.77
Millyard Rd	Seasonal	0.84
Martin Lake Rd	Seasonal	1.48
Co Rd EOO	Seasonal	0.15
Provost Lake Rd	Year Round	0.45
Sporley Lake Dr	Year Round	0.26
M-94	Year Round	0.66
M-553	Year Round	6.06
Unnamed Roads	Seasonal	23.27
	TOTALS	
	Year Round	**7.98**
	Seasonal	**42.40**
	All	**50.38**

RECREATION IN THE FOREST

Recreation is an integral component of a multi-use forest. In addition to the timber resources, the County Forest is rich in recreational opportunities. Forest based recreation has been expanding rapidly and public demand requires opportunities for a wide variety of recreational types. Some forms of recreation utilize roads and trails, others water features such as rivers, streams, and lakes, still others the flora, fauna and scenery.

ROAD BASED RECREATION

The County Forest provides opportunity for ATVs and similar motorized recreation vehicles, including snowmobiles, with over 50 miles of roads. Roads are also used for hiking, biking and possibly horseback riding making it essential for mutual respect among varying recreational activities.

TRAILS

Trails can be classified as non-motorized or motorized. The County Forest has both, though none are specifically signed for one type of use versus another.

MOTORIZED

In addition to the road system there are two specific trails that run essentially north/south through the County Forest and a spur trail that accesses Sawyer (see Figure 3, page 9). The Hiawathaland Snowmobile Club has an annual license issued by the County to maintain a snowmobile trail through the Forest and to Sawyer. Another portion of trail, though not formally designated, runs parallel to M-553 and weaves in and out of the right-of-way partly on County property and partly on Michigan Department of Transportation land. This trail is used by snowmobiles and ATVs depending on the season.

ATVs have extended their range to areas that once were only foot trails such as along the East Branch of the Escanaba River. These areas will need to be monitored for possible negative effects such as erosion, damage to plants and trees, and water quality. Areas negatively impacted may be closed to motorized use.

NON-MOTORIZED

There are no designated non-motorized trails in the County Forest, but there are many informal trails used primarily by fishermen along rivers and streams. There is opportunity for trail development in the Forest. Forest management prescriptions and harvest schedules must be considered if and when trail development is initiated.

WATER BASED RECREATION

Water-related activities can be pursued at numerous locations in the forest. All these locations offer opportunities to fish while others can provide swimming and canoeing. One of the enhancements suggested in this Plan is development of a canoe/kayak put in site along the East Branch of the Escanaba River at a location yet to be determined. The area preferred would be in the most northerly portion of the Forest, perhaps in Section 20 of T46N – R25W of Sands Township. This location would provide a 6 or 7 mile float to Nordeen Park in Gwinn. The potential of fish stocking in that stretch of the river has been discussed with Michigan Department of Natural Resources and Environment personnel.

WILDLIFE RELATED ACTIVITIES

There is a variety of wildlife in the County Forest. Recreational activities relating to wildlife include bird watching, wildlife viewing, photography, and hunting. From a bird watching standpoint the Kirtland's warbler is the premier sighting. These birds are federally listed as endangered and nest primarily in the northern Lower Peninsula and the U.P. Singing males have been located each spring for a number of years in the County Forest.

Hunting opportunities are prevalent in the Forest. Big game includes deer and bear and small game includes rabbits, squirrels, ruffed grouse, woodcock, and ducks. Coyote and bobcat are potentially available. The Forestry Commission annually budgets funds for wildlife enhancement projects. Planting of wildlife corridors, establishment of fruit and mast producing trees, and the Kirtland's warbler habitat project mentioned previously in the Fauna section are examples of wildlife enhancement projects. Various timber management prescriptions also provide for habitat production and/or protection.

Aspen, a prime wildlife habitat, is maintained for diversity in a largely jack pine forest. Future projects will include seeding landing areas and closed roads after logging operations with plants favored by wildlife for forage.

FORAGING

Berry picking is a popular activity in late June and early August. Serviceberry, juneberry, sugarplum, blackberry, and raspberry are present but the most popular of the berries is the blueberry. Blueberries commonly occur in areas where fire has occurred. Since fire is a common occurrence in a jack pine forest there are many areas in the County Forest where berries flourish.

It has been suggested that controlled burning or mechanical preparation by mowing with a brush hog would enhance berry production and may be a future management consideration.

CAMPING

The County Forest provides an opportunity for camping. Currently, camping is allowed at no cost through a camp registration card/permit process, similar to that used by the State on their lands. Registration requires name, address and vehicle information. Camping is limited to a maximum of 15 days in one location. Registration cards are available by calling the Resource Management Department at 906-225-8198 or on the County website www.co.marquette.mi.us under Recreation and Development County Forest.

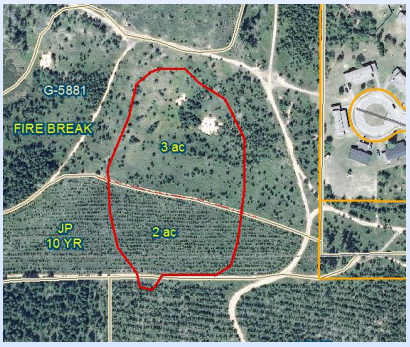
FOREST THREATS

A variety of natural and manmade threats face those tasked with scientific management of the County Forest. Natural threats include fire, insects, disease, invasive species, drought, and windstorms. Humans are also a source of fire, timber theft, and forest dumping.

FIRE

Fire is a part of the natural system. It is through fire that jack pine stands regenerate. Fire exposes mineral soils and the heat opens cones so seeds can be released. Man has interrupted this cycle by suppressing fires when they occur in order to protect people and property from their devastating effects. The end result of management, harvesting, and planting are as close as we can come to imitating the natural cycle.

Fire will always be a threat to the County Forest. Fires can be caused by natural occurrences such as lightning strikes but, by far, the biggest factor is man. Fires have started from trains traversing rail through the forest, motorists on M-553



In 2016, a 5-acre fire was started by an adolescent near a densely populated area. Two acres of 10-year old jack pine were destroyed. The remaining portion of the fire occurred in a fire break area, an area that is intentionally left open to serve as a buffer between a significant volume of fuel and housing.

Fire breaks were first constructed in 1997 on the south side of the Sawyer housing area. As fire traditionally travels from southwest to northeast in the County Forest, significant volumes of fuel were immediately adjacent (within feet) of the housing. It is important to maintain this fire break and to continue implementing mitigation measures.

and downed powerlines. Posing an even greater threat is the encroachment of residential structures on the perimeter of the forest and on private in-holdings. Extensive private development exacerbates the fire hazard to life, property, and resources. Introducing campers to the Forest increases potential for accidental fire as has been proven in the County's Wildfire Protection Plan.

The most significant fire in the County Forest occurred May 6, 1986 and was started by a powerline. An estimated 1,338 acres of County Forest burned; destroying or seriously damaging 1,315 acres of productive forestland. The event could have been even more significant if not for the ability to mobilize substantial numbers of personnel and equipment from nearby K.I. Sawyer Air Force Base to fight the fire. The Michigan Department of Natural Resources and Environment, operating out of Gwinn, will continue in the lead role for fire suppression.

FIRE MITIGATION

Though fire prevention is key to protecting the forest, it is best to be prepared in case it occurs. Some level of preparedness can be obtained through management practices. Locations of roads, post-harvest slash management, tree species diversification and providing defensible areas are important to limiting spread of a fire once ignited.

INSECTS

There are several insects that can damage forest resources. Most prevalent of these in the County Forest is the jack pine budworm though white pine weevil, forest tent caterpillars, spruce budworm, and bark beetles can all cause damage.

JACK PINE BUDWORM

The jack pine budworm is the most significant insect pest affecting jack pine and since 72% of the Forest is jack pine, preventing and mitigating outbreaks is extremely important.

Trees are damaged by the larval form of the insect. They cut the needles at their base and eat only the base portion. The rest of the needle remains caught in the silk left by the larvae and eventually dries turning to a reddish brown, the dominant color in an infested stand.

Outbreaks typically occur in 10 to 12 year cycles with an outbreak lasting 2-4 years. The most recent outbreaks were in 1991 and then 13 years later in 2004, only one year beyond the typical pattern. If this cycle holds true, an outbreak should be occurring at the present time. Stand age which reflects the vigor of the trees and their ability to withstand the defoliation is the most important factor to be considered when managing for budworm control. Over-mature trees are most susceptible to infestation. By eliminating stands over 50 years of age the risk is greatly reduced. A second strategy is to break-up large blocks of jack pine by planting other tree species. On suitable sites the County is currently planting red pine.

WHITE PINE WEEVIL

The larvae of this weevil girdle the uppermost portions of both white pine and jack pine. The damage caused to the tree results in reduced growth rates and tops with multiple rather than a single stem. The last noted infestation in the County Forest was discovered in 1994. As a result of this "attack" nearly 40% of the trees in the stand developed multiple stems.

The most affected areas were those that were understocked. Maintaining fully stocked stands may be a preventive measure. The best solution is converting to red pine however, not all soils are suitable for this conversion.

SPRUCE BUDWORM

Spruce budworm target balsam fir and white spruce; though not a large component of the overall County Forest (4%) there is still a potential problem. The insect defoliates trees causing top kill and mortality. Again, the most susceptible stands are those which are over-mature. A 50 year harvest age should be maintained and stands should be fully stocked.

FOREST TENT CATERPILLAR

These insects target primarily aspen. The aspen component of the County Forest is approximately 5%. Though not a substantial part it is an important part in that it provides some forest diversity and an important cover type for wildlife. The caterpillars are defoliators but their long-term impact is minimal and tree mortality is uncommon.

BARK BEETLES

Bark beetles are not usually attracted to healthy stands. When a stand is damaged by budworms, windthrow, or other naturally occurring conditions the beetles will seek out stressed or freshly killed trees. Bark beetle infestation can be avoided by prompt salvage harvests after the damaging event.

TREE DISEASES

There are a number of diseases that can also impact forest health.

- Scleroderris – fungus that kills lower branches of jack and red pine, can kill trees up to 6' tall.
- White Pine Blister Rust – fungus that attacks white pine and kills branches, can possibly girdle trees.
- Phellinus Igniarius – fungus that causes heart rot in aspen.

INVASIVE SPECIES

Ecosystems all over Michigan are threatened by invasive plants. Every year more and more acres of land are invaded by non-native species. As these plants move into an area native vegetation often cannot compete and are eventually displaced. In turn, the animals that depend on the native plants for food and shelter can no longer be sustained and the ecosystem is entirely disrupted.

Invasive species often arrive as "hitchhikers" from other states or even foreign countries. They may be accidentally introduced by inadvertent transporting of seeds or parts of plants. In other cases, plants may be brought in for a different purpose, such as ornamental use. Some examples of invasive plants currently of concern in Michigan are purple loosestrife, garlic mustard, Japanese knotweed, Japanese barberry, reed canary grass, white sweet clover, spotted knapweed, phragmites, Eurasian milfoil, and glossy buckthorn. Efforts should be made to monitor the County Forest for invasive species on a regular basis and initiate control measures when invasive species are identified.

WEATHER EVENTS

DROUGHT

Sufficient water is critical to trees. In soils with rapid permeability such as the County Forest, consistent rainfall is even more precious. Trees use water in the process of photosynthesis. Through this process, the tree combines sunlight, carbon dioxide and water to produce sugar which is its energy source. A lack of water in drought conditions inhibits the ability to produce energy. The energy that is stored is used the next year to produce new leaves, buds, and growth of the tree. Without the energy the tree will be weakened and susceptible to insect attack and disease.

WINDSTORMS

Under conditions where stands are fully stocked and of sufficient size, windstorms are not a serious threat, however trees with edge exposure can be severely impacted. A windstorm in 2002 required a salvage sale of over 4,000 cords with a value about 25% its normal market.

OTHER HUMAN-CAUSED THREATS

TIMBER THEFT

Another threat to the Forest is timber theft. Timber theft can occur intentionally or unintentionally through the timber sale process. The best preventive measures regarding timber theft are through careful marking and monitoring of timber sales and accurate delineation of County ownership through precise survey. It is extremely important that consultants contracted to mark sales do so clearly and accurately. Resource Management staff shall review the County parcel map for each sale area and appraise the consulting forester of potential ownership issues. Also, a pre-harvest conference between staff, the consultant, and the logger should occur to make sure any confusion over sale limits is eliminated. Survey of the perimeter of the County holdings and any other interfaces with other owners should be performed so no timber trespass occurs. All cases of alleged timber theft on the County Forest will be investigated.

Illegal cutting of trees has occurred within the County Forest and the Honor Camp property. In both cases, hardwoods were harvested illegally. Continued monitoring of the forest and communication with the Sheriff's Department is essential for catching and potentially prosecuting violators.

FOREST DUMPING

Though not necessarily a critical threat to the survival of the County Forest, forest dumping has an aesthetic impact affecting recreational use of the Forest. There is also an increased risk of exposure to hazardous materials. Past efforts include identifying dump locations. The County benefited from an Eagle Scout service project in 2007 that targeted several of these sites, but the amount of illegal dumping appears to have increased and is on the Forestry Commission's radar.

LAND USE

Land uses in the County Forest are forestry, transportation (roads, railroad), extractive (former pits/quarries), and recreational. Some of the factors that can affect land use are; the public interest, transportation, land ownership, land value, natural determinants (physical characteristics of the land), and economics. Future land use plans are determined by the local unit of government. Forsyth and Sands Township master plans identify county forestlands as open space, forest preserve, or conservation/recreation. Despite such future land use designations, economic development opportunities can often influence established land use plans.

Changes to neighboring land can also affect the Forest. Pressure to permit residential development in the area is a concern as it expands the wildland/urban interface, a direct relationship to fire risk.

The County Forest serves as a buffer of the Sawyer International Airport, resulting in little development adjacent to the airport. This land use is secondary to forestry and somewhat unnoticed, but essential to minimizing conflict between the airport and other land uses, increasing safety, and preserving the ability for the airport to expand if warranted in the future.

COMBATING ILLEGAL DUMPING

The Forestry Commission is launching an effort to combat illegal dumping in the Forest. Through collaboration with stakeholders an action plan will be developed.

Although the development of strategies is in its early stages, the following ideas have been thought of so far:

- Implementation of an adopt-a-forest program
- Signage to discourage illegal activity and to report violators
- Sponsor garbage collection events
- Work with local authorities to explore municipal-wide garbage collection

ZONING

Zoning is the mechanism by which municipalities can control the use of land. The County Forest is in both Forsyth and Sands Townships. The majority of the County Forest is zoned resource production or open space permitting timber harvesting and recreation use. A small area of forest along M-553 is zoned industrial and commercial (T45N-R25W S10 & S13). Even though Forsyth Township has allowed the county to harvest timber in districts where it is not listed as a permitted use, rezoning the area to open space would create more consistency. Figure 5 shows zoning districts by township.

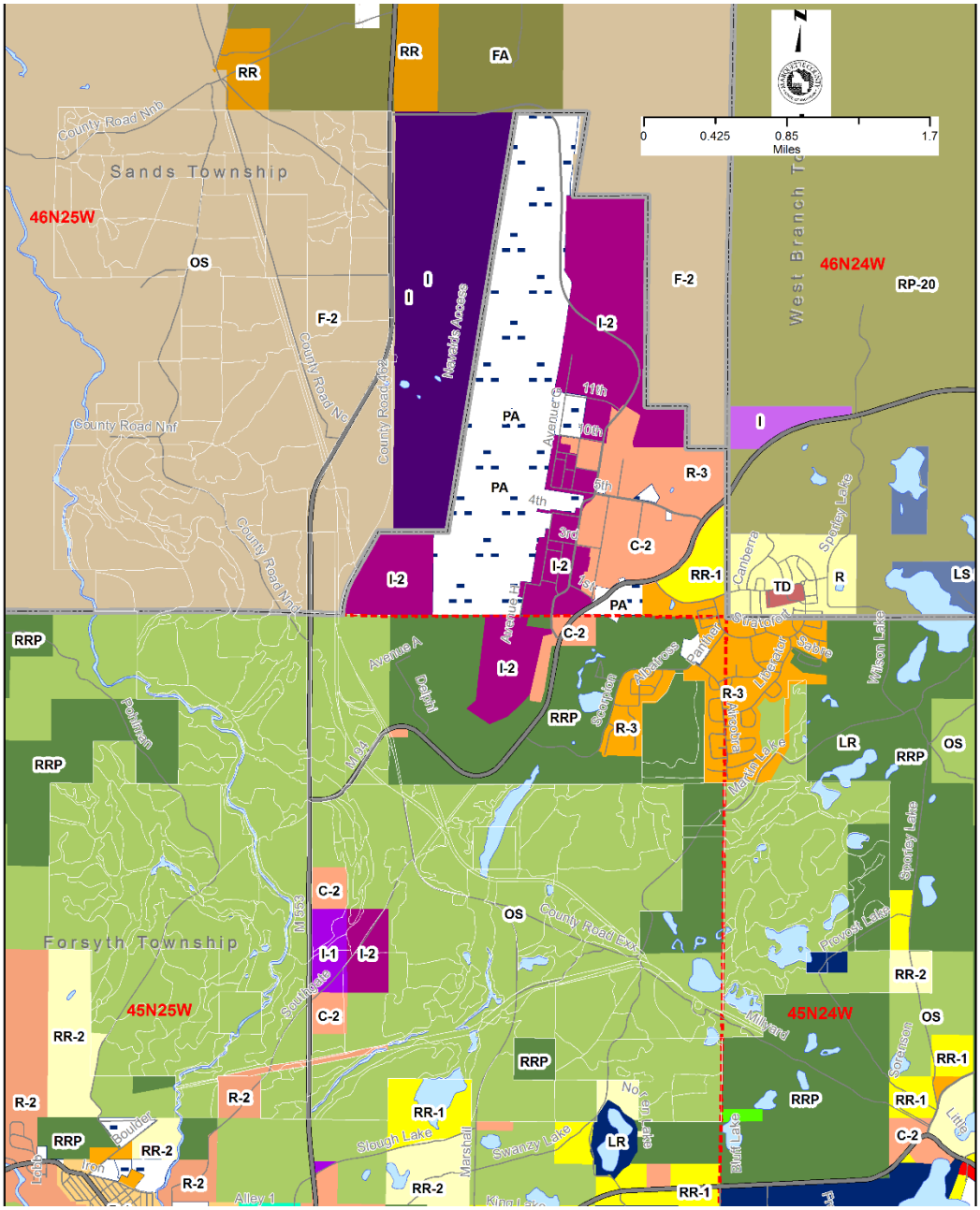


Figure 3 Zoning Map

MANAGEMENT EFFORTS

GOALS AND STRATEGIES

The goals and objectives of this plan are the result of assessing the desired outputs of the County Forest, such as timber products and recreation, and determining how they can best be attained.

Goals

Sustainable annual yields are achieved through area management of jack pine with a secondary focus on red pine and other species.

Forest outputs, both forest products and tourism/recreation create employment opportunities and generate revenue for the local economy.

Land uses in the County Forest are compatible and harmonious with the enjoyment and benefit of a multi-use forest.

Natural and man-made threats are decreased through proactive measures and no garbage exists in the Forest.

Recreational opportunities exist that are consistent with the concept of a multi-use forest.

	Strategies
Economics	Develop a strategy to create access to stands west of Pohlman Drive.
	Maintain a sustained yield of forest products to create employment through logging, trucking, mill operating, and value-added wood products.
	Provide and promote a variety of recreational opportunities in the County Forest.
	Create a stable cash flow in the Forestry Recreation Fund to accommodate Plan implementation as well as support of Sugarloaf Mountain Recreation Area, Perkins Park & Campground, Big Bay Harbor of Refuge, and Little Trout Lake.
	Increase the Forest self-insurance fund, a financial reserve, from a $500,000 balance for unforeseen occurrences.
Land Use	Monitor management prescriptions to assess environmental impact and ability to accommodate the highest public purpose.
	Participate with local units of government in land use planning.
	Monitor zoning amendments in areas adjacent to the County Forest.
	Assess former mineral extraction sites to determine ownership of mineral rights.
	Follow best management practices in riparian buffer zones.
Forest Threats	Take necessary measures to prevent injury and loss of life or resources due to fire.
	Maintain fire break areas by reducing volume.
	Oppose rezoning of adjacent and private in-holdings to residential use.
	Use proper slash management as a component of timber harvest including use as biomass when market allows.

	Orchestrate salvage sales as a mitigative measure in the event of a threat or hazard.
Forest Threats	Work with consulting forester to monitor for insect infestation annually.
	Include observation of invasive species with scheduled forest timber inventories.
	Collaborate with conservation agencies to identify, reduce, and combat invasive species within the Forest.
	Look for grant funding to support inventory and mapping of invasive species locations.
	Work with stakeholders to develop an action plan to reduce illegal dumping.
	Develop a relationship with the Sheriff's Department to obtain assistance with illegal dumping and tree cutting.
	Complete a survey of lines where there is an interface between County and non-county ownerships.
	Use extreme care in marking sale boundaries.
Recreation	Allow for a variety of trail uses and accommodate multi-use.
	Minimize motorized/non-motorized trail conflict.
	Review annually the snowmobile trail license through the County Forest and spur accessing Sawyer.
	Develop a canoe/kayak "put in" site and parking area on the East Branch of the Escanaba River.
	Explore the potential to host non-motorized race(s) in the forest.
	Update the camping reservation process to allow campers to register by phone.
	Identify and maintain areas best suited for wildlife enhancement projects.
	Evaluate timber access and landing areas for potential to seed for wildlife as part of the annual management process.
	Work with entities, such as the US Fish and Wildlife Service and Michigan Department of Natural Resources, to further the goals of this Plan.
Silviculture	Perform inventory updates on at least a 15 year basis.
	Develop a management strategy for the Honor Camp property. Feasibility of a harvest in the northern area of Honor Camp should be evaluated in the next couple of years.
	Harvest trees when they reach maturity.
	Plant seedlings of high quality and at proper stand density.
	Encourage tree species diversification to provide varied wildlife habitat, buffer against large scale insect infestations, provide a variety of forest products, and provide diverse recreational opportunities.
	Explore the use of biosolids to enhance productivity in tree plantations.
Land Ownership	Acquire private parcels within the Forest boundary and adjacent to the boundary as they become available from a willing seller on a case by case basis.
	Maintain County GIS forestry layer and other base data.
	Require GPS use that is compatible with the County's GIS, for all fieldwork including timber sale and reforestation setup.

HISTORICAL MANAGEMENT EFFORTS

Timber resources have long been sought from the region that is now the County Forest. Surveyor's field notes from 1852 read that "the white pine was of excellent quality and large quantities of logs were cut the winter before." This would be some 10 years preceding the civil war. Records also indicate subsequent cutting of jack pine in the mid 1920s and late 1940s.

The land came under initial County control by way of transfer of tax reverted properties from the State of Michigan through PA 217 and PA 233 in 1948. Subsequent property acquisition has brought County Forest holdings to 9,297 acres.

A series of plans have guided management of County-owned forest lands. The following table provides a summary of forest management plans for Marquette County.

Table 5 Historic Management Efforts

Year	Title	Author	Summary
1955	Timber Survey	John J Barnaks	Based on inventory work from the previous year, the plan marked the first scientific approach to management and featured site index, maintaining proper stocking density, a 60 year rotation period for jack pine, recommended strip cutting, and reforestation with seedlings planted in furrows. The plan laid out a harvest schedule for the following 15 years.
1981	Inventory	Spike	
1982	Marquette County Forest Management Plan	Wilson & Spike	A goal of this plan was to attain a regulated jack pine forest with equal acreage growing in every age class from young to old (1 – 50 years) creating a sustained yield or equivalent acreage available for harvest each year. The plan supported harvest by clear cutting in blocks (up to 142 acres) and tree planting to establish fully stocked stands. New to this plan was a departure from purely silvicultural management and included consideration for watershed protection, recreation, and wildlife habitat.
1988	Forest Management Plan		Update of the 1982 plan with additional goals and objectives identified and moved towards strategic planning for managing multiple use.
1999	Inventory & Analysis	Grossman Forestry	New field work compiled in a computer data base and linked to digital maps with GIS
2004	Forest Management Plan		Combined the experience of previous management efforts with new inventory data and improved technology. Management of the forest was greatly enhanced with the ability to analyze data and produce maps with GIS.
2011	Forest Management Plan		Update of the 2004 plan with additional financial analysis and projections
2015	Partial Inventory	American Forest Management	3,400 of 9,400 acres of forestland with missing data inventoried. New data were incorporated into the forest GIS layer.

Site index (SI)- A numerical indication of the quality of a given site for production of a given species of tree. The number assigned to the site represents the average height in feet of dominant trees of that species after fifty years of growth. Wvfa.org

CURRENT MANAGEMENT OF THE COUNTY FOREST

The 2016 update continues with strategies and methods of management set forth in previous Plans. A partial inventory of the Forest was performed in 2015 that targeted areas of the forest where information was missing as well as stands with other species. The goal of the inventory was to improve the harvest schedule over the next 15 years when few harvests of jack pine, the dominant species, are expected. Silvicultural strategies of each tree type are considered, along with the characteristics of the land and the goals and objectives of this Plan, to develop prescriptions. Prescriptions are used to determine how the Forest is harvested and reforested.

FOREST INVENTORY

Knowledge of tree species, age, and volume is critical in developing a silvicultural strategy for management. Inventory data has been utilized in preparation of this and all previous plans. The table to the right compares forest composition as summarized from the various inventories.

The data shows the importance of jack pine to any management decisions regarding the County Forest. Seventy-two percent of the forest cover is in this type. Approximately 10% of the forest is in the aspen/spruce/fir/birch types and about 8% is red/white pine. The balance consists of cedar, oak, and swamp conifers.

Table 6 Historic Forest Types (Acres) per Forest Management Plan

	1954	1981	1988	2003[1]	2010[3]	%
Jack Pine	6,449	6,302	6,422	6,846	6,694	*72%*
White/red pine	281	680	880	605	846	*9%*
Lowland conifer	354	530	354	230	236	*3%*
Hardwood	202	40	93	55	27	*0%*
Aspen/spruce/fir/birch	463	210	441	811	825	*9%*
Non-stocked	1,897	584	1,274	27	135	*1%*
Non-Forest (excluding road right of ways)	707	640		570	447	*5%*
Unknown[2]				342	87	*1%*
TOTAL	**10,353**	**8,986[4]**	**9,464**	**9,486**	**9,297[5]**	

Source: RM/D

1. Inventory done in 1999, acreages modified to eliminate Sawyer holdings, subsequent sales and reforestation.
2. Unknown-properties in Co. Forest missed in 1999 inventory.
3. Derived from 2003 plus/minus timber sales and reforestation.
4. The reduction between 1954 and 1981 resulted from establishment of K.I. Sawyer Air Force Base in this location.
5. A decrease of approximately 200 acres between 2003 and 2010 was the result of increased mapping accuracy.

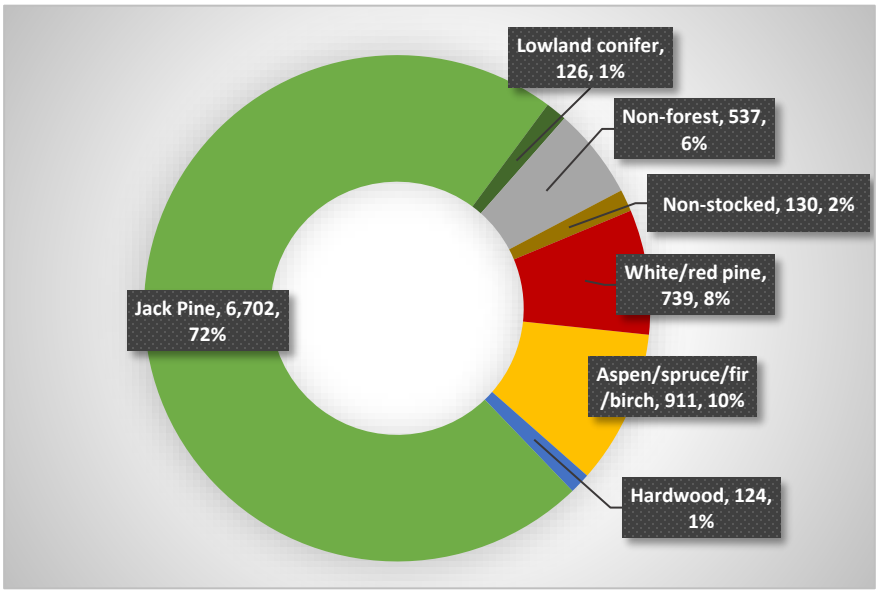


Figure 4 Forest Types, Acres, and %. 2015

SILVICULTURAL STRATEGY

The basic silvicultural strategy has remained the same since formal management of the County Forest began. It is a principle silvicultural objective of this Plan, through manipulation of harvesting and reforestation, to attain area management for the jack pine type. Assuming replanting follows harvest, a sustained yield could be maintained indefinitely on the site.

Jack Pine Area Management Simplified

- Jack pine is harvested at 50 years of age
- Cut 1/50th of the total jack pine forest every year

A secondary focus of the plan is red pine management. Through inventory projects, sites well suited for growing red pine have been identified. After harvest of existing timber occurs, red pine plantations will be established. These stands will be managed primarily for a utility pole product. Pulpwood will result from early thinnings and saw logs from a final harvest.

The third component of the silvicultural strategy addresses all other tree species (white pine, aspen, spruce, fir, birch, etc). Some stands with these types of tree species may be better suited for jack pine or red pine and could potentially be converted. These cover types may also serve other roles such as providing wildlife habitat, watershed protection, species diversification, fire breaks, and recreation. These other types are addressed on a site-by-site basis and will have a greater focus over the next decade.

A fourth component of the strategy is the continued acquisition of land into the County Forest which can aid in attaining area management for jack pine, provide additional red pine sites, or add to species diversification.

A variety of prescriptions, the method by which individual stands will be managed, have been developed over several planning efforts and can be found in the Prescriptions section of this Plan.

JACK PINE

Jack pine inhabits approximately 72% of total forest cover. It is shade intolerant and grows best in pure even-aged stands exposed to full sunlight. Dry, sandy, acidic soils too poor for other species is well suited for jack pine. This is the soil type throughout much of the forest. In these areas, jack pine have thrived and provide valuable timber resources.

This plan advocates area regulation for jack pine. Under this system the total number of acres (6,694) is divided by the rotation age for jack pine (50 years) to determine how many acres could be harvested per year. In this case, 134 acres per year.

Though good in theory, and a sound management philosophy, a number of factors such as catastrophic loss (fire, insects, ice, drought, wind, etc.) social values (recreation, aesthetics), ecology (wildlife, watershed protection), economics (volatile markets, employment), and changes in administrative priorities (budget), can all impact the distribution of age classes. Further complicating area management in the Marquette County Forest, and perhaps the greatest challenge, is an uneven distribution of age classes (1 year old – 70+ years). The following figure shows the current age distribution and acreage of jack pine in each class.

Jack Pine

Range:

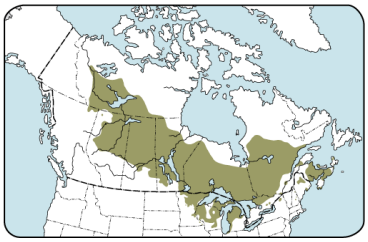


Figure 5 Jack pine range. Natural Resources Canada

Climatic preference:

Summer averages 60° to 70°F

Winter averages 0° to 25° F

Height: 70-80 feet

Diameter: 12-15 inches

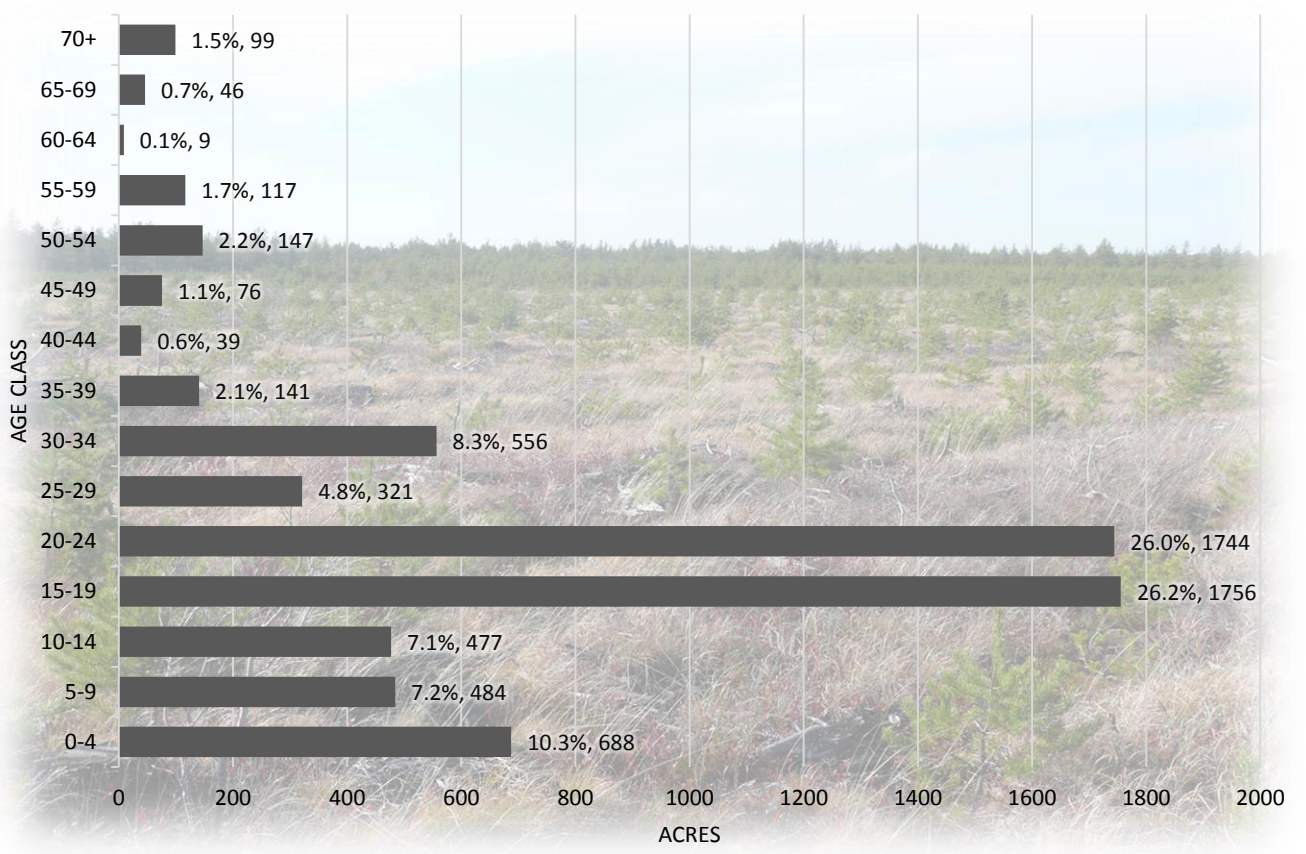


Figure 6 Jack Pine Age and Acreage, 2015

It can be noted that 6% of the jack pine is over 50 years old and should from both a silvicultural and economic standpoint be harvested although the majority of this acreage is not harvestable mostly due to proximity to riparian areas. It is also apparent that 10% of the acreage is not in each age class. The 15-19 and 20-24 classes are high while upper age classes 25-50 are low. Much of the forest was mature or over mature at the same time making it difficult to spread out the age classes. An uneven age distribution of jack pine creates years when no harvests will occur. Subsequent management plans could vary the harvest period from 45-55 years (versus 50) relying on site index for areas where trees will mature faster.

Currently, the County is entering into a 15 year period where there is a major decline of mature jack pine. Only 256 acres of jack pine will become mature during this period. It can be expected to have years where no harvesting occurs. During this period, the County will have to rely heavily on other species, such as mature red pine and spruce, to create desirable timber sales.

There are, of course, other considerations than just age that will go into scheduling of harvest such as distributing visual impact, multi-use forest concepts, fire and other catastrophic events, stand size and distribution, access to stands, etc..

A detailed study of individual year classes more clearly shows gaps within the age bands. For the most part, harvests from present through the year 2027 will have small, if any, jack pine components. During this timeframe, sales will rely heavily on other species. The previous management plan anticipated at least three years with no harvests. Fortunately, the 2015 Inventory yielded additional harvest opportunities. This Plan proposes sale areas for every year although, it may be economical to combine multiple years of sales. This decision will be determined by the Forestry Commission with recommendation from the consulting forester, during that time. Figure 5 shows proposed jack pine harvest areas by year.

Silvicultural Recommendations for Jack Pine

The Marquette County Forest 1999 Inventory Summary & Analysis, prepared by Grossman Forestry Company for the County offers the following recommendations.

1. Monitor for jack pine budworm annually. Initiate salvage operations immediately in mature and over mature stands.
2. Harvest under stocked stands when they become commercially feasible to harvest and re-establish fully stocked stands.
3. Maintain and/or establish fire breaks in cooperation with Michigan DNR.
4. Harvest specifications should maximize the success of stand establishment.
5. Harvest when the ground is not frozen with mechanical equipment. Maximum stump height of 6 inches.
6. Use mechanical and/or chemical site preparation.
   a. While scarification immediately following a jack pine harvest can be successful it is very risky on the typical sites that the County has. The need to plant or interplant is high.
7. Hand plant using the best available seedlings (containerized stock if available – red pine or jack pine – do not plant mixed stands). Machine planting is also acceptable. Plant 680 trees per acre on an 8' by 8' spacing. Re-planting and/or inter-planting is extremely expensive.
8. Monitor survival at 3 years old and 5 years old and interplant/replant as needed.
9. Manage to minimize jack pine budworm and fire danger:
   a. Harvest jack pine when stand age is equal to the site index minus five years. On the average this would be a 49 year rotation for the Marquette Forest.
   b. Maintain basal area between 70 and 110 square feet per acre.
   c. A <u>minimum</u> stand size of 40 acres will reduce the ratio of edge to stand area and is recommended. Avoid very large areas of mature and over mature jack pine.
   d. Avoid leaving or planting narrow strips or islands of jack pine when regenerating a stand.
   e. Regenerate jack pine by clearcutting. Avoid creating uneven-aged or multi-storied jack pine stands. Scattered hardwoods or white pine can be left to enhance diversity.
10. Consider conversion of stands to other species (red pine if site index is greater than 60).

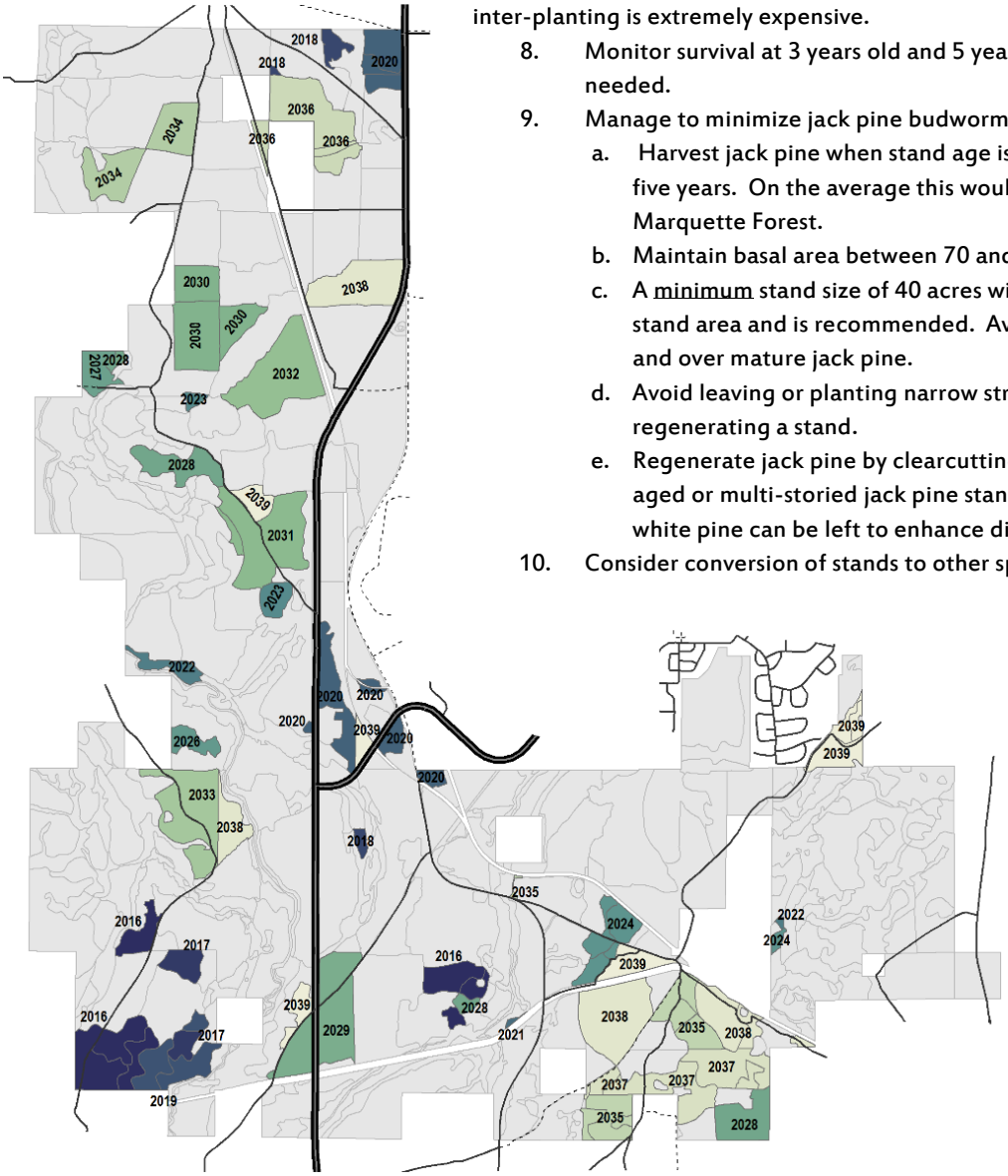


Figure 7 Jack Pine Harvest Schedule 2016-2039

RED PINE

Red pine is found in a relatively small geographic region (1,500 miles long and 500 mile wide) around the Great Lakes and the St. Lawrence River. The tree grows best on light acid sandy soils usually on gently rolling to flat plains.

Though limited primarily by soils with much of the forest having soils that are marginal or poor for red pine (though well suited for jack pine) there are areas where red pine currently exist and additional stands that have soils suitable for red pine. Multiple prescriptions involve red pine management but in general, they are saw timber, aesthetics, and plantation.

Red Pine

Range:

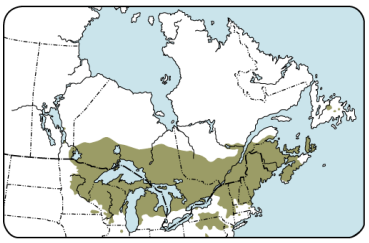


Figure 8 Red pine range. Natural Resources Canada

Climatic preference:

Summer averages 60° to 70°F

Winter averages 0° to 25° F

Height: 70-80 feet

Diameter: up to 2 ½ feet

Saw timber management will take place in areas of naturally occurring red pine. These areas are typically two-storied stands with red and white pine over a jack pine, spruce/fir, aspen or birch under story. A variety of harvest techniques can be used to clear the under story when mature. Some thinning and timber stand improvement can also be done to the pine. The maximum age range for saw timber harvest is 70-100 years. The constraining factor is mill limitation to 18" diameter.

The aesthetic management for red pine is associated with areas of high public use, particularly the East Branch of the Escanaba River drainage system, Sawyer, and adjacent to highway M-553. Red pine will only be planted in areas where the site index is appropriate to support them.

The river regions are associated with wetlands and rock outcroppings that make harvesting difficult and is, at least in part, the reason some of these trees have remained. The trees provide soil stabilization from erosion, shade to keep waters cool, habitat for wildlife, and a scenic corridor for canoeists and other recreational users of the area.

Plantations are another type of red pine management. These plantations will be established through disc trenching and planting of containerized stock at a density of 544 trees/acre. Plantations will be created on only those sites where the site index is 60 or greater.

The recommendation is to manage these stands for a minimum of 70 years. A number of harvests will take place over this period. At age 30 a thinning cut will remove every third row from the plantation producing 8-10 cords of pulpwood per

WOODY BIOMASS

The trees and woody plants, including limbs, tops, needles, leaves, and other woody parts, grown in a forest, woodland, or rangeland environment, that are the by-products of forest management. (USDA, 2016)

Trees harvested from the County Forest are primarily destined for lumber or paper. The consideration in this section, however, is in regard to those portions of the tree, tops and limbs, along with deadwood which typically are not used.

WOODY BIOMASS FOR GREEN ENERGY

The most common use woody biomass on County harvest sites is chipping to produce fuel stock or provide raw material for further processing into fuel by manufacturers. Biomass can be used as a substitute for coal, gas, or oil.

Use of woody biomass can provide additional revenue from County sites and should be encouraged. Not only will availability of another "product" make sales more attractive to bidders, a cleaner site after harvest will also facilitate reforestation efforts. All of the material can be removed because jack pine does not require soil with a high nutrient level.

acre. The next harvest will be a thinning at age 40 and each 10 years thereafter with the objective of growing trees suitable for utility pole use. A final clearcut could be performed at age 70 or delayed until 15 inches in diameter.

Silvicultural Recommendations for Red Pine

The following silvicultural recommendations are provided by Grossman Forestry Company.

When jack pine site index is greater than 60, consider converting the site to red pine.

Harvest specifications should maximize the success of stand establishment:

1. Harvest when the ground is not frozen with mechanical equipment. Maximum stump height of 6 inches.
2. Use mechanical and/or chemical site preparation.
3. Hand plant using the best available seedlings (containerized stock if available) Plant 544 trees per acre on an 8' by 10' spacing.
4. Monitor survival and competition at 3 years old and 5 years old. Use chemical release and/or interplant as needed.
5. Harvest every third row when trees have 2-3 eight foot pulpwood sticks in them (25 - 30 years old). Thin by individual tree selection every 7-10 years after that (thin from basal area 180 to 120). When trees average approximately 15 inches in diameter clear-cut and re-plant (70 to 100 year rotation).

WHITE PINE

White pine once covered a large portion of the Great Lakes region and was a substantial contributor to the early economy of the area. Much of the white pine was harvested and has all but disappeared from the landscape other than small stands or isolated trees. A significant volume of white pine was harvested prior to the 1900s in what is now the County Forest. Roughly 1.5% of the County Forest, or 155 acres, is in the white pine cover type. Most of these stands have access challenges.

Though the white pine resource is valuable, it is still a relatively small component of the Forest as a whole. Some preservation may be considered to provide forest diversity and maintain an ecosystem type which has been nearly eliminated.

White Pine

Range:

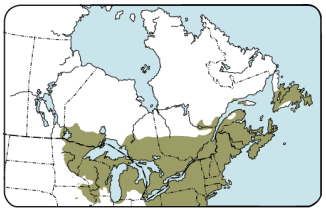


Figure 9 Eastern white pine range. Natural Resources Canada

Climatic preference:

Summer averages 65° to 74°F

Height: 100 feet

Diameter: over 3 feet

CARBON SEQUESTRATION

The process by which atmospheric carbon dioxide is taken up by trees, grasses, and other plants through photosynthesis and stored as carbon in biomass (trunks, branches, foliage, and roots) and soils. (USDA, 2016)

Interest in the use of terrestrial carbon sequestration as a method of mitigating climate change has grown. Industries that produce carbon emissions may reduce their carbon footprint by purchasing carbon credits. Carbon sequestration by trees which remove carbon dioxide from the air is a recognized source of carbon credits available to emitters.

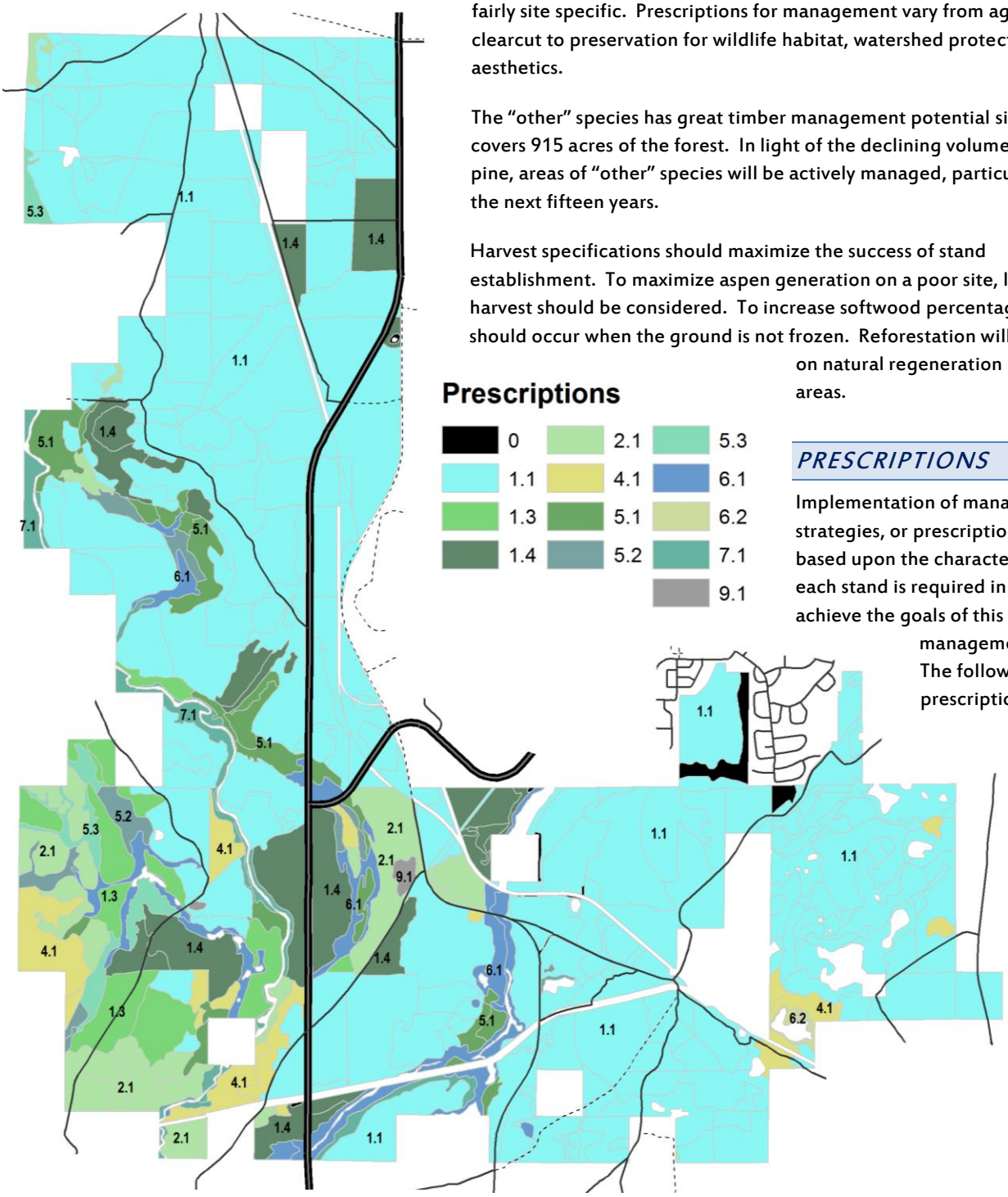
Preliminary research of the potential for Marquette County to participate in such a program is not favorable. The specific type of inventory and analysis required is costly and the size of the forest is below the threshold that can make such a program viable. Requirements like participating in a stewardship certification program and long term commitment (in excess of 100 years) are additional challenges. Time may allow for a viable program for smaller forestland owners. Staff should continue to monitor program developments and explore the potential for County Forest lands to participate in marketing of carbon credits.

OTHER SPECIES

The "other" cover type category includes a variety of tree species and comprises approximately 10 % of the total County Forest acreage. Primary species in this category include aspen, spruce, lowland brush, mixed swamp conifer, and swamp hardwood. These diverse species inhabit different types of sites from upland to wetland and pose management opportunities that become fairly site specific. Prescriptions for management vary from aggressive clearcut to preservation for wildlife habitat, watershed protection, and aesthetics.

The "other" species has great timber management potential since it covers 915 acres of the forest. In light of the declining volume of jack pine, areas of "other" species will be actively managed, particularly during the next fifteen years.

Harvest specifications should maximize the success of stand establishment. To maximize aspen generation on a poor site, leaf off harvest should be considered. To increase softwood percentage, harvest should occur when the ground is not frozen. Reforestation will rely solely on natural regeneration in these areas.



PRESCRIPTIONS

Implementation of management strategies, or prescriptions, that are based upon the characteristics of each stand is required in order to achieve the goals of this forest management plan. The following fifteen prescriptions are used within the county forest.

Figure 10 Management Prescriptions

1.1 JACK PINE MANAGEMENT FOR FIBER PRODUCTIONS

INTENT

Emphasize the production of high quality jack pine fiber.

Produce low to moderate outputs of game/non-game wildlife.

Provide for low intensity dispersed recreational opportunity.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

Surface geology is basically outwash plain, in some cases pitted, or associated with shallow depth to bedrock on rock outcroppings. Soils are mostly Rubicon sand with low fertility.

Lands under this prescription consist of even-aged plantations of jack pine ranging in age from 1-50 years. Size of these plantations generally varies from 40-160 acres. For the most part, these areas are roaded and may contain small tracts of non-productive forest land such as kettles, inactive quarries and ponds. Harvest operations consist of clearcuts either piece cut or mechanized whole tree, with pulp being decked along roadsides. Slash is scattered over the clearcuts or may be chipped and utilized as biomass.

Recreation activities are dispersed including hunting, berry picking and driving for pleasure. Snowmobile and ATV use occurs on the existing road network and on licensed trails.

1.2 JACK PINE MANAGEMENT FOR FIBER/WATER BASED RECREATION

INTENT

Emphasize jack pine fiber production while recognizing the needs of water based recreation.

Provide for medium to high levels of water-based recreation.

Low to moderate amounts of game/non-game wildlife outputs.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

Lands under this prescription occur primarily on glacial outwash plains made up of Rubicon sands. Generally these areas are pitted with small kettles, ponds and lakes. Soils are deep and low in fertility.

These lands consist of even-aged irregular shaped jack pine plantations ranging in age from 1-50 years. Plantations vary in size from 10 to 100 acres.

Harvest operations are clearcut using piece cut or mechanized whole tree methods. Pulpwood decking occurs along roadsides. Slash is scattered across clearcuts or may be chipped and utilized as biomass. It is common to restrict harvesting near water features to preserve water quality and aesthetics associated with recreation areas.

This unit has roads and it receives significant amount of recreational use because of the prevalence of small lakes or other water features (i.e., fishing, boating, canoeing, swimming and camping)

1.3 DISPERSED RECREATION/ WILDLIFE AND PINE SAW TIMBER PRODUCTION

INTENT

Emphasize production of quality pine saw timber while managing other compatible tree species components for fiber.

Encourage low to moderate amounts of dispersed recreational activities.

Medium to high game/non-game wildlife outputs.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

Lands are level to undulating glacial outwash or rock hills and ranges. Such areas are dissected with numerous drainages. Soils are generally sand to loamy sand with higher productivity than the Rubicon sands in units 1.1 and 1.2.

Forests under this prescription are two-storied with large red and white pine over jack pine, spruce, fir, aspen, white birch and red maple. Ultimately this land will contain a diversity of forest types with a mix of naturally and artificially regenerated stands of saw timber. Saw timber is harvested at a minimum age of 70 years. Consideration of timber size accepted at mills would determine maximum age for harvest and may be carried to greater age for diversity, buffering, etc. Partial cutting, clearcutting and timber stand improvement cutting are practices employed in managing these stands.

A significant part of this unit is roadless. Recreational activities are dispersed including such activities as hunting and hiking. Habitat improvement consists of planting forage crops and maintenance of forest specie and age class diversity.

1.4 RED PINE MANAGEMENT FOR UTILITY POLE TIMBER

INTENT

Emphasize the production of high quality utility poles, fiber from thinnings, and saw timber.

Produce low to moderate outputs of game/non-game wildlife

Provide for low intensity dispersed recreational opportunity.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

These units can be identified as outwash plains with light acid sandy soils.

Forests under this prescription will result from conversion of jack pine cover type to red pine plantation in those areas where the site index (greater than 60) dictates a high potential for success. Sites from 10 to 100 acres have been identified. These areas will have established access as conversion follows harvest. Harvest operations will remove every third row from plantation at age 30. Thin by individual tree selection every 10 years following. When trees average 15 inches in diameter clear-cut and re-plant (70 to 100 year rotation).

Recreational activities are dispersed including hunting and driving for pleasure. Snowmobile and ATV use occurs on the existing road network and on licensed trails.

2.1 UPLAND EVEN-AGED MIXED FOREST FOR FIBER PRODUCTION/WILDLIFE

INTENT

Emphasize medium to high levels game and non-game wildlife outputs.

Production of wood fiber from mixed stands of upland conifers, aspen, birch and red maple.

Low to medium amounts of dispersed recreational activities.

DESCRIPTION OF LAND AS MANAGED UNDER THIS UNIT

This unit occurs on level to hilly outwash and moraines. Soils have good drainage and low to medium fertility.

Forests under this prescription are even-aged with mixtures of different age stands in adjacent areas. Clearcuts up to 40 acres in size are the preferred harvest strategy. Rotation age is generally 40-50 years except for scattered small stands of red and white saw log pine. Stands are naturally and artificially regenerated. These areas generally have roads although some access improvement will be scheduled with individual harvests.

Wildlife outputs are to be increased via habitat improvement including seeding roads/landings with forage crops, wildlife openings, and stand age/species diversity. Recreational activities are dispersed with hunting predominating.

4.1 EVEN-AGED MANAGEMENT OF ASPEN FOR FIBER PRODUCTION/WILDLIFE

INTENT

Emphasis is on management of aspen for fiber production and medium to high game/non-game wildlife outputs.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

Sites under this prescription are level to hilly uplands with sand to loamy sands with good drainage. Small areas of lowland dissect this unit.

This unit consists of predominantly aspen forest type with some mixtures of red, white and jack pine, spruce, balsam fir, white birch and red maple. These stands are even-aged with harvesting occurring at 40-50 years in clearcuts up to 40 acres. Regeneration is natural. These areas have roads.

Medium to high wildlife outputs are encouraged by creating different age class stands in adjacent areas, and by seeding roads and landings. Den trees are retained for non-game species utilization.

5.1 LOWLAND CONIFER MANAGEMENT FOR FIBER PRODUCTION

INTENT

Emphasize the production of soft wood fiber.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

This unit occurs in swamps with mineral and organic poorly drained soils.

Lands under this prescription include forests of black spruce, balsam fir and tamarack. Group selection and small (up to 10 acres) patch cuts are the preferred harvesting method. Rotation age is 50 years plus. Internal road access to these stands is limited to winter. Seed tree. Remove the majority of the overstory but leave scattered trees (approximately 50 / acre) to act as a seed source and to provide protection for regeneration. After seedling establishment, remove remaining overstory while minimizing damage to regeneration.

5.2 LOWLAND CONIFER MANAGEMENT FOR WILDLIFE HABITAT

INTENT

Emphasize game/non-game wildlife outputs.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

This unit consists of mixed size stands of black spruce, tamarack, and balsam fir on organic soil with low productivity in swamps and along small drainages. As such, these areas have low fiber producing potential yet retain importance as strategic wildlife habitat. Harvesting is discouraged in view of regeneration limitations. This unit is generally roadless.

Limited recreation potential exists with the exception of hunting.

5.3 MIXED LOWLAND HARDWOOD AND CONIFER MANAGEMENT FOR WILDLIFE AND FIBER PRODUCTION

INTENT

Emphasize wildlife outputs.

Manage lowland hardwoods/softwoods for fiber production.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

These lands consist of lowland hardwoods and softwoods on poorly drained soils. Wildlife outputs are enhanced by planting forage crops and by harvesting trees using group selection and very small patch cuts (two acre minimum). Hunting is the predominant recreational activity pursued in this unit. This unit does not have roads.

6.2 SMALL LAKE BASED FISH AND WILDLIFE HABITAT MANAGEMENT

INTENT

Emphasis is placed upon fish and wildlife outputs.

Watershed protection.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

This unit consists of swamplands surrounding small lakes. These lands have limited capability for producing forest products. As such, no forest harvests are anticipated in this unit. In general, these lands are best suited for wildlife and recreation. Fish and waterfowl resources are to be enhanced.

6.1 WETLANDS MANAGEMENT FOR GAME/NON-GAME WILDLIFE AND DISPERSED RECREATION

INTENT

Emphasize wetland management techniques which provide for game/non-game wildlife outputs especially fish, waterfowl and other water based species.

Watershed protection

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

The majority of land in this unit is non-forested wetlands supporting tag-elder and other lowland brush along stream courses. Soils are organic or mineral and are very poorly drained. Small pockets of conifer may be managed in accordance with prescription 5.2. These areas do not have roads. Recreational activities include fishing, waterfowl hunting and canoeing.

7.1 RIVER-BASED OR LIMITED ACCESS RECREATION FOREST MANAGEMENT FOR WILDLIFE

INTENT

Emphasis is placed upon river based recreation such as fishing, canoeing, hiking and hunting.

Even-aged forest management recognizing wildlife and aesthetic needs and watershed protection.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

Lands in this unit are primarily associated with the East Branch of the Escanaba River drainage system. Timber stands are mixed red and white pine, spruce/fir, aspen, birch and jack pine. The area is limited in its potential to produce forest products because of the predominance of rock and wetlands. Harvesting is limited to wildlife habitat improvement. Emphasis is placed on providing for canoeing, camping, hunting, fishing and hiking.

8.1 AESTHETIC FOREST MANAGEMENT

INTENT

Emphasis on scenic potential for public enjoyment

Medium to high recreational use with trail development

DESCRIPTION OF LAND MANAGED UNDER THIS PRESCRIPTION

Lands under this prescription are typically associated with urban settings and provide greenspace buffers dispersed through developed areas. Buffers may also be created along highway corridors.

Timber management is primarily maintenance of forested areas in and around Sawyer.

The predominant tree species in the housing area is over mature jack pine. Conversion to longer lived and more diverse species is desirable. Techniques to reduce fire hazard will be promoted.

Some stands are associated with developed playgrounds. Interconnecting trails through and between facilities will enhance recreational opportunities.

Wildlife outputs for viewing can be increased via habitat improvement.

9.1 EXTRACTIVE

INTENT

Priority is placed upon providing for future extractive resource needs (i.e., sand, gravel, minerals).

The production of forest products.

DESCRIPTION OF LAND AS MANAGED UNDER THIS PRESCRIPTION

Lands included in this unit may be managed consistent with prescriptions 1-8 above with the exception that extractive resource needs take precedence. Future investment in regeneration of forest resource under this prescription must be carefully examined on a case-by-case basis. In addition, attempts should be made to secure timber before extraction operations commence, or expand.

TIMBER HARVESTS

Harvesting of timber is a critical component in the management of the County Forest. Not only is the practice silvicultrally sound recognizing the life cycle of trees, but it also provides ecological benefits like varied wildlife habitat. Timber harvests provide an economic benefit to the local forestry and wood products industry as well as provide financial support for ongoing forest activities and county sponsored recreation sites.

REFORESTATION

Over its management history, a variety of techniques have been used for reforestation of harvested areas in the County Forest. Early harvesting relied on natural restocking with cones on slash opening to release their seeds randomly over the site. Collecting cones, extracting of seeds, and broadcasting the seeds over harvested areas was tried. Hand scalping (to expose mineral soil) and planting seedlings and, later, a mechanized version of this also was used. All of these techniques were successful to varying degrees.

The most successful approach to reforestation that ideally produces uniform results and the greatest volume is hand planting containerized stock in mechanically prepared disc trenches. This is the principal reforestation technique used in the County Forest although natural generation mostly of aspen and spruce stands also occurs. As the County moves into a period of harvesting species other than jack pine and red pine, varying reforestation techniques may be expected including the consideration of reforesting every-other year to reduce mobilization costs.

Figure 11 on the following page shows the history of planting in the forest since transitioning from seeds to seedlings. A significant decline can be noted from the figure regarding the number of seedlings planted from 2002 onward. This can be attributed to successful implementation of the two previous Forest Management Plans. An objective of these Plans was to eliminate non-stocked or understocked sites. Salvage sales due to a fire and a wind storm also attributed to larger areas requiring reforestation. As a result of full stocking the County Forest has reached a point where essentially only sale areas are planted.

Table 7 Seedlings Planted 1988-2015

	Jack Pine	Red Pine	Acres
TOTAL	4,191,300	527,850	5,816

Figure 11 Planting History by Species

REFORESTATION SPECIFICATIONS

Site Preparation	Seedling	Planting
1. Row scarification shall provide trenches alternating a spacing of 8′ and 10′ between furrow centers. 2. Continuous furrows will be made to displace slash, brush, and organic matter, exposing but not excavating the mineral soil. 3. Furrow direction and orientation will be specifically determined for each site by the County's Forester. (generally parallel to heavily traveled roads). 4. All trenching and associated activities will stay within the boundaries of the treatment areas.	1. Age - All seedlings must be the equivalent of two years old. 2. Genetics - All seedling stock must be grown from seed originating in climatic zones #1 and #2 as shown on the U.S. Forest Service Regional Zone Map. The nursery providing seedlings shall certify that seeds used meets this requirement. 3. Size - Seedlings must average 8" in height. 4. Type - Only containerized stock will be acceptable. Seedlings will be delivered in 14" x 24" styro-blocks or equivalent with 1" plug holes. No bare root stock will be accepted. Stock will be free of freezer burn, insect damage, or other stress characteristics which might reduce their potential for survival once planted.	1. Trees shall be planted vertically resulting in the root plug being one inch below the surface of mineral soil. 2. Trees shall be firmed in the planting hole with mineral soil packed in and around the roots, so they cannot be pulled out of the ground by light tugs about equal to the breaking strength of six jack pine needles. No dry or loose soil, ash, organic matter, rock, or air pockets will be permitted in the planting hole. 3. Tree seedlings must be planted in such manner that twisted, balled, or "J" roots will not occur. After planting, their stems shall stand erect. 4. Red Pine – If 8′ spacing was selected in trenching specifications, then trees will be planted 10 feet apart within trenched furrows. If 10′ spacing of furrows was selected, trees will be planted 8′ apart. Density of 550 trees/acre. Jack Pine – If 8′ spacing was selected in trenching specifications, then trees will be planted 8 feet apart within trenched furrows. If 10′ spacing of furrows was selected trees will be planted 6′ apart. Density of 700 trees/acres.

FOREST RECREATION FUND

The ability to implement the Management Plan is tied directly to the amount of funding available for this purpose. Plan implementation is the driving force behind the budget request submitted annually by the County Forestry Commission to the Marquette County Board of Commissioners.

Table 8 Forest Recreation Fund and Forestry Operating Revenue and Expenses

YEAR	TOTAL ASSETS	CASH	TIMBER SALE REVENUE	FORESTRY EXPENSES	DIFFERENCE
2010	$11,130,686	$541,617	$65,001	$67,081	-$2,080
2011	$11,236,354	$470,061	$73,305	$65,017	$8,288
2012	$11,481,161	$649,127	$176,000	$60,374	$115,626
2013	$11,438,523	$574,116	$124,624	$69,143	$55,481
2014	$11,524,733	$610,538	$126,500	$77,111	$49,389
2015	$11,545,810	$733,307	$187,753	$58,753	$129,000

The source of funding to implement the Plan is the Forest Recreation Fund. This fund was created in 1995 and combined responsibility for management of the County Forest and county-owned recreation facilities (Perkins Park Campground, Big Bay Harbor of Refuge, Sugarloaf Mountain Natural Area and Little Trout Lake) under the Forestry Commission. The primary source of revenue for this fund is from timber sales which are offered to the public on a sealed bid basis by the Commission each year

Other sources of revenue to the Fund are state and federal grants. Grants have been obtained for reforestation and wildlife enhancement projects. As the fund title indicates recreation grants are also pursued and provide for capital improvement projects at the previously mentioned facilities. Still other revenues to the fund result from "user fees" for camping, boat launching, fuel sales, etc. generated at these facilities.

Expenditures from the fund related to the forestry program are principally for reforestation, inventory, forest monitoring and evaluation, survey, and preparing timber sales. Recreation related expenditures are matching funds for grants, capital improvement projects, and balancing user fees versus operational expenses at county-owned recreation facilities.

FUND-SUPPORTED RECREATION FACILITIES

Separate budgets are prepared for Forestry Services which includes timber sale revenues and expenses such as consulting and reforestation and budgets are prepared individually for the recreation facilities: Perkins Park (includes Sugarloaf), Big Bay Harbor, and Little Trout Lake.

Table 9 Perkins Park Operating Revenues and Expenses

YEAR	OPERATING	CAPITAL OUTLAY	TOTAL EXPENSE	REVENUE	DIFFERENCE	REVENUES AS A % OF EXPENSES
2010	$103,821	$1,404	$105,225	$73,829	-$31,396	70%
2011	$102,620	$4,670	$107,290	$82,393	-$24,897	77%
2012	$111,310		$111,310	$91,638	-$19,672	82%
2013	$132,692		$132,692	$93,805	-$38,887	71%
2014	$204,514*		$204,514	$84,020	-$120,494	41%
2015	$144,192	$671	$144,863	$86,577	-$57,615	60%

*Increased expense reflects retirement payout

Table 9 represents revenue and expenses (includes capital and grant matches) at Perkins Park (and Sugarloaf). The Park operates with a deficit every year. The amount varies from year to year and can be attributed to things as simple as bad weather and gas prices which lower camping revenue to more significant differences when capital projects and matches for grants are required.

The Big Bay Harbor of Refuge has a considerably smaller budget than Perkins Park. Mooring fees and fuel sales more closely offset operating expenses. The Harbor has had an average annual deficit of $1,500 since the mid-1980s. The year 2015 was record-breaking with over $8,000 in revenue and increases in launch passes, mooring, and fuel sales. Table 10 shows Harbor figures from 2010-2015.

Table 10 Harbor of Refuge Operating Revenues and Expenses

YEAR	EXPENSES	REVENUES	DIFFERENCE	REVENUES AS A % OF EXPENSES
2010	$11,923	$9,403	-$2,520	79%
2011	$14,672	$11,202	-$3,470	76%
2012	$21,319	$18,401	-$2,918	86%
2013	$20,004	$14,852	-$5,151	74%
2014	$18,273	$15,777	-$2,496	86%
2015	$15,055	$23,436	$8,381	156%

Responsibility for Little Trout Lake was transferred from Sawyer Operations to the Forestry Commission in 2010. The annual budget is $5,000. The average annual expense to the forest fund this far, is $3,726. This facility does not produce any revenue.

FORESTRY RECREATION FUND FUTURE

As can be seen in the previous discussion, there are expenses related to recreation facilities that are anticipated to continue into the future. Funding to offset these shortfalls will come from two primary sources: 1) the difference between timber sales revenue and forestry-related expenses and 2) from the cash balance of the Forestry Fund.

Timber sales will be smaller in size in coming years. With less income and steady or increasing costs, the fund's cash account will carry a steadily increasing annual burden. To estimate this impact on the Fund over time, it is necessary to project timber sale revenues based on the implementation schedule for harvests against annual expenses for forestry services and recreation. Historical timber value and silvicultural strategy are additional variables necessary in determining a projection of the Fund balance.

ESTIMATING TIMBER SALE REVENUE

Jack pine – The following graph shows price per cord (not adjusted for inflation) paid to the County and to the State (Escanaba River State Forest) over a 25-year period. These figures represent actual amounts received and are not adjusted for inflation. The orange line shows an inflation adjustment in 2010 dollars[4] for Marquette County sales. There are many reasons why the jack pine market has shown volatility. These include fluctuating fuel prices, trends to go paperless and the closure of paper mills creating short-term overflow of stock.

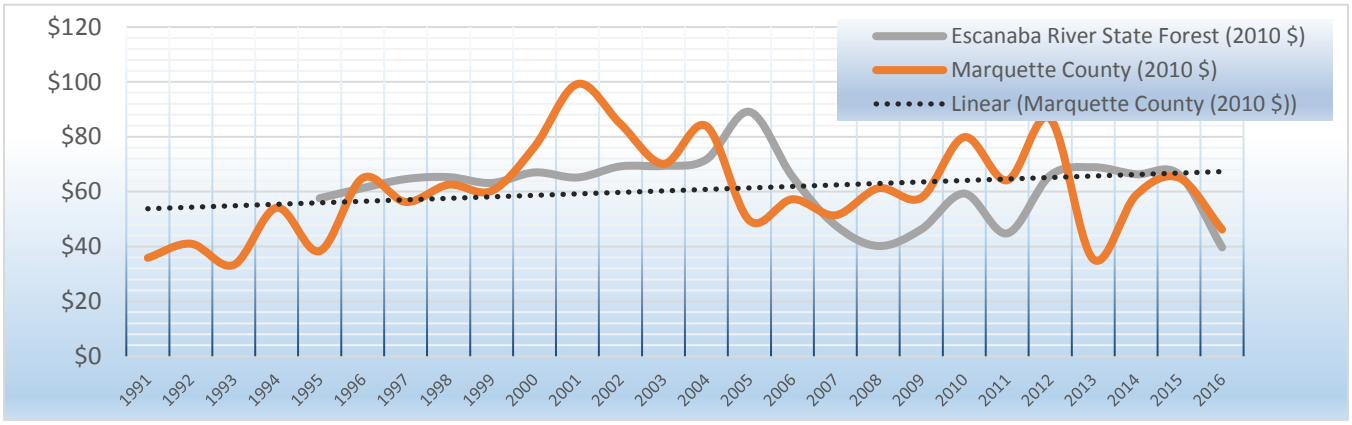


Figure 12 Historical Stumpage Prices

[4] http://www.bls.gov/data/inflation_calculator.htm

Red Pine – Less than 1,000 acres of the Forest is suitable for red pine plantations. Approximately half of this total is planted red pine and the remaining half will be converted over when existing trees are harvested.

In comparing jack pine and red pine stands it is necessary to assess volumes produced over time. The harvest cycle for jack pine is 50 years in County plantations. For the jack pine stand there is one clear-cut harvest at the end of 50 years. Previous county sales have yielded a volume of approximately 15 cords per acre. This figure is expected to increase as plantations with better stocking levels are harvested. Plantation volumes at 28 cords per acre can be anticipated.

The red pine plantation will be thinned once at 30 years and then subsequently thinned at 40, 50 and 60 years then finally clear-cut at 70. The first thinning should produce 8-10 cords/acre. The red pine stand will produce from 1.8 to 1.9 cords per acre/year yielding an additional 18-19 cords at each 10-year increment. Therefore, at age 50, the red pine stand should have produced between 44 and 48 cords per acre versus the 28 in jack pine for the same period. Additionally, a red pine thinning will happen again at 60 and clear-cut of the remaining stand at 70 if desired.

Figure 13 uses the MDNR Average Stumpage Report (1/1/2011 to 3/31/2015), the above volume estimate, and proposed sale area acreage to determine an estimated sale amount.

Sale Revenue Equation:

For example, a 137 acre jack pine sale would be estimated as follows: 15 cords/acre x $51.86 (jack pine value per cord) x 137 (acres) = $106,572.

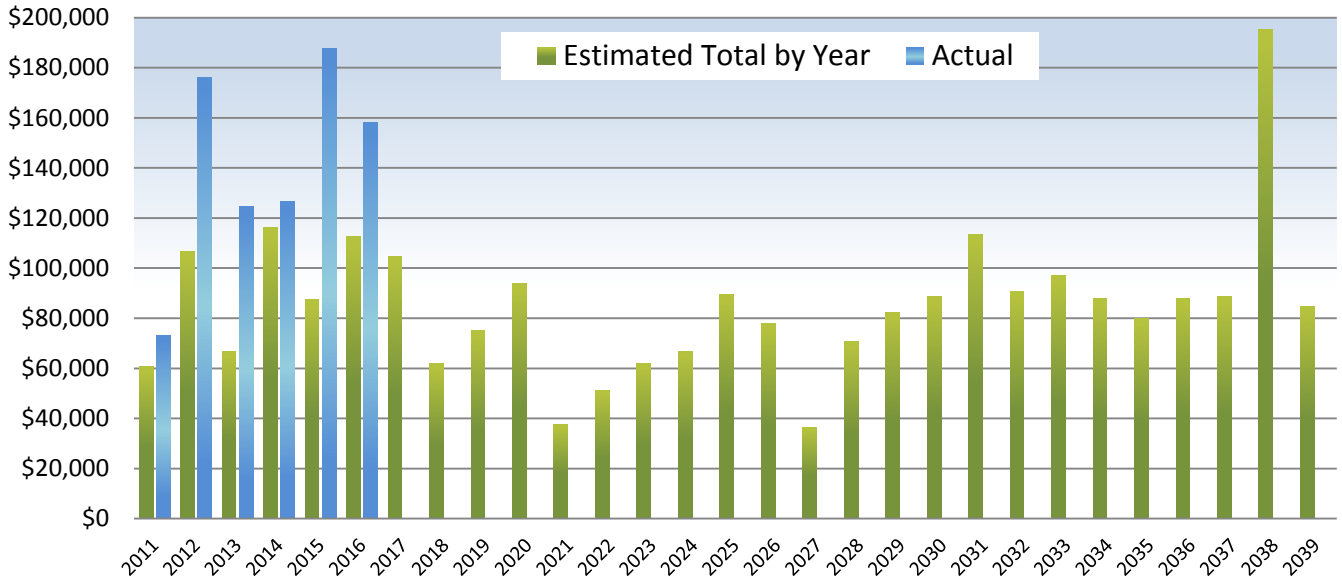


Figure 13 Estimated Revenue from Timber Harvests

Data from the past seven years was used to derive an average annual expense of the forestry fund of $103,660. This was calculated by combining the average annual cost for the forestry operation itself ($63,865), and the annual average deficit at Perkins Park ($34,846), Big Bay Harbor ($1,222), and Little Trout Lake ($3,726). All calculations are in 2016 dollars without adjustment for inflation. This is true of both revenues and expenditures.

The combined effect of declining sales revenue and persisting deficits at the Park, Harbor, and Little Trout Lake will erode the fund balance over time. Figure 14 graphs the impacts of revenue versus expense over time. The decline in fund balance is significant and the fund is entirely depleted by 2027 under the set of assumptions utilized in this analysis.

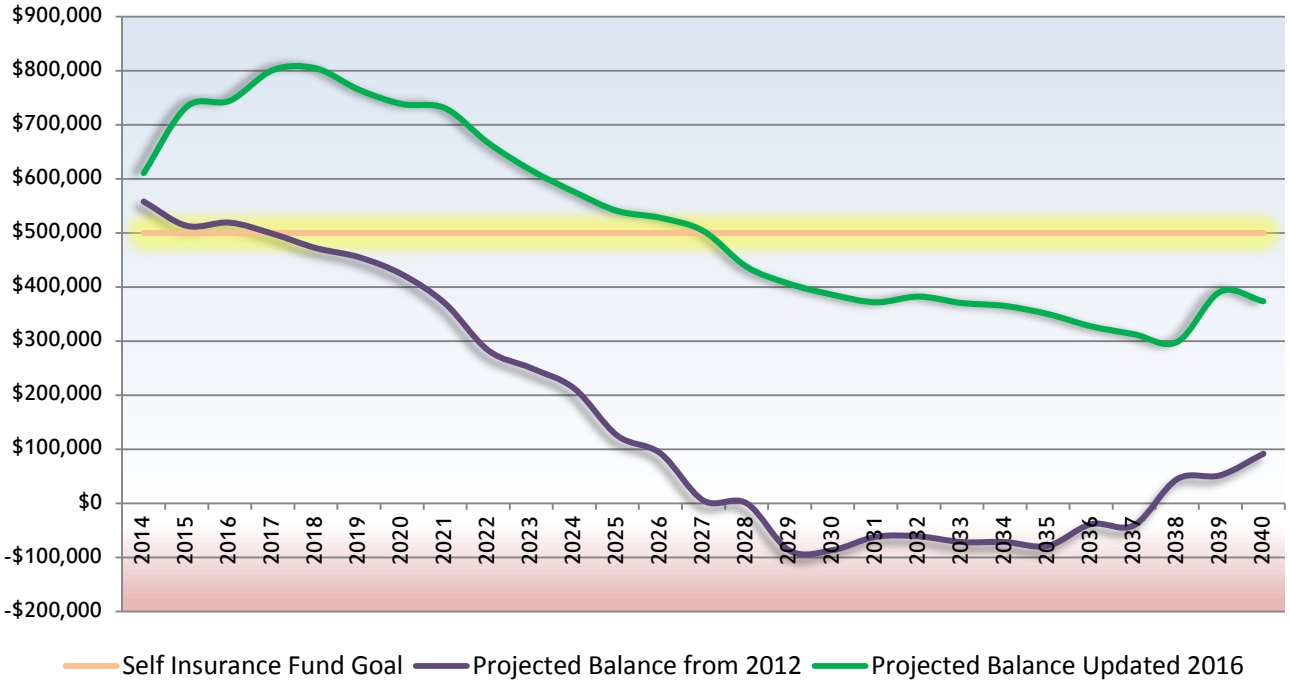


Figure 14 Projected Forest Fund Balance

The financial picture of the Forest Recreation Fund has noticeably changed in the past 5 years and can be attributed to the following:

1. High sale prices, most notable in 2012 and 2015.
2. Addition of red pine stand thinnings, west of Pohlman Road in 2013 and 2014.
3. The 2015 Inventory Project identified additional stands, mostly of other species type, that were added to the harvest schedule during a time when the Fund is most vulnerable due to limited mature jack pine (now through the year 2039).

SELF-INSURANCE FUND

A self-insurance fund for the forest is recommended. Not insurance in a traditional sense (policy), but a financial reserve for unforeseen occurrences. Catastrophic events such as fire, ice storms, drought, and insect infestations pose serious risks to the County Forest. In the case of a jack pine forest, the potential for a significant catastrophic event approaches 100% according to Grossman. To provide a reserve for reforestation following such an event, in 1999 Grossman recommended a self-insurance fund within the Forest Recreation Fund in the amount of $500,000. Adjusted for inflation, that would be over $725,000 today. These funds would be used to reestablish stands lost to a disaster.

Declining size of sales (and corresponding revenue) with increasing expenses threaten the ability to maintain this financial reserve. Although the projection of the Forest Fund Balance has greatly improved, Figure 14 shows the balance dipping below the $500,000 threshold beginning in 2027.

FINANCE SUMMARY

As can be seen from the previous discussion and Figure 14, the County is entering into challenging times with respect to maintaining the balance of the Forest Recreation Fund. The assumptions used in the preceding section may or may not come to fruition and we have already seen improvement in the long-term projection with this Plan update. The trend in the fund balance however continues to be downward. This does not even consider potential catastrophic events that would interrupt the revenue stream and create greater expense without a self insurance fund. Calculations also do not include matching funds for grants or unanticipated expenses. There are only two ways to address this trend: either an increase in revenue or a decrease in expenditures.

Revenue options are limited in that trees only grow so fast. There are timber resources on two County properties outside the County Forest; the Honor Camp and Perkins Park that are mature and should be reevaluated for harvest potential. In 2005 and 2008, sales occurred in the southern part of the Honor Camp. Feasibility of a harvest in the northern area of Honor Camp should be evaluated. There was a timber sale in Perkins Park in 2011 that generated little revenue. Potential for user fee increases at County sites such as the Park and Harbor will need to be kept up to market levels and are expected to increase in 2017. A promotion and marketing campaign for Perkins Park was launched in 2016 aimed at increasing the number of visitors. Another potential solution is subsidizing the Forest Recreation Fund from other County funds.

The other option for mitigating the rate of Fund decline is to reduce expenditures. Implementation of expenditure reducing programs, such as the launching of a centralized refuse system at Perkin Park, will help the bottom line. A recent change in the workforce through retirements is expected to reduce expenses. A "mix of fixes" where revenues increase and expenditures decrease will likely be the long term solution to solvency of the Fund.

An understanding of the scope of the problem and enough "lead time" to take corrective action provides managers an opportunity to maintain a positive Fund balance into the future. The improved circumstance of the projected balance since the adoption of the 2011 Forest Management Plan is proof that corrective action can make a substantial impact.

APPENDIX A HONOR CAMP PROPERTY

The Honor Camp was once a facility operated by the Department of Corrections as part of the Marquette County Branch Prison. In 1966, the facility was closed. The 460 acre tract of land was transferred to the County by quit claim deed in 1982. In April of 2002, the Marquette County Board of Commissioner's approved a request and facilitated a process that transferred 40 acres to Teaching Family Homes, a non-profit organization that provides homes, schooling, and treatment for delinquent or emotionally impaired youth.

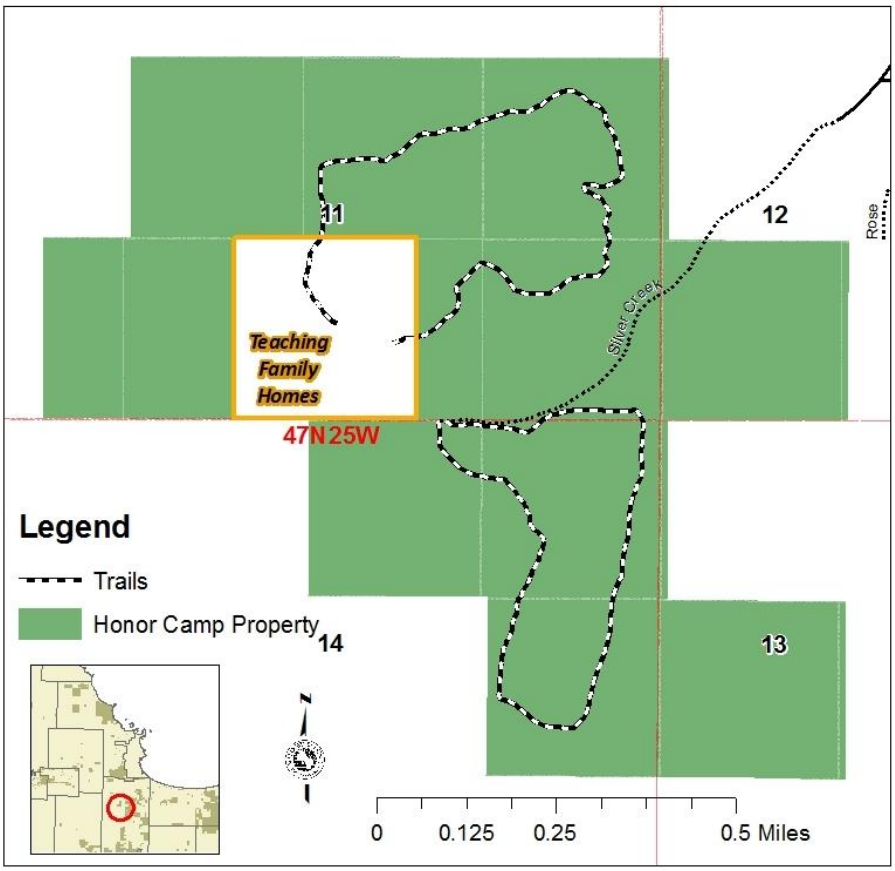


Figure 15 Honor Camp Property

Access constraints to the site on Silver Creek Road limited the County's options for use of the property to passive activities that would not generate significant amounts of traffic. Among these uses are trails for hiking, mountain biking, and cross country skiing, as-well-as opportunities for hunting and fishing. Forestry practices are performed there by the Marquette County Forestry Commission. The forestry component of the now 420 acre tract is of significant value both in timber resource and from an aesthetics standpoint as relates to enjoying the recreational opportunities this public property provides.

Management of the timber has been performed in a manner that preserves the integrity of the trail system. The latest example of this was a timber sale released in February of 2004. This sale encompassed the 120 acres that included the south loop of the existing trail. Sale specifications included a buffer adjacent to the trail, some areas of selective cut tree removal, clear-cut areas, regeneration "preserves", as well as limiting harvest to only aspen and jack pine preserving oak for wildlife and red and white pine that were originally dominant on the Honor Camp site.

In 2008 a small sale was authorized on the southern- most margin of the property. The 36 acre site harvested was south of the Silver Creek which had essentially no access. The State of Michigan was harvesting timber on adjacent land with access via a temporary bridge on private land. By contracting with the same harvester the State was using, the Forestry Commission was able to facilitate the sale.

A long term management strategy and a GIS database need to be developed for the entire Honor Camp property. Feasibility of a harvest in the northern area of Honor Camp should be evaluated in the next couple of years.

APPENDIX B WATER RESOURCE MANAGEMENT PROGRAM

Prepared by American Forest Management as part of the 2015 Inventory Project.

Soil is one of the fundamental resources of the forest, minimizing the disturbances is an essential part of sustainable forest management. Any management activities should be done in accordance with the state Best Management Practices (BMP) manual. Michigan's forestry BMP program describes a set of voluntary Forestry Best Management Practices and is titled *Sustainable Soil and Water Quality Practices on Forest Land.*

The complete document can be found at http://www.michigan.gov/dnr/0,4570,7-153-31154_31261---,00.html

Best management practices help protect water quality, water temperature, nutrient balance, habitat diversity and hydrologic process. BMPs include proper location and construction of logging roads, the use of riparian management zones, installation of culverts and other stream crossings, proper use of pesticides and other chemicals, and site preparation for planting. BMPs also include the proper seasonal timing of activities to minimize the spread of insects or disease.

The best way to protect streams is to avoid crossing them, this is not always possible, and so it is important to minimize any negative impacts from crossing them. Any harvest or road plan should be set up by a professional forester, to minimize soil erosion and other damage. Riparian areas are transitional areas between terrestrial and aquatic areas. Riparian areas help filter sediment and nutrients from runoff, stabilize shorelines and stream banks, provide shade for streams, and provide food and habitat for aquatic organisms. Any forest management activities should minimize soil erosion near wetlands and surface water.

Timber harvesting is to be conducted in a manner that: (1) provides shade on surface waters; (2) minimizes soil erosion; and (3) prevents sedimentation of waterbodies. All BMP precautions shall be taken during planning and operations to meet these objectives.

Within the BMP manual: Chapter 5 (Riparian Management Zones) has specific RMZ guidelines and should be referenced. It is also recommended at least one on-site logging crew and road construction crew member has attend the Sustainable Soil & Water Quality Best Management Practices training put on by the Michigan SFI Implementation Committee.

Guidelines to protect wetlands and waterbodies during timber harvesting:

Protection of wetlands and adjacent areas are important to sustaining proper wetland functions, which provide many beneficial social values, such as flood control, water quality improvement, and wildlife/biodiversity. A non-forested wetland is defined as a transitional area between aquatic and terrestrial ecosystems that does not support tree cover and is inundated or saturated for periods long enough to produce hydric soils and support hydrophytic vegetation (SFIS Definition). Using the classification scheme developed by the U. S. Fish and Wildlife Service (Cowardin et al., 1979), non-forested wetlands can be further classified as:

- Riverine: deepwater habitats contained within the river/stream channel itself
- Lacustrine: lakes and reservoirs that are typically >20 acres in size and lack upland and wetland plants
- Palustrine: all other forested and non-forested wetlands, e.g., marshes, swamps, bogs, fens, prairies, shallow ponds, isolated depressions and bottomland hardwoods

Non-forested wetlands vary by type and location. In most cases riverine and lacustrine wetland systems are large and clearly identifiable, i.e., open or flowing water associated with large waterbodies, and are therefore protected per state best management practices (BMPs) or regulations. Non-forested palustrine wetlands can be more variable, less obvious, and therefore, more difficult to identify.

We recognize that non-forested wetlands, regardless of size, are important ecological features within lands under our management control. As such, operations personnel are encouraged to recognize and protect small non-forested wetlands.

We are committed to protecting waterbodies and riparian zones. This includes riparian management zones (RMZs), as required by the State of Michigan. Forest management activities on adjacent forestland that could impact riparian zones will be prescribed and conducted in a manner consistent with the protection of the resource values in the riparian zones. Written management plans for timber harvest, site preparation, vegetation control, burning, fertilization and road construction or maintenance will document specific measures to protect riparian zones. Employees or contractor designees will inspect forest management activities periodically to assure compliance with management plans.

Michigan does not require mapping of RMZs, riparian areas, wetlands, and waterbodies. However, RMZs should be identified in the field prior to timber harvesting. RMZ boundaries should be identified using one or more of following methods:

- Mark on-the-ground by painting or flagging, or
- Delineate on a map and review with logger prior to harvesting (pre-harvest inspection/meeting).

Non-forested wetlands > 2 acres shall be considered as non-forested wetlands of significant size. Operations personnel are encouraged, however, to conserve smaller wetlands, e.g., vernal pools, kettle ponds, and pitcher plant bogs that contribute to the conservation of forest plants and animals. Non-forested wetlands of significant size >2 acres are readily identified as:

1. Openings in the forest canopy that can be detected on aerial photos at a scale of 1"=1320' or greater,
2. Areas that are mapped as non-forested, open water, or other hydrologic features in the county's GIS data, and/or
3. Areas that are characterized by hydric soils per soil maps (where available).

Additional diagnostic features to consider and use in determining wetland presence include:

- Wetland map symbols (topographic maps), and/or
- Local knowledge of hydrologic conditions/features.

Non-forested wetlands of significant size will be protected by:

1. Establishing a forested buffer adequate to prevent potential adverse impacts from the spraying of forest chemicals and site disturbance related to harvesting and mechanical site preparation, and
2. Identifying these wetlands on maps (code as water feature, other environmentally sensitive area, or equivalent) attached to written plans for forest management operations.

Exceptions to these protection measures can include recently constructed beaver ponds or other recently formed impoundments that are manmade. Operations personnel should manage these sites, on a case-by-case basis, in accordance with local ordinances and state regulations.

All wetlands (forested or non-forested) will be conserved, where the county has verified the presence/existence of:

1. Federally endangered or threatened species, and/or
2. Critically imperiled (G1) or imperiled (G2) species and/or communities.

Guidelines to protect wetlands and waterbodies during road construction and maintenance operations:

New road development should be kept to a minimum in riparian zones. Existing management roads in these sensitive areas should be evaluated to determine if vehicle access can be discontinued.

Where existing riparian roads are part of a strategic primary transportation system, the road right-of-way should be less than 50 feet wide (tree-line to tree-line), or as narrow as safe travel and road maintenance requirements will allow.