

## **INTRODUCTION**

Non-industrial private forestlands make up a large portion of the Michigan landscape, currently covering 10.5 million acres – about 25% of the State's total land surface. These forestlands contribute important environmental qualities, recreational opportunities, and raw materials. With a growing interest in resource management on private lands, the Federal government, in cooperation with state agencies, has introduced several programs to assist landowners. In 1990, the Food, Agriculture, Conservation, and Trade Act authorized the Forest Stewardship Program (FSP) and the Stewardship Incentive Program (SIP) to stimulate management of non-industrial private forests through cost sharing of plan writing and approved practices. While SIP has been discontinued, new Federal programs now provide cost sharing or reimbursement for a broad range of resource management activities to protect or enhance forest ecosystems.

The United States Department of Agriculture – Forest Service and state foresters have leadership responsibilities for FSP at the national and state level, respectively. Local offices of the Natural Resources Conservation Service (NRCS) now handle most of the cost-share programs available to private landowners. To qualify for cost-sharing assistance through most federal and/or state programs, a landowner must first have an approved Forest Stewardship Management Plan (or similar resource management plan) prepared by a certified resource consultant. Such a plan documents the landowner's goals and objectives, and recommends management practices that maintain or improve the land's productivity. A FSP plan is responsive to landowner objectives, is action and multiple-resources oriented, and is multi-disciplinary in scope.

With authorization from the Michigan Department of Natural Resources (MDNR) – Forest Management Division, the following Forest Stewardship Plan was prepared for West Michigan Trout Unlimited (WMTU). WMTU is the qualified landowner of the Dolan Natural Area in Kent County, Michigan. Copies of the approved Plan Eligibility Worksheet and Michigan Forest Stewardship Assessment Form, which were submitted by WMTU, are included in Appendix A of this document.

## **PROPERTY DESCRIPTION**

The Dolan Natural Area is a 127-acre parcel in southeastern Kent County, Michigan. It is located in Sections 34 and 35 of Bowne Township, 1.5 miles northwest of Freeport (Figure 1). The property is accessed from Baker Avenue, which forms most of the western boundary. Historically managed as a nature preserve, the site is largely comprised of idle fields, wetlands, and mixed hardwoods. The property has frontage on two designated trout streams, the Coldwater River and Tyler Creek. Adjacent properties consist primarily of farmlands and large residential lots.

Topography, Soils, and Climate

The site's topography, as shown in Figure 1A, is flat to gently rolling, with slopes primarily to the south. Elevations onsite range between 730 (Coldwater River) and 750 (northwest corner) feet above sea level. According to the 1986 Soil Survey of Kent County, the major upland soil types are Abscota loamy sand and Boyer loamy sand (Figure 2). Algansee loamy fine sand and Adrian muck are the dominant lowland soil types in wetlands on the property. Table 1 summarizes the characteristics and uses for most soil types found on the property.

**Table 1. Characteristics, Limitations, and Uses of Subject Property Soils.**

Soil Type	Drainage/Permeability	Limitations/Uses
Abscota loamy sand 0-3% slopes	Moderately well-drained / rapid permeability with slow runoff	Droughtiness, soil erosion, and occasional flooding are the major management concerns; suitable as pasture and woodlands; poor for building sites and septic fields; limited use of heavy equip.
Boyer loamy sand 0-6% slopes	Well drained / moderately rapid permeability / runoff is very slow	Due to rapid permeability, droughtiness and wind erosion are potential concerns; suitable for agriculture with conservation tillage and green manure crops; well suited for pasture and woodlands; good building sites.
Algansee loamy fine sand 0-1% slopes	Somewhat poorly drained / rapid permeability / slow runoff	Seasonal high water table at a depth of 1-2 feet during excessively wet periods; ditching or tile drainage required for agriculture; fairly well suited as woodland and pasture; unsuited as building sites.
Adrian muck 0-1% slopes	Very poorly drained / mod. slow permeability / very slow runoff	Due to seasonally high water table, subject to flooding and equipment limitations; poorly suited for crops and pasture; timber concerns include windthrow and flooding mortality; unsuited for building sites.
Udipammments 0+% slopes	Mod. well drained / variable permeability and drainage	These variable soils, which occur on disturbed sites (borrow pits, fill areas, gravel mines) are poorly suited for most uses unless redeveloped.

Based on U. S. National Weather Service records kept at Grand Rapids, Michigan (1964-80), the growing season in Kent County extends from about May 6 to October 15 (162 days). The average high temperature during July (warmest month) is 82.8 F, and the average low temperature during February (coldest month) is 14.3 F. The average annual precipitation is 36.4 inches with adequate rainfall usually occurring during the entire growing season. The average annual snowfall in Grand Rapids is 76 inches.

## Wetlands and Riparian Areas

The National Wetlands Inventory (NWI) Map for the Freeport, Michigan, U.S. Geological Survey Topographic Quadrangle indicates that six classified wetlands occur wholly or partially on the site (Figure 3). These include: three excavated, open water ponds; a temporarily flooded, deciduous bottomland; a seasonally flooded, deciduous forestland; and a semi-permanently flooded pond. During site visits in preparing this report, several other small emergent wetlands, sloughs, and one spring (not identified on the NWI map) were located.

Hydrology within wetlands on the property is contributed from underground aquifers, precipitation, runoff, and floodwater. Surface and underground discharge from these wetlands appears to flow southward to the Coldwater River. The Coldwater River flows westerly to the Thornapple River, a tributary of the Grand River. Surface flow, originating from the above referenced spring, occurs continuously within a narrow drain along the west boundary of the property. Surface water is present throughout the year in the Coldwater River, Tyler Creek, and two of the ponds onsite.

All of the wetlands and interconnecting waterways on site appear to be regulated by the Michigan Department of Environmental Quality (DEQ) since they are contiguous to, or within 500 feet of a stream or pond. A permit must be obtained from the DEQ prior to most filling, draining, and/or dredging activities, and other maintained uses within a regulated wetland.

## Recreational and Aesthetic Features

At the present time, the level of recreational use is moderate to high. The Dolan Natural Area is open to the public. Hiking, cross-country skiing, and nature study are encouraged. The Coldwater River and Tyler Creek are frequently used for trout fishing. Two ponds on the property furnish limited fishing opportunities for bass and bluegills. Due to deed restrictions on the property; hunting, trapping, camping, snowmobiling, and ATVs are not permitted.

Convenient access is provided from a parking area off Baker Avenue and an established network of marked hiking trails throughout the property (Figure 4). WMTU has installed two foot bridges to assist hikers in crossing small streams and ravines. Scenic views, interesting vegetation, and the variety of natural habitats within the property provide aesthetic enjoyment. An assortment of flowering trees, wild flowers, and fruit bearing shrubs are present throughout the site. Quietness and solitude can be enjoyed at many locations.

## **CURRENT STATUS OF FOREST AND WILDLIFE RESOURCES**

### Forest Stands/Health

Figures 4 and 5 illustrate the present forest cover and natural features. The health of forest stands on the property ranges from good to very good. The lowland hardwood stands include a few multi-stemmed and poorly formed trees. A number of branchy "wolf" trees are found along field borders. Standing dead timber occurs primarily in wetland areas where heightened water levels or Dutch elm disease may be the

causative factors. A few trees on the property appear to have been impacted by wind damage. The understory has been heavily browsed by deer.

Insects and diseases have impacted tree growth and survival to a minor extent. Based on egg mass observations and other evidence, the populations of gypsy moth and similar defoliators are presently very low. The site's dominant tree species may be susceptible to periodic infestations of gypsy moth, tent caterpillars, and orange-striped oakworms. No other indication of pest infestation was observed, although bark beetles, carpenter ants, borers, etc. can be expected in dead, stressed, and damaged timber.

### Wildlife Populations

Diverse habitats on and near the property already attract a large variety of wildlife. White-tailed deer, tree squirrels, cottontail rabbits, wild turkeys, owls, hawks, woodpeckers, and numerous songbirds are present throughout the property. Wood ducks, herons, raccoons, aquatic furbearers, reptiles, and amphibians are present in wetland habitats. Red fox, coyotes, woodchucks, meadow voles, field mice, and similar upland wildlife may be found mainly in open fields on the property. Woodcocks are occasional visitors in lowland timber areas. Ring-necked pheasants and ruffed grouse, although uncommon, are indigenous to the vicinity. The populations of fish species in Coldwater River, Tyler Creek, and two ponds on the property include rainbow trout, brown trout, bluegill, black crappie, warmouth, largemouth bass, white sucker, and various forage species (minnows, chubs, shiners). Copies of the most recent fisheries population surveys for Coldwater River and Tyler Creek, conducted by the MDMR Fisheries Division, are included in Appendix F.



The Coldwater River and Tyler Creek are regularly stocked with juvenile trout by the MDNR (Baker Bridge 4/26/05).

Oaks, ash, walnut, and beech provide an abundance of mast. A variety of fruit bearing shrubs, vines, aquatic plants, and grasses also furnish wildlife food. Moderate numbers of den trees and nesting cavities occur throughout the property. At present, there are no functional nesting boxes or similar wildlife structures on the site.

#### Endangered, Threatened, and Special Concern Species

For purposes of this report, the service forester for the Forest Stewardship Program in southern Lower Michigan has reported that two special concern, threatened, or endangered animal or plant species are known (presumed) to exist on the property. These are Virginia bluebells (*Mertensia virginica*) and flattened spike-rush (*Eleocharis compressa*); both are State threatened and rare. The above determination is based on lists provided to the service foresters by the MDNR Natural Features Inventory.



Stands of Virginia bluebells occur throughout the south central and southeastern portions of Dolan Natural Area.

#### Exotic and Invasive Species

At least two invasive plants are known to commonly occur on the property. Garlic mustard (*Alliaria petiolata*) is a long-stalked biennial which invades undisturbed forests and roadsides. An early bloomer, garlic mustard outcompetes many native spring wildflowers and herbs by monopolizing sunlight, moisture, and nutrients. Spotted knapweed (*Centaurea maculosa*) is a branchy, wiry-stemmed alien which invades open habitats, including native grasslands, pine barrens, roadsides, and pastures. In addition

to aggressively competing for nutrients and water, this species produces a chemical that prevents other plant species from growing in its immediate vicinity. More information about these invasive plant species and their control is included in Appendix E.

## **MANAGEMENT OBJECTIVES—LANDOWNER GOALS**

As determined by the landowner, the primary objectives of this management plan will be to protect/enhance wetland and riparian areas; improve water and soil conditions; maintain a viable fishery; and increase/diversify wildlife populations on the property.

The secondary objectives will include improving recreational and educational opportunities; protecting rare and endangered species; increasing/maintaining aesthetic qualities; and reforestation/timber management. The following paragraphs define and discuss these prioritized goals and furnish **general** guidelines for achieving them:

### Wetland and Riparian Area Protection

Wetlands are unique ecosystems that serve as the transitional zone between upland and aquatic habitats. Wetland areas are typically identified by three characteristics: the presence of water at or near the surface of the ground for at least part of the year, the presence of distinctive soil types which develop under water-saturated conditions, and the presence of plants adapted for living in these soils. Since wetlands are very productive, they play a significant role in maintaining a high level of biological diversity. Not surprising, wetland habitats are critical to the survival of many threatened or endangered species. Approximately 30 percent of Michigan's threatened and endangered plants and 60 percent of the threatened and endangered animals are wetland species. Of course, wetlands are also valuable for preserving water quality, providing flood control, and producing fish and game species.

In order to protect these valuable natural resources, the State legislature passed Public Act 203 of 1979, the Goemaere-Anderson Wetland Protection Act (now part 303 of Act 451, 1994). This act regulates construction activities in certain wetlands by requiring a permit from the Michigan Department of Environmental Quality (DEQ) for dredging, draining, or filling projects. By definition, all of the wetlands present on the subject property appear to be protected. As a result, any work within these wetlands, involving the above listed activities, should be conducted under the appropriate permit.

Riparian zones are those areas adjacent to rivers, streams, lakes, and other wetlands. Lakeshore and streamside forests are very important in maintaining water quality by removing nutrients and sediment from surface runoff and shallow groundwater. Riparian forest buffer zones also shade streams to optimize light and temperature conditions for fish and other aquatic organisms.

The riparian forest not only improves water quality but also supports a large variety of wildlife. The many kinds of plants, including grasses, sedges, vines, shrubs, and trees, that thrive in these wet-soil areas provide food and nesting sites for wildlife. The streamside forest maintains high biological productivity and diversity in the adjoining water system.

A forested buffer zone 200 feet wide should be left around wetlands larger than one acre in size and along all rivers and streams. A buffer zone 100 feet wide is acceptable for small wetlands less than an acre. These criteria are generally adhered to in this plan.

### Water and Soil Quality

Controlling erosion is a major objective in improving and maintaining high water and soil quality. Sound conservation practices that will protect soil and water include the use of windbreaks, crop rotation, buffer strips (near wetlands), no-till planting methods, and contour farming. Land management practices that improve the quality of soil include using (in addition to those listed above) cover and green manure crops, legumes in rotation, nutrient management, integrated pest management, and irrigation water management. A professional soil conservationist or farm services agent should be consulted for assistance with these endeavors.

The new 2002 Farm Bill has reenacted the Conservation Reserve Program (CRP), the Wetlands Reserve Program (WRP), and other conservation programs designed to control erosion and protect wetlands. Through these programs, funds are available for technical assistance and cost-sharing on conservation practices.

The Conservation Reserve Enhancement Program (CREP) was created in 2000 to address soil erosion, water quality, and wildlife habitat in major watersheds. Through this program, farmers and other landowners can receive cost-share for creating filter strips, riparian buffers, and other conservation practices which protect watershed areas. To date, most of Michigan's CREP funds have been directed to the watershed areas of River Raisin, Lake Macatawa, and Saginaw Bay.

### Fisheries

Establishing a fishery is a common goal among landowners who enjoy fishing and have ponds or streams on their property. Based on existing limnological conditions (water temperatures, oxygen levels, etc.) the appropriate fish species can be stocked and managed. But, fisheries management programs can be fairly complex. For example, a management program could include extensive habitat modifications, artificial feeding, aeration, harvest/size limits, and aquatic weed control. Poorly managed or unmanaged systems may sustain fish die-offs, stunted populations, or improper growth patterns. The Michigan State University publication entitled "Managing Michigan Ponds for Sport Fishing" is a useful guide to landowners who wish to develop ponds for fishing.

The main objective in this plan regarding fisheries management will be to maintain the existing trout fishery in the Coldwater River and Tyler Creek. The MDNR has regularly stocked these streams with hatchery raised trout to sustain a fishery. Striving to maintain suitable trout habitat, WMTU's stream improvement endeavors have included bank stabilization, watershed management, and placement of habitat structures. WMTU also has an opportunity to enhance the warmwater (bass/bluegill) fishery in two existing ponds on the property. An in-depth study of current fish populations and limnological conditions in the two small ponds would be useful in determining an appropriate management program. Reference material for fisheries habitat improvement techniques is included in Appendix F and the above referenced MSU publication.

## Wildlife Population Enhancement—Habitat Improvement

Wildlife **population enhancement** is achieved through a variety of means. Unwanted species can be reduced or eliminated with the use of repellents, scare devices, exclosures (fences) etc. Desired animal species may be introduced through stocking or transplantation. They may be increased through habitat manipulation, predator control, artificial feeding, and other methods. Hunting and trapping are very useful tools in managing animal numbers, sex/age ratios, and health. Wildlife populations often need to be regulated to prevent starvation, disease, and property damage.

**Habitat improvement** means providing the types of plant communities that favor the wildlife species preferred. The types of forest stands, their ages, and how they are arranged determine which wildlife species will benefit. Different wildlife species utilize the different habitat conditions inherent in each stage of succession. Thus, to increase the variety of woodland animals, several different stages of succession should be furnished.

In terms of habitat, edge is the place where plant communities meet, or where successional stages within communities merge. Often, this is the “richest” area in the forest for wildlife abundance and diversity. For this reason, having a variety of cover types and timber age classes will benefit many wildlife species because of the edges they create.

To maintain native wildlife populations in fragmented, human-dominated landscapes, habitat corridors should connect small and large vegetation zones. These corridors, or travel lanes, provide a means for wildlife to safely move from one cover type to another (feeding area, resting sites) and permit genetic flow between populations that would otherwise be isolated.

A forest “opening” is a grassy field or meadow within a wooded area. Openings are important because they provide edge, produce certain important food items, and supply bedding and nesting sites. A number of small, irregular shaped openings should be maintained in heavily wooded areas. Five to ten acres of small (0.5 to 3.0 acres each) forest openings per 100 acres of woods is a desirable ratio.

Aspen should be a primary interest for landowners who wish to manage for ruffed grouse. Grouse need aspen in three age classes: sapling stands from four to 15 years old for brood cover, sapling and small pole stands sixteen to 25 years old for fall and spring cover, and old growth aspen (25-60 years) for wintering and nesting cover. The buds and flowering catkins of male quaking aspen are extremely important as food. All of these age classes should be available within each six to 25-acre grouse territory. Each even-aged aspen stands should range from 0.5 to 3.0 acres in size.

Because aspen is shade intolerant, it often grows in even-aged stands where no other tree species dominates. When aspen reaches maturity at 50 to 60 years of age, it usually gives way to more shade-tolerant species such as oak, maple, and beech. When maintaining aspen stands, clear-cut harvesting is recommended to ensure optimum root sucker regeneration and to remove shade tolerant competitors. On good sites, aspen is ready for harvest as pulpwood in 30 to 35 years. Thus, a 40-year cutting rotation will provide the three age classes of aspen needed by grouse and will produce marketable forest products.

Forests managed for biodiversity must contain the old growth successional stage. Among the wildlife species that benefit from old-growth stands are pileated woodpecker, yellow-billed cuckoo, scarlet tanager, wood thrush, barred owl, water shrew, fisher, and gray tree frog. Most forest stands in North America reach the old growth stage after 100 years. The element that makes these areas unique and valuable to wildlife is decay. Old-growth forests contain an abundance of rotting fallen logs and large dead snags. The multi-layered canopy and diverse vegetation provide special cover and food requirements to some animals. Wood warblers and woodpeckers utilize the abundant supply of insect pests that infest dead timber. Moist soil areas and surface water in old-growth stands furnish breeding habitat for reptiles and amphibians.

Wildlife habitat improvement guidelines for some species are included in Appendix B. These guidelines further elaborate the planned wildlife activities discussed under the "Prescribed Management Practices" section which follows.

### Recreational and Educational Opportunities

Since the forest is a place of beauty, it furnishes an ideal environment for recreation. Fishing, hunting, camping, berry picking, nature study, hiking, skiing, and snowmobiling are some of the activities associated with forests. In addition to the obvious enjoyment that forests provide (scenery, wildlife, etc.), shade, wind protection, fragrant aromas, and noise reduction are other pleasurable elements. The recommended land practices in this plan are expected to increase recreational enjoyment of the property by improving access, increasing species diversity, and expanding wildlife populations.

In maintaining the Dolan Natural Area for public use, WMTU has an opportunity to educate visitors about the importance of watershed management in protecting stream ecosystems. A carefully planned interpretive trail could be useful in teaching ecological principals, wildlife and fisheries management techniques, and/or local history.

### Rare and Endangered Species

The Endangered Species Act of 1974 authorized the MDNR to prepare a list of threatened and endangered species, and to develop plans for their protection. More than 200 species were listed as threatened or endangered by the Michigan Technical Advisory Committee; about 90 species were named as being rare; and 25 were stated to be extinct. The most current revision of this list is included in Appendix C. Before any State threatened or endangered species (such as Virginia bluebells) is harmed, including transplanting, a T&E permit must be obtained from the MDNR Natural Features Inventory office.

Many factors may reduce a species population size to the point where its survival is jeopardized. These factors include habitat destruction, exploitation, habitat restriction, and disease or pest introduction. One major concern of conservation biologists today is the fragmentation of large segments of natural habitat into small isolated patches. Many species, such as flying squirrels, tanagers, flycatchers, and thrushes, depend on large tracts of unbroken, uniform habitat. When fragmenting once continuous habitat, it is very important to furnish travel corridors between the resulting segments. This will minimize isolation and the loss of genetic variety.

## Aesthetic Management

The MDNR Forest Division Bulletin entitled “Woodland and Aesthetic Management” describes what most landowners prefer relative to forest aesthetic features. These include: natural appearing forest landscapes, views and vistas of natural scenes, vegetative variety, large trees, open understory, visually interesting bark characteristics, and fall color. Managing for “aesthetics” does not necessarily suggest a hands-off, preservation approach. The appearance of a forested landscape can be improved by manipulating the vegetation. This includes timber harvest activities. The following guidelines should be used when a primary objective in forest management is to increase aesthetic enjoyment:

- 1) Determine the visual concerns for each area of the property. For example, what is visible from the road or residence, and what areas do not make a major contribution to aesthetic enjoyment?
- 2) Be aware of the visual consequences of various timber management practices, and be familiar with visual mitigation concepts.
- 3) Make sure that visual criteria are included in the timber sale contract when logging professionals are employed.

Forest aesthetics, as applied to the woodlot, has been described as “the beauty, the attractiveness, and the charm of our woodlands.” People like to see things that have a sense of order. Parallel lines (an even-aged conifer plantation), gentle curves (a winding forest trail), and nice symmetry (the shape of a well-developed tree) all have appeal. An unmanaged woodlot can lose these qualities much like one that is improperly managed. This occurs when weed species, diseased or damaged trees, and dead timber become increasingly manifest.

Harvesting timber is a disruptive affair even under the best circumstances. To many people, logging operations are noisy and unsightly. An untrained eye cannot see the immediate and long-term benefits to wildlife, water, and recreational opportunities that will evolve from proper forest management. For this reason, landowners should preview operations (including site restoration and cleanup) on properties similar to their own, by loggers and foresters they intend to employ. In some cases, small demonstration areas can be established on-site to acquaint landowners with the process and outcome before work is done on a grand scale.

While timber production is not a priority at this time, certain practices can be used to improve aesthetic qualities in the long term. Timber stand improvement (TSI) is a conscious effort made in a forest stand to improve future growth and quality. Three specific objectives are as follows: 1) to develop a quality stand by removing defective, damaged, or otherwise undesirable trees, thus concentrating growth on fewer high quality trees; 2) to promote the growth of high value trees by removing species of low economic value; 3) to encourage optimum growth of the residual stand by regulating the number and distribution of trees. Careful planning of a TSI operation will maximize the commercial value of timber stands and greatly reduce wasted forest resources.

### Tree Planting-Reforestation

Trees are planted for many purposes including timber production, wildlife habitat improvement, windbreaks, erosion control, and aesthetics. Where prescribed in this plan, the objectives will include wildlife habitat improvement, reforestation and aesthetic management. A tree planting guide is included in Appendix E.

### **PRESCRIBED MANAGEMENT PRACTICES**

Figure 5 designates six management units (A through F) for the property based on the present forest or herbaceous cover. The following pages provide a detailed description of each management unit and the specific prescribed management activities for each unit for the ten-year period 2006 to 2016. The prescribed activities for the entire property are illustrated on Figure 6.

## MANAGEMENT UNIT INFORMATION

MANAGEMENT UNIT NO.: A NUMBER OF ACRES: 48.9

### =====MAJOR OBJECTIVES FOR THE UNIT=====

Water and Soil Quality  
Wildlife and Fisheries Habitat Management  
Warmwater Fishery

### =====EXISTING CONDITIONS=====

**COVER TYPE AND MAJOR SPECIES:** Unit A consists primarily of old-aged field and fallow areas. Historically, a large portion of this unit was in use as pastureland—deteriorated fencing and posts remain in place. At this time, Unit A is dominated by upland grasses and forbs. Common species include spotted knapweed, red clover, timothy, smooth brome, wild carrot, yarrow, fleabane, St. Johnswort, mullein, sorrel, and Deptford pink. The previous property owner had stocked portions of the abandoned pasture area with rows of conifers and wildlife shrubs. These plantings consisted of red pine, Scotch pine, blue spruce, redbud, autumn olive, and honeysuckle. Having remained idle for years, this open-field unit was gradually invaded by black cherry and other hardwoods--seeding in from nearby woodlots. These wildling saplings and trees are moderately scattered through much of the unit. Several large, wolfy oaks occur in an old fence row near the eastern edge of the unit.

SIZE CLASS: N/A

SOIL TYPE: Boyer loamy sand

SITE QUALITY: Good +/-

STAND QUALITY: N/A

STAND DENSITY: N/A

**MANAGEMENT UNIT DESCRIPTION:** This extensive unit comprises the majority of upland at the Dolan Natural Area. Adding much diversity to the property, the grassy open areas in Unit A attract field sparrows, bluebirds, small rodents, avian predators, woodchucks, fox, deer, and other wildlife by providing suitable nesting/bedding habitat, dusting areas, and fodder. Abundant field-variety wildflowers invite butterflies and bees. The planted conifer rows and shrubs offer travel corridors, food items, perches, and nest sites for wildlife. A segment of established trails on the property, which passes through Unit A, maximizes hiking and nature study experiences. The trail, which originates at the parking area near Baker Avenue, accesses two man-made (excavated) ponds and a small wetland. The ponds offer limited fishing opportunities for bass and bluegills.

=====PLANNED MANAGEMENT ACTIVITIES (PRESCRIPTIONS)=====  
for the next ten years: 2006 to 2016

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To maintain and improve the grassland habitats in Unit A, various management tools including prescribed burning, chemical herbicides, fertilization, and mechanical alterations (mowing, disking, plowing, etc.) may be employed. At this point in time, several small and

medium-sized trees (including their trunks and roots) will need to be cleared from the open field areas.

The primary management goals in Unit A should include soil improvement, vegetative diversity, and invasive species (knapweed) control. To accomplish these goals, Unit A should be subdivided into smaller compartments based on the existing conifer row plantings (Figure 6). The northernmost compartment can be developed into a native grass prairie. The southern compartments can be rotated between hayfield, old field, and small grain crop field. At least one small (1 to 2-acre) food plot can be established to supplement wildlife forage and serve as an educational demonstration. Wildlife food plot plantings and may include corn, sorghum, sunflowers, buckwheat, millet, turnips, rape and/or various mixes available from Pheasants Forever. The following additional practices within these Unit A compartments will promote soil quality and maximize wildlife values:

- 1) Retain stubble and waste grain on the surface of the ground through winter months (avoid winter plowing).
- 2) Reserve several rows of standing grain near brushy cover and woodlots through winter.
- 3) Postpone the first cutting of hay (alfalfa) until after June 1<sup>st</sup> to protect nesting gamebirds.
- 4) Minimize the use of herbicides in crop fields by using the no till method.
- 5) In late summer, mow alternate sections of field areas to control brush and expose insects.
- 6) Time plantings of oats, rye, barley, and turnips in food plots so that crops mature in early fall and green browse is available in early spring.

Directives for establishing native grasslands, crop plantings, and hayfields are included in Appendix B. It will be necessary to retain an experienced professional when conducting prescribed burns and native grass seeding. Local farmers may be hired (or share-cropped) to establish and manage grain plantings, old fields, and hayfields in the unit. A gated service road will furnish access to the Unit A field compartments from Baker Avenue.

To increase timber production, enhance wildlife cover, and expand aesthetic benefits; establish new stands of conifers in Unit A (Figure 6). Several rows of conifers along the west boundary of the unit will ultimately screen out the residences on Baker Avenue, provide a wildlife corridor, and furnish a valuable windbreak. Plant a mixture of spruces, firs, and red pine. Fruit bearing shrubs can be added on the border of the new conifer stands to bolster wildlife food and cover. Guidelines for planting trees and shrubs are included in Appendix E. As a general rule, herbicides should be used to reduce weed competition around shrub plantings. Apply a chemical herbicide in a narrow, 3-foot swathe before planting seedlings; re-treat or plow to maintain weed control. In double rows about five to eight feet apart, plant native shrub varieties such as viburnums, crabapple, nannyberry, lilac, ninebark, sand cherry, and dogwoods.

For recreational benefits, the marked trail system through Unit A, as well as other portions of the property, can be improved through regular mowing, brush hogging, and mulching. The recommended width for low to moderate use cross-country ski trails is ten feet. Occasional grooming is needed to remove fallen trees, rocks, and other debris. Additional signage would be helpful in identifying the trail location—affix new signs on posts or dead timber (not on living vegetation). Remove/replace existing signs that are embedded in

bark or otherwise damaged. For safety and aesthetic benefits, remove dilapidated pasture fences along the hiking trails.

Fishing opportunities can be enhanced in the Unit A ponds by improving access and employing various habitat management techniques. Although both ponds can be further excavated to increase size and depth, this plan recommends enlarging the southern half of the eastern pond. Increase the size of this pond by approximately 0.1 acre with maximum depth to fifteen feet. A reconfigured shape to this pond would better accommodate fishing access and a fly casting practice station. For improved fishing access, add wooden decks to the shoreline of both ponds; a boardwalk or concrete path from the parking area would make the western pond handicap accessible. Improve fish habitat by installing stumps, logs, brush, or other cover. Small, anchored rafts will furnish fish cover and turtle basking sites. A DEQ permit will be required prior to conducting some of these pond management practices.

To further increase wildlife use and production various habitat structures can be placed throughout Unit A. As illustrated on Figure 6, install and maintain several songbird nest boxes, rabbit brush piles, perching stations, etc.



At this time, Unit A primarily supports grasses and forbs (knapweed, St. Johnswort, etc.), with scattered hardwoods.

## MANAGEMENT UNIT INFORMATION

MANAGEMENT UNIT NO.:  B  NUMBER OF ACRES:  1.5

### =====MAJOR OBJECTIVES FOR THE UNIT=====

Wetland and Riparian Zone Protection  
Wildlife Management, Timber Harvest

### =====EXISTING CONDITIONS=====

**COVER TYPE AND MAJOR SPECIES:** Unit B is part of a seasonally flooded, hardwoods swamp, which extends off-site. This wetland appears to remain partially flooded throughout winter and spring, but surface water typically recedes below grade during the summer months. The southern portion of the unit supports a mixed stand of mature ash, silver maple, and red maple; while buttonbush dominates to the north. Herbaceous ground cover is sparse.

SIZE CLASS: Sawlogs and poles

SOIL TYPE: Adrian muck

SITE QUALITY: Poor

STAND QUALITY: Fair

STAND DENSITY: N/A

**MANAGEMENT UNIT DESCRIPTION:** The forested/scrub-shrub wetland environments in Unit B, which are fairly unique to the property, add some plant and animal diversity. During spring, the unit attracts ducks, furbearers, amphibians, and reptiles. As a seasonal wetland, this highly organic area furnishes the special breeding conditions required by invertebrates (insects, crayfish), frogs, and salamanders. The main sources of hydrology to this unit appear to be precipitation and runoff. During early summer, water loss occurs through evapotranspiration and seepage to groundwater.

### =====PLANNED MANAGEMENT ACTIVITIES (PRESCRIPTIONS)=====

for the next ten years: 2006 to 2016

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The primary recommendation for this unit is to protect it from degradation and perpetuate its functions and values. Maintain a buffer area of at least 100 feet wide around its perimeter and avoid grazing livestock or using fertilizers, herbicides and pesticides in shoreline areas.

To increase wetland wildlife use and production, install one wood duck nest box (with predator guard) and one screech owl nest box (plans included in Appendix B). Retain standing dead timber, where available, to benefit woodpeckers. These dead snags will also furnish perches for kingfishers, herons, and raptors.

Some mature ash and silver maple can be harvested at this time. In conjunction with other timber harvests on site, selectively cut about 25% of the Unit B stand in scattered groups of 1-4 trees.



## MANAGEMENT UNIT INFORMATION

MANAGEMENT UNIT NO.:  C  NUMBER OF ACRES:  66.2

### =====MAJOR OBJECTIVES FOR THE UNIT=====

Wetland and Riparian Zone Protection  
Rare and Endangered Species  
Recreation, Coldwater Fishery

### =====EXISTING CONDITIONS=====

**COVER TYPE AND MAJOR SPECIES:** Unit C is a lowland mixed hardwoods forest dominated by sycamore, black ash, American elm, black cherry, bur oak, hackberry, silver maple, and red maple. As the soil type and elevation change from west to east (Figure 2), the stand incorporates sugar maple, American beech, American basswood, black oak, red oak, white oak, and black walnut. Various saplings, prickly ash, ironwood, hornbeam, hawthorn, serviceberry, and spicebush are occasional in the fairly open understory. Ground cover (varying densities) includes wood anemone, Virginia knotweed, cut-leaved toothwort, wild ginger, wild geranium, trout lily, spring beauty, nettles, violets, Virginia bluebells, cleavers, wild scallion, avens, five-finger ivy, poison ivy, sensitive fern, and grasses.

SIZE CLASS: Sawlogs SOIL TYPE: Alganssee loamy fine sand, Abscota loamy sand

SITE QUALITY: Good STAND QUALITY: Good STAND DENSITY: Med (BA=100-120)

**MANAGEMENT UNIT DESCRIPTION:** The Coldwater River and Tyler Creek, which are part of Unit C, form the main focal point of the property. Both rivers are designated trout streams, stocked with trout by the MDNR, and frequently fished. Another interesting water system in this unit is a spring which flows throughout the year and discharges into the Coldwater River near Baker Avenue. In addition to the established hiking trails, fishermen have formed walking paths along the river banks. Similar to other river bottom areas, the ground surface is hummocky, with small mounds, depressions, and sloughs. WMTU has installed rip-rap at one bank location on the Coldwater River to control erosion. Heavy rainfall and rapid snowmelt occasionally result in extreme flowages from upstream, accompanied with scouring and sedimentation.

The inherent timber stand approaches a beech-maple climax forest (typical in southern Michigan) throughout the east half of the unit. Some high quality timber (red oak and sugar maple) occurs in this area. Generally, the high water table and occasional flooding have favored hydrophytes such as sycamore, black ash, and American elm. While overall forest health is good, the stand contains some poorly formed, multi-stemmed (mainly basswood), and dead timber (mainly elm). In many areas, the forest floor is carpeted with wildflowers and other herbaceous growth. The old growth forest conditions in parts of this unit are attractive to wild turkeys, pileated woodpeckers, scarlet tanagers, and wood thrushes. Since hunting is not permitted at the Dolan Natural Area (and hunting is limited on adjacent private parcels), the white-tailed deer population is large. Subsequently, the forest understory is heavily browsed at some locations.



Probably due to extensive deer browsing, the Unit C understory has remained quite open.



At many locations, the forest floor in Unit C is carpeted with wildflowers and other herbaceous growth.

**=====PLANNED MANAGEMENT ACTIVITIES (PRESCRIPTIONS)=====**  
for the next ten years: 2006 to 2016

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The primary management recommendation for Unit C is to maintain forested, riparian buffer zones at least 200 feet wide along the Coldwater River and Tyler Creek. Maintain buffer areas of at least 100 feet wide around other wetlands (springs, vernal ponds, sloughs, etc.) in the unit. Since the occurrences of Virginia bluebells on the property are fairly close to the Coldwater River, this State threatened species will be protected within the prescribed buffer zones. Streamside buffer areas and stream water quality on the Dolan property are largely impacted by land use patterns upstream (see Appendix Fig. G1). For this reason, it will be important to continue working with upstream riparian landowners, watershed councils, and governmental agencies to implement Best Management Practices, thereby reducing non-point pollution, severe flowages, and other factors.

Figure 6 illustrates four locations for potential wetland enhancement projects. Three of these would involve impounding surface runoff entering the Coldwater River from connecting sloughs; the fourth is a shallow pond excavation (maximum depth 18"). The eastern-most impoundment can be accomplished by placing a riser tube in an exiting culvert. The other impoundments can be created by installing concrete square-notch weirs at the down-gradient end of two sloughs. A concrete water control structure (such as pictured in the following illustration photo #1) will minimize earthwork and potential erosion. Following construction, stock the periphery of the impoundment areas with hemlock or white pine to furnish added shade and maintain cool water temperatures. The water levels in these projects will probably fluctuate with the extent of precipitation and ground water levels. MDEQ permits will be required.

For recreational and educational benefits, refurbish the existing trails through Unit C. Illustration photo #2 demonstrates the use wood chips in establishing a forest trail. Wood chips can sometimes be obtained at no cost from the road commission, and then applied with volunteer labor (e.g. Boy Scout groups). New sections of marked trail can be established to access the spring near Baker Avenue and the mouth of Tyler Creek. To offer educational opportunities, construct elevated platforms (with seating) at these sites, and install signage or kiosks to explain the importance of cold water inputs and watershed management in maintaining a trout fishery (illustration photos 3, 4, and 5). The Tyler Creek confluence vicinity can be utilized as a trout habitat demonstration area (illustration photos 6, 7, and 8). Where appropriate, install and identify a variety of habitat forms including "lunker structures", half logs, bank cribs, and wing deflectors.

In addition to the above referenced structures, trout habitat may be improved with other installations. Deep pools may be created with wedge dams, K dams, and double-wing deflectors. Supplemental trout cover can be provided by placing boulders, bank covers, root wads, brush bundles, fallen trees, and logs.

At this time, a limited number of hardwoods can be harvested from the north central portion of Unit C. This area is accessible through Unit A, fairly well drained, and does not support Virginia bluebells. Selectively cut some commercially valuable mature hardwoods (sugar maples, red oak, walnut, black cherry, etc.) and some defective or low value trees. During harvest operations, take precautions to avoid damaging residual trees. Following

harvest, restock the area with sugar maple, red oak, hemlock, and American chestnut by planting whips enclosed in predator guards.



**Illustration Photo #1.** A concrete weir (such as the face of this catch basin) can be used to impound narrow channels.



**Illustration Photo #2.** The wood chips on this trail retard encroaching vegetation and yield a smooth walking surface.



**Illustration Photo #3.** An elevated platform provides a clear view of this waterway and furnishes auxiliary seating.



**Illustration Photo #4.** This elevated platform and sign educate visitors about the functions and values of springs.



Illustration Photo #5. Signage at this Norton Shores park identifies and explains the Mona Lake watershed.



Illustration Photo #6. This demonstration area in Newaygo County exemplifies stream and fisheries management.



**Illustration Photo #7.** At Bigelow Creek a reinforced stairway guides visitors to a water's edge view of trout habitat.



**Illustration Photo #8.** One of many trout habitat structures on exhibit at the Bigelow Creek demonstration area.

## MANAGEMENT UNIT INFORMATION

MANAGEMENT UNIT NO.:  D  NUMBER OF ACRES:  2.8

### =====MAJOR OBJECTIVES FOR THE UNIT=====

Wetland and Riparian Zone Protection  
Wildlife Management

### =====EXISTING CONDITIONS=====

**COVER TYPE AND MAJOR SPECIES:** Unit D is a forested/shrub-scrub wetland dominated by Eastern cottonwood, black ash, and black willow. The eastern portion of this wetland area appears to remain saturated or partially flooded throughout much of the year. Thus, it supports more hydrophytic plant species such as willows, silky dogwood, sedges, and wet-soil grasses. The dense understory in the western part of Unit D includes red maple, box elder, honeysuckle, blackberry, raspberry, multiflora rose, grape, and poison ivy. Garlic mustard, avens, jewel-weed, goldenrods, knotweed, and many other forbs cover the ground.

SIZE CLASS: Sawlogs, poles

SOIL TYPE: Alganssee loamy fine sand

SITE QUALITY: Poor    STAND QUALITY: Poor    STAND DENSITY: Low-Medium

**MANAGEMENT UNIT DESCRIPTION:** The 1978 soils map aerial photo (Figure 2) portrays the Unit D area to be without forest cover—possibly in agricultural use. It appears the area was found too wet to farm, and was subsequently abandoned. Fast-growing wetland timber species, such as cottonwood and willow, have since become established. The dense cover and fruit bearing shrubs provide ideal cover and food items for wildlife. Thus, this unit may be especially valuable as winter shelter for deer and as a forage area to migrating songbirds. The partially flooded, eastern portion of Unit D is potentially important as a breeding area for reptiles, amphibians, insects, and micro-fauna.

### =====PLANNED MANAGEMENT ACTIVITIES (PRESCRIPTIONS)=====

for the next ten years: 2006 to 2016

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As a wetland, the primary recommendation for Unit D is to protect it from degradation and perpetuate its particular functions and values. Avoid cutting all trees that provide bank stabilization. Mulch and/or seed bare soil areas. Exclude this zone from ATVs and other activities that could promote soil erosion. Limit the use of chemical pesticide and fertilizer applications within this zone.

To increase the surface water and marsh habitat in the eastern portion of the unit, shallowly excavate a small pond up to 24 inches deep, redressing the bottom with a layer of native topsoil.

Additional management activities in this unit will include trail maintenance/grooming and garlic mustard control.

## MANAGEMENT UNIT INFORMATION

MANAGEMENT UNIT NO.:  E  NUMBER OF ACRES:  4.2

### =====MAJOR OBJECTIVES FOR THE UNIT=====

Timber Stand Improvement  
Aesthetics

### =====EXISTING CONDITIONS=====

**COVER TYPE AND MAJOR SPECIES:** Unit E consists of two early-succession, upland woodlots dominated by black locust. Sub-mature black cherry and box elder are intermixed. Various saplings, honeysuckle, wafer ash, raspberry, and five-finger ivy comprise the fairly open understory. The dense ground cover includes upland grasses, garlic mustard, bouncing bet, goldenrod, stinging nettle, horse nettle, sicklepod, avens, and pokeweed.

SIZE CLASS: Poles/sawlogs

SOIL TYPE: Boyer loamy sand

SITE QUALITY: Good STAND QUALITY: Fair STAND DENSITY: Low (BA=60-80)

**MANAGEMENT UNIT DESCRIPTION:** With frontage on Baker Avenue, Unit E encompasses the driveway entrance and parking area to the property. Due to its high visibility, aesthetic values are a major concern. Similar to Unit D, this area appears in earlier air photos to have been non-forested, possibly utilized as pasture (residual fence and 1978 soils map aerial photo). When left idle, the site proved to be ideal for fast growing black locust. As a transition zone between open field and mature forest or wetlands, Unit E is an important wildlife use area. A variety of songbirds [including Eastern towhee, song sparrow, northern cardinal, chickadee, and woodpeckers], cottontail rabbits, tree squirrels, and deer are expected to frequent this area.

### =====PLANNED MANAGEMENT ACTIVITIES (PRESCRIPTIONS)=====

for the next ten years: 2006 to 2016

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To increase aesthetic beauty, vegetation diversity, and future timber value in Unit E, plant white pine, sugar maple, red oak, flowering dogwood, Canadian redbud, with various other hardwoods and flowering shrubs (tree guards will be needed to eliminate deer browsing). Timber stand improvement (TSI) can be employed to gradually reduce black locust, box elder and other low value trees in the stand, limit timber removal activities within the buffer zone (100-200 feet) adjacent to wetlands and ponds. Black locust, which is very shade intolerant, will not regenerate under forest cover, but will volunteer into open areas (such as Unit A) if permitted.

Safety can be greatly improved at the driveway entrance by removing vegetation to afford a clear view of the traffic on Baker Avenue. After timber removal, occasional brush-hogging will suffice in maintaining visibility.

A bulletin board can be installed in the parking area to educate visitors about Trout Unlimited, the history of Dolan Natural Area, public use opportunities, user rules/restrictions, etc. A supply of site maps, which illustrate hiking trails and points of interest, can be furnished at the bulletin board.

Garlic mustard control efforts can be emphasized in this highly visible and accessible unit.

## MANAGEMENT UNIT INFORMATION

MANAGEMENT UNIT NO.:   F   NUMBER OF ACRES:   3.4  

### =====MAJOR OBJECTIVES FOR THE UNIT=====

Timber Production  
Aesthetics

### =====EXISTING CONDITIONS=====

**COVER TYPE AND MAJOR SPECIES:** Unit F is a small, middle-aged red pine plantation. This 30-40 year-old, even-aged stand contains a few wilding black cherry of similar age. The sparse understory includes ash seedlings, blackberry, grape, five-finger ivy, and upland grasses.

SIZE CLASS: Small sawlogs

SOIL TYPE: Boyer loamy sand

SITE QUALITY: Good STAND QUALITY: Good STAND DENSITY: High (BA=150-160)

**MANAGEMENT UNIT DESCRIPTION:** Some of the red pine crowns in Unit F are now crowded, but no significant die-off has occurred among overtopped trees. Light thinning is needed at this time to increase growth potentials and exclude poorly formed individuals. As a unique timber stand on the property, it provides roosting habitat for songbirds, crows and owls, and winter cover for deer and turkeys. Aesthetically, this area on the property furnishes pine-scented aromas and wispy sounds.

### =====PLANNED MANAGEMENT ACTIVITIES (PRESCRIPTIONS)=====

for the next ten years: 2006 to 2016

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As stated above, a light to moderate thinning is needed in this conifer stand to eliminate small diameter, deformed, twin stemmed, and co-dominant trees. When managing red pine plantations for optimum growth and sawlog production, two pre-harvest thinnings are usually recommended. These thinnings typically occur when the stand is 25-30 and 40-45 years old. In the initial thinning, every other or every third row is completely removed; leaving no more than 700 trees per acre. During the second thinning all remaining trees of poor form (damaged, crooked) are selectively removed; leaving 100 to 150 crop trees per acre. The final harvest of mature, high quality timber occurs when the stand reaches 80 to 120 years of age. Some red pine stands reach 200 years of age, and some individual trees survive to age 400. As an alternative, the mature stand may be retained for aesthetic values and understory plantings of white pine may be installed within the newly created "open" areas. While small red pine saw-logs have some value as fence post material, WMTU may wish to use these logs in constructing bank covers and other trout habitat.

To increase red pine production on the property, Unit F can be expanded to the west—planting that portion of Unit A which is lightly stocked with mixture of conifers and shrubs.

Following proper site preparation, plant 600 to 1000 red pines per acre in this area (refer to the tree planting guide included in Appendix E.



Removal of the twin-stemmed and subdominant trees in Unit F will favor productivity of the residual red pine stand.

## SUMMARY OF PLANNED MANAGEMENT ACTIVITIES

Management activities to be accomplished within the next 10 years

<u>Unit</u>	<u>Acres or Approx.#/Unit</u>	<u>Prescription</u>	<u>Year Planned</u>	<u>Year Completed</u>
A, C, E	2000, 250, 50	Plant conifers	2006-09	
E	100	Plant hardwoods	2006-09	
A	250	Plant shrubs	2006-9	
F	3A	TSI thinning for release of desirable tree species	2006-7	
B, C	15, 75	Selectively harvest mature hardwoods	2006-7	
A, C	½ mi, 1 mi	Mulch, restore existing trail; and create new trail	2007-11	
A, C	2, 2	Install platforms and educational signage	2008-16	
A, B, C	7, 2, 4	Install artificial wildlife/fish structures	2006-8	
A, E	30 A, 4A	Invasive species control	2006-16	
A	15A	Establish native grass prairie	2007-10	
A	15A	Hayfield, crop field, and mowing in rotation	2006-16	
A	1A	Fertilize and plant wildlife food patches	even yrs	
A	0.1A	Enlarge existing deep pond for warm-water fish	2010-16	
C, D	4, 1	Construct shallow water ponds for wildlife	2006-10	

**Notes:**

## **CONCLUSION**

Proper forest management will maximize growth rates, reduce waste, and promote trees of good form and high quality (which ultimately produce higher income as products). Management is also concerned with replanting trees to replace harvested timber. Timber management will enhance a woodland's suitability for many forms of wildlife. Activities such as thinning, weeding, and clear-cutting (for species such as aspen) allow the woodlot to regenerate and produce plants that animals need for food and cover. A diversity of vegetation types and age classes will support the greatest variety of wildlife as well as increase aesthetic benefits.

Funded through the USDA Forest Service, and administered by the MDNR Forest Management Division, the Forest Stewardship Program (FSP) encourages private landowners to actively manage their forest and related natural resources. The Forest Stewardship Management Plan is a detailed plan that addresses several aspects of the environment, including forestry, wetlands, soil erosion, wildlife and fisheries. Once a landowner obtains a FSP plan, he/she may be eligible to apply for financial assistance to implement the plan. A variety of federal cost-share incentive programs such as FLEP, WHIP, CRP, and WRP are available through the 2002 Farm Bill. Contact your county Conservation District office or the MDNR to decide which programs best meet the goals set forth in your plan.

The management suggestions and ideas in this plan should be helpful in achieving many of the landowner's expressed goals. In carrying out the recommended practices, assistance from professional consultants may be required occasionally. Technical assistance, financial aid, on-site evaluation, reference material, etc. can be obtained from the MDNR, U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), Michigan State University Cooperative Extension Service, and other agencies. Various organizations including the Michigan Wildlife Conservancy, Pheasants Forever, Wild Turkey Federation, and local sportsman's groups may also be contacted for support.

## REFERENCES

- Cwikel, W. 1997. Living With Michigan's Wetlands: A Landowner's Guide Tip of the Mitt Watershed Council, Conway, MI, 132 pp.
- Dudderar, G. 1990. Managing Woodlands for Wildlife Dept. Fish and Wildlife, Mich. State Univ., Lansing, MI, 26pp.
- Giles, R.H. 1971. Wildlife Management Techniques The Wildlife Society, Washington DC, 633 pp.
- Linde, A. F. 1969. Techniques for Wetland Management Wisconsin Department of Natural Resources, Madison, WI, 156 pp.
- Manion, P. D. 1981. Tree Disease Concepts Prentice Hall, Englewood Cliffs, NJ, 399 pp.
- Michigan Dept. of Nat. Res. 1996. Michigan's Forests Forest Management Division, Lansing, MI, 32 pp.
- Minnesota Dept. of Nat. Res. 1989. Managing your Woodland for Wildlife St. Paul, MN.
- Payne, N. F. 1992. Techniques for Wildlife Habitat Management of Wetlands McGraw-Hill, Inc., NY, NY, 549 pp.
- Payne, N. F. and F. C. Bryant. 1994. Techniques for Wildlife Habitat Management of Uplands McGraw-Hill, Inc., NY, NY, 840 pp.
- Perkey, A. W. and B. L. Wilkins. 1993. Crop Tree Management in Eastern Hardwoods USDA Forest Service, Morgantown, WV, 57 pp. (+ appendices).
- Sargent, M. S. and K. S. Carter, 1999 Managing Michigan's Wildlife: A Landowner's Guide Michigan United Conservation Clubs, Lansing, MI. 297pp.
- Schrouder, J. D. and C. M. Smith. 1994. Managing Michigan Ponds for Sport Fishing Extension Bull. E-1554. Michigan State Univ. Extension, East Lansing, 67 pp.
- Smith, D. M. 1962. The Practice of Silviculture Wiley and Sons, NY, NY, 578 pp.
- U.S. Dept. of Agriculture, Soil Cons. Service 1986. Soil Survey of Keny County, Michigan, 263 pp. (+ maps).
- Wenger, K. F. Forestry Handbook, Second Edit. 1984. Wiley and Sons, NY, NY, 1335 pp.