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Environmental Assessment for the Northeast Lake Project #29409

Poplar Bluff Ranger District Mark Twain National Forest Wayne County, Missouri



Cover Photo: Example of a salvage and site preparation prescription one year after treatment that removed some trees. This treatment retains large overstory trees and creates openings in the canopy that allows some sunlight to reach the forest floor. Photo by Michael Stevens, District Silviculturist, of the Twin Ponds area on County Road 442 in Wayne County).

For Further Information Contact:

Paul Whitworth, Ph.D.
NEPA Environmental Coordinator
Poplar Bluff Ranger District
Mark Twain National Forest
P.O. Box 988
Poplar Bluff, Missouri 63901
Phone: (573) 996-2153
E-Mail: comments-eastern-mark-twain-poplar-bluff@fs.fed.us

Responsible Official:

Doug Oliver, District Ranger
Poplar Bluff Ranger District
Mark Twain National Forest
P.O. Box 988
Poplar Bluff, Missouri 63901
Phone: (573) 785-1475
E-Mail: comments-eastern-mark-twain-poplar-bluff@fs.fed.us

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CHAPTER 1—PURPOSE AND NEED

INTRODUCTION

What is proposed in the Northeast Lake Project?

The Northeast Lake Project would use timber treatments to move the forest toward historic landscape patterns. Small *stands* (15 acres or less in size) would be harvested to create new *early seral forest* (up to 10 years in age). (The first use of specialized terms appear in *italics* and are defined in the Glossary.) The Northeast Lake Project would improve forest health by harvesting mature oaks, oaks and other trees exhibiting decline, and blown down timber. The project would include work on roads to improve access and to protect soil and water resources, and remove trash dumps. Maintenance would be conducted on ponds to protect water sources to benefit wildlife.

Details of project activities are described in this document and attachments, other published project documents, and the planning project record (Project Record, Poplar Bluff Ranger District, Northeast Lake Compartment Folders, n.d.).

DOCUMENT OVERVIEW AND STRUCTURE

The Forest Service has prepared this Environmental Assessment in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. It also provides the supporting information for a determination to prepare either an Environmental Impact Statement or a Finding of No Significant Impact.

Additional documentation, including more detailed analyses of project-area resources, can be found in the project planning record located at the Poplar Bluff Ranger District Office.

The Environmental Assessment is organized into four chapters:

- **Chapter 1—Purpose and Need for Action:** The chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency’s proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- **Chapter 2—Alternatives Considered:** This chapter provides a more detailed description of the agency’s proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on issues raised by the interdisciplinary team, public, and other agencies. This discussion also includes possible mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- **Chapter 3—Environmental Consequences:** This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by Physical, Biological and Social Environment resource areas; individual

resource topics are addressed under each of these headings. Each resource discussion will address the affected environment, effects of the No Action Alternative, Proposed Action, short-term uses, long-term productivity, and cumulative effects of each alternative proposed for implementation.

- **Chapter 4—Consultation and Coordination:** This brief section provides a list of preparers and agencies consulted during the development of the Environmental Assessment.
- **Appendices:** The appendices provide more detailed information to support the analysis presented in the preliminary assessment.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Poplar Bluff Ranger District Office.

BACKGROUND

Location, Setting, and Background

Where is the general project area located?

The Northeast Lake Project area is located on the Poplar Bluff Ranger District of the Mark Twain National Forest. The general project area is located east of U.S. Highway 67, and east of the St. Francis River and Wappapello Lake. The nearest rural community is Greenville, Missouri, approximately two miles east of the project area. See Appendix A Northeast Lake Project Vicinity Map for the general project area. The “Northeast Lake Project - Vicinity Map” is also included in separate electronic files.

Where is the analysis area located?

Project activities would occur in Wayne County, Missouri. Project locations include: Township 28 North, Range 6 East, sections 1-6, 8-12, 14-17, 20-28, and 33-36; and Township 27 North, Range 6 East, sections 1-3, and 11-13. Township, Range, and Section designations are shown on the electronic file entitled “Northeast Lake Project Area - Index Map for Maps 1-6.”

What are the characteristics of the analysis area?

The project area is characterized by a topography consisting of gently rolling hills typical of Southern Missouri and the region around the project area. The forest found in the project area today is the culmination of years of natural development and active forest management. Like most areas on the Mark Twain National Forest, these hills have had a history of timber harvest and various attempts at cultivation and livestock grazing prior to being abandoned in the early 1900s.

The project area contains a mix of upland forest and closed woodland natural communities generally located on ridges and side slopes. An upland forest has dense tree cover and closed *canopy* with limited to very sparse ground vegetation (Nelson, 2005). A closed woodland exhibits scattered breaks in the canopy with some grass, forbs and shrubs present in the understory (Nelson, 2005). These upland forest and closed woodland areas contain shortleaf pine, oak-pine, white oak, mixed oaks, and black oak-scarlet oak-hickory stands.

What is the background of the project?

The Northeast Lake Project area exhibits widespread oak decline, mature oak stands, and downed timber. Wildlife ponds are deteriorating and being overtaken by the invasive plant watershield. Forest Service roads need maintenance and illegal trash dumps removed. Illegal, user-created roads and trails are causing resource damage and degrading the setting and need to be closed.

PURPOSE AND NEED FOR ACTION

A need exists within the Northeast Lake area to improve forest health, rehabilitate wildlife ponds, improve roads, removal trash dumps, and close illegal trails and roads. This action is needed for several reasons. The Northeast Lake Project is needed to provide wildlife habitat diversity and maintain healthy, sustainable forest conditions. In addition, the proposed action will improve the forest transportation system, protect soil and water resources, and diversify recreation settings and opportunities.

Existing natural vegetative communities differ substantially from the natural communities that were historically present in the area (Nelson, 2005). The project area now contains more trees, a more closed canopy, and less ground vegetation than that which existed pre-settlement (Nelson, 2005).

An estimated 75% of the project area exhibits 70-90% canopy closure (Schanta, 2010). Further, 75% of the area has between 71 and 90 *basal area* (Schanta, 2010). Basal area refers to the area of a section of land occupied by the cross-section of tree trunks and stems at their trunk.

Oak decline and mortality is a pressing concern for forest health in the project area. Most stands of red oak are at the end of their life cycle, and many trees are dead or dying (M. Stevens, Personal Communication, March 1, 2012). Site visits by forest staff have confirmed widespread and serious red oak decline in most stands (Project File, Robinson, S., Report of Field Visit, November 9, 2008; Poplar Bluff District Stand Recon Sheet Field Notes 2009-2010).

A lack of age class diversity exists within the Northeast Lake Project area (Schanta, 2010). Most mature red oak trees are 75-100 years of age (Project File, Poplar Bluff Ranger District, n.d., Northeast Lake FS Veg database, FS Veg extract_veg_cds.dbf May 9, 2011, FS Veg extract_veg_cds.xlsx April 30, 2012.). Old, damaged, and dying oak trees are vulnerable to insect and disease attacks, such as the red oak borer (Donley & Acciavatti, 1980; Kessler & Houston, 1989).

The Northeast Lake Project area lacks early seral habitat, forbs and native grasses. Most of the area contains closed canopy stands with a shaded herbaceous layer (Poplar Bluff District Stand Recon Sheet Field Notes, 2009, 2010).

Approximately 30 wildlife ponds need maintenance to improve pond and dam integrity (Project Record, King, B., Pond Inventory Field Notes, October 8, 2010). Trees, shrubs and saplings are growing on pond dams. Tree roots penetrate the dams which weakens structural integrity.

Watershield, an invasive plant, is overtaking the surfaces of many of these ponds. There are an estimated 15 small wildlife ponds with varying amounts of watershield surface coverage (Project

Record, King, B., Pond Inventory Field Notes, October 8, 2010). Watershield covers the surfaces of ponds and renders them virtually useless as water source for wildlife species.

There are approximately 14.6 miles of National Forest System roads within the project area. (Throughout this document, roads that are part of the National Forest System will be referred to as System roads, while illegal, unauthorized, and user-created roads and trails will be referred to as non-System roads.) Some System roads have deteriorated over time and currently do not meet Forest Service engineering standards. Road maintenance and reconstruction are needed to provide a safe transportation system that is compatible with the natural environment.

There is an estimated 32 miles of known non-System roads present in the project area. Non-System roads occur as illegal, unauthorized, and unplanned user-created roads, off-road vehicle trails, and or abandoned travel ways. Illegal, non-System roads and trails often creates resource damage and degrades the natural setting and experiences of forest visitors. Non-System roads negatively impacts forest resources, safety, and other forest visitors (Hammit & Cole, 1998; Hunt, Lemelin, & Saunders, 2009).

Many non-System roads contain illegal trash dumps that degrade the natural setting and visitor experience. The presence of trash dumps are unsightly. Trash dumps also may contain materials that could pose harm to natural resources and or forest visitors.

The proposed Northeast Lake Project responds to the goals and objectives outlined in the Mark Twain National Forest 2005 Land and Resource Management Plan (2005 Forest Plan) (USDA Forest Service, Mark Twain National Forest, 2005a). Implementation of the Northeast Lake Project and 2005 Forest Plan would move the project area toward the desired conditions described in the 2005 Forest Plan (USDA Forest Service, Mark Twain National Forest, September 2005a).

Consistent with the 2005 Forest Plan, the Northeast Lake Project would move habitat conditions toward their historical natural community types, structure and *composition*. The desired condition would exhibit landscape patterns and functions similar to historic natural conditions and within their range of natural variability. Actions would also be taken to manage habitat to benefit wildlife as directed in the 2005 Forest Plan. Ponds would be managed to protect the dams of wildlife ponds and drinking water to benefit wildlife.

Consistent with the 2005 Forest Plan, Forest Service System roads would be managed to provide a safe transportation system and protect soil and water resources. Consistently, non-System roads and illegal trails would be closed and trash dumps removed to protect forest resources, forest visitors, and their recreation setting and experience.

ROLE OF THE 2005 FOREST PLAN

What is the 2005 Forest Plan, and what is its role in this project?

The Mark Twain National Forest 2005 Land and Resource Management Plan (2005 Forest Plan) (USDA Forest Service, Mark Twain National Forest, September 2005a) guides forest planning. The 2005 Forest Plan reflects agency goals, executive orders, regulations, and agency directives. It also reflects laws such as the Forest and Rangeland Renewable Resources Planning Act.

The 2005 Forest Plan is available at:

http://www.fs.usda.gov/detail/mtnf/landmanagement/?cid=fsm8_045643

The 2005 Forest Plan provides for multiple-use of the forest and its resources. These multiple-use purposes include outdoor recreation, range, timber, watershed, and fish and wildlife. Multiple-use resources are managed to support sustained yield of these forest uses, products and services. The National Forest Management Act, Multiple-Use and Sustained-Yield Act, and Forest and Rangeland Renewable Resources Planning Act require multiple-use management of forest lands.

The Final Environmental Impact Statement to Accompany the 2005 Land and Resource Management Plan (2005 Forest Plan) (USDA Forest Service, Mark Twain National Forest, September 2005b) analyzed the forest-wide effects of the 2005 Forest Plan. For more information, see:

http://www.fs.usda.gov/detail/mtnf/landmanagement/planning/?cid=fsm8_045642

The 2005 Forest Plan specifies goals and objectives for the management of the Mark Twain National Forest. The 2005 Forest Plan links broad agency goals as set forth in law, executive orders, regulations, and agency directives with forest management goals, objectives, standards and guidelines. The goals and objectives convey what the desired condition of forest resources will be in the foreseeable future and are the basis for all project-level planning.

The 2005 Forest Plan, standards, guidelines, and management prescriptions (MP) set parameters which guide the management direction of project-level planning and implementation. Site-specific projects are proposed, analyzed and carried out within the framework of the 2005 Forest Plan and its standards and guidelines. The Northeast Lake Project must be consistent with these parameters (16 U.S.C. 1604(i)). Projects are also considered under the U.S. Fish and Wildlife Service's Programmatic Biological Opinion for the Mark Twain National Forest 2005 Forest Plan (U.S. Fish and Wildlife Service, 2005) and consultation with that agency.

Relevant standards and guidelines from the 2005 Forest Plan that apply to this project are provided in Appendix B.

How does Management Prescription 6.2 apply to the project area?

The Northeast Lake Project area is located within Management Prescription (MP) 6.2 (2005 Forest Plan, pp. 3-37 through 3-39). MP 6.2 goals and objectives allow for enhancement of natural communities, improvement of forest health conditions, and roaded natural recreation experiences. MP 6.2 features management of natural vegetative communities under limited investments to enhance the semi-primitive motorized dispersed recreation experience.

The 2005 Forest Plan vegetation management goals relevant to Management Prescription 6.2 are to:

- Manage natural vegetative communities and their successional stages under limited investment (Adapted from 2005 Forest Plan, p. 3-37);
- Provide wildlife habitat diversity common to managed natural communities (Adapted from 2005 Forest Plan, p. 3-37);
- Provide dispersed recreation opportunities emphasizing Semi-Primitive Motorized ROS [Recreation Opportunity Spectrum] objectives (Adapted from 2005 Forest Plan, p. 3-37);

- Provide for low to moderate production of other resources such as timber products, fish and wildlife, and forage where they do not limit natural vegetative community management opportunities or dispersed semi-primitive recreation objectives (Adapted from 2005 Forest Plan, p. 3-37);
- Respond to disturbance events (storms, wildfires, disease, insect attacks, etc., including oak decline) in a timely manner, and providing timber and wood products to help support sustainable local industry and economic interests (Adapted from 2005 Forest Plan, pp. 1-5 through 1-6);
- Develop and maintain a transportation system which provides the minimum permanent road access needed to meet resource management objectives, while providing for reasonable public access (Adapted from 2005 Forest Plan, p. 1-5);
- Minimize erosion and compaction (Adapted from 2005 Forest Plan, p. 1-3);
- Maintain or enhance the quality of scenic resources to provide the desired landscape character (Adapted from 2005 Forest Plan, p. 1-6).

What is the Desired Condition for MP 6.2 areas as specified in the 2005 Forest Plan?

The desired condition provides a snapshot of what the management area will look like when 2005 Forest Plan goals, objectives, standards, and guidelines are met. The Desired Condition for MP 6.2 is:

- These areas, normally 2,500 acres or larger, provide a semi-primitive motorized environment. Recreation opportunities provide for interaction between users ranging from low to moderate. There is limited motor vehicle access for recreational activities.
- Stand composition will somewhat reflect the character of historical natural communities with the landscape dominated by variable age tree species. The environment may be naturally appearing, but structural characteristics of specific natural communities will be different than their known historical condition.
- Areas exhibiting old growth characteristics comprise 8 percent to 12 percent of the management area, and *regeneration* openings comprise 5 percent to 10 percent of the management area.
- The natural appearing setting has moderately dominant alterations, but these alterations do not draw the attention of motorized observers from trails or primitive roads.
- Only those facilities, structures, utility corridors and developments subject to existing rights are present. (Adapted from 2005 Forest Plan, p. 3-37.)

DESIRED CONDITIONS

What are the desired conditions for the Northeast Lake Project area?

Move Landscapes Toward Their Historic Natural Vegetative Communities

The Northeast Lake Project would seek to maintain, enhance, or restore site-appropriate natural vegetative communities consistent with 2005 Forest Plan Goal 1.1 (p. 1-1). The desired vegetative conditions would be based on the 2005 Forest Plan and Nelson's (2005) text, *The Terrestrial Natural Communities of Missouri*. The desired communities include open woodland, closed woodland and forest natural community types (Nelson, 2005).

Salvage harvest stands would move vegetative conditions toward open and closed woodland natural communities consistent with the 2005 Forest Plan (p. A-3). These communities would usually vary from 40%-90% canopy cover, 40-100 basal area, 5%-40% shrub, and about 30%-40% ground cover. Ground cover would consist of scattered sedges, grasses and forbs with 30%-100% leaf litter.

Increase Vegetative Diversity and Provide Habitat for Wildlife and Management Indicator Species

The forest canopy would be partially open to allow light to reach the forest floor. Openings and increased light would promote vegetative diversity, different age trees, and a healthier *microclimate* for both plants and animals. Herbaceous species would respond to openings and light with an increase in species diversity and plant biomass (McMurray, Muzika, Loewenstein, Grabner, & Hartman, 2007). As an example, timber treatments and opening the canopy promotes native grasses, forbs and other early seral habitat valuable to many wildlife species. Examples of such species include Northern bobwhite quail, Eastern cottontail rabbit, mice, voles, and many other species. (See Bolen & Robinson, 2003; Litvaitis, 2001; Natural Resources Conservation Service and Wildlife Habitat Council, 2007; Thompson & DeGraaf, 2001).

Openings and increased light would benefit certain uncommon plant species. Uncommon plant species such as Rattlesnake master (*Eryngium yuccifolium*), Blazingstar (*Liatris spp.*), Fall panicgrass (*Panicum dichotomiflorum* Michx.), and Coneflower (*Echinacea spp.*) would become more prevalent (M. York-Harris, personal communication, May 4, 2012).

Increased vegetative diversity and a mix of age classes would benefit many wildlife species and *Management Indicator Species* (Fitzgerald & Pashley, 2000). Management Indicator Species include select plants, animals, and natural communities. Effects of actions on these species serve as an indicator of effects to other plants, animal species, and natural communities with similar habitat needs. For more information, see USDA Forest Service, Mark Twain National Forest, Final Environmental Impact Statement to Accompany the 2005 Land and Resource Management Plan (2005 Forest Plan) (2005b) pages 3-115 through 3-129, the Northeast Lake Project Scoping Report, and the Northeast Lake Project 30-Day Comment Report.

Move Landscapes Toward Their Historic Tree Species Composition

Natural communities would include the full range of vegetation composition consistent with 2005 Forest Plan Goal 1.1 (p. 1-1). Landscapes within the project area would be moved toward their historic tree species composition. According to Paul Nelson, Forest Ecologist, Mark Twain National Forest, General Land Office (U.S. Department of Interior, Bureau of Land Management, 2012) survey records indicate that tree species composition for the project area should be predominantly white oak stands (M. Stevens, personal communication, May 3, 2011).

It is estimated that about 50% of the tree species historically present consisted of white oak/post oak trees. About 30% of the species are estimated to have been black oak and 20% as hickory or other species. Areas and openings within the Northeast Lake Project area would be exposed to full sunlight to promote black oak seedlings and saplings (Sander, 1990). The amount of scarlet oak, elm, ash, blackgum, maple and black cherry trees would be reduced. These species currently occupy a much higher percentage of land as compared to historical conditions (Schanta, 2010).

Move Landscapes Toward Their Historic Stand Structure

Stand structure would move toward historic conditions (2005 Forest Plan, p. 1-1). *Regeneration openings* would be distributed proportionately to historical natural communities and range in size from ¼-15 acres (2005 Forest Plan, p. 3-38). Approximately 5-10% of each management area would be in regeneration openings for early seral habitat (2005 Forest Plan, p. 3-37). Desired vegetative conditions by stand are included in stand treatment *prescriptions* (Poplar Bluff Ranger District, Northeast Lake Stand Prescription Forms, 2011-2012).

Provide Wildlife Ponds with Open Surface Water

Wildlife ponds would be free of invasive floating vegetation and would provide access to water for a variety of wildlife species. Pond dams would be free of large vegetation that compromises structural integrity. Fallen woody vegetation on pond dams would remain and provide amphibian habitat. A 100-foot wide buffer of trees and vegetation would exist around each pond to provide shade to moderate pond temperatures. The desired conditions are consistent with the 2005 Forest Plan (p. 2-14).

Provide a Safe Transportation System Compatible with the Natural Environment

National Forest System roads would exist and be safe and compatible with the natural environment. These roads would be designed and maintained to Forest Service standards. Non-System roads would be closed to protect forest resources, forest visitors, and their recreational experiences.

PROPOSED ACTION—PRELIMINARY ALTERNATIVES

A minimum of two alternatives will be analyzed and considered. Under Alternative 1—No Action, the Forest Service would not conduct any management action in the Northeast Lake Project area. Under Alternative 2—Proposed Action, the Forest Service would conduct timber

treatments, designate old growth, maintain ponds, manage System roads, remove trash dumps and close non-System roads. Modification of the proposed action or the addition of alternatives could occur if significant issues or additional management actions not already considered are identified. The alternatives are discussed in the following sections.

Alternative 1—No Action Alternative

This alternative provides a baseline or reference against which to describe environmental effects of the action alternative. This is a viable alternative and addresses concerns of those who may desire that project activities not be conducted. The no action alternative would not receive the proposed management actions. Foregone management actions include vegetation management activities (logging or other timber treatments), herbicide application to ponds, dam maintenance, and all needed road work. The existing conditions would remain and many natural resource conditions would continue to decline.

Alternative 2—Proposed Action

The Northeast Lake Project would conduct resource management activities on National Forest System lands only. Approximately 8,631 acres would be subject to forest management activities (Poplar Bluff Ranger District, Northeast Lake Stand Prescription Forms, 2011-2012). Of that amount, 1,526 acres would be managed as old growth. In addition, 1,057 acres would have understory or timber stand improvement activities conducted only on small trees. Approximately 6,049 acres would be subject to timber treatment(s), and many of these areas may include multiple entries and treatments. Importantly, the various acreages reported for these management activities are not summative due to the nature of multiple entries on the same lands.

All proposed project activities reflect estimates based on field data and analysis in a Geographic Information System (GIS) (Poplar Bluff Ranger District, Northeast Lake Project GIS Database, n.d.). During project implementation, the actual units of measure may vary based on field conditions and standards and guidelines in the 2005 Forest Plan. As examples, numerous flowering and fruiting tree species would be retained to meet visual quality objectives, and wildlife den trees and *snags* would also be retained.

Specific treatment methods are prescribed by compartment and stand and detailed in the electronic file entitled “Forest MGT Treatment Table by Compartment and Stand.” Specific stands can be found by viewing the “Northeast Lake Project Area - Index Map for Maps 1-6,” “Northeast Lake Project Area” and Maps 1-6.

Trees would be cut by mechanical methods including chainsaw and timber felling machinery. Bulldozers may be used in some areas during the creation of openings and or temporary roads. Equipment such as loaders, tractors and skidders would be used in moving logs and loading them onto large trucks for transport to saw mills.

The Northeast Lake Project proposes to:

- Conduct vegetation management and timber treatments on 6,049 acres;
- Conduct timber stand improvement and understory work on 1,057 acres of small-diameter understory trees;
- Designate 1,526 acres for management as old growth;

- Maintain 30 wildlife ponds;
- Control invasive species on 15 ponds;
- Reconstruct 6.6 miles of road;
- Maintain 8.0 miles of road;
- Decommission 27.0 miles of illegal user-created road and trails;
- Remove trash dumps;
- Create 22.2 miles of temporary roads for vegetation management activities that would be decommissioned once activities are complete.

All even-aged and group selections harvests would require *site preparation*. Salvage stands with a residual basal area below 60 would also undergo site preparation.

Vegetation Management Activities

Salvage Treatment

Salvage and Sanitation Harvests—Approximately 4,166 Acres

Most of the stands proposed for salvage or sanitation harvest contain at least 30 basal area of healthy trees. These trees would remain and form open and closed woodlands. Retained (uncut) trees would include shortleaf pine, white oak, post oak, hickory, and blackgum depending on what currently exists in the stand. Other less common tree species would also be retained.

For salvage harvests that result in less than 60 basal area, site-preparation would be prescribed. Site preparation activities would remove older and poorly formed trees that are less than 9 inches in *diameter at breast height*. (Planting suitable native tree species, if needed, may also be conducted on a stand-by-stand basis.) Mechanical and/or hand tool treatments would be used over the next 15 years to perform site preparation post-harvest.

The estimated acres for salvage and sanitation harvests include salvage treatment acres without site preparation and salvage treatment acres with site preparation. The summation of these treatment acres is important for understanding the numbers that are reported in the electronic file entitled “Forest MGT Treatment Table by Compartment and Stand.”

Intermediate Treatments

Timber Stand Improvement—Approximately 873 Acres

Timber stand improvement would be conducted within 10-15 years. Tree planting may also be prescribed in stands that lack adequate existing young trees. These activities would be subject to the availability of funding.

Commercial Thinning—Approximately 697 Acres

Stands thinned in this way would retain an average of 70 basal area. Shortleaf pine and white oak would be the preferred species to retain as standing trees. Other species would be kept standing where those were not available.

Control of Understory Vegetation—Approximately 184 Acres

Understory removal would be conducted using chainsaw felling and or mechanized harvester. These activities would be subject to the availability of funding.

Even-aged Treatments

Approximately 1,043 acres of early seral habitat would be created. Approximately 7% of Forest Service land within the project area would be converted to early seral openings consistent with the 2005 Forest Plan (p. 3-37) direction of 5-10%. These temporary openings would be 15 acres or less in size (2005 Forest Plan, p. 3-37, p. 3-39).

At least 7-10% of each harvest area would be retained in reserve trees or reserve tree groups (2005 Forest Plan, p. 2-28). The reserve(s) would include the largest, long-lived species present of pine, white oak, post oak, hickory and gum. The reserve(s) would also include standing dead trees and cavity or den trees. Reserve and reserve tree groups would be spaced to mimic, as much as possible, natural community structure and composition. The groups would include a combination of at least five trees in each group.

Following harvest in regeneration areas, small older trees, except some fruiting/flowering species, would be cut to stimulate regeneration and early seral habitat.

Seed Tree Harvest with Reserves—Approximately 555 Acres

Approximately 10 dispersed trees per acre would be retained as a seed source. The seed trees along with other reserve trees would be retained indefinitely.

Clearcut Harvest with Reserves—Approximately 488 Acres

Clearcut harvest with reserves is the harvest of essentially all trees that are of low quality, poor form and/or species composition or where temporary openings are needed (Poplar Bluff Ranger District Northeast Lake Stand Prescription Forms, 2011-2012).

Shelterwood Establishment Harvest—Approximately 36 Acres

Shelterwood establishment harvest would reduce the residual basal area to approximately 50 by harvesting low quality or declining black and scarlet oak and other species.

Shelterwood Removal Harvest with Reserves—Approximately 13 Acres

Shelterwood removal harvest with reserves would cut most overstory trees remaining from a previous shelterwood establishment harvest and create temporary openings.

Uneven-aged Treatment

Group Selection Harvest—Approximately 94 Acres

Group selection treatments would harvest commercial size trees over small areas that are 0.3-2.0 acres in size. Treatment prescriptions specify that 1/3 of the area within each stand would be harvested in the current entry for treatment. These stands would be revisited with additional harvests on approximately 20-year intervals.

Other Forest and Wildlife Management Activities

What other forest and wildlife management activities would occur?

Site Preparation Treatments—Approximately 4,506 Acres

Numerous old, small-diameter trees (less than 9 inches diameter at breast height) would be removed to create growing space for new healthy trees and more vigorous tree regeneration (McGee, 1981; Miller & others, 2011).

The estimated acres for site preparation treatments include the acreages within seed tree harvest with reserves, shelterwood establishment harvest with reserves, clearcut with reserves, salvage treatment with site preparation, and 2/3 of each group selection. The summation of these treatment acres is important for understanding the numbers that are reported in the electronic file entitled “Forest MGT Treatment Table by Compartment and Stand.”

Designation of Old Growth—Approximately 1,526 Acres

An estimated 10% of the project area would be designated as *Old Growth*, consistent with the 2005 Forest Plan (p. 3-37) direction of 8-12%. No management activities would occur in the areas designated as old growth.

Pond Dam Maintenance on 30 ponds

Maintenance would be conducted on 30 existing small ponds to improve pond and dam integrity. Chainsaws and hand tools would be used to clear vegetation from the dams. Some removed vegetation, at least 4 inches in diameter would be placed in the north ends of ponds to benefit amphibians and various wildlife species (2005 Forest Plan, p. 2-14). Details on the locations of the ponds are contained within a separate file entitled “Northeast Lake Pond Activities Map.”

Treat Watershed on 15 Ponds

Approximately 15 ponds will be treated with an aquatic-labeled glyphosate herbicide to control watershed. Repeat applications may be conducted as needed. For more detail on the locations of the ponds, see separate file entitled “Northeast Lake Pond Activities Map.”

Transportation System Activities

What road activities would occur in this project?

The Northeast Lake Project proposes to conduct road reconstruction, maintenance and decommissioning, and remove trash dumps. The Northeast Lake Project would also create temporary roads for Forest Service administrative use that would be decommissioned when they are no longer needed.

The locations of System and non-System roads identified for action in the Northeast Lake Project are detailed in the electronic file entitled “Northeast Lake Project Road Activities wo PII.xls.” Project roads are shown on the map entitled “Northeast Lake Project Road Activities Map.” Additional candidate roads, needed easements, and needed special use permit authorizations may be identified and processed as the Northeast Lake Project progresses.

Reconstruct Approximately 6.6 Miles of System Roads

Road reconstruction would be conducted on Forest Service Roads 3118 (Harper North), 3121 (Happy Mine), 3590A (Hickory Fork Spur A), 3601 (Nunley), 3615 (Lost Creek Ridge), and 3637 (Lost Holiday). Road reconstruction would consist of clearing roadside vegetation, installing drainage features, and placing aggregate surface material. In some cases, realignment of the road may be necessary to safely accommodate vehicles.

Conduct Maintenance on Approximately 8.0 Miles of System Roads

Road maintenance would be conducted on Forest Service Roads 3121 (Happy Mine), 3579 (Yellow Ridge), 3590 (Hickory Fork), 3599 (Thornton Creek), 3613 (Holmes Chapel), 3614 (Holmes School), and 3637 (Lost Holiday). Road maintenance may include surface blading, replacement of surface material, mowing and limbing roadside vegetation, cleaning and restoring drainage features, and replacing road signs.

Decommission Non-System Roads—Approximately 27 Miles

All non-System roads would be decommissioned unless under special use permit or easement. These roads would be decommissioned using a barrier of rock and/or earth berms or vegetative slash. Some decommissioned roads would be obliterated and would be planted with native species appropriate to the site. Sterile non-native, annual species (wheat, rye, etc.) may be used as needed in the short-term to mitigate soil erosion. Mud holes that exist on ridgetop roads may be retained as seasonal pools and habitat for amphibians and to benefit various wildlife species.

Create Temporary Roads for Administrative Use—Approximately 22.2 Miles

Temporary roads and skid trails would be created for timber management and or other forest management purposes (2005 Forest Plan, p. 2-31, pp. 2-41 through 2-42). The actual locations and routes of temporary roads will reflect forest environmental conditions, the 2005 Forest Plan, and written agreement between the Forest Service and timber sale purchasers. Once resource management activities are complete, temporary roads would be decommissioned.

Remove Trash Dumps

Any trash dumps found along roads would be removed and properly disposed of given available funding.

Connected Actions

What connected activities may occur as part of the Northeast Lake Project?

Firewood Collection

Tree tops and remnants from timber treatments or other resource management activities would be available to the public as firewood by permit. Standing trees would only be allowed to be taken between November 1 and April 1.

Woody Biomass Collection

Excess small-diameter trees and low-value wood residue from forest management activities may be collected as woody biomass material.

ISSUES

The Forest Service separated identified issues into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, the 2005 Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence.

The Council on Environmental Quality's (CEQ) (n.d.) regulations for implementing the National Environmental Policy Act in Sec. 1501.7 require agencies to “. . . identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3) . . .” Some non-significant issues were raised during public involvement. These issues involved comments by one respondent that were not directed toward site-specific actions, but were made in a general nature that the Forest Service should not build roads or conduct timber harvest. These comments were outside the scope of the proposed action and involved higher level policy and decisions.

As for significant issues, the Forest Service identified two topics raised during internal scoping with Forest Service staff. These issues included concerns about the Indiana Bat and Bald Eagle. The Northeast Lake Project may contain the Indiana Bat and Bald Eagle or their habitats. Section 7 of the Endangered Species Act requires federal agencies to insure that agency actions are not likely to jeopardize the continued existence of federally-listed, threatened and endangered species or modify their critical habitat.

Issue #1: Indiana Bat

Forest Service staff conducted informal consultation with the U.S. Fish and Wildlife Service regarding activities that could affect the Indiana bat (M. York-Harris, personal communication, February 23, 2012). Consultation occurred among the U.S. Fish and Wildlife Service Biologist, Forest Service District Wildlife Biologist, and Forest Service District Silviculturist.

The Forest Service considered the Indiana bat and modified proposed project activities to minimize potential impacts to the bat. Proposals for timber harvest reflect accommodations to provide roost trees and habitat for the Indiana bat. Timber harvests within a 2-mile wide corridor along the St. Francis River were modified by specifying the number of recruitment snags retained as potentially suitable Indiana bat roost trees. It is expected that Indiana bats would stay within a 2-mile wide general corridor from either side of the river.

Approximately 7-15% of the identified harvest areas would be retained (uncut) to provide roost trees for bats. At least 10-15% of affected salvage harvest stand areas would be retained in a variety of patch sizes distributed across the treated stand areas. Appropriate declining trees would also be retained as recruitment snags.

In salvage stands that have ≥ 20 residual basal area, 3 recruitment snags of ≥ 15 inches in diameter would be retained. Where this sized tree does not exist, the next size smaller available tree would be retained. Approximately 868 acres would receive this type of treatment.

Approximately 55 acres of salvage harvest area would have less than 20 residual basal area. Six recruitment snags ≥ 15 inches in diameter would be retained in those areas. For areas where trees are less than 15 inches in diameter, the next largest trees present would be retained.

The Wildlife Biologist would monitor salvage and sanitation treatment areas three years post-harvest. A monitoring visit would be made to each area to determine if a sufficient number of snags exist. If, in the future, an insufficient number of snags exist in any area, additional snags would be created by girdling.

Issue #2: Bald Eagle

The proposed action would protect potential bald eagle habitat near Wappapello Lake. The 2005 Forest Plan (p. 2-6) requires a permanent $\frac{1}{4}$ mile wide old growth corridor along Wappapello Lake. This designation would benefit the bald eagle.

DECISION FRAMEWORK

Given the project's purpose and need, the deciding official reviews the proposed action and the other alternatives in order to make decisions. This Environmental Assessment does not document a decision. The purpose of this document is to disclose the effects and possible consequences of proposed management activities. The decision that will be made is not one of land allocation (for example, suitability for timber harvest, appropriate Management Area designation, and so on). The analysis is also not intended to look at every possible combination of activities. The scope of the decision will be confined to a range of reasonable alternatives that will meet the project's purpose and need on this area of National Forest System lands only.

Based on the analysis documented in this Environmental Assessment, the District Ranger will determine whether there are significant environmental effects requiring the preparation of an Environmental Impact Statement (EIS). If an EIS is not required, the District Ranger will issue a Finding of No Significant Impact (FONSI) and decide whether or not to implement the Proposed Action (Alternative 2) or an alternative course of action to guide the management of these lands over the next fifteen to twenty years.

The District Ranger's decision will be based on the ability of the chosen alternative to meet the project purpose and need while also considering environmental effects and mitigations; agency mission, relevant laws and directives; and public involvement and concerns.

Given the project's purpose and need, the deciding official reviews the Proposed Action (Alternative 2) and other alternatives in order to make a decision. The District Ranger may decide to select:

1. Either the Proposed Action (Alternative 2) or the No Action Alternative (Alternative 1);
2. Modify the Proposed Action (Alternative 2); or
3. Defer making a decision at this time.

Documentation and rationale of any project modifications, mitigation measures, and implementation of standards and guidelines in the 2005 Forest Plan would be made in the decision. Any decision would be implemented in compliance with all federal, state and local laws, regulations or requirements and the 2005 Forest Plan standards and guidelines.

PUBLIC INVOLVEMENT

Scoping

What public involvement was conducted as part of Scoping for the Northeast Lake Project?

The Northeast Lake Project was proposed in May, 2012, and the public invited to comment. Scoping and public involvement was conducted to inform the public of the proposed project and request any comments or concerns that the public may have.

The project was entered into the Forest Service Planning, Appeals, and Litigation System (PALS). The project was originally posted on the Mark Twain National Forest's Schedule of Proposed Action's (SOPA) on April 1, 2010, and updated on April 1, 2012.

A Scoping Package consisting of a Scoping Letter, Scoping Report, public comment forms, project maps and tables were available to the public on the Mark Twain National Forest website. Full Scoping Packages were also maintained at the Popular Bluff Ranger District Office and available to parties who requested that they be mailed all project materials.

A Scoping Letter was mailed to interested and affected stakeholders beginning on May 25, 2012 (Oliver, 2012). The Scoping Letter invited public comment and directed interested parties to the full Scoping Package posted on the Mark Twain National Forest website (<http://www.fs.usda.gov/projects/mtnf/landmanagement/projects>). The letter also listed whom they may contact for further information or to request hard copies of materials.

Scoping letters were mailed (or e-mailed) to approximately 30 individuals and nearby landowners, 23 people affiliated with an organization or business, 17 governmental or elected officials, and 54 tribal representatives listed on the Mark Twain National Forest list of Tribal Chiefs and Heritage Resources Staff (Project Record, Northeast Lake Project Mailing Lists, Correspondence).

Public Service Announcements (PSA) about the Northeast Lake Project were mailed to local newspapers in the vicinity of the project area. The *Daily American Republic* published a PSA entitled "Comments sought on Wayne Co. forest project" (Project Record, *Daily American Republic*, May 31, 2012).

What types of comments were received during Scoping?

All comments received during Scoping were reviewed and considered by the Interdisciplinary Team during a meeting on July 12, 2012 (Project Record, Northeast Lake Project Scoping Results, Public Comments and Response to Comments).

Forest Service staff conducted field site visits with a stakeholder (on August 15, 2012) who had questions and concerns about project activities. Several specific issues were discussed during the

field visit and both parties gained a greater understanding of how the other views the highest priorities for management activities.

Some respondent comments stated that timber harvest, pond maintenance, and road maintenance should be conducted for various environmental reasons. One property owner adjacent to a project area expressed concern about potential runoff into their pond. Other respondent comments included questions about specific forest roads needed to access private property and whether the roads would be decommissioned.

A few commenters requested hard copies of all Scoping Package materials. One respondent expressed concern that copies of all materials are no longer being mailed out to all potential stakeholders.

Several Tribes and other groups commented that they had no concerns with the proposed project. Some Tribes requested to be contacted if human remains or cultural artifacts are discovered during project implementation.

How was the Northeast Lake Project revised based on public Scoping?

Minor adjustments were made to the proposed action based on comments received during public involvement. Proposed treatment on approximately 14.1 acres in Compartment 17 Stand 27 was changed from clearcut harvest with reserves to managing this area as old growth. This change in prescription also resulted in approximately 14.1 acres less site preparation. This change was made due to public comments about managing for visual quality in this area.

The prescribed treatment in Compartment 17 Stand 25 of clearcut harvest with reserves was reduced from 15 acres to approximately 11 acres. Site preparation acres remain the same. This reduction in treatment acres reflected concerns from a private landowner that their pond may be impacted from runoff.

30-Day Comment Period

How was the 30-Day Comment Period conducted?

Notice of the 30-Day Comment Period appeared in the Forest Service Planning, Appeals, and Litigation System (PALS). The 30-Day Comment Package materials were posted through PALS to the Mark Twain National Forest's external website and published on the Schedule of Proposed Action's (SOPA).

A 30-Day Comment Package consisting of a letter, 30-Day Comment Report, public comment forms, project maps and tables were available to the public on the Mark Twain National Forest website. Full Scoping Packages were also maintained at the Popular Bluff Ranger District Office and available to parties who requested that they be mailed all project materials.

Letters and e-mails were sent to interested and affected stakeholders beginning on August 30, 2012 (Oliver, 2012). The letter invited public comment during the 30-Day Comment Period and directed interested parties to the full 30-Day Comment Package posted on the Mark Twain National Forest website (<http://www.fs.usda.gov/projects/mtnf/landmanagement/projects>). The letter also listed whom interested parties may contact for further information or to request hard copies of materials.

Letters for the 30-Day Comment Period were mailed (or e-mailed) to approximately 30 individuals and nearby landowners, 23 people affiliated with an organization or business, 17 governmental or elected officials, and 54 tribal representatives listed on the Mark Twain National Forest list of Tribal Chiefs and Heritage Resources Staff (Project Record, Northeast Lake Project Mailing Lists, Correspondence).

Legal Notice of the 30-Day Comment Period was published in *the Daily American Republic*, the official Newspaper of Record, on August 30, 2012 (USDA Forest Service, Mark Twain National Forest). To ensure that citizens in Wayne County were notified, the legal notice also appeared in the *Wayne County Journal-Banner* on August 30, 2012 (USDA Forest Service, Mark Twain National Forest).

What types of comments were received during the 30-Day Comment Period?

One respondent sent comments asserting that timber harvest, roads, and all actions cause negative effects and provided references to support that position. Another commenter expressed concerns that previous clearcutting has altered water flows in creeks on their property and that the proposed project would increase runoff onto a road at their property. The commenter also stated that the Forest Service has not maintained the road to their property and requested a contact person for road maintenance.

Several Tribes commented that they had no concerns or comments about the proposed project. Some Tribes requested to be contacted if human remains or cultural artifacts are discovered during project implementation. One Tribe requested copies of the 30-Day Comment Report, Archeologist's and State Historic Preservation report, and the Environmental Assessment when it becomes available.

How was the Northeast Lake Project revised based upon responses from the 30-Day Comment Period?

All comments submitted during the 30-Day Comment Period were reviewed and considered and responses developed for each comment (Project Record, 30-Day Comments and Response to Comments). Requests for information and reports were promptly issued to the requesters. Comments related to timber harvest and roads were reviewed by respective specialists and the Interdisciplinary Team. The comments were found to be broad in nature and did not address site-specific locations and activities that were the focus of the Northeast Lake Project.

Comments from the individual that asserted that previous clearcutting has altered water flows in creeks on their property and that the proposed project would increase runoff onto an unmaintained road at their property were investigated by the Popular Bluff District Silviculturist. It was found that decades old harvests in the area were not the cause of the erosion. The non-System road is improperly located next to a stream course. Planned harvest units would not contribute to flooding near the private property.

Importantly, it was found that the commenter was illegally using a creek as a travel route which is not designated as a National Forest System road and is not maintained by the Forest Service. A letter was sent to the commenter detailing how to obtain a special use permit and access routes to travel to the property legally.

While not related to any public comments, the Mark Twain National Forest Soil Scientist and Poplar Bluff Ranger District Silviculturist conducted site visits to specific stands that potentially included riparian areas and sensitive soils to evaluate their suitability for timber harvest (Project File, W. Dillon Monitoring Item #3 – Soil Quality Field Inspection Form, Mark Twain National Forest, 2012). Based on these site visits, 3 timber stand units were dropped from the proposed project due to potential effects to sensitive soils and riparian areas.

PERMITS, LICENSES, AND CONSULTATION REQUIREMENTS

The Forest Service has consulted with the U.S. Fish and Wildlife Service, Missouri State Historic Preservation Office, and recognized Tribes and fulfilled required consultation requirements. Although it was not anticipated that Clean Water Act Section 404 Permits would be required, project information was sent to the U.S. Army Corps of Engineers, St. Louis District Regulatory Branch. Similarly, project information was sent to the Missouri Department of Natural Resources even though it was not anticipated that 401 Water Certification would be needed.

The Endangered Species Act requires Section 7 Consultation with the U.S. Fish and Wildlife Service for any federal action that may have the potential to impact protected, endangered, threatened, or listed species or their habitats. The Forest Service conducted informal consultation with the U.S. Fish and Wildlife Service early as the proposed action was being developed and adapted proposed activities to accommodate U.S. Fish and Wildlife Service requests. The Forest Service also engaged in formal consultation with the U.S. Fish and Wildlife Service. The U.S. Fish and Wildlife Service issued a letter of concurrence and fulfillment of Section 7 Consultation Requirement for the Northeast Lake Project on October 5, 2012 (Project Record, U.S. Fish and Wildlife Service Letter of Concurrence, Amy Salveter, Field Supervisor, U.S. Fish and Wildlife Service).

The National Historic Preservation Act requires consultation under Sections 106 and 110 with the State Historic Preservation Officer for any federal action that has the potential to impact archaeological sites and other historic resources eligible for listing on the National Register of Historic Places. The Forest Service conducted archaeological surveys and consulted with the Missouri State Historic Preservation Office (Gibson, 2012). A letter of concurrence from the Missouri State Historic Preservation Officer was received for the project (Project Record, Letter of Concurrence from Mark Miles, State Historic Preservation Officer, RE: Northeast Lake Project (USDA/FS) Wayne County, Missouri, August 17, 2012).

The Forest Service also informed recognized Tribes of proposed actions to support compliance with the Native American Graves Protection and Repatriation Act. Federal agencies are required to consult with Tribes and engage in government-to-government relations in carrying out the Act. The Act requires protection and repatriation of Native American human remains, sacred objects and other cultural objects to tribal descendants.

Uncertainty About Stormwater Discharge from Logging Roads—Due to a recent court ruling in the National Environmental Defense Center (NEDC) v. Brown, 640 F.3d 1063 (9th Cir. 2011), there is uncertainty whether a National Pollution Discharge Elimination System (NPDES) permit would be required for stormwater discharges from logging roads. On December 7, 2012, the

U.S. Environmental Protection Agency (EPA) issued a rule declaring that logging roads do not require stormwater discharge permits under the Clean Water Act (*77 Fed. Reg. 72920*). However, on June 25, 2012, the U.S. Supreme Court decided to review the Ninth Circuit's decision in *NEDC v. Brown*, and heard oral arguments on December 3, 2012. A decision is expected by June 2013, and could impact the final rule issued by EPA and whether any NPDES permitting requirements apply to stormwater discharges from logging roads. If requirements change during implementation of this project, any necessary permits would be obtained as required by law.

Any permits required by law would be obtained.

Chapter 2—Alternatives

INTRODUCTION

This chapter describes and compares the alternatives considered for the Northeast Lake Project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public.

Some of the information used to compare the alternatives is based upon the design of the alternative (i.e., helicopter logging versus the use of skid trails) and some of the information is based upon the environmental, social and economic effects of implementing each alternative (i.e., the amount of erosion or cost of helicopter logging versus skidding).

ALTERNATIVES

Alternative 1—No Action Alternative

Under the No Action Alternative, current management plans would continue to guide management of the project area. No Northeast Lake Project activities would be implemented to accomplish project goals.

Under Alternative 1, the No Action Alternative, existing resource and setting conditions would continue. Oak decline would continue and oak trees would die off increasing the amount of dead woody debris on the ground. Increased downed woody debris may increase hazardous fuel conditions. Other species that may be undesirable or invasive would replace the oak species as they die off and change the character of the ecosystem and its vegetative characteristics. Decreased productivity and forest health would likely occur.

Other forest areas would continue to grow dense until a natural event such as a windstorm developed openings. The dense growth of vegetation would continue degrading views, develop ladder fuels, and create hazard trees and hazardous fuel conditions. This growth would continue in the absence of silvicultural treatments and other resource management actions.

Forest areas would not be designated and managed as Old Growth. Undesirable and unhealthy forest conditions would likely continue on a path increasingly divergent from the historic and desired conditions.

Wildlife ponds would continue to degrade and eventually fail. Wildlife and amphibian species would suffer the losses of these important watering areas.

Alternative 1 would allow resource conditions to further degrade. User-created and illegal trails and roads would not be closed and resource impacts and damage would likely expand and worsen. Trash dumps would not be removed and would likely expand. Failure to close the user-

created and illegal trails and roads and remove trash dumps would likely promote these and other illegal behaviors by others.

Under Alternative 1, many roads may go unmaintained and further deteriorate causing soil and water impacts. Roads would degrade and vegetation would overtake the road areas reducing access to forest areas. Forest visitors and their vehicles, bicycles and so on may be endangered.

The No Action Alternative responds to the concerns of those who want no vegetation management activities, or “No logging.” The No Action Alternative also serves as a baseline or reference point against which to describe and compare environmental effects of the action alternative. The “Northeast Lake Project Area - Index Map for Maps 1-6” shows the project area that would exist as the No Action Alternative. Simply ignore the lines for the project area. Similarly, specific stands appear on “Northeast Lake Project Area” Maps 1-6; simply ignore the treatment symbols.

Past Actions Relevant to Resource Conditions

Prior to national forest land acquisition, the project area was in private ownership. The area supported numerous small family farms where livestock was raised along with some grain. Burning was used to keep the area open in order to provide grazing forage for livestock (Nelson, 2005).

A review of historic documents and aerial photos indicate that timber harvest occurred on these private lands in the past. Historically, open woodland and closed woodland were the dominant natural community types; there was little or no forest natural community type. Logging at the turn of the century removed most of the large pine, white oak and black oak that historically covered the area.

As a result of past actions, the project area is skewed toward forest and closed woodland natural community types, which constitute an estimated 77% of the project area (Schanta, 2010). This condition is not in compliance with 2005 Forest Plan Management Prescription 6.2.

Once the Forest Service began to acquire the land, burning and open range grazing were gradually curtailed. However, past clearcutting, grazing, and burning by local residents resulted in uniform timber stand ages prior to Forest Service management. As a result of uniform timber stand ages, the red oak component of these stands is now subject to heavy mortality due to their natural life span being exceeded.

Small even-aged harvests in the project area from the late 1970s to the early 1990s have modified this uniform structure somewhat. An estimated 23% of stands in the project area are now 20-35 years old (Project File, Popular Bluff Ranger District, Northeast Lake FSVeg database, n.d.). Less than 5% of stands in the project area have originated since 1995.

Over the past few decades, Mark Twain National Forest foresters have tried various treatments of stands containing a plurality of red oak including thinning, sanitation, and uneven-aged management harvest treatments in an effort to prolong regeneration. More often than not, results have often led to stands in which much of the remaining red oak groups incur mortality before the next entry because the stands collapsed as they reached their biological rotation age.

Present Actions of Relevance

Checkerboard property ownership exists within the project area consisting of private and federal lands. Private lands within the area are a mix of forest and open pasture, and agricultural and residential activities occur in the area. The U.S. Army Corps of Engineers Wappapello Lake Project includes not only the lake, but open fields and lands managed for crops and other early seral habitats.

The Forest Service will soon begin implementation of the Carson Hill and Hickory Creek Salvage Projects (approximately 250 acres or less each). These decisions were recently issued and can begin implementation immediately.

Reasonably Foreseeable Actions of Relevance

Agricultural and residential activities on private lands will likely continue in the future, as well as timber harvest and similar activities. The U.S. Army Corps of Engineers is proposing to implement timber harvest on 2,100 acres at the Wappapello Lake Project directly adjacent to national forest lands within the project area (U.S. Army Corps of Engineers, St. Louis District, Environmental Compliance Branch, 2011). Proposed actions by the U.S. Army Corps of Engineers at Wappapello Lake include the use of uneven-aged timber management (single tree selection and group selection) and prescribed fire. Timber harvest on U.S. Army Corps of Engineers lands will likely commence within a year.

Several Forest Service projects are tentatively scheduled across the Popular Bluff Ranger District. Major landscape projects would likely include the Blackwell Ridge Project (16,603 acres) in Fiscal Year 2014 or so. Smaller project would include the Cattail Creek and Kelley Valley Salvage Projects (250 acres or less each) and Brown's Hollow Project (4,027 acres) for wildlife purposes that would likely involve decisions in Fiscal Year 2013 or so. Projected acreages are tentative estimates only.

Alternative 2—Proposed Action

The Northeast Lake Project proposes to conduct vegetation management and timber treatments on 6,049 acres, conduct timber stand improvement and understory work on 1,057 acres of small-diameter understory trees, designate 1,526 acres for management as old growth, maintain 30 wildlife ponds, control invasive species on 15 ponds, reconstruct 6.6 miles of road, maintain 8.0 miles of road, decommission 27.0 miles of illegal user-created road and trails, remove trash dumps, and create 22.2 miles of temporary roads for vegetation management activities that would be decommissioned once activities are complete. All measures given are estimates.

Details of forest management activities are shown in separate maps that show specific compartments, stands and treatments with details. To locate these details, first open the file entitled "Northeast Lake Project Area - Index Map for Maps 1-6." Next, you would open the file entitled "Northeast Lake Project Area - Map 6 of 6." On Map 6, you would locate the specific stand(s) of interest. Finally, you would compare the stand pattern observed on Map 6 to the map "Legend" on Map 1 or Map 6. By comparing the stand pattern(s) to the Legend, you will be able to identify the specific treatment(s) that the respective stand(s) would receive. You can also open the separate electronic file entitled "Forest MGT Treatment Table by Compartment and Stand" for more details of treatments.

Past, Present, and Reasonably Foreseeable Actions of Relevance

See Alternative 1 sections on *Past Actions Relevant to Resource Conditions*, *Present Actions of Relevance*, and *Reasonably Foreseeable Actions of Relevance*.

MITIGATION MEASURES

Heritage Resources

Prior to the implementation of any ground disturbing activities associated with the project's proposed activities, a heritage resources survey is conducted in those areas in which ground disturbing activities will take place. Site protection measures and other 2005 Forest Plan standards and guidelines would be in place for heritage resources prior to any action. Site avoidance is the preferred mitigation action (standard and guideline) pursuant to the 2005 Forest Plan, Chapter 2, page 2-27, and Forest Service Manual (FSM) FSM 2364.

The Northeast Lake Project would be implemented following applicable 2005 Forest Plan standards and guidelines, and mitigation measures. Cultural mitigation measures were specified in the report to the Missouri State Historic Preservation Officer (SHPO) entitled: *Determination of Eligibility and Effect for Northeast Lake Project Area, Wayne County, Missouri, Poplar Bluff Ranger District, Mark Twain National Forest* (Project File, Mark Twain National Forest Cultural Resources Report No. R2012-09-05-04-462). Cultural resources (CR) mitigation measures applicable to the sites and proposed activities in the Northeast Lake Project include the following:

CR1: Site Avoidance

Avoidance of cultural resources will be understood to require the retention of such properties in place and their protection from effects resulting from the undertaking. Effects will be avoided by implementing the following specific actions:

- (1) Establishing buffer zones around those sites in areas where harvest activities will take place [to include timber harvest as well as construction of skid trails and landings]. Buffer zones will be of sufficient size to ensure that the integrity of the characteristics and values which contribute to, or may potentially contribute to, the property's significance will not be affected. The size of the zones may vary depending on the method of timber harvest to be employed and the height of the standing timber in the stand.
- (2) Routing temporary roads away from archaeological sites.
- (3) Routing road re-alignments to avoid archaeological sites.

CR2: Road Maintenance

Where existing, built Forest Service System Roads that are scheduled for maintenance only, and not for any reconstruction, pass through archaeological sites, road work will be confined to the existing roadway and ditches (see Mitigation Measure CR4 for exception).

CR3: Survey of Landings, Temporary Roads, Skid Trails, Roads to be Reconstructed /Realigned

Not all of these areas have necessarily been surveyed for cultural resources. Some activities will be located in stands in which other activities are also proposed and which have been included in the cultural resources surveys completed so far. In those cases in which these activities will take place outside stands not already included in cultural resources surveys, then cultural resource surveys will be completed prior to project implementation. Appropriate mitigation measures as noted in CR1 and CR5 will be applied prior to project implementation to protect any archaeological sites that may be located in these areas. Consultation with the Missouri State Historic Preservation Officer will be completed prior to project implementation.

CR4: Special Mitigation Measures for the Old Military Road/Natchitoches Trace (23BU1466)

The extant portions of the Old Military Road/Natchitoches Trace will have a no activity buffer zone of 100 feet from the outside edge and a slash reduction zone of an additional 100 feet with an exception in areas where System Roads are within the buffer. Where System Roads are within the buffer, the area between the System Road and the Old Military Road/Natchitoches Trace will be sufficient for one side of a buffer zone. Because the Old Military Road/Natchitoches Trace often approaches and intersects existing modern roads, road maintenance in the vicinity of the Old Military Road/Natchitoches Trace will be monitored to ensure that inadvertent damage to the Old Military Road/Natchitoches Trace does not occur.

CR5: Other Mitigation Measures

If it is not feasible to completely avoid an archaeological site (CR1) and if mitigation measures outlined in CR2 and CR3 are not applicable, then the following steps will be taken. (1) In consultation with the Missouri State Historic Preservation Officer (SHPO), the site(s) will be evaluated against National Register of Historic Places significance criteria (36 CFR 60.4) to determine if the site is eligible for, or appears to be eligible for, inclusion in the National Register of Historic Places. (2) In consultation with the Missouri State Historic Preservation Officer, mitigation measures will be developed which will lessen, or minimize, the adverse effects on the site, so that a finding of No Adverse Effect results. (3) The agreed-upon mitigation measures will be implemented prior to initiation of project activities that have the potential to affect the site.

CR6: Discovery of Cultural Resources during Project Implementation

Although the cultural resources surveys completed for this project are designed to locate all archaeological sites that might be eligible for the National Register, such sites may go undetected for a variety of reasons. Pursuant to the provisions found in 36 CFR 800.13, should any previously unrecorded cultural resources be discovered during project implementation, activities that may be affecting that resource will be halted immediately; the resource will be evaluated by a professional archaeologist; and consultation will be initiated with the Missouri State Historic Preservation Officer as well as with the Advisory Council on Historic Preservation, if required, to determine appropriate actions for protecting the resource and for mitigating any adverse effects on the resource.

Project activities will not be resumed until the resource is adequately protected and until agreed-upon mitigation measures are implemented with State Historic Preservation Officer approval.

COMPARISON OF ALTERNATIVES

This section provides a summary of the effects of implementing each alternative. Information is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives. Outputs of the alternatives are compared in Table 1—Comparison of Alternatives by Key Indicators.

Table 1—Comparison of Alternatives by Key Indicators

	*Alternative 1 - No Action	*Alternative 2 - Proposed Action
Vegetation Management Activities		
Salvage and Sanitation Harvest	0.0 Acres	4,166 Acres
Intermediate Treatments		
Timber Stand Improvement	0.0 Acres	873 Acres
Commercial Thinning	0.0 Acres	697 Acres
Control of Understory Vegetation	0.0 Acres	184 Acres
Even-Aged Treatments		
Seed Tree Harvest with Reserves	0.0 Acres	555 Acres
Clearcut Harvest with Reserves	0.0 Acres	488 Acres
Shelterwood Establishment Harvest	0.0 Acres	36 Acres
Shelterwood Removal Harvest with Reserves	0.0 Acres	13 Acres
Uneven-Aged Treatment		
Group Selection Harvest	0.0 Acres	94 Acres
Other Forest and Wildlife Management Activities		
Site Preparation Treatments	0.0 Acres	4,506 Acres
Old Growth Designation	0.0 Acres	1,526 Acres
Pond Maintenance		
Pond Dam Maintenance	0 Ponds	30 Ponds
Treat Watershed on Ponds	0 Ponds	15 Ponds
Transportation System Actions		
Road Reconstruction on System Roads	0.0 Miles	6.6 Miles
Road Maintenance on System Roads	0.0 Miles	8.0 Miles
Decommissioning of Non-System Roads and Illegal Trails	0.0 Miles	27.0 Miles
Create Temporary Roads for Administrative Use	0.0 Miles	22.2 Miles
Remove Trash Dumps Along System, Non- System and Illegal Roads and Trails	None	As Needed
Connected Actions		
Firewood Collection	By Permit	By Permit
Woody Biomass Collection	No	By Demand

*All reported acreages are estimates.

CHAPTER 3—ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This section summarizes the physical, biological, social and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for the comparison of alternatives presented in the comparison of alternative chart in Chapter 2.

Resource specialists analyze the magnitude of direct, indirect, and cumulative effects of the proposed activities on both short and long-term productivity. Only information necessary to understand the environmental consequences is included in this document. The project record contains all project-specific information, including specialist reports and results of public participation. The project record is located at the Popular Bluff Ranger District Office. Information from the record is available upon request.

The following paragraphs provide definitions of terms used in discussing the environmental effects of proposed activities.

Affected environment (40 CFR 1502.15) is a brief description of the area(s) to be affected by the proposed activities. The description shall be no longer than necessary to understand the effects of the alternatives. **Direct effects** (40 CFR 1508.8) are those occurring at the same time and place as the triggering action (e.g., Prescribed fire causes smoke). **Indirect effects** (40 CFR 1508.8) are those caused by the action, but occur later, or at a distance from the triggering action (e.g., prescribed fire causes smoke, which puts particulates in the air and may cause adverse health effects to nearby residents).

Cumulative effects (40 CFR 1508.7) are the effects on the environment that result from the incremental effect of the action added to the effects of other past, present, and reasonably foreseeable future actions, regardless of whether or not the agency or person undertakes them and regardless of land ownership on which other actions occur. An individual action, when considered alone, may not have a significant effect, but when its effects are considered in addition to effects of other past, present, and reasonably foreseeable future actions, the effects may be significant (e.g., effects of timber harvest from this project in addition to timber harvest from other projects occurring in the same area would be cumulative).

The cumulative effects analysis for each alternative is evaluated separately for each resource and may have different spatial and temporal boundaries. Agencies are not required to list or analyze the effects of individual past actions unless such information is necessary to describe the cumulative effects of all past actions combined. The analysis of cumulative effects begins with consideration of the direct and indirect effects on the environment that are expected or likely to result from the alternative proposals for agency action. Agencies then look for present effects of past actions that are, in the judgment of the agency, relevant and useful because they have a

significant cause-and-effect relationship with the direct and indirect effects of the proposal for agency action and its alternatives.

The USDA-Forest Service uses the most reliable and timely data available. Accuracy from the Combined Data Systems (CDS), Geographical Information Systems (GIS), Natural Resource Information System (NRIS), Forest Inventory and Analysis Database (FIADB), Infrastructures Database (INFRA), Missouri Fish and Wildlife Information System (MOFWIS), and other databases vary in accuracy. All attempts to verify and update this information have been made where possible.

SOIL, WATER, AND RIPARIAN RESOURCES

AFFECTED ENVIRONMENT/EXISTING CONDITIONS

Nelson (2005) classified the general area of the Northeast Lake region of Missouri as Dry Chert Woodland or Dry-Mesic Chert Woodland natural community types. Associated natural communities are Dry-Mesic Forest and Mesic Bottomland forest.

The Land Type Association in the project area is within the OZ14c Black River Ozark Border Subsection Wappapello Oak-Pine Woodland/Forest Hills (Nigh & Schroeder, 2002). The OZ14c Land Type Association consists of moderately dissected hills with over 250 feet of local elevation relief. Elevations in the project area range from 400-800 feet above sea level. Broad, moderately dissected uplands in the area give way to steep slopes and ample valleys. Topographic elevation relief over much of the area averages less than 100 feet but increases near river margins.

This Land Type Association was historically covered in pine and oak-pine woodland and forests on soils that are mainly cherty with low-base saturation that are associated with the Roubidoux and Gasconade Formations. Today, the region is dominated by second-growth oak with some oak-pine forest that is less open than when settlers arrived in the area. The Land Type Association receives little development pressure but small farms often occupy the flatter lowland areas.

A significant portion of the Land Type Association is in public lands managed by the Mark Twain National Forest, Missouri Department of Conservation, and the U.S. Army Corps of Engineers Wappapello Lake Project. The Missouri Department of Conservation lands are not included in the Northeast Lake Project area.

Historically, fire was used to maintain much of the area. Prior to European settlement, a mantle of loess soil, 2-5 feet deep, blanketed southern Missouri, with loess deposits decreasing in depth in the southern most areas of the Ozarks. Loess is a silty type soil derived from glacial deposits that were transported by major rivers and windblown across wide areas. This mantle was extremely productive and provided the substrate for a rich and diverse floral community above ground and an even richer and more diverse floral and faunal community on the ground (Scrivner & others, 1966). Soil conditions of the region have been described as ranging from barrens with soils poor and covered only with grass to rich soils with heavy tree growth (Nigh, 1992; Schoolcraft 1821 as cited in Jacobson & Primm, 1997).

Past land use has resulted in the erosion of much of the loess mantle. Aside from erosion occurring from geologic and other natural processes, erosion is essentially a function of past land use practices (Scrivner & others, 1966). Farming, annual burning and grazing, and the clearcut harvest of pines, began near the turn of the century and continued through the 1930s.

When the timber resources were exhausted, local people turned to farming. Those attempting to pasture the cutover lands had to contend with re-sprouting of hardwoods. Intensive sheep and goat grazing and use of fire were the primary methods for controlling hardwood re-growth and restoring grass cover. Repeated fires exposed the thin Ozark soils to erosion which robbed the hillsides of nutrients essential for both grass and tree growth (Cunningham & Hauser, 1989). With the loss of ground and/or canopy cover, erosion of the loess mantle continued (Jacobson & Primm, 1997). During this period of settlement, it has been estimated that 6-8 inches of surface soil washed away (Law, 1992).

From the 1930s to the end of the 1950s, public land managers became concerned with healing the eroding lands, ending annual forest burning, and establishing young forests. Even so, it was not until 1969 that the period of free roaming livestock ended (Keefe, 1987; Law, 1992). As a result, many of the soils in the Northeast Lake Project area have shallow surface horizons, low available water holding capacities, and relatively low soil fertility.

Past, Present, and Reasonably Foreseeable Actions of Relevance

For more details on past, present and reasonably foreseeable actions related to the project, see Chapter 2, Alternative 1 sections on *Past Actions Relevant to Resource Conditions*, *Present Actions of Relevance*, and *Reasonably Foreseeable Actions of Relevance*.

MANAGEMENT CONSIDERATIONS

Management considerations describe soil characteristics that may be affected by implementation of Alternative 2, the Proposed Action. The primary management concerns for soils in the project area are rutting, compaction, and erosion; especially for ridgetop soils with a fragipan that can perch water tables. The dominant soil types in the project area are Captina-Scholten complex and Clarksville-Scholten complex which are moderately well-drained to somewhat excessively drained. To a lesser degree, Yelton-Scholten and Captina soil series are present in some areas of the project area. Fragipans may slow drainage on Captina-Scholten, Yelton-Scholten, and Captina soils.

The use of heavy equipment required to harvest trees creates a risk of soil disturbances that could reduce the productivity of forest soils. The resulting soil disturbances could contribute to reduced water infiltration rates, increased runoff and sediment delivery to streams, and demonstrated poor land management. Soil disturbances resulting from timber harvests can be limited by using the appropriate equipment, avoiding operations during wet periods, and by careful monitoring during harvest operations. When disturbances occur, their potentially negative effects can be reduced by remedial actions such as tillage, the reestablishment of drainage patterns, and or implementing erosion control.

A brief listing of potential soil issues and concerns associated with timber harvest include the following:

- **Compaction:** Compaction is likely one of the leading causes of soil degradation resulting from timber harvest operations (Brais, 2001). The immediate (direct) effects of heavy

equipment on soil properties are: a) increased soil resistance to penetration; b) reduced conductivity of soil to water and gas flow through a reduction in the size, continuity, and total volume of pores, especially large pores; and c) reduced number, size, and/or strength of structural aggregates. The distribution of these effects within the soil profile is a function of ground pressure and total load (ground pressure X contact area of the tire or track), soil characteristics (e.g., texture, structure), and moisture conditions at the time of operation.

Soil compaction commonly reduces the growth of young trees that regenerate on the site following conventional harvest (Greacen & Sands, 1980). Severely compacted forest soils could remain compacted for decades (Froehlich, Miles, & Robbins, 1985). Even in cold climates where freezing and thawing are assumed to loosen soil to considerable depths, the bulk density of compacted soil decreases slowly (Corns, 1988; Voorhees, 1983).

- **Displacement:** Displacement refers to the excessive mechanical relocation or removal of surface minerals and or organic soil layers sufficient to reduce long-term productivity and the biodiversity of soil dependent flora and fauna. This is especially important because most of the soil nutrients are held in the surface horizons (Brady, 1974). Mixing mineral and organic soil materials is not considered detrimental soil displacement. However, its effects must be assessed on a case-by-case basis.
- **Puddling:** Puddling is the result of the destruction of the natural structure of a mineral soil when the ground is too wet or saturated. Fine-textured soils containing high amounts of clay are more susceptible to puddling type disturbances. Puddling usually results in a reduction of macropore space by 50% or more in severely damaged areas; this condition may restrict or even prevent the infiltration of water at the ground surface, causing erosion by surface runoff conditions.
- **Ground Cover:** A lack of adequate effective ground cover usually results in accelerated surface erosion. Effective ground cover can include low growing vegetation including lichens and mosses, and rock, litter, and duff. The amount of effective ground cover needed to prevent erosion varies by local climate, slope and soil texture.

Another consideration is timber harvest on soils located on steeper slopes. Soils on steep slopes are susceptible to erosion, especially on droughty, south-facing aspects. When disturbed by harvest activity, soils with steep slopes and southern aspect conditions may be subject to erosion levels in excess of standards specified in the 2005 Forest Plan.

Relatively few timber stands in the Northeast Project area occur on slopes greater than 35%. Portions of stands with slopes exceeding 35% would be excluded from timber harvest. Timber harvest would not occur in stands with predominant slopes exceeding 35%, in accordance with the 2005 Forest Plan.

SOILS

The Soil Survey of Wayne County, Missouri (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture 2005), was reviewed and considered during this soil analysis. The soil survey is available at:

http://soildatamart.nrcs.usda.gov/Manuscripts/MO223/0/Wayne_MO.pdf

The Soil Survey of Wayne County, Missouri, describes numerous soil characteristics that are relevant to the Northeast Lake Project. The ground cover in the project area is primarily leaves, sticks and other organic matter. Rocks are scattered on the surface. Puddling and soil compaction are concerns due to seasonal perched water tables extending 2-3 feet below the ground surface in some soils.

According to the soil survey, the project area is gently sloping to steep, with soils that are somewhat excessively drained and moderately well-drained. They are formed in residuum from cherty dolomite or cherty limestone on steep side slopes and narrow ridgetops. A minor amount of sandstone derived soils are also present. Erosion hazard is slight on slopes less than 35% and moderate to severe on slopes greater than 35%. Equipment limitations are slight to moderate on slopes less than 35% and severe on slopes exceeding 35%.

Permeability is moderately rapid. Permeability is moderate in the upper layers and slow in soils with fragipans. Extended periods of rain or seasonal high water tables may make slowly permeable soils inoperable at times.

WATER

The Northeast Lake Project area lies within the Upper St. Francis Hydrological Unit Code (HUC 08020202) (Missouri Department of Conservation, 2012a). The Upper St. Francis basin is a subwatershed of the much larger St. Francis hydrologic unit (drainage basin) within the Lower Mississippi-St. Francis Sub Region.

The upper subbasin includes the area above Wappapello Dam (Missouri Department of Conservation, 2012b). The headwater area is dominated by igneous rock in the Ozark uplift, followed downstream by sandstone and dolomites. Impervious rock in the upper basin limits infiltration and subsurface flows causing rapid runoff, flash flooding, and a poor aquifer with unstable base flows. Basin streams exhibit good water quality and most streams are classified as full use attainment, but some streams have minor problems. Two permitted water supply surface withdrawals exist in the upper subbasin.

Much of the Northeast Lake Project area flows directly into the St. Francis River/Wappapello Lake system. Northern and western portions of the project area flow into the East and West Forks of Lost Creek, Hickory Flat Creek, and Little Creek before eventually draining into the St. Francis River/Wappapello Lake system. There are no published monitoring stations on these streams.

There are no perennial streams on national forest lands in the Northeast Lake Project area (Missouri Department of Conservation, 2012a). There are small ephemeral and intermittent drainages on national forest lands which flow into the previously mentioned creeks. Holliday Creek is the only ephemeral stream with a name, but approximately 58 other unnamed ephemerals originate from national forest lands in the project area.

During large rain storm events, surface water within the project area would flow overland into the West Fork Lost Creek, East Fork Lost Creek, Perkins Branch, Hickory Flat Creek, Little Creek and downstream into Lake Wappapello and the St. Francis River system (Missouri Department of Conservation, 2012a).

Classification and Designated Uses

Classification and State of Missouri water quality standards are defined in the Code of State Regulations for the Missouri Department of Natural Resources, Division 20, and Chapter 7, page 31 (Missouri Secretary of State, 2010). There are no designated “Outstanding National or State Waters ” within the Northeast Lake Project area.

The Missouri Department of Natural Resources, Water Protection Program (n.d.) designates potential stream and lake uses based on state water quality standards and as an impaired beneficial use or other unimpaired use not affected by pollution for specific uses. The potential uses of waters may include protection of aquatic life, whole body contact recreation (swimming), public drinking water supply, livestock and wildlife watering, and secondary contact recreation (fishing and boating), irrigation, and industrial water. See Table 2—Water Bodies and Their Designated Uses in the Northeast Lake Project Area for more details.

Table 2—Water Bodies and Designated Uses in the Northeast Lake Project Area

Water Body Name	Designated Uses
West Fork of Lost Creek East Fork of Lost Creek Perkins Branch Hickory Flat Creek Little Creek	Protection of warm water aquatic life and human health (fish consumption) Livestock and wildlife watering Category B - Whole body contact recreation (Secondary contact recreation - fishing, wading, & boating, but not swimming)
Lake Wappapello – which includes U.S. Army Corps of Engineers lands, but, within 0.25 miles of national forest lands	Protection of warm water aquatic life and human health (fish consumption) Livestock and wildlife watering Category A - Whole body contact recreation – includes swimming

There are no streams designated for industrial use or as a drinking water supply within the project area.

Missouri is a riparian water rights state (Styron, n.d.). Under riparian water rights, the quantity of water withdrawn may not be so much that it adversely affects another riparian water user utilizing water from the same source. Under riparian water rights, landowners have the right to use the water that is beside or below their lands, but they do not own it. The Mark Twain National Forest has no existing or proposed water withdrawals within the project area.

Surface Water Quality Monitoring - 303(d) list

Section 303(d) of the Federal Clean Water Act requires that states identify those waters for which current pollution control measures are inadequate. Adequate pollution control requirements have not yet been put into place and a Total Maximum Daily Load document has not yet been written for these waters.

Impaired waters within the State of Missouri have been reviewed using the Environmental Protection Agency Approved 2010 List - Final Action 2010 303(d) list, approved October 6,

2011 (Missouri Department of Natural Resources, Water Protection Program, n.d.; Missouri Department of Natural Resources, Water Protection Program, 2011). None of the creeks in the Northeast Lake Project area appear on the approved 2010 303(d) list as being impaired. However, Wappapello Lake (which appears on Missouri's lists as Lake Wappapello), Water Identification Number 7336, is listed as impaired for nutrients (chlorophyll, nitrogen, and phosphorous).

According to the Missouri Department of Natural Resources, Water Protection Program (n.d.) webpage entitled "Waters on the 2010 303(d) List but Proposed for De-Listing in 2012," Lake Wappapello ID 7336 has been proposed for delisting of nitrogen as a pollutant for meeting water quality standards. Table notes indicate that many of the nutrients will be removed from the list due to their removal from state standards.

The Missouri Department of Natural Resources, Water Protection Program's (n.d.) website has a posting for the Proposed 2012 303(d) List which includes portions of Lost Creek (Water Identification Number 1617.00 and 3278.00). These portions have been proposed for listing due to pollutants for aquatic macroinvertebrate bioassessments and *Escherichia coli*.

Wappapello Lake is managed by the U.S. Army Corps of Engineers. (Wappapello Lake is the official name of the waterbody as designated by the U.S. Army Corps of Engineers.) There are no national forest lands any nearer than ¼ mile of Wappapello Lake. There will be no timber harvest in the vicinity of the lake, and several of the nearby areas have been designated to be managed as old growth. The proposed Northeast Lake Project timber management activities would not likely affect Wappapello Lake, nor other water resources.

The U.S. Environmental Protection Agency's (1993) Chapter 3 Management Measures for Forestry states:

Sudden removal of large quantities of vegetation through harvesting can . . . increase leaching of nutrients from the soil system into surface waters and ground waters by disrupting the nitrogen cycle Excessive amounts of nutrients may cause enrichment of waterbodies, stimulating algal blooms. (p. 3-4)

Algal blooms are episodes of excessive aquatic plant growth usually associated with a sudden increase in nutrient levels.

According to the Missouri Department of Natural Resources, Water Pollution Control Program (2004):

Available data do not indicate any large detrimental increase in dissolved nutrient concentrations in stream flow as a result of silvicultural activities. Nitrate concentrations of 0.83 mg/l are documented in the stream flow of a Missouri watershed after harvesting. Nitrate concentrations in water samples from a buffer strip are approximately 0.4 milligrams per liter. In all study cases, concentrations have remained below the drinking water standard of 10 ppm for nitrates. (p. 86)

Further, "studies in Missouri have documented that forested areas release less nitrogen to streams than other land uses" (Missouri Department of Natural Resources, Water Pollution Control Program, 2004, p. 86).

Importantly, according to Jacobson (2004):

Downstream effects of timber harvest on dissolved constituents in water will be small. Timber harvest pulses can disrupt nutrient cycling and release pulses of nutrients to streams; however, these pulses are short-lived and relatively small in magnitude. Effects of timber harvest on water quality are certainly small when compared to effects of alternative land uses such as agriculture and urbanization. (pp. 120-122)

Ground Water

For the purpose of resource evaluation, Missouri has been divided into seven groundwater provinces. The project area is located in the Salem Plateau groundwater province. Groundwater quality in the Salem Plateau groundwater province is generally good. In most areas of the province, groundwater quality meets Missouri's public drinking water standards with little or no treatment. The water is generally a moderately-mineralized calcium-magnesium-bicarbonate type.

The most important aquifer in the Salem Plateau is the Ozark Aquifer. Nearly every town, city, and rural water district draw most, if not all, of their water from this aquifer. It also is tapped by a vast majority of private domestic wells. The Ozark Aquifer in the Salem Plateau is recharged by precipitation.

Where the aquifer is deep enough to be saturated, and is overlain by 100 feet or more dolomite, its water quality is generally not adversely affected by surface activities. Water-soluble contaminants introduced through water losing streams and sinkholes will generally follow well-defined flow paths through bedrock conduits. While the contaminant may cause serious water quality problems at the spring where the water resurfaces, deep groundwater aquifers are largely unaffected (Miller & Vandike, 1997).

It would be highly unlikely that groundwater in deep aquifers in karst terrain would be affected by forestry operations using Best Management Practices (United States Environmental Protection Agency, Office of Water, 2005). In many karst areas, subsurface streams are simply surface streams that, after disappearing underground, flow through subsurface conduits to reappear at springs where they become surface streams again.

The proposed Northeast Lake Project and its associated management activities would not contribute to groundwater contamination in shallow water aquifers.

DIRECT AND INDIRECT EFFECTS ON SOIL, WATER, AND RIPARIAN RESOURCES BY ALTERNATIVE

Alternative 1 – the No Action alternative, and Alternative 2 – the Proposed Action, were evaluated to determine if implementation would result in any detrimental effects to the soil, water, and riparian resources. Potential concerns associated with proposed timber harvests, road activities, and pond activities include: impacts due to erosion; impacts on microorganisms such as fungi and bacteria in the soil; compaction and nutrient removal from the soil; soil heating; water quality; sedimentation to streams; and increased ground temperatures.

General Effects of Soil Disturbance

Because soil is eroded off the surface horizon, erosion results in a loss of nutrients for forest productivity (Pritchett & Fisher, 1987). It also results in a loss of biodiversity of thousands of

species of soil microorganisms, which are lost where soil erosion takes place (Pierzynski, Sims, & Vance, 2000; Roesch et al., 2007). In addition, erosion can result in a loss of carbon sequestered in the surface horizon (Boyle, 2002).

Erosion Hazard is rated according to the risk of erosion on forestland where normal practices are used in managing and harvesting trees. A *Slight* erosion hazard rating indicates soil loss is not an important concern. A *moderate* erosion hazard rating indicates that some attention to soil loss is required.

A *Severe* erosion hazard rating indicates that intensive treatments (such as seeding and mulching disturbed areas, water diversions, etc.) or special equipment and methods of operation are required to minimize erosion. Potential erosion hazard is principally based on slope and erodibility, as well as soil depth.

Direct and indirect effects to soils include soil compaction, soil puddling, soil displacement, and soil surface erosion from heavy equipment operation on sites where management activities would occur. Soil surface disturbance is important because it has an impact on soil quality, maintenance, and sustainability. This disturbance would be expected to occur on or adjacent to log skid trails and landings, both during and after harvest activities.

Alternative 1—No Action Alternative

Under Alternative 1, no new management activities would take place, nor any activities associated with Alternative 2. Therefore, no appreciable management-related changes in productivity of the land would occur. Resource management activities by the Forest Service approved under other project decisions or management authorities would be implemented. There would be no impacts to the soil and water resources from Northeast Lake Project management activities since none would be implemented.

Soils would be impacted by regular maintenance and use of roads as well as any other planned and ongoing natural resource management activities. In the absence of wildfire, current runoff and erosion patterns would continue with no appreciable increases expected. Disturbance to the soil and water resources would generally occur only at natural rates. An upland erosion rate of less than 1 ton/acre/year is predicted by Water Erosion Prediction Project modeling for stands on steep slopes in similar soils and near water in the absence of fire (Elliot & Hall, 2010; Heikens, 1999).

Natural processes and functions would continue to occur as dead material decomposes. Actual soil organic matter may increase with an accompanying increase in microorganisms and fungi. Since there would be no harvesting, no carbon would be removed from the forest. Dead and dying trees would decay with carbon released to the atmosphere.

Existing conditions would continue as described in the *General Effects of Soil Erosion* section. Forest areas would remain normally functioning, and soils would remain in good condition unless they are disturbed in areas where the terrain is hilly or steep. The only disturbances to soil and water would be abnormal rainfall (excessively high or low amounts) and possible wildfire. Otherwise, natural conditions would continue. Organic matter would continue to increase, with expected dead and blown-down trees contributing to the overall organic matter collecting on the ground.

Abnormal rainfall volumes could affect soil, water, and riparian areas. Low amounts of rainfall would have little effect on soils, but could substantially decrease stream flows. In dry years, vegetation in riparian areas near intermittent streams would be in poor condition. High amounts of rainfall would increase erosion, and other events, such as wind-thrown trees would be more likely to occur when soils become saturated and unstable.

Under Alternative 1, the No Action Alternative, fuel-loading conditions would not be reduced nor would biomass be removed through silvicultural treatments. Wildfires could occur under conditions of increased fuel loading and be expected to burn at a higher intensity and over a larger area than would have occurred if fires had burned at historical fire frequencies (Guyette & Spetich, 2003; Neary, Ryan, & DeBano, 2008).

Water Erosion Prediction Project modeling conducted for the Pine Ridge Project (2005) on a nearby project area of the Poplar Bluff Ranger District indicated that a high severity fire in an area with conditions similar to those in the Northeast Lake Project area could produce a 10-15 fold increase in soil erosion (depending on slope), and a like increase in sedimentation. According to the model, wildfire produces many times more erosion than do prescribed burns. Predicted erosion and sediment quantities for the Northeast Lake Project are listed in the soil scientist's Water Erosion Prediction Project reports filed at the Poplar Bluff Ranger District office (Project File, Water Erosion Prediction Project reports, January 22-23, 2013).

The condition of National Forest System roads would continue to degrade resulting in vehicle traffic enlarging road corridors in some locations because of attempts to avoid rutting in the center of roads. Traffic would compact the soil in the adjacent forest in avoidance of potholes.

No user-developed trails would be closed. Illegal ATV trails and other off-road vehicle use, and associated soil resource damage, is occurring in the project area and would continue.

Alternative 2—Proposed Action

Under Alternative 2, the Proposed Action, two proposed resource management activities have the greatest potential to affect the soil resource: 1) commercial harvesting; and 2) road maintenance, road reconstruction, and the creation of temporary roads.

Timber Harvest

Timber harvest has the potential to adversely impact soil resources. Timber harvest can result in short- and long-term effects to soil productivity. Short-term effects generally last 3 years or less, and include the recovery period in which disturbed soils become reestablished with vegetative cover. Short-term effects imply that the existing soil profile is left essentially intact. Surface disturbances, such as shallow compaction and removal of vegetation are possible short-term impacts.

Long-term effects are associated with activities which displace the topsoil. Many years are needed for the soil to recover its original productivity when the surface layers are removed. Soil formation typically occurs at a rate of one inch per 200-1,000 years, and depends on many local environmental factors. Severe compaction caused by rutting is an example of a long-term impact. Harvest operations should be suspended during wet periods to limit the risk of rutting.

In conventional harvest operations, the impacts of unbladed primary and lateral skid trails should be short-term. Anticipated soil disturbances caused by skidding include minor soil displacement

and tracking. Temporary roads and log landings are expected to have more adverse impacts to the soil due to the high amount of traffic they receive.

Log landings would be no larger than necessary (approx. 1/4 acre or less) and located on stable, adequately drained soils where skidding is directed away from stream courses. No log landing cleared to mineral soil in the Northeast Lake Project would require more than one acre of land.

Areas within timber harvest units adjacent to skid trails should recover quickly. Research has shown that the upper few inches of soil recovers quickly, within 5 years from minor compaction (Reisinger, Pope, & Hammond, 1992). This is due to additions of organic matter from logging debris, soil biota activity, freezing and thawing, and plant root growth from existing and new vegetation. Recovery from compaction is slower in the 8-12 inch soil depth zone, but compaction is not expected at these depths unless equipment operates in wet conditions.

Soil compaction would occur on log landings and primary skid trails as a result of heavy equipment use with Alternative 2. Areas of concentrated use, such as log landings and primary skid tails are expected to receive the most use and impacts. Specific impacts include rutting and compaction which could increase soil bulk density, and decrease pore space, the infiltration rate, and water holding capacity. These effects are considered detrimental to plant growth. Jordan, Ponder, and Hubbard (2003) reported decreased rates of height growth, dry weight, and nitrogen uptake of red oak (*Quercus rubra*) and scarlet oak (*Quercus coccinea*) as compared to a control following 6 months of growth in highly compacted soil.

The degree and depth of compaction depends on the number of passes made by the equipment, and the moisture content of the soil at the time the passes are made. Changes in pore space do not normally occur on well-drained soils, such as those that occur over most of the project area, until three or more passes have occurred. Compacted areas should be ripped and seeded to help mitigate the effects of compaction and promote revegetation.

Compaction potential would be greater during periods of wet soil conditions. Rutting would occur if equipment operates on wet soils; therefore wet soils should be avoided in logging plans. Seasonal soil wetness is difficult to predict, but when soils are prone to high seasonal water tables, logging during the summer-dry season or on frozen soil is preferred. Harvesting equipment is moderately suited to this ground during periods of dry weather.

When rutting occurs in the harvest area, it is considered a long-term effect. The time required for natural recovery from compaction is determined by a variety of factors, such as the soil's physical characteristics, chemical characteristics, climate, and the severity of compaction. Recovery may be faster where soils are subject to freezing-thawing or wetting-drying cycles. In the absence of site-specific information, the effects of compaction on forest soils may be assumed to persist for several decades (Miller, Colbert, & Morris, 2004).

Soil movement (erosion) can occur on long, unimpeded slopes, where mineral soil material is exposed to raindrop impact and overland water flow. Soil on upper slopes can lose productive topsoil as it moves downslope with water. Soil erosion may occur where bare soil is exposed on a slope as a result of equipment tracking difficulties (such as spinning wheels), bladed skid roads and landings, or where logs are dragged across the soil repeatedly.

The placement of landings on gentle topography prevents long, unimpeded runs. Vegetative soil cover, water diversions, and slash mats from logging debris, which is commonly found on harvested areas, would prevent long, unimpeded runs, and reduce the likelihood of soil erosion.

No timber harvest activities are planned for riparian areas of intermittent or permanent streams. Any riparian areas that may exist downslope from harvest sites would receive minimal effects because they would be protected by buffer strips. These buffer strips should keep erosion from reaching stream beds.

During timber harvest, an initial surge of available plant nutrients would occur once the forest canopy is opened. The resulting increase in soil moisture, surface soil temperatures and residual logging debris would produce ideal conditions for accelerated organic matter decomposition. This would result in increased availability of nutrients in the upper part of the soil profile.

Soil microbial communities are not expected to be adversely impacted by commercial harvests because residual logging debris (tops, limbs, and cull logs) would be left to decay on-site. In a study of the effects of logging methods on soils, Ponder and Tadros (2002) found no significant differences in microbial biomass following whole tree and bole only harvests. Therefore, logging-related soil disturbance on microbial activity does not appear to have long-term effects.

All applicable 2005 Forest Plan standards and guidelines would be implemented to minimize or prevent adverse effects to soil and water resources. In addition to 2005 Forest Plan guidance, the Mark Twain National Forest commonly uses Best Management Practices such as those suggested by Waters (1995). Forest practices to protect soil and water resources and stream courses typically include locating roads on appropriate sites, and the use of water barring, drainage diversions, and so on to reduce impacts from temporary roads, skid trails, and other management actions. Using methods prescribed by the 2005 Forest Plan and Best Management Practices, erosion levels would be expected to return to pre-harvest levels within 2-3 years after treatment.

Timber harvest activities under 2005 Forest Plan and Best Management Practices would be expected to have no effect on Missouri Department of Natural Resources' designated beneficial water uses nor on the water quality or quantity for waterbodies located in or near the project area. Implementing the 2005 Forest Plan and Best management Practices would result in no effect to Missouri Department of Natural Resources' designated beneficial water uses for Little Creek, Hickory Flat Creek, Perkins Branch, or the East or West Forks of Lost Creek. Further, non-point source contaminants from harvest activities, including temporary roads, should not have an adverse effect on water quality and quantity.

The Northeast Lake Project should have no effect on water quality or quantity, contribute to groundwater contamination in shallow aquifers, nor negatively impact the deeper aquifer.

Road Management Activities

Roads affect the physical environment by influencing geomorphic and hydrologic processes. Roads affect geomorphic processes by four primary mechanisms: 1) accelerating erosion from the road surface and prism; 2) directly affecting channel structure and geometry; 3) altering surface flow paths, leading to diversion or extension of channels onto the previously un-channelized portion of the landscape; and 4) triggering interactions among water, sediment, and woody debris at road crossings of streams.

Roads have three primary hydrological effects: 1) they intercept rainfall directly on the road surface and road cut slope banks and intercept subsurface water moving down the hill slope; 2) they concentrate flow, either on the surface or in an adjacent ditch or channel; and 3) they divert or reroute water from flow paths that would otherwise be taken if the road was not present. Most

of the hydrologic and geomorphic consequences of roads result from one or more of these processes.

The degree to which roads influence the watershed and water quality depends on road development standards and the location of the road on the landscape. Ridgetop, midslope and valley floor roads all behave differently based on the topography they cross, the degree and type of interaction with stream networks, the stability and response to storms, and the effects on fire, wildlife and vegetation (Gucinski, Furniss, Ziemer, & Brookes, 2001).

Roads generally contribute the greatest amount of erosion and sediment in any forested area. Road reconstruction, maintenance, and road decommissioning could be expected to result in minimal short-term erosion and sediment increases at the time the treatments are implemented. Importantly, these actions would be expected to ultimately result in long-term decreases in erosion and sediment transport.

Forest Service Manual FSM 2500 – Watershed and Air management, Chapter 2550 - Soil Management (United States Department of Agriculture, Forest Service, National Headquarters (WO) 2010) provides guidance for actions related to soils. Strict adherence to the 2005 Forest Plan standards and guidelines, and any site-specific mitigation measures described in this document, would be expected to minimize soil erosion and sedimentation. In addition, monitoring would be conducted during implementation to ensure that mitigation measures are effective.

Based on Water Erosion Prediction Project (WEPP) modeling, erosion levels could range from 0.4 to 11.2 tons/acre/year for specific timber stands depending on climate, slope, residual soil cover, and soil texture. Soil erosion levels generally return to pre-harvest levels 2-3 years after the harvest is completed. However, erosion control measures such as water diversions, slash matting, and post-harvest seeding would reduce the amount of soil erosion significantly (Elliot & Hall, 2010).

Road Maintenance

Road maintenance activities are preventive measures that are used to stabilize the road, protect road investments, and minimize disturbance to surrounding resources. Activities associated with road maintenance and improvement may include surface blading, replacement of driving surface material, mowing and limbing of roadside vegetation, cleaning and restoring drainage features, and replacing signs. The effects of maintaining 8.0 miles of existing National Forest System roads to 2005 Forest Plan standards would improve watershed conditions by reducing erosion and sedimentation into nearby stream systems that occurs from under-maintained roads.

Road maintenance is the ongoing upkeep of a road necessary to retain or restore the road to the approved road management objective. Activities associated with road maintenance may include surface blading, replacement of surface material, mowing and limbing of roadside vegetation, cleaning and restoring drainage features, and replacing signs.

Road Reconstruction

Some roads in the project area would be reconstructed or reconditioned (with road maintenance), and some temporary woods roads utilized for temporary timber harvest access. Road reconstruction results in the improvement or partial realignment of an existing road. Road reconstruction may increase a road's capacity for traffic or change its original design function.

An example of road improvement would be changing the road's surface from aggregate to asphalt. Road realignment results in a new location of a road or a portion of the road and the treatment of the old roadway.

Road reconstruction consists of clearing vegetation from the roadway, installing drainage features, and adding aggregate to harden the road-driving surface. In some cases, realignment of the road may be necessary. As part of the Northeast Lake Project, 6.6 miles of National Forest System roads would be reconstructed.

Road reconstruction would result in short-term increases in erosion and sediment production levels. However, road reconstruction to Forest Service engineering standards would ultimately result in a long-term reduction in road-related erosion and sediment.

Wayne County Road 538

Wayne County Road CR 538 connects Compartment 6 to Highway D. It follows an intermittent stream through a private farm and residential land. In one location an undersized concrete bridge crosses the stream at an angle too severe to allow log truck traffic. There is an adjacent low water crossing which would need reconstruction to allow short log trucks to pass. This action would cause a temporary increase in sediment until log truck traffic ceases.

Decommissioning Non-System Roads and User-Created Trails

Non-System roads and user-created trails exist that have been used as networks for unauthorized motor vehicle and ATV use. These non-System roads and trails are resulting in significant amounts of erosion. In the long run, closing these roads and trails can be expected to reduce erosion, especially when the road closing includes erosion control measures (Switalski, Bissonette, DeLuca, Luce, & Madej, 2004). Sedimentation resulting from precipitation on compacted surfaces and runoff into the stream system would decrease over time following motor vehicle exclusion. As a result, watershed health would be enhanced over the long run.

Adverse impacts under either action alternative would be unlikely. With the implementation of 2005 Forest Plan standards and guidelines and other mitigation measures, general impacts on national forest land would be expected to be minimal.

CUMULATIVE EFFECTS OF ALTERNATIVE 2 ON SOILS, WATER, AND RIPARIAN RESOURCES

Spatial Boundary

The spatial boundary for the soil and water analysis focuses on the Northeast Lake Project area.

Temporal Boundary

The temporal boundary of analysis considers soil development through geologic time with the historic effects to soils created by humans and other impacts that have affected soil and water resources.

Most of the soils in the project area developed as loess soil—a loamy material formed by glaciers and transported by wind—and in residuum from cherty limestone, dolomite, and sandstone. The soils are old, stony, highly weathered, and acidic, except on some broad ridges and bottomlands (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2005b).

Cumulative Effects

Cumulative impacts on soils over the past 200 years have been generally negative, beginning when the European settlers first came to the Ozark Plateau. As summarized in the *General Effects of Soil Erosion* section, early settlers cleared potential farmlands, especially the fertile areas around streams. These cleared areas were either farmed or, in some instances, converted to cool-grass pastures. In either case, soils were exposed to the effects of farming, logging, equipment and vehicle operations, and use by animals, thus causing increased erosion. There were little, if any, mitigation measures utilized to reduce negative soil impacts.

On national forest lands, past activities have included timber harvest and associated road building and maintenance, the creation of log landings and haul roads, mining, and the construction and maintenance of wildlife openings. Past resource management activities have affected the soils to some degree. Such impacts came from temporary roads, fireline construction, and logging, for example.

Results from field investigations (Project File, W. Dillon Monitoring Item #3 – Soil Quality Field Inspection Form, Mark Twain National Forest, September 26, 2012) indicate that Forest Service activities have had no long-term negative impacts on soil productivity, and minimal impacts on soils. There is no scientific evidence of accelerated erosion in the uplands. Revegetation in areas of past timber harvests have occurred naturally and/or artificially as 2005 Forest Plan standards and guidelines were applied. Further, minimal bare soil was exposed in these past harvest units (M. Stevens, personal communication, September 26, 2012).

Recent activities on the Poplar Bluff Ranger District have included timber sales associated with the Cane Ridge East and West Projects (2007, 2009). Future proposed projects within the Poplar Bluff Ranger District (other than the Northeast Lake Project) include the Ten Mile Project. None of these projects are adjacent to the Northeast Lake Project area.

Alternative 2, the Proposed Action, has the potential to affect soil resources as a result of activities associated with timber harvest. The effects of these activities on soil resources in the project area can be described in terms of short- and long-term effects on soil productivity. Short-term effects are those lasting 3 years or less, and are associated with a recovery period in which disturbed areas revegetate. Short-term effects imply that the existing soil profile is left essentially intact. Surface disturbances, such as shallow compaction and removal of vegetation are potential short-term impacts.

In contrast, long-term effects are associated with activities which displace the upper portions of the soil profile (topsoil). Many years are needed for the soil to recover its original productivity when surface layers are removed.

Estimated acres impacted by the proposed activities are listed in Table 3—Estimated Acres Impacted by Alternative 2—Proposed Action. Estimates are classified as related to potential short-term or long-term impacts to soil productivity. Total impacted acres would be in addition to those affected by current and past use in the North East Lake Project area.

Table 3—Estimated Acres Impacted by Alternative 2

<i>PROJECT ACTIVITY</i>	<i>SOIL EFFECTS</i>		
	<i>SHORT-TERM</i>	<i>LONG-TERM</i>	<i>TOTAL</i>
System Road Maintenance: 8.0 mi.	14.54 ac.	0.00 ac.	14.54 ac.
System Road Reconstruction: 6.6 mi.	12.00 ac.	0.00 ac.	12.00 ac.
Temporary Road Construction: 22.2 mi.	5.38 ac.	26.90 ac.	32.28 ac.
Non-System Road Decommissioning: 27.0 mi.	32.72 ac.	0.00 ac.	32.72 ac.
Log Landing Construction: 329 Landings @ 0.25 ac. each	41.12 ac.	41.12 ac.	82.24 ac.
Primary Skid Trails, 500 ft. to each Landing	40.78 ac.	4.53 ac.	45.31 ac.
Total	146.54 ac.	72.55 ac.	219.09 ac.

Assumptions used for developing Table 3 Estimated Acres Impacted by Alternative 2—The Proposed Action included the following:

1. Haul roads have 10 feet of travel way and 12 feet of cleared right-of-way.
2. System roads have 15 feet of travel way and 17 feet of cleared right-of-way.
3. Temporary haul road construction impacts areas that are currently, and will continue to be, expected to produce biomass in the future. Temporarily using these sites for roads will cause some long-term impacts to soil productivity.
4. Haul road travel way is bladed, and topsoil is displaced.
5. Primary skid trails are unbladed and have a 12 foot width.
6. Log landings will usually be constructed at the end of each temporary road. Log landings are normally 0.25 acre each and 50% of this area receives a long-term impact due to blading and compaction where trucks are loaded, while the balance of the area is unbladed and considered to receive a short-term impact.

Under Alternative 2, the Proposed Action, the amount of land and soils impacted would not be significant. To put the magnitude of land and soil impacts into perspective, the Northeast Lake Project area consists of 6,049 acres that will be receiving one or more forms of treatment. Short-term effects are limited to an estimated 146.54 acres, or 2.42% of the project area. Long-term effects may occur on an estimated 72.55 acres, or 1.19% of the project area.

Dump Cleanup

There are 34 currently known illegal dump sites on national forest lands located adjacent to Forest Service roads within the project area. Dumping along national forest roads is very noticeable. Items dumped illegally include household trash, old appliances, old furniture, dead animals and discarded tires. There are no known chemical hazards associated with these dump sites.

No dump site is located in a perennial stream course. It is difficult to determine how these dump sites have impacted water quality. However, it would be safe to say that every dump site has the

potential to negatively impact water resources, either directly or indirectly. Trash thrown into stream side areas that flood after a hard rain would be washed into watercourses. Trash tossed onto roadsides or a bank of a hill could end up in a stream course.

Alternative 2 would allow for removal of these dumps within the analysis area. Dump cleanup would involve using equipment or manual labor to scoop materials into a truck and dispose of it properly. Removal of refuse would help maintain or improve water quality. When appropriate, “No Dumping” signs would be posted at frequently-used sites. This action would be taken to help prevent future dumping.

Irretrievable and Irreversible Effects

Irreversible effects may occur if unauthorized and illegal, user-created roads and trails are allowed to exist and expand over decades. Such use would not only degrade resources but could also change the characteristics of soil and water resources. Failure to maintain existing roads over decades would result in significant soil and water impacts over time and may generate changes in their physical characteristics that could eventually become irreversible.

SUMMARY OF EFFECTS ON SOILS, WATER, AND RIPARIAN RESOURCES

Implementing the activities proposed in the Northeast Lake Project would allow the Mark Twain National Forest to enhance terrestrial natural communities and move the area towards the desired condition. Additional benefits include a reduction of erosion and sediment from unneeded roads as well as removal of trash dumps, which would improve overall watershed health. Based on review of existing field conditions and the project proposal, activities proposed in this project combined with existing activities is unlikely to produce sufficient long-term impacts to the soil resource to move the Northeast Lake Project area into a detrimentally disturbed condition.

Table 4—Summary of Activity Effects on Water Resources for Alternative 2 overviews the effects of Northeast Lake Project activities.

Table 4—Summary of Activity Effects on Soil and Water Resources for Alternative 2

Activity	Measure (Approximate)	Potential Effects on Water Quality
<p>Use commercial harvest to improve forest health and restore ecosystems. Connected actions include reconstruction and maintenance of System roads and construction of temporary roads which would be obliterated after use.</p>	<p>Vegetation Management</p> <ul style="list-style-type: none"> • Commercial harvest: 6,049 ac. • Commercial Thinning: 697 ac. <p>Transportation:</p> <ul style="list-style-type: none"> • Temporary roads and skid trails (indeterminate) followed by decommissioning - 22.2 mi. • Reconstruct 6.6 mi. of System road. • Maintain 8.0 mi. of System road. 	<p>Sediment generated by silvicultural treatments and associated road construction and operation could enter streams and alter natural relationships between the biota and the stream substrate by changing the condition of the substrate. With proper road maintenance and implementation of Best Management Practices, there would be no effect on Missouri Department of Natural Resources' (MDNR)-designated beneficial water uses.</p>
<p>Use non-commercial thinning to restore natural communities by reducing the basal area to desired levels.</p>	<p>Precommercial Thinning and Understory Control – 1,057 acres.</p>	<p>Using a chainsaw to cut trees without removal of the trees would expose little to no mineral soil. This action would have no effect on MDNR-designated beneficial water uses.</p>
<p>Decommission and rehabilitates non-System roads.</p>	<p>Decommission 27.0 mi. of non-System roads.</p>	<p>Abandoned roads contribute sediment to streams which could lower water quality. Non-System roads and System roads to be decommissioned would be closed; water bars installed, and vegetated. This action would help maintain MDNR-designated beneficial water uses downstream of the project area.</p>
<p>Remove illegal dumps.</p>	<p>34 sites (known)</p>	<p>Existing dump sites invite oil, chemical and dead animal disposal which may pollute streams. Removal of refuse would help maintain MDNR-designated beneficial water uses.</p>

TRANSPORTATION RESOURCES

AFFECTED ENVIRONMENT/EXISTING CONDITIONS

The Northeast Lake Project area is located in the northeast portion of the Poplar Bluff Ranger District; east of US Highway 67 and east of the St. Francis River and Wappapello Lake. The project area is approximately 2 miles from Greenville, in Wayne County. The project area is within a Management Prescription 6.2 area, which emphasizes natural vegetative management under limited investment, while enhancing a semi-primitive motorized recreation experience.

Roads under state jurisdiction normally move people from one major point to another within the state and traverse a large part of the state. State highways are paved to handle large amounts of commercial truck traffic and high volumes of passenger car traffic.

State Highway D, in Wayne County, is designated as a Forest Highway. Forest Highways are eligible for specific Federal Highway funding for improving the road and its related features. According to the 2007 Road Inventory Report for the Mark Twain National Forest by the Federal Highway Administration's Eastern Federal Lands Highway Division (2007), this forest highway is generally in fair condition.

County and Mark Twain National Forest System roads provide localized access within the project area. The county roads have an aggregate surface, whereas Forest Service roads have an aggregate or native surface. County and Forest Service roads are used by passenger and high clearance vehicles, and carry considerably less traffic than state highways. Anyone traveling to the project area is likely to drive upon a combination of state, county, and Forest Service roads.

Privately owned land occurs primarily along the perimeter of the project area and is accessed mainly by state and county roads. Forest Service roads access several private in-holdings. Seven non-System roads are managed under special use permits.

The project area contains 11 National Forest System roads, with a combined length of 15.1 miles. These roads vary in length from 0.6 miles to over 2.0 miles. Most of these roads are single lane and dead-end within the national forest. National Forest System roads are marked with brown, vertical posts showing the road's number and length. Some System roads also have a tree marked with pink paint at the road's designated ending point for motorized travel.

On September 15, 2012 the Mark Twain National Forest updated the Motor Vehicle Use Map (United States Department of Agriculture, Forest Service, 2012, September) for the Poplar Bluff Ranger District in which the project area is located. This map identifies those Forest Service System roads designated for public motorized vehicle use. Motorized use is limited to those vehicles and operators must comply with all federal, state, and local traffic laws and regulations. The map also shows which designated roads have seasonal restrictions.

Public motorized access is prohibited on any Forest Service road not shown on the Motor Vehicle Use Map. This black and white map is free to the public and will be updated annually. ATV operators with a valid Wayne County ATV or UTV permit may use those county roads and any Forest Service System roads shown on the Motor Vehicle Use Map within that particular

county. Mixed-use of the roads by licensed trucks and cars and permitted ATVs/UTVs is a common occurrence.

National Forest System roads are developed and maintained for long-term access and as such provide primary access into the project area for recreation, administration, and commodity production. System roads within the project area are generally located on ridgetops, have been constructed to Forest Service engineering standards, are maintained and signed in accordance with their objective maintenance level, and are considered adequate for use under normal operating conditions.

Any management activity, which increases use or considerably alters normal road conditions or traffic patterns, may be mitigated with appropriate warning and precautionary signing. Additional road maintenance may be required to safely accommodate heavier volumes of traffic. Roads may also require reconstruction in order to allow commercial vehicle access for resource management activities.

In addition to System roads, there are approximately 32 miles of non-System roads on National Forest land in the project area. Non-System roads are roads on Forest Service managed land that are generally not needed for long-term access. Many have been in place since the early 1900s when the area was first harvested for timber. However, they generally aren't needed to accomplish forest management activities.

The condition of non-System roads is usually fair to poor because little or no improvements or maintenance work has ever been done. Those located on ridgetops are relatively stable, except for areas that become soft when wet. Those located on side slopes or riparian areas are less stable and may become entrenched, rutted, or washed out.

These non-System roads have continued to be used for recreational activities, timber harvesting, and other resource management activities. Some of the non-System roads have been decommissioned by the Forest Service or have become inaccessible due to natural vegetation growth, but many have remained open because of continued recreational vehicle use. Motorized use on non-System roads is prohibited, unless written authorization is granted.

Some non-System roads access private property and are under a special use permit. A special use permit authorizes the permit holder to use a non-System road for access to private property. The road is still under the jurisdiction of the Forest Service, but the permit holder is solely responsible for performing any necessary road maintenance.

The conditions of special use permit roads vary. Those special use permit roads that access a primary residence are more likely to be maintained for low-clearance vehicles (passenger cars), while those used to reach property primarily used for agricultural or recreational purposes are generally maintained for use by high-clearance vehicles (trucks and SUVs). Currently, there are seven non-System roads under special use permit within the project area.

All open roads, including both System and non-System roads, receive some degree of vehicular traffic. Use occurs primarily on weekends for recreational driving, hunting, firewood gathering, and other recreational pursuits. Evidence of hunter camps can be seen along several of the roads. A majority of non-System roads within the project area are used frequently by unauthorized high clearance vehicles and ATVs. As stated previously, the Motor Vehicle Use Map prohibits motorized vehicles on non-System roads, without written authorization. However, non-motorized travel, such as hiking, biking, or horseback riding is allowed.

Past, Present, and Reasonably Foreseeable Actions of Relevance

For more details on past, present and reasonably foreseeable actions related to the project, see Chapter 2, Alternative 1 sections on *Past Actions Relevant to Resource Conditions*, *Present Actions of Relevance*, and *Reasonably Foreseeable Actions of Relevance*.

DIRECT AND INDIRECT EFFECTS ON TRANSPORTATION BY ALTERNATIVE

The network of System roads needed for resource management activities and public access is already in place. The need for road maintenance, reconstruction, or decommissioning activities is based on management area objectives, proposed management activities, and the need for resource protection. National Forest System roads are meant to provide safe and efficient access for the public, agency employees, and agency contractors.

The intent of road construction or reconstruction is to provide long-term access into an area with the least amount of disturbance possible. Part of the “least disturbance” objective is to ensure resource damage does not occur after a road has been constructed or reconstructed. Proper construction or reconstruction would minimize disturbance to the area. Road construction or reconstruction increases the degree of soil and vegetative disturbance in the short-term, while providing long-term load bearing strength and stabilization of the surrounding soil and vegetation.

Roads are constructed or reconstructed to provide a minimum standard of road necessary for management area objectives. Road reconstruction would reduce seasonal access restrictions due to wet weather. Road reconstruction consists of clearing vegetation from the roadway, installing drainage features, and adding aggregate to harden the driving surface of the road. In some cases, realignment of the road may be necessary.

Road maintenance is the ongoing upkeep of a road necessary to retain or restore it to its approved road management objective. Road maintenance activities are preventive measures, used to stabilize the road, protect road investments, and minimize disturbance to surrounding resources. Activities associated with road maintenance and improvement may include surface blading, replacement of driving surface material, mowing and limbing of roadside vegetation, cleaning and restoring drainage features, and replacing signs.

Roads identified for decommissioning are not needed for long-term resource management and in many cases are poorly located on the landscape, within or very close to streams and drainages, or on extremely steep slopes that are highly erosive. Road decommissioning eliminates motorized vehicular travel and returns the roadway back to a natural state. The result of road decommissioning is restored hydrology, a reduction in soil erosion and sedimentation, and the growth of new vegetation where the road once existed.

Road decommissioning may involve one or more of the following treatments: blocking access with earthen berms, rock berms, boulders, or slash piles; restoring natural drainage features by removing culverts and re-contouring the area; scarifying the roadbed; promoting revegetation by seeding, planting, or fertilizing; and signing to discourage motorized use of the road. Priority roads for decommissioning are those causing the greatest resource damage, such as from erosion, and/or constituting a risk to public safety.

All road miles in the analysis are estimates and are based on current data in the Mark Twain National Forest's Geographical Information System (GIS) and infrastructure application INFRA database. Some adjustment of estimated miles may occur in order to protect resources, reconcile GIS and INFRA mileage differences, and provide for the application of sound engineering judgment when implementing proposed road projects on the ground.

Alternative 1—No Action Alternative

No changes would be made to the existing 15.1 miles of National Forest System roads within the project area. Routine maintenance on approximately 8.1 miles of System roads would continue. These maintained roads would continue to provide access for both Forest Service management activities and public enjoyment of the area.

No reconstruction of System roads would occur. Without reconstruction, these roads would continue to deteriorate and become less safe to travel upon. Travel would be impeded due to rutting and vegetation growing within or next to the roadway. Without aggregate surfacing, the roads would continue to be a source of soil erosion and sedimentation into nearby streams.

Lack of surfacing material would exacerbate rutting and mud holes when vehicles are driven on saturated soils within the road. Excessive rutting and large mud holes would force drivers to maneuver around them, which could result in the vehicle leaving the roadway or even dragging or hitting the bottom of the vehicle, and thus make driving more hazardous. In addition, trees, bushes, and grasses growing along or within the road would limit sight distance, scratch the sides of vehicles that brush against them, and smack windshields.

No unneeded roads would be decommissioned within the project area. These roads would likely continue to receive unauthorized motorized traffic, diminishing the ability of the roads to revegetate naturally and return the area to a natural appearing environment.

This alternative would not foreclose authorization of the current 5.0 miles of special use permit roads or future potential special use permits for non-System roads used to access private property within the project area.

Alternative 2—Proposed Action

This alternative would address the purpose and need of providing a safe and efficient transportation system at a level that meets the need for resource management and public access. Routine maintenance of approximately 8.1 miles of System road would continue. The effects of road maintenance would be the same as in Alternative 1.

In addition, approximately 7.0 miles of System road would be reconstructed. Road reconstruction would improve motorized access into the Northeast Lake Project area. High-clearance and/or commercial vehicles could safely use reconstructed roads, as drivers would not encounter large mud holes, ruts, or tree limbs whacking their vehicles. Sight distances would also be improved.

Upon completion of road reconstruction, drivers could travel much more safely and efficiently. Due to their hardened driving surface, reconstructed roads would have less erosion, and thus release less sedimentation into nearby streams. The area's recreational experiences would be enhanced by improved driving conditions on the reconstructed roads.

Approximately 27.0 miles of non-System road would be decommissioned. Motorized access on these unneeded roads would be eliminated. Decommissioning would help ensure that drivers are not using unsafe roads. Decommissioning would return the land back to suitable conditions for natural resource production (wood products, wildlife habitat, forage, etc.). These unneeded roads would no longer be a source of soil erosion and sedimentation into nearby streams, springs, seeps, or fens.

Seven non-System roads are currently managed under special use permit for access to private land (5.0 miles total). If it is determined that access is not necessary or no longer needed for any of these roads, they would also be decommissioned.

Table 5—Alternative 2 Road Management Activities provides estimated measures of proposed activities in miles. Table 6—Comparison of Road Management Activities by Alternative provides miles of road activities by alternative.

Table 5—Alternative 2 Road Management Activities

<i>Alternative 2 - Proposed Activities</i>	<i>Measures (Estimated)</i>
System road maintenance on: Forest Service Roads 3121 (0.5 mi), 3579 (1.9 mi), 3590 (0.6 mi), 3599 (0.6 mi), 3613 (2.2 mi), 3614 (1.9 mi), 3637 (0.4 mi).	8.1 miles
System road reconstruction: Forest Service Roads 3118 (0.8 mi), 3121 (1.9 mi), 3590A (1.0 mi), 3601 (1.2 mi), 3615 (1.2 mi), 3637 (0.9 mi).	7.0 miles
Decommission non-System roads not under special use permit.	27.0 miles
Manage non-System roads under special use permits.	5.0 miles

Table 6—Comparison of Road Management Activities by Alternative

<i>Road Management Activities</i>	<i>Alt. 1</i>	<i>Alt. 2</i>
Total miles of System roads	15.1	15.1
Miles of System road to maintain	8.1	8.1
Miles of System road to reconstruct	0.0	7.0
Miles of non-System road to decommission	0.0	27.0
Miles of non-System road managed under special use permits	5.0	5.0

CUMULATIVE EFFECTS OF ALTERNATIVE 2 ON TRANSPORTATION

Spatial Boundary

The Northeast Lake Project area is the cumulative effects boundary for transportation. The Northeast Lake Project area was selected as the appropriate analysis boundary to give the Responsible Official the site-specific context dealing with roads to determine the ultimate effects of the Northeast Lake Project actions.

Temporal Boundary

Cumulative effects for roads will be analyzed for the next 5 years because government (federal, state, and local) transportation planning is normally limited to a five-year period. Government road-related budgets are also difficult to predict beyond a couple of years.

Cumulative Effects

The Northeast Lake Project travel analysis evaluated both System and non-System roads within the project area. These are the types of roads more readily impacted by project actions. The travel analysis evaluated which roads should be maintained, reconstructed, constructed, or decommissioned. The analysis did not identify any new opportunities for motorized trails or areas within the project area.

The Mark Twain National Forest 2005 Land and Resource Management Plan (2005 Forest Plan) calls for decommissioning unneeded roads, with priority given to those roads that pose the greatest risk to public safety or where use is causing unacceptable resource damage, such as soil erosion. This would be applicable to Alternative 2 as discussed previously.

When needed, an existing non-System road may be used to temporarily access project activities, but would then be decommissioned when such activities are completed. This would reduce the amount of new road construction needed and associated sediment movement. Unauthorized use of non-System roads would be reduced or eliminated after roads are decommissioned.

Non-System roads have been identified as current or potential candidates for special use permits. If it were determined that any of these roads provide primary access to private property, then they would not be decommissioned, and would be managed as special use permit roads. The private individual who is issued the special use permit would be responsible for any necessary road maintenance.

The mitigation measures currently employed and found in the 2005 Forest Plans standards and guidelines, such as constructing roads with less than a 10% grade or installing drainage features at appropriate intervals, ensure that the integrity of the roads is maintained. Roads, which were used in the past, will likely be used again.

The Forest Service has 5 maintenance levels for roads (United States Department of Agriculture, Forest Service, Technology and Development Program, 2005). Maintenance Level 5 roads provide a high degree of user comfort and convenience. They are normally double-lane and paved, while some may be aggregate surface and dust abated. There are no Maintenance Level 5 roads on the Mark Twain National Forest.

Maintenance Level 4 roads provide moderate user comfort and travel speeds. Most roads are double-lane and aggregate surfaced. Some roads may be paved, single lane, and or dust abated. Maintenance Level 4 roads on the Mark Twain National Forest are paved.

Maintenance Level 3 roads provide for low speed travel by passenger cars with comfort and convenience as low priorities. They typically are single lane with turnouts and spot surfacing with native or processed material. Maintenance Level 3 roads on the Mark Twain National Forest have an aggregate surface and are generally smooth to drive upon.

Maintenance Level 2 roads are open for use by high-clearance vehicles and minor traffic, such as for recreation or log haul. Maintenance Level 2 roads on the Mark Twain National Forest may

have either an aggregate or native surface and are one-lane. The majority of roads fall under this category.

Maintenance Level 1 roads are typically closed to motorized traffic but may be used for intermittent service and nonmotorized uses. Maintenance on Maintenance Level 1 roads is limited to that needed for resource protection and forest management.

Current Forest Service annual road maintenance budgets have only been adequate for Maintenance Levels 3 and 4 roads, and a small percentage of Maintenance Level 2 roads. Maintenance Level 3 and 4 roads are the most heavily traveled roads on the Forest. In addition to the annual road budget, road maintenance deposits collected through commercial activities (such as timber harvesting) have been used for surface blading and roadside mowing and limbing. In some cases, commercial users of roads have performed road reconstruction and maintenance activities themselves, such as: surface blading, removal of roadside vegetation, or replacement of road surfacing materials, primarily on Maintenance Level 2 roads.

Periodic road maintenance activities would provide a safe and efficient transportation system within the Northeast Lake Project area. Without regular maintenance, future road reconstruction would likely be needed on System roads within 10-20 years.

The 2005 Forest Plan requires an assessment of the types and amounts of traffic found on Forest Service roads. Where public traffic on these roads is primarily due to non-forest activities, the appropriate county should be contacted to determine their maintenance responsibility. However, all Forest Service roads within the Northeast Lake Project area appear to serve mainly Forest Service-related travel activities.

According to Missouri's 2010-2014 Statewide Transportation Improvement Plan (Missouri Department of Transportation, n.d.a, n.d.b), no state highways or routes within the analysis area are scheduled for improvement. Routine maintenance of state highways is expected to continue within the project area. A review of the Missouri Department of Transportation's Plans and Projects for 800 Better Bridges reports, map, and various project listings indicate that no bridges are planned inside the project area (Missouri Department of Transportation, n.d.c).

It is expected that the vast majority of road activities by Wayne County would consist of routine maintenance, such as surface blading, culvert cleaning, and roadside mowing and limbing.

Access to the project area should be safer and more efficient for motorized travel as a result of Forest Service road reconstruction (as identified in Alternative 2) and maintenance of state, county, and Forest Service roads.

The current single lane bridge located on Wayne County Road 538, over an intermittent stream, is not adequate for the commercial hauling of timber. An alternative route would be needed to remove timber in the vicinity of the bridge or shorter logging trucks would need to be utilized. Without an established weight limit, use of the bridge by 80,000 ton gross vehicle weighted trucks is questionable.

The paved surface of State Highways 67, BB, D, and E eliminate surface erosion, but present impacts from winter salt and petroleum product residues from the road surface. Residues come from the paving material itself (asphalt) and leaks from automobiles, trucks, farm machinery and other gas-powered vehicles.

Aggregate roads, in particular Forest Service and county roads, will continue to be sources of sediment that may migrate to area streams. National Forest System roads and county roads represent the same potential source of fine material via erosion that affects water resources as sediment. Aggregate roads are perpetual sources of fine materials (dust and small particles) that have the potential to become sediment in nearby streams.

With routine maintenance, the amount of sediment eroding from roads surfaces would be reduced. An aggregate road would produce a minimum amount of sediment when the road is used infrequently during wet periods, heavy truck traffic is limited, maintenance is performed on a routine basis, or any type of off-road use that disturbs the road is prohibited.

Since Forest Service System roads are normally built and maintained to a higher standard than most private roads (with the possible exception of private roads that directly access homes and are driven by low-clearance passenger vehicles), private roads would be expected to have a greater impact on stream sedimentation from erosion of their road surface materials.

Past transportation system activities, current proposed actions, and reasonably foreseeable future activities do not pose any appreciable cumulative effects on motorized access to or use of the project area or its vicinity for all alternatives.

The preceding analysis was based on the following resources: 1) GIS spatial data and maps; 2) Tabular road data in INFRA; 3) Missouri's 2013-2017 Statewide Transportation Improvement Plan (Missouri Department of Transportation, n.d.a, n.d.b); 4) Missouri State Safe and Sound Bridge Improvement Project (Missouri Department of Transportation, n.d.a, n.d.b); and 5) Monitoring by personal observation. Information was also borrowed from the soils analysis using the Water Erosion Prediction Project soil erosion model (USDA Forest Service, n.d.a).

Irretrievable and Irreversible Effects

Irreversible effects may occur if unauthorized and illegal, user-created roads and trails are allowed to exist and expand over decades. Such use would not only degrade resources but could also change the characteristics of soil and water resources. Failure to maintain existing roads over decades would lead to irretrievable losses of investment as the roads degrade and revert to natural conditions.

SUMMARY OF PROJECT EFFECTS ON TRANSPORTATION AND RESOURCES

Implementing the activities proposed in the Northeast Lake Project would allow the Mark Twain National Forest to continue to provide safe and efficient National Forest System roads needed for long-term resource management and public access with the least disturbance. Project actions and proper construction, reconstruction, and maintenance would stabilize roads, protect road investments, and minimize disturbance to surrounding resources. Road decommissioning would eliminate unauthorized and illegal motorized vehicular travel and return the roadways back to a natural state. Implementing the proposed action with mitigation measures in the 2005 Forest Plan standards and guidelines would ensure the integrity of the roads and reduce the amount of sediment eroding from roads.

VEGETATION RESOURCES

AFFECTED ENVIRONMENT/EXISTING CONDITIONS

The project area is dominated by tree cover with most stands lacking thriving populations of forbs or grasses. Vegetation includes trees, shrubs, forbs and grasses. Vegetation types have been assigned to each stand based on the dominant species found in the stand. Vegetation types identify the mix of species in the stand and their relative abundance.

The majority of the project area is currently upland forest and closed woodland natural community complexes which are generally located on the ridges and side slopes. Within the project area, 95% of the area has a canopy closure greater than 50%, equivalent to closed woodland and forest community groups. Closed tree canopies are inhibiting understory growth of forbs and grasses.

On National Forest System lands in the project area, predominant forest types include approximately 5.3% (775 acres) shortleaf pine; 7.8% (1,162 acres) shortleaf pine-oak; 21.7% (3,197 acres) Black oak-Scarlet oak-Hickory and Scarlet oak; 22.4% (3,294 acres) white oak; and 42.7% (6,297 acres) various types of mixed oak stands (Schanta, 2010). However, according to Mark Twain National Forest's Forest Ecologist Paul Nelson, prior to European settlement, mixtures of white oak, black oak and shortleaf pine were the principal tree species within the project area (M. Stevens, Personal Communication, March 1, 2012). Currently, scarlet oak and the combined hickory species are the third and fourth most common species in the project area.

Canopy closure was also much less dense prior to settlement (Nelson, 2005). Canopy closure is now estimated to be above 80% in 2/3 of the project area (Schanta, 2010). The 2005 Forest Plan classifies woodland canopy closures as less than 80%. Also, shade tolerant and fire intolerant tree species are much more prevalent in the understory than was typical historically (Nelson, 2005).

Past, Present, and Reasonably Foreseeable Actions of Relevance

For more details on past, present and reasonably foreseeable actions related to the project, see Chapter 2, Alternative 1 sections on *Past Actions Relevant to Resource Conditions*, *Present Actions of Relevance*, and *Reasonably Foreseeable Actions of Relevance*.

SILVICULTURE OBJECTIVES AND EVALUATION CRITERIA

A priority management objective of the Northeast Lake Project is the restoration of its historical white oak, black oak and shortleaf pine composition. Silvicultural objectives for the project area include:

1. Enhance the conditions of terrestrial natural communities.
 - Stimulate the ground surface vegetation by creating openings in the canopy to allow light to reach the ground surface.
 - Create early seral habitat within the context of historical variability.
 - Increase stand age class diversity.

2. Improve current forest health conditions.
 - Remove trees exhibiting signs of oak decline and reduce risk of oak decline.
 - Promote long lived species.
3. Increase local economic activity.
 - Provide commercial wood products.
 - Employ workers in stand tending activities.
4. Address hazardous fuel conditions.
 - Reduce potential hazardous fuel accumulation.

DIRECT AND INDIRECT EFFECTS ON VEGETATION BY ALTERNATIVE

Alternative 1—No Action Alternative

Alternative 1 provides a basis of comparison for action alternative(s). It also responds to the issue that some people feel that logging should not take place on national forest lands.

Alternative 1 would be the least beneficial approach for attaining vegetation objectives of Management Prescription 6.2. This alternative would not meet the objective of restoring and enhancing natural communities in Management Prescription 6.2. Many stands of black oak and scarlet oak are past their rotation ages as defined by the 2005 Forest Plan (page 2-28). Their current ages put them at high risk for oak decline (Dwyer & others, 2007). Alternative 1 would not address the issue of oak decline and mortality and could increase the susceptibility of the forest to attack by insects and disease in the future.

Oak decline is not necessarily predictable due to its association with environmental factors, but the risk can be associated with increased age. Kabrick, Day, Jensen, and Wallendorf (2008) determined that cumulative mortality of black and scarlet oak was not significantly different among ecological land types. These authors also report that dominant and co-dominant black and scarlet oak >12" DBH or diameter at breast height, have mortality rates of about 20% per decade and that mortality rates were roughly twice those of white oak and post oak.

Trees would mature and become less vigorous, and tree density would increase thus increasing competition for nutrients. Species diversity would decrease, making the tree more susceptible to an attack from species-specific pathogens. Further, Alternative 1 would not decrease fuel-loading conditions and thus increase the risk of escaped wildfires. Alternative 1 may result in heavy fuel-accumulation and the highest number of hazardous snags over the next decade.

Hazardous fuel conditions would increase as a result of oak decline and tree mortality. Oak decline can also cause snags that present a direct safety hazard to both the public and forest workers if the tree or large limbs fall unexpectedly. Burning snags near wildfire containment lines often ignite spot fires causing increased fireline construction and additional hazards to firefighting personnel. Where a high density of large fallen trees exist, firefighters are exposed to greater risk of getting trapped by the fire while using direct attack on the wildfire with standard methods. As a result firefighters must change normal tactics, which can result in larger

fires covering more acres and greater risk of escaped fires as snags and embers are blown across the fire line.

Alternative 1 would not alter species composition of stands in the short-term. Alternative 1 would continue the trend of less light reaching the forest floor, and natural communities moving toward a closed forest natural community type, farther and farther away from the historic and desired conditions of open and closed woodland natural community types. Shade intolerant and short-lived species such as scarlet oak and black oak would inexorably fall out of stands over the next ten years (Kabric & others, 2008; Nowacki, 2008).

Currently, the greatest risk of decline is within the red oak group. These trees are reaching biological maximums and are past their rotation age. Mortality and decline is prevalent in all mature stands containing red oak within the project area (M. Stevens, Personal Communication, March 1, 2012).

Overstory species composition would move towards trees in the white oak group and hickory as the red oak group declines. Longer-lived species such as shortleaf pine, white oak, post oak, and hickory would grow into small gaps left by the ongoing mortality. Established shade tolerant saplings would respond to this environment in the mid-story and eventually become a major component of most stands in the project area (Loftis, 1990; Nowacki, 2008). Natural disturbances that create small canopy gaps would most likely continue this trend; however, a large scale natural disturbance such as a tornado could re-initiate the predominance of red oak once again into the stand.

Pine regeneration would not occur unless some natural event, such as a tornado opened up a large area with a pine seed source nearby. The pine component would gradually become less a part of the forest landscape.

White oak would become the predominant overstory species. Shade tolerant species would become dominant in the understory because they are better able to thrive in lower light levels than oak and pine species. The open woodland and closed woodland natural communities would not be restored unless by random natural events. Stand age-class distribution would continue to be heavily skewed toward the older age groups.

Alternative 1 would fail to provide commercial wood products for the marketplace and not meet Congressional intent and direction. No harvests would occur and no commercial wood products would be available under Alternative 1. The economy of Wayne County would be negatively affected because wood products from national forest lands would not be provided to the marketplace and labor would not be required for harvest or timber stand improvement activities.

Alternative 2—Proposed Action

Alternative 2 would remove individual trees within a stand that are at the highest risk of developing or currently exhibiting insect or disease infestations. Oak mortality is an immediate forest health concern for parts of the project area (Fan, Spretich, Shifley, & Jensen, 2008). Vegetation treatments implemented under Alternative 2 would improve forest health in the area by salvaging dead and dying black and scarlet oaks in danger of being killed by insects and/or disease or other factors.

Alternative 2 (the Proposed Action) would move natural community types in the project area into closer compliance with the Desired Condition as generally described in the 2005 Forest Plan and

Management Prescription 6.2. Open woodland would increase; closed woodland would decrease; and forest natural community types would be slightly reduced. Acreages and percentages, although not at historical levels, would be closer to the desired conditions than those that currently exist.

Timber harvest and non-commercial stand-tending measures in Alternative 2 would increase and maintain natural community types. The use of commercial and non-commercial activities would move vegetation towards the desired balance of natural communities. Temporary openings created by even-aged regeneration harvest would be 15 acres or less in size.

Alternative 2 would reduce the risk of catastrophic wildfire and the potential for large numbers of hazardous trees. Silvicultural activities would be used to balance fuel conditions over time and to reduce the potential for hazardous fuel-loading (Northeast Regional Strategy Committee of the National Cohesive Wildland Fire Management Strategy Committee, 2012, Part II-17). Alternative 2 would reduce heavy fuel accumulations, and help mitigate the potential for a significant number of standing dead hazard trees.

While temporary increases in activity fuels may be expected, once the small trees and large limbs decay, hazardous fuel conditions would be improved. Also, unless considered a risk for public safety, at least 3 large existing snags per acre (where available) within harvest stands would be left standing for ecological benefits such as wildlife habitat.

More open canopy in treated open woodland stands, and to a lesser degree, closed woodland stands, would provide additional light for the red oak seedlings and saplings to compete with more shade tolerant individuals. Which species regenerate in a particular stand would depend on the residual canopy cover, advanced regeneration, stump sprouting and available seed sources. If a pine seed source is within the treatment area or there is a seed source nearby, shortleaf pine would become more abundant. The age of the residual dominant species for stands that have harvest treatment proposed could vary from staying the same to moving to a much younger age-class, depending on the number and dominance of the trees removed.

Midstory control and other stand-tending measures would promote maximum tree growth of residual trees. Age of the stands would not change where only these small tree treatments are conducted.

Alternative 2 would promote long-lived species. The promotion of longer lived species provides forest managers more options in the management of stand vegetation in the future. Generally, longer lived species are less susceptible to injurious agents, such as insects and disease. They have a wider range of time before a need for final harvest. In situations where large landscapes are in a similar age class, more time is allowed to regulate the stand age classes. Vigorous trees of long lived species can enable long-term retention and provide a variety of potential benefits, for wildlife.

Alternative 2 would stimulate the ground surface vegetation by creating openings in the canopy to allow light to reach the ground surface. Enhancement of terrestrial natural communities in the project area primarily involves allowing light to reach the forest floor which increases ground vegetative diversity and the regeneration potential of more desirable shade intolerant species in the project area. Without the use of fire or other continuing disturbances, only short- and medium-term gains can be realized. However, short-term gains in many stands could favor the survival of seed sources of certain plants that could be lost in a continual degrading condition.

Implementation of Alternative 2 (the Proposed Action) would create various sizes of canopy gaps dependent upon individual harvest and/or stand-tending treatment, and allow light to reach the forest floor. Forbs and grasses that would benefit from vegetative treatments and increased light reaching the forest floor include the following species:

American feverfew	dittany	slender mountain mint
beggar ticks	hairy sunflower	smooth beard-tongue
big bluestem	Indian physic	spring beauty
black-eyed Susan	Indian tobacco	St. Andrew's cross
Bosc's panic grass	inland sea oats	tick trefoil
bracted plantain	late boneset	tickseed coreopsis
butterfly weed	little bluestem	variegated milkweed
Christmas fern	Purple coneflower	wild bergamot
common cinquefoil	Queen Anne's lace	wild sweet William
common ragweed	rattlesnake master	wooly croton
daisy fleabane	showy partridge-pea	

Alternative 2 would improve current forest health conditions. Alternative 2 would remove trees exhibiting signs of oak decline and reduce risk of oak decline. Alternative 2 would encourage long lived species both in the short-term and long-term. Alternative 2 would use timber harvest to mimic natural disturbance processes while capturing the value of the timber for the wood products marketplace.

Large shortleaf pine and white oak would be favored as reserve trees in even-aged harvest systems and remain as the predominant species in salvage and uneven-aged harvest systems. Both shortleaf pine and white oak regenerate most successfully in full sunlight (Sander, 1990). Even-aged harvests followed by timber stand improvement treatments will promote young stands dominated by these desirable species (Johnson & others, 2009).

Alternative 2 would provide wood products that would support the marketplace and local and regional economy for the foreseeable future (10 years). The economy of the Northeast Lake Project area would directly benefit from products and services generated from activities on national forest lands. Forest resources are very important in supporting the local economy and the Missouri forest products industry (Missouri Department of Conservation, 2012c; Missouri Department of Conservation and U.S.D.A Forest Service 2010; Missouri Forest Products Association, 2012).

Alternative 2 would produce approximately 18 million board feet of timber over the next 10 years. The beneficial effects on the local economy would be multi-fold. Alternative 2 would provide direct employment in timber harvest, forest regeneration activities, and timber stand improvement that would economically benefit individuals and local businesses. Timber receipts would be shared with the Wayne County government to help offset the lack of property taxes due to the presence of federal lands as described in the *Economics* section.

Alternative 2 would provide contract work opportunities for associated forest activities. Many of the stands in the project area would involve the felling of undesirable small trees. Some even-aged stand prescriptions would require tree planting. In addition, approximately 5,581 acres would require stand tending measures. Most of this work would be contracted to private companies.

Alternative 2 would generate additional economic benefits as raw forest products are transformed into finished products. Businesses within the geographical region would employ people to process raw wood materials into finished products. Value-added finished products such as railroad ties, pallets, and hardwood flooring would be sold into local, regional and national markets.

The Mark Twain National Forest's Allowable Sale Quantity permits the forest to harvest and sale of 103 million board feet per year as reported in the Final Environmental Impact Statement to Accompany the 2005 Land and Resource Management Plan (2005 Forest Plan) (USDA Forest Service, Mark Twain National Forest, 2005b). Timber sales would be an efficient and effective means to move toward the desired conditions for vegetation on the landscape. The sale of timber products would be an appropriate use of national forest lands as authorized and directed by various federal laws including the Multiple-Use Sustained Yield Act of 1960 and National Forest Management Act of 1976.

CUMULATIVE EFFECTS ON VEGETATION RESOURCES

Alternative 1—No Action Alternative

Alternative 1 would not likely produce an environment that would recruit young white oak, black oak or shortleaf pine due to the lack of openings large enough to create full sunlight (Johnson, Shifley, & Rogers, 2009). The red oak group would gradually decline as these trees mature and die out of the overstory. Eventually shade tolerant species such as maple, elm, ash, black gum and sassafras which are currently present in the understory will fill in canopy gaps caused by the death of mature oaks in the overstory (Nowacki & Abrams, 2008). This will result in future stands moving away from the desired conditions described in the 2005 Forest Plan.

Alternative 2—Proposed Action

Spatial Boundary

A cumulative effects spatial boundary of the Northeast Lake Project area was selected because effects of Alternative 2 (the Proposed Action) would be limited to the area receiving vegetative treatment. This spatial boundary was selected because this is the extent where the cumulative effects information would be measurable and meaningful and the effects would be relevant.

Temporal Boundary

A cumulative effects temporal boundary of 10 years was selected because that is considered the life of the expected effects of the Northeast Lake Project activities. This temporal spatial boundary was selected because this is the extent where the cumulative effects information would be measurable and meaningful and the effects would be relevant.

Cumulative Effects

Alternative 2 would improve forest health in the Northeast Lake Project area and move the area towards Desired Conditions as generally described in the 2005 Forest Plan. Open woodland would increase; closed woodland would decrease; and forest natural community types would be slightly reduced. Acreages and percentages would move closer to the Desired Conditions than those that currently exist. Alternative 2 would also reduce the risk of catastrophic wildfire and the potential for large numbers of hazardous trees.

Irretrievable and Irreversible Effects

Irreversible commitment of part of the vegetation resource would occur when large trees are harvested. However, with time, young trees would grow and replace large trees that are removed during harvest treatments. Future timber would be available for use under either Alternative 1 or 2. Under Alternative 1, the opportunity to enhance the natural communities would be lost for the next 10-15 years.

The next time this area is evaluated (10-15 years), a decision could be made to restore or enhance natural communities or to harvest timber, as well as address oak decline. However, the longer the period before management action is initiated, the longer the time necessary to restore natural communities and address oak decline. The further the current conditions move away from the Desired Conditions, the more difficult and costly it will be to achieve the Desired Conditions.

Irretrievable commitments would occur to the existing vegetation conditions such as the species mix under either alternative, since it is unlikely that the same conditions could be maintained or replicated. The current condition is the result of unique combinations of activities both natural and human-caused that are highly unlikely to occur again. There would be an irretrievable loss of the timber value under Alternative 1 if the trees were allowed to die and not be utilized by society. Demand for wood products would continue, potentially exploiting markets overseas that may have little or no environmental controls regarding timber harvesting.

SUMMARY OF PROJECT EFFECTS ON VEGETATION RESOURCES

Under Alternative 1, trees would mature and become less vigorous, tree density would increase, species diversity would decrease, and the area would become more susceptible to insect attack and hazardous fuels conditions. Implementing Alternative 2, the Proposed Action, would improve forest health in the area by salvaging dead and dying black and scarlet oaks in danger of being killed by insects and/or disease or other factors.

Alternative 2 would move natural community types in the project area into closer compliance with the 2005 Forest Plan and Management Prescription 6.2. Open woodland would increase; closed woodland would decrease; forest natural community types would move closer to the desired conditions; and the risk of catastrophic wildfire and hazardous trees would be reduced. More open canopy would provide additional light for the red oak seedlings and saplings. Project activities would promote maximum tree growth of residual trees and long-lived species that are less susceptible to injurious agents, such as insects and disease. The Proposed Action would improve forest health conditions.

WILDLIFE RESOURCES

AFFECTED ENVIRONMENT/EXISTING CONDITIONS

Due to the old age of the project area, conditions include predominantly mature forest with many dead and dying trees scattered throughout. There is an array of cavities and downed woody debris. In these mature stands the herbaceous/shrub layer is not well-developed. Some of the plant species documented in the area include dittany (*Cunila origanoides*), wild bergamot (*Monarda fistulosa*), *Vaccinium* spp., *Cornus* spp., Virginia creeper (*Parthenocissus quinquefolia*), fragrant sumac (*Rhus aromatica*), *Aster* spp., *Carex* spp., and buckbrush (*Andrachne phyllanoides*). These plants are scarce and scattered across the area. A few of the birds seen or heard in the area include summer tanager, worm-eating warbler, black and white warbler, red-eyed vireo, ovenbird, northern parula, red-tailed hawk, and white-breasted nuthatch.

A wildfire, approximately 146 acres in size, occurred in the Harper Valley portion of the project area March 5, 2012. This fire was entirely on national forest lands (M. Pomeroy, personal communication, July 26, 2012). This incident involved a low intensity fire that had little effect on the mature timber.

There are no permanent streams within the project area on national forest lands. The upper reaches of the West Fork of Lost Creek flows through the project area on private land, as well as Holliday Creek. Holliday Creek has water year-round, and a portion of it flows through U.S. Army Corps of Engineers lands. Many other tributaries associated with the St. Francis River are within the project area, but these permanent streams are located on U.S. Army Corps of Engineers lands. Much of the lowland intermittent stream habitat within the project area is owned by private individuals, and some of this land is in open pasture conditions occupied by cattle.

There are 37 human-created wildlife ponds within the project area. These ponds are generally less than ½ acre in size with sapling-sized and larger trees growing on the dams. Some of the ponds have watershield (*Brasenia schreberi*) floating on the surface. These ponds have not been maintained in many years. Two of the ponds were dry during a site visit by the District Biologist in 2010 and two others were merely mud holes, which are unlikely to hold water throughout the summer.

No unique habitats such as caves, springs, fens, shrub swamps, and so on, are documented or been observed within the project area during field visits, and none are documented on national forest lands within the project area (A. Moore and M. Stevens, personal communication, October 4, October 10, 2012). However, a small cave exists on U.S. Army Corps of Engineers lands within the project area (E. Lemons, personal communication, July 26, 2012).

Past, Present, and Reasonably Foreseeable Actions

Past activities on private land have probably affected neotropical migratory birds in the lower Midwest including conversion of riparian foraging and nesting areas to agricultural or residential uses, deforestation of riparian foraging and nesting areas, and lack of prescribed fire.

A review of the project area was conducted using aerial photos and Google Earth. Private lands are currently a mix of predominantly forest, pasture, agricultural fields, and small developed

communities. Very little national forest land within the project area is located in the vicinity of perennial creeks or rivers, which are well-defined on aerial photos in an open condition.

On private lands, it is evident that timber harvest has taken place within the last few years north of Highway E near Wayne County Road 502, just north of the project area. This area exhibits evidence of a fairly extensive cut. There has also been some timber removal on private lands along Wayne County Road 528. This area appears to have been a smaller cut. Gravel mining or some other disturbance on the West Fork of Lost Creek has also taken place along Wayne County Road 528. It is likely that timber harvest would continue on private lands in the project area in the future, but it is unknown how many acres would be affected.

Other actions that may take place on private lands in the future include construction of roads, continued agricultural use of riparian areas, and activities associated with nearby residences. Private lands within the cumulative effects area would continue to be a mix of forest and open pasture. A review of Google Earth and aerial photos of the project area, area site visits that were conducted, and discussions with U.S. Forest Service Poplar Bluff Ranger District and U.S. Army Corps of Engineers personnel were used in analyzing area lands and developing conclusions.

Present or reasonably foreseeable future activities on private land which may have an impact on neotropical migratory birds include the construction or use of roads in riparian areas, continued agricultural use of riparian areas, and timber harvest and “high grading” activities on a short age rotation. High grading is the removal of the most valuable trees and leaving residual trees of poor condition or species composition which may create genetic, economic, and forest health consequences.

For more details on past, present and reasonably foreseeable actions related to the project, see Chapter 2, Alternative 1 sections on *Past Actions Relevant to Resource Conditions*, *Present Actions of Relevance*, and *Reasonably Foreseeable Actions of Relevance*.

NEOTROPICAL MIGRATORY BIRDS

Baseline Data

Migratory birds are listed by Partner’s in Flight (PIF) as priority species for the Ozark-Ouachita Plateau in physiographic area 19 (Fitzgerald & Pashley, 2000). Many bird species listed by Partners in Flight as conservation priority species have centers of abundance in this physiographic area.

Species representing several habitat types can be found listed on the Partner’s in Flight website at http://www.partnersinflight.org/bcps/pl_19sum.htm and are considered in this analysis. Some species listed on the Partner’s in Flight website are considered Regional Forester’s Sensitive Species (RFSS) or Management Indicator Species (MIS) and are indicated as such in Table 7—Neotropical Migratory Bird Species Analyzed in the Northeast Lake Project Area.

Partner’s in Flight species chosen for this analysis include cerulean warbler (RFSS), worm-eating warbler (MIS), Kentucky warbler, Louisiana waterthrush, whip-poor-will, red-cockaded woodpecker, Bachman’s sparrow (RFSS), Bewick’s wren, and field sparrow. These species represent habitats that include grassland/early succession, deciduous mixed forest, pine forest, and riparian areas. Of the species analyzed, 4 of 9 of these species (worm-eating warbler, Kentucky warbler, Louisiana waterthrush, and whip-poor-will) appear stable in the

physiographic area and are thought to provide a source population for the surrounding Midwest populations.

Table 7—Neotropical Migratory Bird Species Analyzed in the Northeast Lake Project Area

Bird Species	Habitat Association	Special Status	Population Trend
Cerulean Warbler ¹	Prefer very large tracts of forest with gaps in the canopy and emergent canopy trees	RFSS	Rangewide Decline
Worm Eating Warbler ¹	Older forest with well-developed shrub layer and open mid-story; sensitive to fragmentation; ground nester	MIS	Stable in Ozark-Ouachita Plateau
Kentucky Warbler ¹	Moist forest with abundant understory; ground nester	PIF Priority Species	Stable in Ozark-Ouachita Plateau
Whip-Poor-Will ^{1,2}	Open woodland; well-developed understory, open mid-story; ground nester	PIF Priority Species	Stable in Ozark-Ouachita Plateau
Louisiana Waterthrush ¹	Near rocky streams; ground nester	PIF Priority Species	Stable in Ozark-Ouachita Plateau
Red-Cockaded Woodpecker	Mature, open pine woodland	PIF Priority Species	Extirpated from parts of the Ozark-Ouachita Plateau; does not occur on the Poplar Bluff Ranger District
Bewick's Wren ³	Nests built in cavities, crevices or placed on ledges	PIF Priority Species	Stable in Ozark-Ouachita Plateau but has declined drastically rangewide
Bachman's Sparrow ³	Open Pine Woodland; Utilizes 1-3 year old clearcuts with a dense cover of grasses and weeds; ground nester	RFSS and MIS	Trend not available but suspected decline
Field Sparrow ³	Grassland/Shrub; ground nester	PIF Priority Species	Declining

Notes: ¹ Oak-hickory sawtimber or mature upland deciduous forest; ² Sapling, poletimber, or young, upland deciduous, pine, or mixed pine forest; also uses mature upland pine and mixed pine forest; ³ Grass/forb through shrub/seedling seral stage of the oak-hickory, mixed pine-hardwood, and pine forest or plantation.

There are 33 species designated as species of conservation priority for the Ozark-Ouachita Plateau (Fitzgerald & Pashley, 2000). According to Fitzgerald and Pashley (2000), a number of species of concern that have declined significantly in the physiographic area are associated with grass-shrub or early successional forest, which can be provided by idling agricultural lands, even-aged timber management, restoration of glade, savanna, and open woodland habitats, or in areas of catastrophic natural events, such as extensive tornadoes that touched down in 2002 and 2011. For more information on the status of bird species within this physiographic area see Fitzgerald and Pashley's (2000) report at:

http://www.partnersinflight.org/bcps/plan/pl_19_10.pdf

The cerulean warbler has been documented along major riparian systems, such as the St. Francis River, but there is no suitable habitat on Poplar Bluff Ranger District lands within the project area for this species. Louisiana waterthrush uses similar riparian habitats with rocky substrates, but due to the lack of perennial streams on national forest lands there is no suitable habitat for this species in the project area. Both of these species use riparian areas along permanent waterways on U.S. Army Corps of Engineers and private lands.

There is no suitable habitat for the red-cockaded woodpecker in the project area. This species occurred historically approximately 45 miles west of the project area in over-mature, open pine woodlands that have since been harvested. It uses intensively managed pine woodlands with minimal mid-story and low basal areas, and this condition is absent across the Northeast Lake Project area. There is very limited pure shortleaf pine in the project area.

Worm-eating warbler was documented in the project area during a field visit by the District Biologist. The area where this species was documented had minimal brushy cover and did not appear to have optimal habitat conditions. Kentucky warbler is also likely to occur within the project area. These species would use tree fall gaps and may be found along roadsides or within areas of dieback where shrubbier habitat may exist with some mature trees remaining.

Bachman's sparrow, Bewick's wren, and field sparrow are likely to be limited to the gas pipeline and powerline corridor on the national forest and other lands where a grass and shrub component exists. Bachman's sparrow has not been documented in the Northeast Lake Project area, likely due to a lack of suitable habitat in the form of grasslands. This species is generally found in areas with red-cockaded woodpecker where there is mature pine and open grasslands.

There is suitable habitat in the project area for the whip-poor-will, although this species prefers more open woodlands with widely scattered trees. It may occur near tree fall gaps and in those areas of dieback where the shrub component is higher.

Direct and Indirect Effects on Neotropical Migratory Birds

The most likely impact to neotropical migratory birds would occur as a result of habitat change caused by timber management in the Northeast Lake Project area. These actions, as proposed in Alternative 2, have the potential to create a variety of structural characteristics necessary to benefit several neotropical migratory birds analyzed.

Alternative 1—No Action Alternative

With the implementation of this alternative, forested areas would continue to mature, and the only new early seral conditions that would develop would be in those areas with extensive oak

decline or areas that may be impacted by storm events. In those areas, shrubbier, more open, early seral habitats would occur, providing suitable habitat for field sparrow and Bewick's wren.

No prescribed burning, road management, or any other activities would occur. Trees that have not yet reached maturity would become larger before dying out, and minimal structural diversity would occur across the project area. Habitat would improve for species that use mature forests with a more open understory. Tree fall gaps would continue to be provided on a naturally-occurring basis.

Cerulean warbler, Louisiana waterthrush, and red-cockaded woodpecker would not be impacted with the implementation of Alternative 1 because the project area is lacking well-developed riparian areas and extensive mature pine habitat. Kentucky warbler, worm-eating warbler, and whip-poor-will are expected to remain stable with the implementation of Alternative 1.

Benefits to these species would happen very slowly as shrubby growth takes over in areas where older trees have died and fallen, but as young trees mature, this habitat would disappear once again. Thus, benefits to these species would be relatively short-lived. In a study where managed sites were compared to non-managed sites in the central hardwoods region, worm-eating warblers were found to be more abundant in non-managed sites (Thompson, Reidy, Kendrick, & Fitzgerald, 2007).

Alternative 2—Proposed Action

Forest management. This alternative includes timber harvest, intermediate actions such as timber stand improvement, understory removal, site preparation, and shortleaf pine planting. Even-aged regeneration would create early seral habitat conditions across the Northeast Lake Project area on approximately 1,092 acres. In addition, a small portion of the salvage/sanitation areas would be harvested to a low enough basal area to provide early seral habitat for some bird species. On those acres, basal areas would be lowered to 10-30.

Field sparrow would benefit from these actions. Habitat would be provided for Bachman's sparrow and Bewick's wren, but the habitat created would be of marginal value to the species that have not been documented in the project area. Habitat improvement would occur for the whip-poor-will, but this benefit would not be immediately recognized. It would take approximately 10 years for the sapling stage to develop in those stands, providing suitable habitat for whip-poor-will. This action would negatively affect the Kentucky warbler, worm-eating warbler, and whip-poor-will by removing mature forest, including the shrub/understory layer.

Proposed harvested areas that yield a higher residual basal area of mature forest (approximately 838 acres plus the majority of the salvage/sanitation acres) would provide a more developed shrub layer for the Kentucky warbler and worm-eating warbler, but these benefits would be short-lived if the shrub layer were not maintained. This shrub layer would develop within approximately 3 years. Understory removal and timber stand improvement would occur on an estimate 1,057 acres, which would benefit the Kentucky warbler and worm-eating warbler within a few years as 2-9 inch diameter trees re-sprout and grow into shrubby habitat.

No impacts are anticipated to the cerulean warbler or Louisiana waterthrush due to a lack of permanent waterways. Red-cockaded woodpeckers have been extirpated from Missouri, and even with the pine planting in the project area, this species would not benefit from forest management actions due to the absence of prescribed fire across the project area.

Direct effects could occur to migratory birds using the project area if harvests take place during the breeding season before the young fledge (begin to fly). Direct mortality to adults is less likely because they would have the capability of flying from a tree that is being harvested. Displacement of individuals could also occur as certain areas are being harvested. This could force individuals to seek other nesting areas for the summer; re-nesting for some species may take place if the original nest is destroyed.

The number of acres harvested in any one season is estimated to be about 1,000 acres, which is relatively small (7%) given the large project area. With less than one-half of the project area (42%) affected by harvest in the Northeast Lake Project, and the long-term population trends showing most forest bird species are stable in the Ozarks or would benefit harvests, timber management in the Northeast Lake Project area is expected to improve habitat conditions for several neotropical migratory birds.

The brown-headed cowbird is a nest parasite that uses forest edge while foraging in short grasses and agricultural areas. This species is distributed statewide. Cowbird parasitism is more common for some neotropical migrant species than others, particularly those requiring shrub/grassland habitat to carry out life processes. Brown-headed cowbirds can more easily find nests in shrub/grassland habitats.

Some species, such as the field sparrow, have created ways to avoid or mitigate the effects of cowbird parasitism. The field sparrow abandons nests with cowbird eggs. A study in Missouri, found that 21 of 47 parasitized nests were deserted; of 54 cowbird eggs in 50 nests, only 4 cowbird chicks fledged from 4 nests (Dechant et al., 1999).

Cowbirds have been documented commuting up to 4.35 miles between foraging and nesting areas (Robinson et al., 1993). Suitable foraging habitats that exist on private or U.S. Army Corps of Engineers lands within the project area are within commuting distance to national forest lands. Therefore, given the shape and distribution of open field/agricultural habitats and their distances from national forest land in the project area, it is highly likely that the brown-headed cowbird parasitizes nests within the project area. However, this species was not heard or seen during field visits by the District Biologist.

Checkerboard property ownership exists within the project area, including private lands that are being grazed and open fields on U.S. Army Corps of Engineers lands that are managed for crops and other early seral habitats, as well as national forest land. The proposed harvest activities on national forest lands are not expected to encourage brown-headed cowbirds to use this area in any greater amounts than that which is already occurring.

Pond dam maintenance and control of watershed. It is likely that ponds that receive maintenance and watershed treatment would provide drinking water sources for a variety of neotropical migratory birds. Water is limited on national forest lands within the project area and ponds are extremely important for a variety of wildlife, particularly during severe droughts.

Ponds that are treated with glyphosate for watershed would have little effect on fish and wildlife. Sera, Inc., prepared risk assessments for human health effects and ecological effects to support an assessment of the environmental consequences of using glyphosate in Forest Service vegetation management programs (Durkin, 2003). Durkin (2003) reported in their risk characterization of glyphosate that “based on the current data, it has been determined that effects to birds, mammals, fish and invertebrates are minimal” (p. 4-42, p. 4-43). Durkin further noted

that this risk characterization was consistent with that provided by the U.S. Environmental Protection Agency.

Durkin (2003) reported that at the typical application rate of 2 lbs. acid equivalents/acre of glyphosate, none of the hazard quotients for acute or chronic scenarios reaches a level of concern even at the upper ranges of exposure for terrestrial organisms. Therefore, the application of glyphosate to wildlife ponds would have minimal impact on neotropical migratory birds.

The vast majority of neotropical migratory birds should be gone from the project area during the time of glyphosate application, with the birds having already migrated to their winter habitats. However, a few species may be present at the time of treatment since the project area is within their winter range.

Old growth designation. Of the neotropical migratory birds analyzed, only the red-cockaded woodpecker is considered an old growth-dependent species. This species requires older pine trees characterized by flat crowns that contain heart wood rot. This softens the center of the tree, providing faster and easier excavation of cavities by the woodpecker. Five other neotropical migrants analyzed inhabit mature forests, including the cerulean warbler, Louisiana waterthrush, worm-eating warbler, Kentucky warbler, and whip-poor-will. Whip-poor-will also inhabits younger poletimber forests.

The estimated 1,526 acres of forest designated as old growth would have no effect on the red-cockaded woodpecker, cerulean warbler, or Louisiana waterthrush. National forest lands within the project area lack the extensive pine forest necessary for red-cockaded woodpecker and also lack riparian habitats with permanent waterways needed by the cerulean warbler and Louisiana waterthrush.

Old growth designation would provide habitat that can be used by the worm-eating warbler, Kentucky warbler, and whip-poor-will. Forested stands chosen for old growth designation are no different structurally than the remaining mature forest across the project area. The suite of species is also the same in the old growth areas. Eventually the structure within the old growth area would become more open.

The project area currently exhibits oak decline and other diseases, which has provided a number of dead trees across the landscape. As these trees fall, old growth areas would become more open and the shrub layer would take advantage of the opportunity to flourish. These old growth areas, if left in perpetuity, would provide a variety of structural characteristics and stages of growth as mature trees die and fall at different rates, and these trees are replaced by younger growth.

The benefits of old growth designation are likely to be relatively short-term (20-30 years) before the forested stand is replaced by younger growth forest, depending on the timing and rate of mature tree replacement.

Transportation management. Transportation management would occur throughout the project area in the form of constructing temporary roads, conducting maintenance and reconstruction of existing System roads, and decommissioning non-System roads and trails. Temporary road construction would allow access to harvest units for timber removal and related activities. These areas would be closed to public access upon completion of harvest operations and would re-forest themselves after a few years.

If transportation management activities (particularly road realignment) are conducted during the bird breeding season, individuals could be displaced, nests could be destroyed, or young birds could be killed or injured. It is likely that adult birds would be able to flee if trees targeted for harvest are occupied. Most warblers do not re-nest due to their size, the short breeding season, and their late arrival on the breeding grounds. However, the earlier the nest is disturbed in the breeding season, the more likely they are to re-nest. Sparrows and wrens are fairly common re-nesters.

Firewood gathering and woody biomass removal. These actions would have minimal impact on neotropical migratory birds. Although several of these species are ground nesters and require shrubby cover for concealment, there would be an abundance of slash in the form of tree tops remaining in harvest units when harvest is complete. The flush of growth that occurs immediately post-harvest would also provide cover for ground nesting birds and those adults and fledglings that forage in early seral habitats. If tree tops are removed as part of the woody biomass removal, access would be limited to those areas accessible from System roads.

Cumulative Impacts to Neotropical Migratory Birds

Cumulative impact is described by the Council on Environmental Quality (n.d.) as:

. . . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (Part 1508.7)

Spatial Boundary

The geographic cumulative effects boundary for neotropical migratory birds is the same as the project area. The Northeast Lake Project area would involve approximately 8,631 acres of national forest lands that are subject to forest management activities (Poplar Bluff Ranger District, Northeast Lake Stand Prescription Forms 2011-2012).

This boundary was selected because the bird species analyzed defend fairly small territories (less than 100 acres) in relation to the project area size. Territories range from approximately 0.72 acre for the field sparrow (Dechant et al., 1999) to 480 acres for the red-cockaded woodpecker. The red-cockaded woodpecker does not occur in the project area (U.S. Fish and Wildlife Service, Southeast Region 1999).

Temporal Boundary

The temporal boundary would range from less than a year, which would begin providing habitat conditions for early seral species following harvest, to 60 years, which would provide mature forest conditions for whip-poor-will, the worm-eating warbler, and Kentucky warbler.

Cumulative Effects

A number of factors have been implicated in songbird population declines, but most scientists agree on two major causes: increased predation and parasitism of songbird nests in the North American breeding grounds, and conversion of forest to agricultural lands in the tropical wintering grounds. There is little evidence that conventional timber harvest in North America has been a significant factor in songbird decline (Lorimer, 1994). Studies of timber harvest

effects in the 1990s on public lands in Missouri, Pennsylvania, and New Hampshire have indeed shown that managed forest landscapes have higher bird species diversity (including a number of priority neotropical migrants) than landscapes where no timber harvest is being done (Lorimer, 1994).

Because nest predation and parasitism are higher along the edges of farm and suburban woodlots, one might assume that patch cutting has a similar impact. However, a small woodlot surrounded by a sea of corn and soybeans represents a much different environment than a forest opening of 1/5 to 40 acres surrounded by a matrix of dense forest (Lorimer, 1994). Thus, a picture of the larger surrounding landscape is important when considering the effects on neotropical migratory birds from timber management.

As expected, the quality, size, topography, and distribution of edge habitat within these forested tracts greatly influence not only bird territory size, but also bird densities found in the project area. Several neotropical migratory birds are also “area sensitive,” meaning that they only occur in larger forested tracts and are frequently absent from small (<50 acres) forest fragments. The same is true for densities of Kentucky warblers according to Wenny, Clawson, Faaborg and Sheriff (as cited in Fitzgerald & Pashley, 2000).

The Kentucky warbler has been found to locate its breeding territory preferentially within clearcut harvest areas in oak-hickory forests in Missouri according to Thompson and Fritzell (as cited in Fitzgerald & Pashley, 2000). In contrast, the same can be said for early seral bird species. Some prefer larger tracts of early successional habitat, while others may be able to thrive in smaller tracts of forest treated by even-aged management. Intermediate cuts may not be optimal for either forest-interior or early seral neotropical migratory birds.

The Missouri Department of Conservation initiated a long-term forest management study called the Missouri Ozark Forest Ecosystem Project (MOFEP) in the early 1990s to study the effects of typical forest management strategies on a variety of biological resources (Clawson et al., 1997; Clawson, Faaborg, Gram, & Porneluzi, 2002). Birds were a part of the study. Pre-treatment data was collected and harvests occurred in 1996-1997. Even-aged, uneven-aged and no harvest treatments were replicated on a variety of sites. Pre-treatment and initial results of this study were published in the proceedings of two symposia (Clawson, Faaborg, & Seon, 1997; Clawson et al., 2002).

Immediately following treatment, populations of forest-interior species declined on all study sites. Post-treatment, forest-interior species responded both positively and negatively to the even-aged and uneven-aged treatment types. Neither nest predation rates nor nest parasitism rates increased following treatment. It was concluded that the short-term effects of even-aged management are mixed, both positively and negatively, for forest-interior species, although each forest-interior species responds slightly differently to forest management. In addition, the response by early successional species is greater for even-aged than for uneven-aged management (Clawson et al., 2002).

Many studies have been conducted regarding the effects of clearcut timber harvest on both adult and fledgling mature forest birds. Based on recaptures during a study conducted in Missouri, Pagen, Thompson, and Burhans (2000) found that worm-eating warblers may nest in mature forest and occasionally forage in 3-4 year old forests nearby, or may establish territories that overlap with both mature forest and early-successional forest. Kentucky warblers are also believed to occasionally breed in early successional forest.

Streby, Peterson, McAllister, and Anderson (2011) documented nests of mature forest birds in clearcuts in north-central Minnesota. According to Streby et al. (2011), mature forest birds colonize regenerating stands as they mature, not after they mature, and such colonization may occur earlier than is commonly assumed. Important considerations for the management of forest birds in clearcuts may be the rapidity with which species of concern recolonize regenerating stands and how well they reproduce within those stands.

As discussed by Haulton (2008), no single method can provide suitable habitat conditions necessary for the conservation of all forest bird species. Where avian species diversity is a forest management goal, the most effective approach is to employ a variety of management techniques, tools, and alternatives across forested landscapes. Haulton's suggestion of using a variety of forest management techniques to promote avian diversity closely reflects the proposed action for the Northeast Lake Project. Thompson reached a similar conclusion, stating "[w]e believe a mix of even- and uneven-aged silvicultural practices, designated reserve areas, and use of prescribed fire would be required within the Central Hardwood Region to meet bird conservation objectives and other objectives for forest lands" (as cited in Haulton, 2008, p. 13).

The implementation of the Northeast Lake Project would not reduce the size of the forested area. There would be no forest management on approximately 58% of the project area. The Northeast Lake Project would not likely negatively impact neotropical migratory birds.

Habitat changes as a result of the implementation of Alternative 2 are expected to benefit many neotropical migratory birds, both forest-interior and early seral species. Although some nests could be destroyed and young birds killed, the creation of suitable habitat, future successional stages, and additional open woodlands may maintain or increase neotropical migratory bird population densities in the long-term. No negative cumulative impacts to neotropical migratory birds are expected based on a review of research conducted on this topic.

MANAGEMENT INDICATOR SPECIES AND ECOLOGICAL SPECIES

Management Indicator Species Considered

This analysis examined 5 Management Indicator Species and 3 natural communities to represent effects of forest management on suites of species. Management Indicator Species inhabiting the Mark Twain National Forest include Northern bobwhite, summer tanager, Bachman's sparrow, worm-eating warbler, and red bat. Bachman's sparrow and worm-eating warbler are considered as a Partner's in Flight priority species in the Ozark-Ouachita Plateau physiographic area (Fitzgerald & Pashley 2000), of which the Poplar Bluff Ranger District is included. These two species were addressed in the *Neotropical Migratory Birds* section and would not be analyzed again here, but their population status is discussed. The summer tanager and Northern bobwhite are also listed as priority species for this area.

Management Indicator Natural Communities

Management indicator natural communities analyzed include Glade, Open Woodland, and Groundwater seepage communities as identified in the Mark Twain National Forest Final Environmental Impact Statement to Accompany the 2005 Land and Resource Management Plan (2005 Forest Plan) (United States Department of Agriculture, Forest Service, Mark Twain

National Forest, 2005b, p. 3-116). None of these natural communities exist in the project area on national forest lands, but open woodlands would be created with the implementation of Alternative 2.

Affected Environment and Status of Management Indicator Species, Communities, and Ecological Indicators

The affected environment for Management Indicator Species is the same as that described for neotropical migratory birds. The worm-eating warbler, summer tanager, and red bat have been observed within the project area.

Recent population trends of Management Indicator Species birds listed for the Mark Twain National Forest was published in the Fiscal Year 2010 Mark Twain National Forest Monitoring and Evaluation Report (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2011). This report discusses the population status of Management Indicator Species across the Mark Twain National Forest based on monitoring information gathered on each ranger district. According to the report, there are several breeding bird survey routes across the forest. None of the routes occur across the Northeast Lake Project area.

Population trends from 2000-2009 indicate that the worm-eating warbler and summer tanager populations are stable to increasing according to Sauer, Hines, Fallon, Pardieck, Ziolkowski, Jr., and Link (as cited in United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2011, pp. 15-16). Trends for the same period for Bachman's sparrow (a Management Indicator Species and Regional Forester's Sensitive Species) are not available. This species has not been documented in Wayne County on the Poplar Bluff Ranger District (Jacobs & Wilson, 1997; Missouri Department of Conservation, n.d.).

A review of the Missouri Natural Heritage Database 2012 (Missouri Department of Conservation, n.d.) was conducted by the Poplar Bluff Wildlife Biologist on July 17 and August 24, 2012 (York-Harris, 2012, August 24, October 16). (See Project Record, Northeast Lake Project Federal Biological Evaluation for Federally-Listed and Candidate Species, August 24, 2012; Northeast Lake Project Biological Evaluation for Regional Forester Sensitive Species and State Endangered Species October 16, 2012). The review indicated that Bachman's sparrow is likely absent from the project area due to a lack of mature open pine savanna.

According to the Fiscal Year 2010 Mark Twain National Forest Monitoring and Evaluation Report (United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2011), only statewide survey data collected by the Missouri Department of Conservation is available for the Northern bobwhite. As noted in the report, the statewide Northern bobwhite population index continues to decline with an index of 2.2 quail per 30-mile route in 2010. This is 17% below the 2009 index of 2.7.

The number of quail counted in the Ozark-Ouachita Plateau region did not change from 2009, but the long term average shows a decline of 31.2% according to Emmerich (as cited in United States Department of Agriculture, Forest Service, Mark Twain National Forest, 2011, p. 16). The survey routes run mainly through private lands, making it difficult to analyze the effects on quail from management activities conducted on the Mark Twain National Forest.

Red bat populations on the Mark Twain National Forest are thought to be stable or increasing. Spring and summer bat surveys (mist-net and acoustic) have been conducted on the Mark Twain

National Forest since 1997 (Project File, Bat Survey Reports). Red bats have historically been the most commonly captured species, but within the last couple years, the Northern bat has also had a high capture rate.

Trapping results across the Poplar Bluff Ranger District have shown no indication that the red bat species is in decline. In fact, one site trapped on U.S. Army Corps of Engineers lands in the summer of 2012 resulted in the capture of 35 red bats in 4 hours of netting (Project File, Bat Survey Reports). The red bat accounted for 81% of the captures that evening. The site was a wooded road corridor leading across a creek into a large expanse of agricultural fields. Red bats comprised 34% of all captures (202 individuals of 9 species) on Poplar Bluff Ranger District lands and federal lands directly adjacent to them during the summer of 2012.

Mist netting conducted at four sites within the Northeast Lake Project area in 2006 resulted in only 5 red bats from among 17 bats of 4 species captured (McClanahan, n.d.). These numbers are extremely low, but the habitat was much more cluttered (forested) at those sites versus the site in 2012.

Direct and Indirect Effects on Management Indicator Species and Ecological Indicators

Northern bobwhite

The bobwhite quail is usually found in prairies and grasslands along forest edges. It prefers to nest along the edge of forest or a field, in tall grass or brush piles. The primary nesting season for this bird is between March and September.

Because of diminishing suitable habitat, populations have been declining in recent years. This decline is not surprising given that many other prairie and grassland species numbers are declining in Missouri, the Midwest, and other portions of the country. Optimal habitat for the Northern bobwhite includes 1/3 of the habitat in grasses and forbs, 1/3 in shrubs, and 1/3 in bare soil. In addition, Missouri research found quail within 70 feet of shrubby cover at any given time of day (Missouri Department of Conservation, USDA Natural Resources Conservation Service, and University of Missouri Extension, 2010).

Due to the lack of extensive grass/shrub habitat, it is likely that Northern bobwhite numbers are extremely low on national forest lands within the project area. The gas pipeline and powerline corridors, which are maintained on a regular basis, provide the most suitable long-term habitat for this species on national forest lands. It is more reasonable to assume, if Northern bobwhite occurs in the project area, individuals are finding the necessary breeding, feeding, and cover on U.S. Army Corps of Engineers lands or private lands, which provide open conditions that are larger in size and more consistently maintained. Habitat for this species must be constantly manipulated in order to maintain suitability for Northern bobwhite.

Alternative 1—No Action Alternative

There would be no direct effects such as loss of individuals or nests from this alternative. Indirect effects include further encroachment of hardwoods, leaving the majority of the project area unsuitable for quail as foraging, nesting, and brooding habitat. Overall, this alternative would have a negative impact on Northern bobwhite in the project area due to the lack of early seral habitat and disturbance needed to provide bare ground.

Alternative 2—Proposed Action

Forest management. Forest management activities would improve potentially suitable habitat across the project area for Northern bobwhite but only on a short-term basis. Harvesting is targeted for larger expanses of older timber, which is unsuitable for Northern bobwhite. Logging conducted directly adjacent to the gas pipeline or powerline corridor or directly adjacent to U.S. Army Corps of Engineers lands consisting of early seral habitat could impact nests or kill or injure young birds that cannot move quickly or fly efficiently. This is virtually the only area where Northern bobwhite is likely to occur on national forest lands within the project area.

Timber activities, such as timber stand improvement, site preparation, and understory removal, would improve habitat conditions for quail. The smaller diameter trees remaining in harvested units would provide a large amount of cover, which is important for the winter survival of quail (Missouri Department of Conservation, USDA Natural Resources Conservation Service, and University of Missouri Extension, 2010). The planting of shortleaf pine within harvest units would have similar effects on Northern bobwhite, providing benefits initially in the form of cover and possibly food, but this benefit would fade within 10-15 years unless the habitat is maintained.

Pond dam maintenance and control of watershed. Although Northern bobwhite could use ponds within closer proximity to shrub and grass/forb habitats, non-native invasive species treatments are not likely to directly affect quail populations in the project area. Some of the ponds to be treated are within 1/10 mile of private land, which may or may not provide habitat for Northern bobwhite.

Glyphosate would be used in accordance with label specifications to treat the surface of upland ponds. The application of glyphosate is not likely to have any effect on quail throughout the project area, primarily because the application areas are extremely small and scattered, and quail require very specific habitat conditions within open areas to carry out life processes. Because the majority of suitable Northern bobwhite habitat is in lowlands along riparian habitats, the use of upland ponds is likely to be minimal.

According to Durkin (2003), the use of glyphosate would have minimal effects to birds, mammals, fish and invertebrates at the typical application rate of 2 lbs. acid equivalents/acre. Further, Durkin reports that none of the hazard quotients for acute or chronic scenarios reach a level of concern even at the upper ranges of exposure for terrestrial organisms. Therefore, bobwhite quail are not likely to be impacted by the application of glyphosate to pond surfaces.

Old growth designation. This action would have negative impacts on Northern bobwhite. Because quail is an early seral-dependent species, old growth conditions are unusable by Northern bobwhite. Old growth conditions would provide no suitable habitat for Northern bobwhite until the forest begins to die out and trees begin to fall.

Depending on the timing and severity of the vegetation decline with designated old growth, the stand could provide short-term suitable habitat if many trees die and fall about the same time. Stands in which trees die and fall about the same time would create brushy habitat with some bare soil. Alternatively, vegetation decline may not provide suitable habitat at all, if trees die in a scattered manner, creating mostly single tree gaps within the forest. Either way, old growth areas are unlikely to be occupied by Northern bobwhite because they lack the structural diversity needed to carry out life processes.

Transportation management. Temporary road construction, and the reconstruction and maintenance of existing System roads may create potentially suitable habitat for the Northern bobwhite in the form of bare ground and maintenance of shrub/grassy habitat along the edges of these roads. This shrub/grassy habitat would be marginal at best for Northern bobwhite.

Decommissioning non-System roads and trails has the potential to decrease the amount of erosion and prevent illegal ATV use, and increase ground cover, plant diversity, and insect abundance in areas that could be used by Northern bobwhite. Although this alternative would close illegally-travelled paths and provide more solitude for many forest species, it is unlikely that quail occurs in any large numbers in the forested setting. Benefits to this species as a result of transportation management would be so small that it is extremely unlikely to cause any change to the overall population in the project area.

Firewood gathering and woody biomass removal. These activities may temporarily displace bobwhite quail that may be using the project area. However, because changes in habitat structure and quantity would be minimal, it is unlikely to have any measureable effect on Northern bobwhite. If this species occurs within harvested areas made available for firewood or woody biomass removal, displacement of this species would be short-term, having essentially no effect on this species.

Summer tanager

The summer tanager is found in mature pine-oak forests, bottomland deciduous woodlands, parks, and other open savanna-like areas. Nests are located 4-70 feet high in shrubs or trees (Harrison, 1979; The Cornell Lab of Ornithology, n.d.). Food sources for the summer tanager include bees, wasps, and other insects, as well as berries and other fruits. The summer tanager gleans insects and forages during flight. The summer tanager's primary nesting season is May-June; it migrates to Central and South America, where it spends the winter (The Cornell Lab of Ornithology, n.d.).

The summer tanager has been observed in the project area in a forested stand proposed for harvest. This stand has a basal area of 120 (M. Stevens, personal communication, October 3, 2012). It appears this species would use a denser forest in the absence of its competitor, the scarlet tanager, as documented by Nicholson (1997).

Alternative 1—No Action Alternative

Under Alternative 1, the lack of forest management would ensure a more dense-canopied, mature forest, reducing the abundance of summer tanagers. Habitat improvement would only occur as a result of wind events, oak decline/dieback, diseases, and other natural disturbances. No direct effects would occur to this species as a result of Alternative 1. Indirect effects include the loss of preferred nesting and foraging habitat.

Alternative 2—Proposed Action

Forest management. Tree harvest during nesting and brood rearing season may inadvertently destroy summer tanager nests or young birds that are unable to fly. Because the summer tanager can nest in shrubs or taller trees, the use of skidders or other heavy equipment during the breeding season could destroy nests or young birds that are unable to move out of the way. Mechanized equipment used for timber harvest and skid trails may also crush vegetation, making

it not only unsuitable as a nesting place, but also have direct and indirect effects on individuals of these species.

Localized adverse impacts to individuals during timber activities do not appear to present major threats to the viability of summer tanager. Direct effects from timber activities include the loss of individuals, nests, and suitable nesting sites during breeding season. Adults should be able to escape. However, young birds born that year may be lost or negatively affected in the short-term.

Indirectly, forest management would benefit this species by providing edge and canopy gaps in oak and mixed oak-pine stands as habitat in which this species prefers to nest and forage. Site preparation, timber stand improvement, and understory removal would emulate the more open, park-like canopy preferred by this species and increase plant diversity and insect populations (summer tanager prey). Thompson et al. (2007) found that summer tanagers reached greatest abundance at approximately 40% canopy cover on a site managed for open woodland in the central hardwoods region. Approximately 77% of the Northeast Lake Project area consists of a canopy cover of 75% or greater (Schanta, 2010). Thus, timber management would thin the canopy and provide long-term benefits for this species.

Pond dam maintenance and control of watershed. Although summer tanager may use upland ponds within the project area as water sources, non-native invasive species treatments are not expected to directly affect summer tanager populations in Alternative 2. Ponds are small, scattered, and few would be treated across the landscape. In addition, glyphosate would be used in accordance with label specifications.

As reported by Durkin (2003), the use of glyphosate would have minimal effects to birds, mammals, fish and invertebrates at the typical application rate of 2 lbs. acid equivalents/acre. Further, Durkin reports that none of the hazard quotients for acute or chronic scenarios reach a level of concern even at the upper ranges of exposure for terrestrial organisms.

Summer tanager would likely be absent from these areas during the time of herbicide application (late October). This species would likely benefit from this activity long-term because treatment of the ponds would open up the water surface, provide easier access to the water for drinking on the fly, and ensure the integrity of the ponds for years to come.

Old growth designation. The abundance of summer tanager is not expected to change as a result of old growth designation. Although this species prefers mature forest, it also prefers more open, park-like structure. Within the old growth designated areas, open structure would occur only as mature trees fall, providing scattered canopy gaps throughout the landscape. Tree fall is already occurring in some areas, but timing would vary across the project area.

It is likely that summer tanager would continue to use old growth designated areas for nesting and foraging in higher basal area stands, as documented by the presence of this species in the project area. However, these areas do not provide optimal habitat conditions for summer tanager. The benefits of old growth designation are likely to be relatively short-term (20-30 years) before the forested stand is replaced by younger growth forest.

Transportation management. Road reconstruction and maintenance would have minimal effects on the summer tanager. This species is an aerial insectivore that prefers to nest far out on horizontal branches (Thompson et al., 2007). Openings in the canopy would provide an ideal structure for summer tanager nesting along roads.

Maintaining open areas along roads may benefit this species, providing preferred nesting sites. Decommissioning roads and road maintenance has the potential to decrease the amount of erosion, prevent illegal ATV use, and increase ground cover, plant diversity, and insect abundance. All road work has the capability to temporarily displace individuals, but this displacement would be short-term.

Direct effects could occur to summer tanager as a result of road reconstruction when trees are cut to realign a System road. If this were to happen, adults would be able to fly to escape harm, but young birds and eggs could be destroyed.

Firewood gathering and woody biomass removal. Firewood gathering and woody biomass removal may temporarily displace the summer tanager in the project area. However, no changes in preferred habitat structure or quantity would occur. Displacement of the summer tanager would be short-term, having essentially no effect on this species.

Eastern Red bat

The red bat uses deciduous forests year-round in Missouri, for roosting and hibernation. This species roosts in the foliage of deciduous and coniferous trees. In Missouri, the red bat often roosts in Eastern red cedar. In winter, individuals hibernate in trees and under leaf litter. On warmer winter nights, the red bat forages for insects. It uses open habitats where it can maneuver more easily while foraging for moths, crickets, flies, mosquitoes, true bugs, beetles, cicadas, and other insects. This species mates in August and September, and 2-4 pups are born in late spring or early summer.

Alternative 1—No Action Alternative

Forested conditions within the project area would continue to provide roosting habitat for the red bat. Foraging would be limited to open intermittent stream corridors; ecotones of forest and agricultural lands, road ruts and corridors; and wildlife ponds. Due to the closed canopy conditions, national forest lands within the project area would provide minimal foraging opportunities, and in the long-term, the implementation of Alternative 1 would not benefit the red bat.

Alternative 2—Proposed Action

Forest management. Timber harvest activities may inadvertently injure or kill young red bats unable to fly (in the summer months) or cause roosting red bats to fly during summer and winter months, using additional energy to find a new roost site. Because red bats also roost under leaf litter during the winter, adults could be crushed by logging equipment if bats are in deep torpor and disturbance goes undetected.

Indirect beneficial effects of timber harvest include the creation of open woodland habitat, additional areas suitable for roosting and foraging, and greater insect abundance. Commercial harvest activities would provide additional edge and canopy gaps in the forested areas in which this species prefers to forage. Understory removal, timber stand improvement, and site preparation would create a park-like forest structure, which would improve maneuverability and foraging habitat in this natural community type.

Timber harvest would remove some trees used by male red bats, which have been documented using saplings approximately two inches in diameter (Perry, Thill, & Carter, 2007). Although some roosts (in the form of tree foliage) would be removed, a large number of trees would

remain within 58% of the area not harvested, which would continue to provide roosting habitat for red bats. Regeneration of the forest would provide roosting habitat for males within a year or two of harvest. Log landings would also provide open foraging areas preferred by this species. Overall, the more open forest structure would make remaining habitat more suitable than that which previously existed.

Pond dam maintenance and control of watershed. Herbicide application to ponds would not directly affect red bat populations, even though this species has been documented using wildlife ponds as water sources. Glyphosate would be used in accordance with label specifications.

The use of glyphosate would have minimal effects to birds, mammals, fish and invertebrates at the typical application rate of 2 lbs. acid equivalents/acre (Durkin, 2003). Further, according to Durkin (2003), none of the hazard quotients for acute or chronic scenarios reach a level of concern even at the upper ranges of exposure for terrestrial organisms.

Indirect beneficial effects to the red bat include maintaining an open pond surface and providing available water for drinking while in flight. Herbicide application is not likely to displace individuals in the project area because work would be done during daylight hours when bats are roosting, and it would take a matter of minutes to apply the herbicide.

No direct effects would occur to the red bat as a result of mechanically maintaining pond dams. This work would be completed in late October when red bats are fully capable of flight. Both indirect beneficial and negative effects may occur to the red bat as the pond dams are maintained.

During pond maintenance, potential roost trees would be removed, but the integrity of the pond dam would be improved. Without this maintenance, tree roots would eventually penetrate the dam causing failure of the pond. In the event of dam failure, the lost pond would not be available as water sources or foraging habitat for the red bat. These small negative impacts are believed to be very minor, given the number of ponds to be maintained and their scattered distribution across the project area. Overall, the maintenance of pond dams and control of watershed would benefit this species.

Old growth designation. Old growth designation is not expected to have any impact on the red bat. The species would continue to use these areas in the current manner. As mature trees die and fall, saplings would take their place. These saplings would be used by male red bats, but only to a smaller degree. Canopy gaps would provide foraging areas for the red bat, and eventually a new forest would provide both foraging and roosting habitat for this species. It would take many years for nature to provide a mature forest (larger trees) needed for female roosting habitat.

Transportation management. In Alternative 2, road reconstruction and maintenance of System roads and the decommissioning of non-System roads would decrease the potential for erosion into intermittent waterways. These actions may increase ground cover and plant diversity in areas that could be used as foraging sites by the red bat. As work is being conducted on roads, short-term displacement of individuals may occur within the road corridors (during foraging) and along edges as roosting habitat may be removed.

The creation of routes used as temporary haul roads are likely to be used by foraging red bats. These open areas provide a gap in the canopy that is easy to maneuver through while foraging.

Firewood gathering and woody biomass removal. These activities may temporarily displace roosting red bats using the project area. However, no changes in habitat structure or quantity would occur. Displacement of this species would be short-term, having essentially no effect on this species.

Glades and Groundwater Seepage Communities

No *Glade* or *Groundwater Seepage Communities* are documented in the project area (A. Moore, J. Strange, and M. Stevens, personal communication, October 4 and 10, 2012; Missouri Department of Conservation, n.d.). Therefore, no direct or indirect effects would occur to these communities and they are not discussed any further.

Open Woodland

Alternative 1—No Action Alternative

The implementation of the No Action alternative may have negative effects on the open woodland natural community. The project area would continue to be a mature, closed canopy forest, only changing slowly as individual trees die, fall to the ground, and are replaced by saplings. There is currently no open woodland community in the project area, thus there is little sunlight reaching the forest floor and few grasses and forbs present.

Alternative 2—Proposed Action

Forest management. With the implementation of Alternative 2, a total of 3,590 acres of open woodland would be created through a combination of shelterwood, seedtree, and salvage harvest. These actions are considered even-aged harvests that would add to the open woodland community, but the availability of this community would be relatively short-lived without further disturbance. These conditions are likely to disappear within 20 years of harvest.

Pond dam maintenance and control of watershed. There would be no measurable direct or indirect effect on open woodlands as a result of management activities within and around ponds. These activities would not change the structure of open woodland natural communities.

Old growth designation. This activity would have a negative impact on the potential creation of the open woodland natural community. Old growth designation would ensure a long-term closed canopy forest with little to no herbaceous cover on the forest floor.

Transportation management. There would be no measurable direct or indirect effect on open woodland as a result of transportation management activities because neither the structure nor function of the community would be impacted. No open woodland would be created or negatively altered with this activity.

Firewood gathering and woody biomass removal. There would be no direct or indirect effect on open woodlands as a result of firewood gathering or woody biomass removal. Although these activities conducted in open woodlands have the potential to make forested areas more open, it would not change canopy density or the character of the natural community in the long-term.

Cumulative Effects on Management Indicator Species

Spatial Boundary

The cumulative effects geographic boundary for the 4 Management Indicator Species analyzed is the Northeast Lake Project area. This boundary was selected because the bird species analyzed defend fairly small territories in relation to the project area size, but some of the birds, such as worm-eating warbler, require relatively large tracts (available in the project area) of forest for breeding.

For red bat, the geographic boundary is also the project area, which is expected to provide marginal foraging and abundant roosting habitat. Red bats have been documented foraging up to 3.4 miles from their roost and use up to 2,286 acres for foraging (Hutchinson & Lacki, 1999). More open areas outside of the project area are likely to provide optimal conditions for this species.

Temporal Boundary

The temporal boundary would range from less than a year, which would begin providing habitat conditions for Northern bobwhite, to 60 years, which would provide mature forest conditions for the summer tanager and Eastern red bat.

Cumulative Effects

Cumulative effects as discussed in the *Neotropical Migratory Birds* section also applies to Northern bobwhite and summer tanager. The proposed activity that would have the most impact on Management Indicator Species abundance is forest management. Approximately 1,000 acres of habitat across the project area is 10 years old or less. The majority of potentially suitable habitat within the project area for Northern bobwhite is located on private lands, U.S. Army Corps of Engineers lands, and within the gas pipeline and powerline corridors.

Habitat would be created for Northern bobwhite as a result of approximately 4,078 acres of harvest, including clearcut, seedtree, shelterwood cuts, and low residual basal area harvests. Areas harvested by group selection, thinning, and higher residual basal area salvages would provide fair to marginal habitat for Northern bobwhite. Therefore, there would initially be beneficial cumulative effects as a result of Alternative 2.

The benefits of Alternative 2 would begin to fade approximately 10 years after harvest. Habitat created through harvest would not persist without additional manipulation, such as the use of prescribed fire. There would be negative cumulative effects on Northern bobwhite as a result of the lack of continued management of the Northeast Lake Project area.

There would be beneficial cumulative effects on the summer tanager as the canopy cover is opened through the harvest of approximately 1,229 acres proposed for shelterwood and high residual basal area salvage cuts. This species would also use the remainder of the project area, both unmanaged areas and areas managed with high and low residual basal areas, but its abundance would likely be lower in those areas. Changes in forest structure over time may change abundance but would have less drastic of an impact on the overall population as compared to that of Northern bobwhite.

The Eastern red bat depends on open woodland communities primarily for foraging. It also needs large trees for roosting, but males occasionally use smaller diameter trees. Timber

management across the project area would create 3,590 acres of open woodland that would be used by this species.

The presence of the red bat has been documented within the project area using wildlife ponds, but the number of captures was extremely low. The low number of captures is most likely due to the closed canopy condition of the project area, making it more difficult for this species to maneuver through the canopy while foraging. In addition, winter roost sites that receive more sun are more likely to be used. Thus, a more open canopy is preferred by this species. The implementation of Alternative 2 would have beneficial cumulative effects on the red bat by providing more suitable habitat across the project area.

Glade Communities would not be affected by the implementation of Alternatives 1 or 2 because this community type does not exist in the project area. In addition, there are no *Groundwater Seepage Communities* in the project area. No cumulative effects would occur to these two types of natural communities.

There may be negative cumulative effects to the open woodland community with the implementation of the No Action alternative. This was determined because no open woodland occurs in the Northeast Lake Project area. The implementation of Alternative 2 would have cumulative beneficial effects on the open woodland community by providing 3,590 acres of open woodland for an array of species.

FEDERAL SPECIES CONSIDERED IN THIS PROJECT

The most recent list of federal species received from the U.S. Fish and Wildlife Service is dated March 22, 2012. The 14 threatened and endangered species on this list that are known or likely to occur on the Mark Twain National Forest include: Virginia sneezeweed, running buffalo clover, Curtis' pearly mussel, Hine's emerald dragonfly, Tumbling Creek cavesnail, pink mucket pearly mussel, scaleshell mussel, gray bat, Indiana bat, Mead's milkweed, Ozark hellbender, snuffbox, spectaclecase, and sheepnose. In addition, one candidate species, rabbitsfoot, is on this list. There is also designated critical habitat for the Hine's emerald dragonfly.

Details of the life history of the federal species considered, biological analysis and findings are contained within the Northeast Lake Project Federal Biological Evaluation for Federally-Listed and Candidate Species (York-Harris, August 24, 2012). (See Project Record.)

Rationale for Federal Species Evaluated in Detail

Two species were evaluated in detail. These are the gray bat and Indiana bat. All other species were dropped from further consideration.

Gray bats have been captured to the west and east within 1.0 and 2.5 miles of the project area, respectively. This species may forage or drink from 33 upland ponds on national forest lands and perennial streams on U.S. Army Corps of Engineers lands or private lands within the proposed project area. Although no gray bat caves are documented in the project area on national forest lands (Missouri Department of Conservation, n.d.), it is likely that suitable caves exist along the St. Francis River, and some of these caves are likely occupied by the gray bat.

Male, female, and juvenile Indiana bats have been documented during the summer months on lands within the Poplar Bluff Ranger District (Project File, Bat Survey Reports). There is potentially suitable roosting and foraging habitat within the proposed project area that is

proposed for removal. Some trees proposed for removal have characteristics suitable for Indiana bat roosting. Other trees would have ample time to develop these characteristics before harvest is complete.

A secondary roost tree (within the project area) and a primary maternity tree (outside of the project area) are located on U.S. Army Corps of Engineers lands but within 1.0 mile of national forest lands. Therefore, it is assumed that national forest lands within the project area may provide potentially suitable habitat and be occupied by this species during the summer months.

GRAY BAT

Direct and Indirect Effects

The only direct effect that could occur to the gray bat would be direct impacts on occupied caves. Because no caves are documented on national forest lands within the Northeast Lake Project area, there would be no direct effects to the gray bat. Indirect effects could occur if occupied foraging habitat was removed along major waterways, if water quality of streams and rivers was degraded and decreased the amount or distribution of the prey base, or if timber removal changed travel routes to and from ponds. Questionable or unknown effects include the use of pesticides and illegal ATV use along rivers, streams, and lakesides.

Full analysis of the proposed Alternatives are detailed in the Northeast Lake Project Federal Biological Evaluation for Federally-Listed and Candidate Species (York-Harris, August 24, 2012). (See Project Record.) This evaluation details effects on the gray bat and mitigation measures incorporated into the project to minimize effects on this species.

Cumulative Effects Analysis for the Gray Bat

Spatial Boundary

The geographic cumulative effects boundary for the gray bat includes a 4.5 mile radius from the nearest capture sites to the project area (Project Record, York-Harris, Northeast Lake Project Federal Biological Evaluation for Federally-Listed and Candidate Species, August 24, 2012, Appendix A). This boundary was selected as there is no known literature regarding how gray bats choose travel routes, where they are flying to or from, or how they use artificial or natural upland ponds. Importantly, gray bats have been captured during summer over upland ponds within 4.5 miles of a maternity cave.

Temporal Boundary

The temporal cumulative effects boundary for the gray bat is 10 years. This time frame includes management actions that could occur within the proposed project area.

Cumulative Effects

Past activities on private land which have probably affected the gray bat in the lower Midwest include conversion of riparian foraging areas to agricultural or residential uses, deforestation of riparian foraging areas, and disturbance to hibernacula through flooding, cave ceiling collapse, or actions by humans.

A review of the project area was conducted using aerial photos and Google Earth. Private lands in the project area are currently a mix of predominantly forest, pasture, agricultural fields, and small developed communities. Very little land is federally owned adjacent to perennial creeks or

ivers, which are well defined on aerial photos in an open condition. These lands are not part of the proposed project.

It is evident that harvesting has taken place on private lands within the last few years north of Highway E near Wayne County Road 502, just a couple miles north of, but outside of, the Poplar Bluff Ranger District. This area exhibits evidence of an extensive cut, but the amount of acres harvested is unknown. There has also been some timber removal on private lands along Wayne County Road 528. This area appears to be a smaller cut. Gravel mining or some other disturbance to the West Fork of Lost Creek has also taken place along Wayne County Road 528.

It is likely that timber harvest would continue on private lands in the future. However, it is unknown how many acres would be affected. Other actions that may take place on private lands in the future include construction of roads, continued agricultural use of riparian areas, and activities associated with nearby residences. Private lands within the cumulative effects area would continue to be a mix of forest and open pasture. Reviews of Google Earth and aerial photos, site visits of the project area, and discussions with Poplar Bluff Ranger District personnel and U.S. Army Corps of Engineers personnel were used to reach these conclusions (Project File).

Present or reasonably foreseeable activities on private lands which may have an impact on this species include construction or use of roads in riparian areas, continued agricultural use of riparian areas and timber harvest. Other activities that may impact the species include disturbances to caves and the use of caves for recreational purposes, including public tours, camping, and spelunking.

Past activities on national forest lands which may have affected gray bats include timber harvest in riparian areas and disturbance to caves. Some of the present or reasonably foreseeable activities on national forest land within the region include: timber harvest operations and associated forest modification actions; firewood gathering; prescribed burning; pond maintenance; road construction, reconstruction, and maintenance; road closures; and old growth designation. A five-year project planning schedule was recently completed for the Poplar Bluff Ranger District that includes several projects across the district.

The Forest Service plans to propose the Brown's Hollow Project in the near future which would include ground-disturbing actions within this cumulative effects boundary. The Brown's Hollow Project would propose to cut approximately 56 acres of timber in 100-foot long linear swaths scattered across a 2,800 acre area. Understory removal and pond dam maintenance will be included in the proposed actions. These actions are expected to have no effect on the gray bat.

Any future Forest Service activities would comply with the 2005 Forest Plan. Standards and guidelines in the 2005 Forest Plan apply to each project to protect individuals and special habitats.

A proposal is being developed for the Blackwell Ridge Project to remove green and salvage timber, as well as conduct other associated activities, within an area near Williamsville, approximately 6 miles southwest of the Northeast Lake Project area. This project is still in the preliminary planning phases.

There is no known literature regarding gray bat use of upland ponds, details of why gray bats may use these areas, or how travel routes are chosen, are unknown. Due to the proximity of both adult female and male capture sites to the project area, it is assumed that the bats are using upland ponds in the project area for foraging and drinking. Gray bats have been documented

flying 12-21 miles in one night along a riparian corridor to forage according to Goebel et al. (as cited in York-Harris, August 24, 2012, Northeast Lake Project Federal Biological Evaluation for Federally-Listed and Candidate Species, Project Record).

Although the Northeast Lake Project may affect, but is not likely to adversely affect the gray bat, no cumulative effects are expected. This determination was based on the lack of extensive riparian habitat in the project area, lack of documented gray bat caves within or adjacent to the project area, the degree of maintenance and protection of ponds within the project area, and because approximately 58% of the project area has no commercial timber harvest proposed, leaving intact forested travel corridors for the gray bat. In addition, no impact to the water quality of ponds or perennial waterways is expected, which would protect the aquatic insect productivity of those areas.

Determination of Effect

The primary gray bat foraging corridor nearest to the project area is the St. Francis River. Bat surveys specific to the Northeast Lake Project area resulted in no gray bat captures (McClanahan, n.d.). No acoustic monitoring was done in the project area, but this species has been detected on the Poplar Bluff Ranger District using upland ponds, and been captured over upland ponds on other national forest lands. All gray bats captured to-date have been in well-developed streams wide enough for easy maneuverability. All these captures have been on U.S. Army Corps of Engineers lands.

There are no documented gray bat caves on the Poplar Bluff Ranger District or within the project area (Missouri Department of Conservation, n.d.; A. Moore and M. Stevens, personal communications, October 4 and 10, 2012). Because no caves are documented in the project area, and due to the nocturnal nature of the gray bat, no direct effects would occur to this species as a result of the implementation of the proposed action.

Given the recent presence of gray bats within fairly close proximity to the project area and the assumption that gray bats may use upland ponds within the project area, timber harvest has the potential to cause indirect effects by changing travel corridors to and from upland water sources. Standards and guidelines in the 2005 Forest Plan would be implemented near water sources to protect water quality and foraging habitat along major waterways. A 100-foot no-cut buffer would be established around all ponds within the project area.

It is likely that if the area is used by the gray bat, non-reproductive females and males would be more willing to fly further distances to forage in interior upland areas further from major riparian areas and caves along those corridors. However, because a pregnant gray bat was captured within 1.0 mile of the project area, it is not out of the question that females with young could forage over upland ponds located closer to the St. Francis River (Project Record, Northeast Lake Project Federal Biological Evaluation for Federally-Listed and Candidate Species, August 24, 2012).

Depending upon the residual basal areas in various timber stands, beneficial impacts may occur to the gray bat as the forest is opened up. More open areas may allow the gray bat to more easily maneuver through the forest to and from drinking and foraging areas and to and from maternity and winter caves. It is unlikely that the project area is used very extensively by the gray bat for foraging and drinking.

It was determined that implementation of this project **may affect but is not likely to adversely affect** the gray bat due to: 1) an expected change in travel corridors to and from drinking and foraging areas, and 2) possible beneficial effects as a result of the management of long-term water sources and easier flight maneuverability through the forest during feeding and migration. The U.S. Fish and Wildlife Service concurred with this determination, and consultation with this agency would be re-initiated if an occupied gray bat cave is discovered in or directly adjacent to the project area (Project Record, U.S. Fish and Wildlife Service, Letter of Concurrence, October 5, 2012).

INDIANA BAT

Direct and Indirect Effects of the Proposed Action

Direct effects could occur to the Indiana bat as a result of removing an occupied roost tree during several activities, including salvage harvest, construction of temporary roads and skid trails, creation of log landings, or when hazard trees are cut for safety purposes. Potential causes of indirect effects include a reduction in the species forage base due to the loss of foraging habitat, a loss of the species prey base due to degradation of water quality, the loss of roosting habitat, or changes in forested canopy important for migration.

Full details of the impacts of the action alternatives are contained within the Northeast Lake Project Federal Biological Evaluation for Federally-Listed and Candidate Species dated August 24, 2012 (York-Harris; see Project Record). This document addresses effects on the Indiana bat and mitigation measures incorporated into the project to minimize effects on this species.

Cumulative Effects

General information on past, present, and reasonably foreseeable actions and cumulative effects are detailed in the *Gray Bat* section of the Northeast Lake Project Federal Biological Evaluation for Federally-Listed and Candidate Species (Project Record, York-Harris, August 24, 2012). Past activities on private lands which have probably affected Indiana bat in the lower Midwest include conversion of riparian foraging and roosting areas to agricultural or residential uses, heavy timber harvest of foraging and roosting areas, and disturbance to hibernacula through flooding, cave ceiling collapse, or by humans, and the lack of prescribed burning (U.S. Fish and Wildlife Service, 1982).

Past federal actions in the project area include timber harvest and associated timber activities, prescribed burning and wildfire suppression, road improvements and construction, construction of ponds, and stocking of ponds. Timber harvest has taken place in various areas across the Poplar Bluff Ranger District. A table reflecting the past eight years of salvage and green tree sales planned or implemented in the Indiana bat cumulative effects area is presented in Appendix D of the Northeast Lake Project Federal Biological Evaluation for Federally-Listed and Candidate Species (Project Record, York-Harris, August 24, 2012). These past projects have provided heterogeneity across the landscape.

The five-year project planning schedule for the Poplar Bluff Ranger District includes the Blackwell Ridge Project, a major landscape scale project, and several smaller projects such as salvage harvests scattered across Poplar Bluff Ranger District. All projects are planned to occur within the cumulative effects boundary. Specifics have not yet been planned for each of these projects.

It is likely that future projects in the region would include timber harvesting, road improvement, prescribed burning, timber stand improvement, site preparation, watershed improvement, pond maintenance, vernal pool construction, and old growth designation, among others. These future projects and activities would be completed in compliance with the 2005 Forest Plan and the Programmatic Biological Opinion for the Mark Twain National Forest 2005 Forest Plan (U.S. Fish and Wildlife Service, Department of the Interior, Columbia, Missouri Ecological Services Field Office, 2005). Standards and guidelines in the 2005 Forest Plan and Reasonable and Prudent Measures and Terms and Conditions listed in the Programmatic Biological Opinion are implemented with each project to protect individuals and special habitats such as those required by the Indiana bat.

The next major proposed project on the Popular Bluff Ranger District is Blackwell Ridge. This project is just north of the town of Williamsville. Activities proposed in the Blackwell Ridge Project are the same as those proposed in the Northeast Lake Project. This project is in the preliminary phases of planning with initial data collection occurring now.

Incidental take acres are being tracked for each project to ensure that maximum acres for salvage sales, hazard tree removal, and temporary road construction do not exceed the allowable acres specified by the Programmatic Biological Opinion for the Mark Twain National Forest 2005 Forest Plan (U.S. Fish and Wildlife Service, Department of the Interior, Columbia, Missouri Ecological Services Field Office, 2005). Consultation with the U.S. Fish and Wildlife Service would occur as each potential future Forest Service project is proposed.

The U.S. Army Corps of Engineers is proposing to implement timber harvest at the Wappapello Lake Project directly adjacent to national forest lands within the project area (U.S. Army Corps of Engineers, St. Louis District, Environmental Compliance Branch, 2011). The U.S. Army Corps of Engineers proposes timber harvest at Blue Springs (Compartment 6) on the east side of Wappapello Lake and Brown's Hollow (Compartment 2), and Otter Creek (Compartment 8) on the west side of Wappapello Lake. The U.S. Army Corps of Engineers will consult with the U.S. Fish and Wildlife Service on the project to minimize any potential impacts to the Indiana bat across the landscape.

Proposed actions by the U.S. Army Corps of Engineers at Wappapello Lake include the use of uneven-aged timber management (single tree selection and group selection) and prescribed fire, with the intention of retaining dead trees as snags and den trees, and a basal area of 60-70. The U.S. Army Corps of Engineers was also granted a special use permit by the Forest Service to haul timber across national forest lands near Page Branch. This permit was issued to lessen impacts on the aquatic resource, minimize soil rutting, and minimize the need to build or maintain excessive roads to haul timber. Timber harvesting as it relates to U.S. Army Corps of Engineers lands would likely commence within a year.

A biological evaluation of the Northeast Lake Project considered the U.S. Army Corps of Engineers activities at Wappapello Lake (Project Record, Northeast Lake Project Federal Biological Evaluation for Federally-Listed and Candidate Species, York-Harris, August 24, 2012, Appendix C). Findings from the biological evaluation determined that there would be no cumulative effects on Indiana bat as a result of the implementation of the Northeast Lake Project.

The implementation of the proposed Northeast Lake Project would create approximately 1,093 acres of optimal or marginal bat foraging habitat that would benefit the Indiana bat. These bat foraging acres reflect all proposed thinning of stands, group selection stands, and salvage stands

that have sufficient healthy white oak, post oak, hickory, and shortleaf pine to provide 60-80 residual basal area. Additional suitable habitat would be created in areas proposed for understory removal. The mid-story would be opened-up in those areas, providing easier maneuverability for the Indiana bat.

Findings of Programmatic Biological Opinion Compliance

All Reasonable and Prudent Measures and associated Terms and Conditions listed in the Programmatic Biological Opinion for the Mark Twain National Forest 2005 Forest Plan (U.S. Fish and Wildlife Service, Department of the Interior, Columbia, Missouri Ecological Services Field Office, 2005) would be followed. There is nothing in the Northeast Lake Project that would prevent compliance with these measures.

Incidental Take

The Programmatic Biological Opinion for the Mark Twain National Forest 2005 Forest Plan (U.S. Fish and Wildlife Service, Department of the Interior, Columbia, Missouri Ecological Services Field Office, 2005) anticipates that incidental take may occur from the loss of an unknown occupied roost tree. To date, all known maternity roosts on the Mark Twain National Forest have been dead trees in advanced stages of decay (T. Davidson, personal communication, July 23, 2012).

Actions that may cause the removal of potentially suitable roost trees include salvage sales and hazard tree removal resulting from trail maintenance, recreation site maintenance, road construction or reconstruction, temporary road construction, and fireline construction. Incidental take would be monitored using the number of acres specified by the Programmatic Biological Opinion for the Mark Twain National Forest 2005 Forest Plan (U.S. Fish and Wildlife Service, Department of the Interior, Columbia, Missouri Ecological Services Field Office, 2005, Table 11, p. 67).

As explained in the Programmatic Biological Opinion, incidental take for hazard tree removal includes 1,500 acres of recreation site maintenance per year; 2,000 acres of trail maintenance per year; 100 acres of road construction/reconstruction per year; 800 acres temporary roads and skid trails per year; and 240 miles of fireline per year. Hazard tree removals are generally individual trees being removed, not acres of forest being removed. These numbers are inflated estimates of acres that could be affected across the Mark Twain National Forest throughout the 10 year project period.

Incidental take for salvage harvest includes 15,000 acres per year. This means a maximum of 15,000 acres of salvage harvest can be conducted each year across the Mark Twain National Forest.

Estimates of incidental take for the Northeast Lake Project are provided in Table 8—Northeast Lake Project Projected Incidental Take Acres. This table projects the cumulative take acres with the implementation of Alternative 2, the Proposed Action, for the Northeast Lake Project. It also provides estimates of anticipated take acres of project implementation by year. Acreages in the incidental take analysis table were updated on August 20, 2012, as a result of correspondence with other Mark Twain National Forest Wildlife Biologists regarding new projects on their respective districts.

Estimates of incidental take acres and or project actions would be updated during project implementation if on-the-ground actions deviate from these numbers. Actions would be taken to ensure that the maximum allowable acreages by activity as listed in the Programmatic Biological Opinion are not exceeded.

Table 8—Northeast Lake Project Projected Incidental Take Acres

Activity		Affected in Fiscal Year 2013	Affected in Fiscal Year 2014	Affected in Fiscal Year 2015	Affected in Fiscal Year 2016	Affected in Fiscal Year 2017
Salvage Harvest Acres (Even or Uneven-aged Harvest)		1,000 ac. Cumulative for MTNF: 2,926 ac.	1,000 ac. Cumulative for MTNF: 1,488 ac.	1,000 ac. Cumulative for MTNF: 1,491 ac.	1,000 ac. Cumulative for MTNF: 1,000 ac.	166 ac. Cumulative for MTNF: 166 ac.
Hazard Tree Removal	Acres	8.3 ac.	8.3 ac.	8.3 ac.	8.3 ac.	8.3 ac.
	Road & Trail Related	Cumulative for MTNF: 82 ac.	Cumulative for MTNF: 47 ac.	Cumulative for MTNF: 25 ac.	Cumulative for MTNF: 8.3 ac.	Cumulative for MTNF: 8.3 ac.
	Miles Fireline Construction	N/A	N/A	N/A	N/A	N/A

Additional Recommendations or Mitigation Measures

Because all Reasonable and Prudent Measures and Terms and Conditions applicable to this project would be followed, and standards and guidelines of the 2005 Forest Plan have been incorporated into the proposed action, no additional recommendations are necessary to protect or further recover Indiana bats.

Determination of Effect

During mist netting and acoustic surveys across the district, no Indiana bats have been documented within the project area on national forest lands. However, this species has been observed using a secondary roost tree on U.S. Army Corps of Engineers lands near Holliday Creek. This area was managed for the emerald ash borer in 2010, which opened up the canopy in that area and could promote bat use near riparian areas. Recent survey work indicates this species is heavily tied to riparian habitats.

There are no documented Indiana bat hibernacula on the Poplar Bluff Ranger District or within the project area, and no maternity trees have been located within the project area. However, this species is highly vagile and could easily move into uplands in the project area at any time.

Activities proposed in the Northeast Lake Project area incorporate 2005 Forest Plan standards and guidelines. The standards and guidelines include measures to protect Indiana bat individuals and populations, and enhance potentially suitable roosting and foraging habitat. In addition, silvicultural prescriptions will protect bat habitat along 2.0 miles of the St. Francis River to ensure long-term availability of future snags. As part of this management, trees may be girdled to provide snags in areas where they may be lacking.

The Indiana bat forages over a wide variety of habitats including riparian corridors, upland areas, fields, shelterwood cuts, and other disturbed areas. This behavior has been observed adjacent to national forest lands on the Poplar Bluff Ranger District. Indiana bat primary roost trees have been found adjacent to agricultural fields and open woodland habitats managed by timber harvesting and prescribed fires.

Primary trees have also been observed within areas where ash trees were removed in an effort to eradicate the emerald ash borer. This action has opened areas up and possibly increased the suitability of the remaining snags for Indiana bat use. Therefore, it is expected that more diverse habitats created through the implementation of the Northeast Lake Project would provide a variety of roosting and foraging opportunities.

Approximately 15% of the commercial harvested acres would become optimal foraging habitat for the Indiana bat with the implementation of this project. However, 20% of these harvest acres would be considered poor due to low residual basal area. Additional areas receiving understory removal would also become optimal.

This project is likely to benefit the Indiana bat overall by improving foraging and roosting habitat by opening up the canopy, exposing remaining roost trees to sunlight, and allowing the Indiana bat to more easily maneuver throughout the forest. However, a portion of the existing and future roosts would be removed during timber harvest activities including temporary road construction, skid trail use, the creation of log landings, and any timber harvest lowering the canopy closure to less than marginal levels. These activities increase the chance of removing an occupied primary maternity tree.

It was determined that this project **may affect - is likely to adversely affect** the Indiana bat. Consultation with the U.S. Fish and Wildlife Service would be re-initiated if caves or occupied roost trees are discovered in the project area.

REGION 9 REGIONAL FORESTER'S SENSITIVE SPECIES AND STATE ENDANGERED SPECIES

Species considered for this project are those Regional Forester's Sensitive Species (RFSS) and State Endangered Species known or likely to occur across Mark Twain National Forest lands. The most recent Region Nine (R9) Regional Forester's Sensitive Species list is dated December 14, 2012. The Mark Twain National Forest portion of the updated Regional Forester's Sensitive Species list contains 139 species of plants and animals.

Relevant species on the Regional Forester's Sensitive Species list were reviewed on February 22, 2012. It was determined that 76 species are known or likely to occur on the Poplar Bluff Ranger District when considering the documented distribution and availability of potentially suitable habitat. All remaining species were dropped from further consideration. Habitat associations for relevant Regional Forester's Sensitive Species that could occur on the Poplar Bluff Ranger District are detailed in the Northeast Lake Project Biological Evaluation for Regional Forester Sensitive Species and State Endangered Species (Project Record, York-Harris, October 16, 2012).

Species that are known or likely to occur in the Northeast Lake Project area are presented in Table 9—Listing of Regional Forester Sensitive Species Known or Likely to Occur in Wayne County, Missouri, and Table 10—Listing of State Endangered Species Known or Likely to Occur in Wayne County, Missouri. The Northeast Lake Project Biological Evaluation for Regional Forester Sensitive Species and State Endangered Species (Project Record, October 16, 2012) provides details of how these species were determined and considered.

Four additional generalist species did not show up during a review of the Missouri Natural Heritage Database 2012 (Missouri Department of Conservation, n.d.) conducted by the Poplar Bluff Wildlife Biologist on July 17 and August 24, 2012. Since these species could occur within the project area based on potentially suitable habitat, they were also addressed in detail. These include the bald eagle, Northern bat, little brown bat, and tri-colored bat.

Table 9—Listing of Regional Forester Sensitive Species Known or Likely to Occur in Wayne County, Missouri

Plants	Birds/Mammals	Reptiles / Amphibians	Fish	Mollusks	<u>Invertebrate</u>
*Featherfoil *Pale Manna Grass *Green Wood Orchid *Fox or Triangular Sedge *Pale Green Wood Orchid Yellow-Fringed Orchid Pale Avens	Migrant Loggerhead Shrike *Swainson’s Warbler Plains Spotted Skunk	Alligator Snapping Turtle*	*Crystal Darter *Longnose Darter	Western Fanshell*	Big Creek Crayfish

Notes: *Species with an asterisk either require permanent water for survival or are otherwise very closely dependent upon permanent water to carry out their life cycle; these species are closely associated with wet habitats but may also be found in upland situations. This list does not include candidate, proposed, or federally-listed species

Table 10—Listing of State Endangered Species Known or Likely to Occur in Wayne County, Missouri

Birds/Mammals	Fish/Reptile
American Bittern Northern Harrier King Rail	*Mountain Madtom Western Chicken Turtle*

Notes: *Species with an asterisk either require permanent water for survival or are otherwise very closely dependent upon permanent water to carry out their life cycle; these species are closely associated with wet habitats but may also be found in upland situations. This list does not include candidate, proposed, or federally-listed species

Direct and Indirect Effects on Regional Forester Sensitive Species and State Endangered Species

Wet habitat. There are 37 ponds within the proposed project area, 33 of which hold water throughout the year. There are no perennial streams within the project area on national forest lands. Standards and guidelines in the 2005 Forest Plan include measures to protect intermittent and perennial streams and ponds from soil erosion, resource damage to waterways (such as from rutting, excessive soil movement), super heating of the water, and major vegetation changes along the perimeter of permanent water sources.

A 100-foot no cut buffer would be established around ponds within harvest units. This would protect all listed plant species that requires permanent water during all or a large portion of their life cycle.

The pond environment is unsuitable for the crystal darter, longnose darter, Big Creek crayfish, western fanshell, and mountain madtom which occur in permanent streams not found within the project area. Alligator snapping turtle is not expected to use ponds within the project area primarily due to the size the ponds and their scattered locations in upland habitats.

Ponds within the project area are marginal at best for king rail and American bittern, which are considered wetland-dependent species that forage in shallow areas. The king rail and American bittern could use the perimeter of upland ponds while feeding or resting during migration. If these areas were used it would provide minimal opportunities for foraging due to the small size of the ponds and shallow depth of the majority of these ponds.

Although the western chicken turtle is known to spend time traveling through uplands to reach wetland habitats, ponds in the Northeast Lake Project area are considered poor habitat for this species due to the shallow depth of the water. There is a lack of extensive wetlands in the project area, but this species could meander through the project area to reach wetland areas on U.S. Army Corps of Engineers lands or private lands. The nearest documented occurrence of a western chicken turtle is approximately 23 miles east of the project area. It is highly unlikely this species occurs within the project area.

There are documented bald eagle nests on Wappapello Lake, but no nests have been documented on national forest lands nearby, probably due to the lack of riparian habitat. No eagles were observed during site visits, but bald eagles likely pass through the project area during migration. Because buffers would be in place adjacent to ponds, the fishery resource would not be impacted. Further, no bald eagle nests were observed during site visits. Thus, it was determined that no direct or indirect effects would occur to the bald eagle.

No other Regional Forester Sensitive Species or State Endangered Species associated with wet habitats have been documented in the project area.

Open grassland-shrub habitat. There is grass/shrub habitat on the national forest, U.S. Army Corps of Engineers lands, and private lands within the gas pipeline right-of-way in Compartments 6, 7, 10, and 11. This habitat is maintained by mowing on a three-year rotation. Therefore, this habitat would be maintained in perpetuity. Other grass/shrub habitats occur throughout the project area on private lands and U.S. Army Corps of Engineers lands along the St. Francis River.

Although the plains spotted skunk has not been documented within the project area, this species could live within the pipeline right-of-way or pass through forested areas proposed for salvage where brush piles have been created as a result of trees dying and falling over. It is also likely that the Northern harrier uses the pipeline for hunting during the winter months.

Plains spotted skunk

In the last 10 years, a large amount of cover in the form of downed woody debris has been created for the plains spotted skunk as a result of a variety of natural disasters (wind events, microbursts, and tornadoes). Potentially suitable habitat is also available to this species in areas that have been harvested in the recent past. In addition to areas that have been harvested, many of the trees across the district are stressed and or old. These trees are dying, falling to the ground, and creating shrubby canopy gaps throughout the forest. This shrubby habitat provides excellent foraging, hiding, and den areas for the plains spotted skunk.

On national forest lands, suitable habitat for this species in the project area is limited to primarily the gas pipeline in its later stages of growth (providing more cover). However, this habitat is considered poor at best for the plains spotted skunk because it is mowed on a regular basis. Other areas that could provide suitable habitat are scattered areas impacted by wind events and areas with forest health issues that contain downed trees. Again, these habitats are considered poor due to their scarcity on the landscape, as well as their scattered locations across the project area.

Alternative 1—No Action Alternative

The lack of timber harvest would limit the acres of potentially suitable habitat for plains spotted skunk. Fewer acres would be in the younger age class required by this species. However, there are no plains spotted skunks documented in the project area. No direct or indirect effects to plains spotted skunk are expected as a result of lack of management. This conclusion reflects conditions in which shrubby areas are created as trees in the project area die, fall to the ground, and create canopy gaps and areas for younger growth.

Alternative 2—Proposed Action

No direct or indirect impacts to the plains spotted skunk are anticipated with this project because potentially suitable habitat is considered poor within the project area and there are no documented occurrences of this species in Wayne County. If this species happens to meander through the area, it would be able to move out of the way during logging operations. Potentially suitable habitat in the form of a shrub component would develop for the plains spotted skunk within approximately 3 years after timber harvest.

It was determined that the implementation of this project would have no negative direct or indirect effects on the plains spotted skunk. Beneficial short-term indirect impacts include the creation of shrubby habitat on approximately 3,590 acres.

Northern Harrier and Migrant Loggerhead Shrike

Suitable habitat for the Northern harrier and loggerhead shrike is provided predominantly within gas pipeline and powerline corridors on national forest lands. Some private lands in the surrounding area may provide habitat for the migrant loggerhead shrike since the majority of open areas on private land is in the form of fescue fields (many with barbed wire fencing) rather

than true grasslands. The Northern harrier can also be found foraging over open private pastures, and agricultural areas on U.S. Army Corps of Engineers lands within the project area.

Alternative 1—No Action Alternative

The lack of timber harvest would have no direct or indirect effect on Northern harrier or migrant loggerhead shrike. These species most likely do not use national forest lands within the project area based on the quantity and quality of existing suitable habitat. The habitat created as a result of timber harvest would not necessarily provide optimal areas necessary to carry out Northern Harrier life processes. Trees would quickly reclaim any site that was harvested, thus, these species would not persist within harvested forest areas. Therefore, Alternative 1 would have no direct or indirect effect on Northern harrier or migrant loggerhead shrike.

Alternative 2—Proposed Action

No direct effects would occur to loggerhead shrike or Northern harrier as a result of Alternative 2. Areas proposed for timber management are unsuitable for these species. Thus, the areas would be unoccupied by these species during harvest activities.

Suitable habitat for loggerhead shrike would be created as a result of Alternative 2, but this indirect benefit would be short-lived if the area is not burned or otherwise maintained on a regular basis. Other proposed activities would have no additional indirect effect on suitable habitat for these species. The proposed action would have no indirect effect on Northern harrier because no suitable habitat would be created for this species. No negative direct or indirect effects to these species are anticipated as a result of the implementation of Alternatives 1 or 2.

Upland Forest Species

It was concluded that 5 upland species may occur in the project area, including pale avens, yellow-fringed orchid, bald eagle, Northern bat, little brown bat, and tri-colored bat (formerly known as Eastern pipistrelle).

None of the 5 potential upland habitat plant species have been documented in the project area but pale avens and yellow-fringed orchid are known to occur in Wayne County. With the exception of canopy gaps where small clusters of trees have died, the majority of the forest floor is shaded. This shaded condition is expected to change relatively quickly, given the deteriorating condition of the trees. Approximately 697 acres is considered shortleaf pine that dominates the stand. The remaining project area is a mix of pine/hardwood or mixed hardwood species.

Pale Avens and Yellow-Fringed Orchid

Alternative 1—No Action Alternative

No direct effects are expected as a result of this alternative because these species have not been documented within the project area. However, negative indirect effects may occur as a result of the lack of timber harvest proposed with this alternative. Trees within the project area would continue to die and fall naturally, which would provide minimal light on the forest floor. With this alternative, chances of these plants naturally propagating within the project area would be low, based on a lack of potentially suitable habitat across the project area.

Alternative 2—Proposed Action

Pale avens and yellow-fringed orchid could occur in the project area with suitable habitat. Yellow-fringed orchid has been found in fen complexes, but these two plant species can be considered generalists, having rarely been found in a variety of upland sites. These forest types are prevalent across the Poplar Bluff Ranger District.

Pale avens prefers open woodland/savanna in upland oak-hickory forest, and yellow-fringed orchid is found in wet habitats such as acid seeps, spring branches, and sinkhole ponds. One of the nine populations of yellow-fringed orchid in the state has been found in a pine dominated upland forest. At its nearest locations, yellow-fringed orchid has been found approximately 19 miles southwest of the project area and approximately 13 miles north of the project area.

Pale avens was discovered in 1985 on U.S. Army Corps of Engineers lands within the project area. However, pale avens was not found in the most recent survey in 2001, according to the Missouri Natural Heritage database (Missouri Department of Conservation, n.d.). There would be no direct effects on these species because none are documented on national forest lands within the project area. Further, there are no spring branches or wet habitats that would be impacted with Alternative 2, and no savanna or open woodland within the project area on national forest lands. The only treatment proposed for pine stands in the project area is thinning and/or old growth designation.

According to the Missouri Natural Heritage Database 2012 (Missouri Department of Conservation, n.d.), beneficial actions for yellow-fringed orchid include thinning the forest to promote partial sunlight. Therefore, there would be beneficial indirect effects to yellow-fringed orchid and pale avens as 697 acres are thinned and approximately 3,590 acres of open woodland created bringing more sunlight to the forest floor and providing conditions more suitable for these species. Proposed actions would have indirect beneficial effects on these.

Little Brown Bat, Tri-Colored Bat, and Northern Bat

Bat surveys have been conducted on the Mark Twain National Forest since 1997, and are ongoing, using mist netting, harp trapping, and acoustic detection (Project File, Bat Survey Reports). Bat surveys were conducted within the Northeast Lake Project area in 2006 (Project File, Bat Survey Reports). Four sites were surveyed – 3 on national forest lands, and 1 on adjacent U.S. Army Corps of Engineers lands. Northern bats and tri-colored bats were captured during these surveys. No little brown bats were captured.

Results of the 2006 bat surveys are typical across the Poplar Bluff Ranger District. Although little brown bats are not captured frequently during mist-net surveys, this species has been captured and or detected on the Poplar Bluff Ranger District several times.

Alternative 1—No Action Alternative

No direct or indirect effects are expected to these species as a result of Alternative 1, the No Action Alternative. There would be plenty of potential roost trees for these bats in the form of dead and dying trees. As dead and dying trees fall, canopy gaps would provide foraging areas for these species.

Although the forest would be somewhat denser with this alternative, these species would continue to forage on the edges of forest and openings along the gas pipeline and powerline

corridor. They would also forage along areas where national forest land and openings on U.S. Army Corps of Engineers lands adjoin.

It is difficult to estimate how long the integrity of ponds would last without dam maintenance, or how long ponds would be usable as drinking and foraging sources without management of floating vegetation. It would likely take many years to deter bats from attempting to use those areas.

Alternative 2—Proposed Action

There is abundant potentially suitable summer habitat for the Northern, little brown, and tri-colored bats within the project area. Trees in decline (having cracks, crevices, and loose bark) could be used by any of these species. Live trees could also be used by the Northern and tri-colored bats.

Because this project specifically targets the removal of live and dead and dying trees, and two of the bat species have been observed in the project area, there could be direct impacts to all three bat species. Adult and young bats could be injured or killed during harvest, particularly if harvest is conducted outside of hibernation season. Indirect effects are likely to benefit tri-colored and Northern bats, which would forage in canopy gaps, edges, and lower density forests. The resulting habitat throughout the project area would be a mix of structural conditions that are likely to provide higher insect abundance and easier maneuverability through the forest.

Cumulative Effects on Regional Forester Sensitive Species and State Endangered Species

Because no direct or indirect negative effects are expected for wetland or grassland/shrub species as a result of the implementation of Alternatives 1 and 2, there would be no cumulative effects on any species with those habitat associations. Cumulative effects for the three upland bat species (little brown, tri-colored, and Northern), as well as the two plant species that are sometimes but rarely found in uplands (pale avens and yellow-fringed orchid) were addressed in the Northeast Lake Project Biological Evaluation for Regional Forester Sensitive Species and State Endangered Species (Project Record, York-Harris, October 16, 2012).

Negative cumulative effects are not expected to occur to pale avens or yellow-fringed orchid as a result of either Alternatives 1 or 2. No direct effects would occur to these species due to the lack of documented occurrences on national forest lands within the project area. Thus, no uprooting or destruction of live plants would occur.

The nearest known occurrences of the plants in question are quite a distance from the project area, and it is unlikely that seed dispersal would reach the project area whether timber management occurred or not. The documented occurrences of these two species across the Mark Twain National Forest and Missouri would not be disturbed or altered in any way. Thus, the implementation of this project (or lack of implementation) is not expected to have any impacts on populations of these species across their range.

With the implementation of Alternative 2, negative direct effects may occur to any of the three bat species as a result of cutting an occupied tree.

The geographic boundary for the project area was defined as a 25-mile radius from the approximate center of the project area. This was chosen because it includes all land (federal,

state, and private) within a 25-mile radius and also allows for the inclusion of the entire Poplar Bluff Ranger District. The existing condition for the cumulative effects analysis area is the same as that described in the *Indiana bat* section.

Thus far, there has been no indication that populations of little brown, tri-colored, or Northern bats are in decline. Bat trapping occurs on the Poplar Bluff Ranger District every year, and these species continue to be captured in similar numbers year after year despite management activities on national forest and other lands.

There is an abundance of potentially suitable roosting, foraging, and drinking habitat across the geographic cumulative effects area, particularly on national forest lands. Timber harvest on national forest lands within the recent past has improved foraging conditions by thinning the forest canopy, creating canopy gaps, and providing easier bat maneuverability through the forest while hunting insects. Therefore, cumulative effects on these species are not expected as a result of the implementation of Alternative 2.

Determination of Effect

The plains spotted skunk is a generalist across Missouri and has not been documented in Wayne County. There is an abundance of suitable habitat for this species across the Poplar Bluff Ranger District. There would be no negative direct or indirect effects on the plains spotted skunk. No cumulative effects to this species are anticipated with the implementation of this project. Beneficial short-term indirect impacts for the species include the creation of shrubby habitat on approximately 3,590 acres.

No direct effects would occur to loggerhead shrike or Northern harrier as a result of Alternative 2. The areas proposed for timber management are unsuitable for these species, thus they would be unoccupied during harvest activities. Suitable habitat for loggerhead shrike would be created as a result of Alternative 2, but this indirect benefit would be short-lived if the area is not burned or otherwise maintained on a regular basis.

Other proposed activities would have no additional indirect effect on suitable habitat for these species. The proposed action would have no indirect effect on Northern harrier because no suitable habitat would be created for this species. No negative direct, indirect, or cumulative effects to these two bird species are anticipated as a result of the implementation of Alternatives 1 or 2.

Alternative 2 would have beneficial indirect effects on pale avens and yellow-fringed orchid. These species are associated with open woodland communities that would be created with the implementation of this project. No direct effects or cumulative effects are expected on these species.

It was determined that Alternative 2 of the Northeast Lake Project may directly affect Northern, little brown, and tri-colored bats in the project area based on documented occurrences and an abundance of suitable habitat within the project area. Indirect effects are likely to benefit tri-colored and Northern bats, which would forage in canopy gaps, edges, and lower density forests created during timber harvest and associated activities.

Cumulative effects are not expected to occur to these species. Little brown bats occur in very low numbers on national forest lands. Habitat conditions would improve for the tri-colored and

Northern bat. Further, there are no indications that populations of these species are in decline across the Mark Twain National Forest or Poplar Bluff Ranger District.

If changes occur to the proposed project, or further information is gathered regarding Regional Forester Sensitive Species or State Endangered Species in the project area, additional analysis may take place. The implementation of Alternative 2, as proposed, is not likely to cause a trend toward federal listing or loss of viability to any Regional Forester Sensitive Species or State Endangered Species analyzed in this document.

HERITAGE RESOURCES

AFFECTED ENVIRONMENT/EXISTING CONDITIONS

To date, 40 archaeological sites have been identified within the area of potential effect for the Northeast Lake Project. Of these 40 sites, 6 contain evidence of prehistoric activities and 34 contain evidence of historic period activities. All 40 sites are in the Area of Potential Effect identified for this project.

In addition to the archaeological sites, a number of historic features (isolated historic features such as livestock pens, improved springs, depressions, rock features, refuse dumps, or mining pits that are not associated with larger archaeological sites or with artifacts), were also recorded in the project area (Moerbe & Gannon, 2011). Because these features are not considered to be Historic Properties for Section 106 purposes, they will not be considered further.

Prehistoric sites within the Northeast Lake Project area consist mostly of seasonal camps and limited activity locations. Seasonal camps were used by small groups during resource procurement. The limited activity locations usually consist of few or isolated artifacts and represent light, short duration activity.

The late nineteenth and early twentieth century sites within the Northeast Lake Project area are represented by farmstead and domestic habitations, historic fields, mines and mining pits, a historic road, and a logging-era tram.

Investigations to date at 8 of the 40 archaeological sites are insufficient to fully evaluate them against the National Register of Historic Places significance criteria as found in 36 CFR 60. These archaeological sites are being managed as unevaluated properties that appear to meet one or both of two National Register of Historic Places significance criteria as found in 36 CR 60.6:

Criterion A: “. . . That are associated with events that have made a significant contribution to the broad pattern of our history”; and

Criterion D: “. . . That have yielded, or may be likely to yield, information important in prehistory or history.”

The unevaluated sites are afforded protection from project activities that may harm the sites in the same manner as sites that are considered eligible for the National Register.

Thirty-one of the 40 archaeological sites in the project area do not meet National Register significance criteria as found in 36 CFR 60.6. Because they are not considered to be historic, or eligible, properties, these sites do not require protection during project implementation.

One of the 40 archaeological sites, the Old Military Road/Natchitoches Trace (23BU1466), meets National Register Criterion A and has been determined eligible for the National Register of Historic Places. This site would be protected from any adverse effects during project implementation through the use of mitigation measures designed specifically for this site.

Regulatory consultation with the Missouri State Historic Preservation Officer (SHPO) has been carried out for the activities proposed in the Northeast Lake Project. Consultation is required under the National Historic Preservation Act, as Amended, and the accompanying regulations found at 36 CFR 800.

A letter of concurrence was received from the Missouri State Historic Preservation Officer dated August 17, 2012. The State Historic Preservation Officer concurred with the site eligibility determinations and recommendation that there would be “no adverse effect,” with regard to project effects on historic properties if 2005 Forest Plan standards and guidelines and other mitigation measures as described in the *Determination of Eligibility and Effect* report are implemented (Project Record, Letter of Concurrence from Mark Miles, State Historic Preservation Officer RE: Northeast Lake Project (USDA/FS) Wayne County, Missouri). A list of mitigation measures are provided in Chapter 2 of this Environmental Assessment. During implementation, applicable 2005 Forest Plan standards and guidelines would be followed to protect sites.

Tribal consultation with recognized Native American tribes has been completed. In the event that human remains are unintentionally discovered during project activities, the Forest Service, as consistent with the 2005 Forest Plan, would follow provisions specified in the Native American Graves Protection and Repatriation Act and Chapter 214, Cemeteries, and Chapter 194, Unmarked Human Burials, Revised Statutes of Missouri.

Past, Present, and Reasonably Foreseeable Actions of Relevance

For more details on past, present and reasonably foreseeable actions related to the project, see Chapter 2, Alternative 1 sections on *Past Actions Relevant to Resource Conditions*, *Present Actions of Relevance*, and *Reasonably Foreseeable Actions of Relevance*.

Definition of Effects and Area of Potential Effect

An *Effect* to a cultural resource is defined as “. . . alteration to the characteristics of a historic property qualifying it for inclusion in or eligibility for the National Register” [36 CFR 800.16(i)]. An Adverse Effect is found “when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association” [36 CFR 800.5(a)(1), (a)(2)]. Effects to cultural resources may be either Direct or Indirect.

The Area of Potential Effect is defined as “. . . the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking” [36 CFR 800.16(d)].

Monitoring of 2005 Forest Plan standards and guidelines and other mitigation measures for cultural resource site protection on previous projects with nearly identical activities resulted in minimal to no impacts to cultural resources.

Definition of Direct Effects

With respect to the Northeast Lake Project, direct effects are those effects that occur during project implementation. These effects can occur during implementation of forest management activities, as well as during some kinds of road maintenance and reconstruction. In essence, any activity that has the potential to disturb the ground has the potential to directly affect archaeological sites.

Specific activities outlined in the Northeast Lake Project **that have the potential to directly affect cultural resources, and therefore, are considered to be undertakings for the purposes of this project** include the following:

Forest Management and Wildlife Habitat Management

- Commercial timber harvest.
- Construction of landings, temporary roads, skid trails.
- Trash dump cleanup along all System, non-System and illegal roads and trails.

Roads

- Maintenance of Forest Service roads that are not currently maintained and where ground disturbance takes place outside existing road prisms and ditches.
- Road realignment.
- Road reconstruction depending on the specific nature of the reconstruction.
- Road and illegal trail closure using ground disturbing methods, such as construction of a pit and berm and gate installation.
- Decommissioning non-System roads involving obliteration and native species planting.

The Areas of Potential Effect for the above-listed Northeast Lake Project activities are those geographic areas in which the ground disturbing activities would take place.

Activities proposed for the Northeast Lake Project that **do not have the potential to affect cultural resources, and therefore, are not considered to be undertakings for purposes of this project** include the following:

Forest and Wildlife Habitat Management

- Control of non-native invasive plant species using herbicides.
- Pond maintenance.
- Pre-commercial thinning.
- Site preparation for natural regeneration only (in areas outside surveyed harvest stands).

Roads

- Continued maintenance of existing, built Forest Service roads where ground disturbance does not take place outside existing road prisms with the exception of the Old Military Road/Natchitoches Trace [23BU1466] which is protected under specifically designed Mitigation Measure Cultural Resource (CR) CR4.
- Reconstruction of Forest Service roads where ground disturbance does not take place outside existing road prisms and ditches and depending on the nature of the reconstruction.
- Road closure using non-ground disturbing methods, such as placement of large boulders across road.

Definition of Direct Indirect Effects

In general, project activities of the kinds proposed for the Northeast Lake Project area has the potential to indirectly affect cultural resources by opening up, through road improvements, areas of the forest in which cultural resources are located. These areas may then see increased visitor use. Increased visitor use of an area in which archaeological sites are located can render the sites vulnerable to both intentional damage, as well as unintentional damage. Intentional damage can occur through unauthorized digging in archaeological sites and unauthorized collecting of artifacts from sites. Unintentional damage can result from such activities as driving motorized vehicles across archaeological sites, as well as from other activities that disturb the ground during dispersed recreational use.

Cultural Resources Surveys

Cultural resources inventory surveys in the Northeast Lake Project area have focused on those stands and areas in which activities are proposed that have the potential to affect archaeological sites, as described in the *Definition of Effects and the Areas of Potential Effects* section. To date, all areas of the project where known ground-disturbance is proposed to occur have had complete coverage surveys that meet current standards for archaeological fieldwork and reporting.

Maps providing information on the location of cultural resources surveys in the project area and a listing of reports documenting the cultural resources surveys in the Northeast Lake Project area may be found in the zone archeologist's files maintained at the Eleven Point Ranger District office.

Survey Limitations

Cultural resources surveys have not necessarily been completed for the following proposed activities:

1. Temporary roads, skid trails, and landings for commercial timber harvest.
2. Forest road activities.
3. Trash dump cleanup along all System, non-System and illegal roads and trails.

Temporary roads, skid trails, and landings. At least some of these activities may be carried out in stands that have been surveyed for other reasons, such as for timber management activities. In such cases, the areas will not be re-surveyed. In many cases, however, the locations of skid trails and landings may not be known until the time of project implementation. In these cases, once

the locations are known, the areas of potential effect, if they have not yet been surveyed for cultural resources, they will be surveyed, and Section 106 consultation will be completed prior to project implementation.

Forest Service road activities. Information has not yet been provided on specific locations along Forest Service System Roads where the following activities might take place:

- Maintenance of Forest Service System roads that are not currently maintained and where ground disturbance takes place outside existing road prisms and ditches.
- Road realignment.
- Road reconstruction depending on the specific nature of the reconstruction.
- Road and illegal trail closure using ground disturbing methods, such as construction of a pit and berm and gate installation.
- Conversion of non-System roads to System road status.

Once the locations are known, the areas of potential effect will be surveyed, and Section 106 consultation will be completed prior to project implementation.

Trash dump cleanup along all System, non-System and illegal roads and trails. The locations of trash dump cleanup may not be known until the time of project implementation. The areas of potential effect for any trash cleanup involving ground disturbing activities and/or within the proximity of historic properties will be surveyed, and Section 106 consultation will be completed prior to implementation.

DIRECT AND INDIRECT EFFECTS ON ARCHAEOLOGICAL RESOURCES

Summary statements of expected effects for the activities proposed for the Northeast Lake Project are presented in this section.

Alternative 1—No Action Alternative

There would be no effects on the cultural resources existing condition with selection of this alternative.

Alternative 2—Proposed Action

In general, the effects on the cultural resources of the various activities that are proposed for this project are expected to be as follows:

- (1) In those stands and project areas where no historic properties (archaeological sites meeting National Register criteria) are present, the proposed project activities have **No Potential to Effect** cultural resources.
- (2) In those stands and other project areas in which ground disturbing activities would be carried out as listed in the *Definition of Effects and Areas of Potential Effect* section, where historic and/or unevaluated properties are present, and where Site Avoidance (Mitigation Measure CR1) is feasible and is implemented, the proposed project activities are expected to have **No Effect** on cultural resources.

- (3) Where archaeological sites occur along routes of access (such as old woods roads that have not been maintained) and where site avoidance (CR1) is not feasible, then Mitigation Measure CR5 will be applied with the expectation that a mitigation plan can be developed to result in a finding of **No Adverse Effect** on cultural resources.

In the case of the Northeast Lake Project area, increased site vulnerability is expected to be the principal indirect effect to cultural resources resulting from activities included in the Proposed Alternative as listed in the *Definition of Effects and Areas of Potential Effect* section. With application of appropriate mitigation measures, it is not expected that the proposed project activities in any of the alternatives would increase visitor use in those areas in which archaeological sites are located. Therefore, it is not expected that implementation of the proposed activities would have indirect effects on the cultural resources.

Because it is expected that implementation of project activities would result in findings of either No Effect or No Adverse Effect, there is expected to be little change over the existing condition with respect to the archaeological sites.

CUMULATIVE EFFECTS

Spatial Boundary

The spatial boundary for the analysis is the Northeast Lake Project area.

Temporal Boundary

The temporal boundary for the analysis included historic and prehistoric sites and features.

Project activities in the Northeast Lake Project area have the potential to affect cultural resources. Cultural resources surveys have not necessarily been completed for temporary roads, skid trails, and landings; forest road activities; and trash dump cleanup. As locations of these activities become known, they will be surveyed, and Section 106 consultation will be completed prior to project implementation.

Section 106 Consultation

The necessary consultation with the Missouri State Historic Preservation Officer (SHPO) as outlined in the National Historic Preservation Act (as amended, 2000), and the accompanying regulations found at 36 CFR 800, will be carried out with respect to all Areas of Potential Effect and historic and unevaluated properties prior to project implementation. Such consultation will offer the Missouri State Historic Preservation Officer the opportunity to comment on the forest's efforts to identify historic properties, the determination of National Register eligibility of the archaeological sites in the Northeast Lake Project area and on the forest's determination of effect for the project actions with respect to the eligible and unevaluated sites.

Gibson (2012) provided documentation to the Missouri State Historic Preservation Officer to date as the basis for the regulatory consultation. The letter of concurrence from the Missouri State Historic Preservation Officer is contained within the project record (Project Record, Letter of Concurrence from Mark Miles, State Historic Preservation Officer RE: Northeast Lake Project (USDA/FS) Wayne County, Missouri, August 17, 2012). As noted previously, regulatory consultation will be carried out as required for the remaining project areas as surveys of those areas are completed.

Irretrievable and Irreversible Effects

Irretrievable and irreversible effects from the Northeast Lake Project are unlikely as long as locations of activities are surveyed, Section 106 consultation occurs, and 2005 Forest Plan standards and guidelines and specified cultural mitigation measures are applied. Failure to provide for adequate cultural surveys and resource protection could result in irretrievable and irreversible damage to historic and prehistoric sites that may have met National Register of Historic Places significance criteria.

SUMMARY OF PROJECT EFFECTS ON HERITAGE RESOURCES

Numerous historic and prehistoric sites and features have been identified within the Area of Potential Effect for the Northeast Lake Project. Limited investigations have been conducted in the area. Of those sites investigated, the investigations were insufficient to fully evaluate them against the National Register of Historic Places significance criteria, and these sites are being managed as unevaluated properties. The unevaluated sites are afforded protection from project activities that may harm the sites. Of particular note, the Old Military Road/Natchitoches Trace (23BU1466), meets National Register Criterion A and has been determined eligible for the National Register of Historic Places. This site would be protected from any adverse effects during project implementation through the use of specifically-designed mitigation measures.

Project activities in the Northeast Lake Project area have the potential to affect cultural resources. Cultural resources inventory surveys in the Northeast Lake Project area have focused on locations and areas in which proposed activities have the potential to affect archaeological sites. Areas where known ground-disturbance is proposed to occur have had complete cultural survey coverage. Activities that occur in areas that have been surveyed will not be re-surveyed. Cultural resources surveys have not necessarily been completed for temporary roads, skid trails, and landings; forest road activities; and trash dump cleanup. However, as locations of these activities become known, they will be surveyed, and Section 106 consultation will be completed prior to project implementation.

VISUAL RESOURCES

AFFECTED ENVIRONMENT/EXISTING CONDITIONS

The Northeast Lake Project area contains lands administered under 2005 Forest Plan Management Prescription 6.2 (General Forest Area). Management Prescription 6.2 features the management of natural vegetative communities under limited investments to enhance the semi-primitive motorized dispersed recreation experience.

The **Visual Quality Objective** is determined for a specific area by referring to the visual quality matrix found in the 2005 Forest Plan standards and guidelines for each management prescription. Each district has variety classes and sensitivity levels mapped and the criteria for determining variety classes and sensitivity levels are documented in the 2005 Forest Plan, Appendix G. They may be changed based on field conditions. The following narrative describes Northeast Lake Project Area characteristics based on Appendix G-2.

The Northeast Lake Project area is classified as Visual Variety Class B—Typical. This classification applies to areas of ordinary or common scenic quality.

Landscape sensitivity levels have been assigned to forest areas based upon the number and types of users and the distance they are able to view the landscape from travelways and use areas. Sensitivity levels range from Level 1 (highest) to Level 3 (seldom seen). The Northeast Lake Project area contains Sensitivity Level 3 travelways. These areas are primarily primitive roads with soil and or gravel surfaced two-wheel tracks with high non-recreational use and low recreational use.

The main highway access to the area is from old Highway 67 and Missouri State Highway D. All the roads or travelways are Sensitivity Level 3 with a Visual Quality Objective of Maximum Modification for all zones. The existing road surfaces, other than paved state highways, are gravel or chip and seal, with an average low travel speed and little or no shoulder as consistent with the 2005 Forest Plan, Table 3-8 Visual Quality Objective for Management Prescription 6.2 (p. 3-38) (Project Record, Northeast Lake Visual Quality Objective Map.)

Maximum Modification classification permits management activities including vegetative and land form alterations that may dominate the landscape. However, when viewed as background landscape the area must visually appear as natural occurrences within the surrounding landscape. Reduction of contrast should occur within 5 years.

Under a Visual Quality Objective of Maximum Modification, the maximum height for treatment residue or slash along travelways is 48 inches within the visual near foreground from 0-300 feet from the travelway. Maximum residue treatment heights are not applicable in secondary visual zones from 300-600 feet. The maximum residue treatment height for Sensitivity Level 3 travelways for all distances zones in the Visual Quality Objective of Maximum Modification is optional.

Past, Present, and Reasonably Foreseeable Actions of Relevance

For more details on past, present and reasonably foreseeable actions related to the project, see Chapter 2, Alternative 1 sections on *Past Actions Relevant to Resource Conditions*, *Present Actions of Relevance*, and *Reasonably Foreseeable Actions of Relevance*.

Variety/Scenic Attractiveness Classifications

Class A (Distinctive) - areas where landform, vegetation patterns, water characteristics, and cultural features combine to provide unusual, unique, or outstanding scenic quality. These landscapes have strong positive attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.

Class B (Typical) - areas where landform, vegetation patterns, water characteristics, and cultural features use combine to provide ordinary or common scenic quality. These landscapes have generally positive, yet common, attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern and balance. Normally they would form the basic matrix within the ecological unit.

Class C (Indistinctive) - areas where landform, vegetation patterns, water characteristics, and cultural land use have low scenic quality. Often water and rock form of any consequence are missing in Class C landscapes. These landscapes have weak or missing attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.

Sensitivity levels for travelways were developed considering user-related concerns and expectations. Landscape visibility is subject to many essential, interconnected considerations which include:

- Context and experiences of viewers;
- Expected images;
- Position of observer in the landscape;
- Number of people; and,
- Viewer scrutiny of the landscape caused by duration of view, viewing distance, air clarity, and visual magnitude.

The Northeast Lake Project area has some visual variety throughout the area. There are primarily a variety of hardwood trees throughout the project area with some conifers present. Due to changes in elevation of the terrain and vegetation, it is not common to see internal areas from travelways, especially during the time of year when deciduous trees have their leaves.

There are mixed vegetative species that provide seasonal color and texture in all vertical levels of the forest from low-growing mayapples that sprout and bloom in spring to large oak trees turning colors in the fall. The roadways are primarily narrow gravel surfaces that are winding and climb up and down hills. Many bird and animal species can be seen and heard throughout the year.

The existing Scenic Integrity for the Northeast Lake Project area ranges from Moderate (appears slightly altered-partial retention) to Very Low (heavily altered - maximum modification) depending on the area being viewed. The frame of reference for measuring achievement of scenic integrity levels is the valued attributes of the “EXISTING” landscape character “BEING VIEWED” (United States Department of Agriculture, Forest Service, 1995). In Natural or Natural Appearing character, this is limited to natural or natural appearing vegetative patterns and features, water, rock and landforms. Direct human alterations may be included if they have become accepted over time as positive landscape character attributes.

The Visual Quality Objective requires that we meet integrity levels. In general, a specific integrity level can be achieved by decreasing the visual contrast of the deviations being viewed by using several approaches. The following are those pertaining to this project area (United States Department of Agriculture, Forest Service, 1995):

- 1) . . . To repeat form, line, color, texture, pattern and scale common to the valued landscape character being viewed. . . . If repetition is accurate and well designed the deviation may blend so well the change is not evident (HIGH). It may only borrow well enough to be noticeable but visually subordinate (MODERATE). Designing and maintaining trails and associated structures to repeat form, line, color, texture, pattern and scale common to the valued landscape character being viewed.
- 2) . . . To borrow form, line, color, texture, pattern and scale from similar but different valued landscapes outside that being viewed. Because these are introduced elements from landscape character outside the one being viewed these are usually evident (MODERATE) if not dominant (LOW). . . . [Trails and associated structures] . . . would be designed and maintained such that they fit the landscape and utilize similar form, color, texture, pattern and scale.

- 3) An approach used for the (VERY LOW) level is to shape and blend only with the land forms. . . . [Trails] . . . would conform to folds and ridge lines in the landscape to avoid dominance. Trails and associated structures would be designed and maintained such that they blend only with the land forms.

Adapted from United States Department of Agriculture, Forest Service, 1995, p. 2-5 Scenic Integrity.

2005 Forest Plan Standards and Guidelines for Visual Management

The 2005 Forest Plan (p. 2-24) provides the following required standards (in bold) and guidelines for Visual Quality Objectives (VQO):

- **Resource management activities must meet or exceed the established VQO.**
Allow a short-term reduction, the equivalent of one VQO, for central hardwood regeneration or similarly impacting activities.
- **Foreground sensitivity level 1 (fg1) or foreground sensitivity level 2 (fg2) areas must not be reduced below modification.**
- **Retain the original VQO for adjusted areas, and meet it within 20 years after initial entry into the corridor or viewshed. Residue treatment requirements must meet those specified for the original VQO.**

Within fg1 and fg2 areas with a VQO of Retention or Partial Retention:

- **Mitigate negative visual impacts concurrently with or immediately after each phase or activity;**
- **Complete mitigating measures for each cutting unit or project area before beginning activities in the next sequential block or project area in the same corridor or viewshed; and**
- **Complete obligations specified by a contract or a project prescription within one year from initiation of activities for any single cutting unit or project area. Emphasize completing all work within these areas in a systematic manner within the shortest practical time.**

Within fg1 and fg2 areas with a VQO of modification, the standards are the same as above except the total lapsed time from initiation of activities to completion of obligations specified by a contract or a project prescription shall not exceed two years for any sale block or project area.

Implementation of treatments would meet Visual Quality Objectives as specified in Table 11—Maximum Residue Treatment Heights (Above Ground Surface) for Designated Travelways and Use Areas by Sensitivity Levels.

Table 11—Maximum Residue Treatment Heights (Above Ground Surface) for Designated Travelways and Use Areas by Sensitivity Levels

Visual Quality Objective - VQO	Distance Zone	Travel Speed MPH	Sensitivity Level 1 (Mandatory)	Sensitivity Level 2 (Mandatory)	Sensitivity Level 3 (Optional)
Retention - R	Nfg (0-300')	0-10	18 inches	N.A.	N.A.
		11-35	24 inches		
36-55		30 inches			
Secondary Zones (up to 600')	0-10	6 feet	N.A.	N.A.	
	11-35	8 feet			
	36-55	8 feet			
Partial Retention - PR	Nfg (0-300')	0-10	18 inches	30 inches	36 inches
		11-35	24 inches	30 inches	36 inches
36-55		30 inches	36 inches	48 inches	
Secondary Zones (up to 600')	0-10	8 feet	10 feet	12 feet	
	11-35	8 feet			
	36-55	12 feet			
Modification - M	Nfg (0-300')	0-10	N.A.	36 inches	48 inches
		11-35		48 inches	48 inches
36-55		48 inches		48 inches	
Secondary Zones (up to 600')	All Speeds	N.A.	12 feet	N.A.	
Maximum Modification - MM	Nfg (0-300')	All Speeds	N.A.	N.A.	48 inches
		Secondary Zones (up to 600')			All Speeds

Adapted from the 2005 Forest Plan, Table 2-6, p. 2-26.

DIRECT AND INDIRECT EFFECTS ON VISUAL RESOURCES

This section describes the area of analysis for direct and indirect effects and the area evaluated for cumulative effects. The scope of the analysis includes the scenic resources within the Northeast Lake Project area and potential visual quality effects from developed recreation areas, roads, trails and waterways within and adjacent to the area. Because the forest provides a wide range of recreation opportunities and scenic landscapes, there are no scenery resources limited to or specific to the Northeast Lake Project area.

Alternative 1—No Action Alternative

No sudden changes from the existing condition would be expected to occur. Barring natural disturbance, it is anticipated that the existing visual condition of the project area would slowly change. The project area as a whole would appear as a natural mature or old growth forest in the

future. Over time there would be less visual variety than exists now as the declining oak species die and habitat diversity would not improve without timber management activity.

Alternative 2—Proposed Action

Under this alternative, the activity would be visible to forest users within the project area and in the time immediately following the activity, slash would be visible on the ground. For the long-term effect, the proposed action would improve the visuals of the area and increase the diversity of both flora and fauna and open some understory. By decommissioning roads and unauthorized trails, this alternative would improve the look of the area, and by reconstructing and maintaining roads it would make it safer and easier for the forest visitor to see and enjoy the project area.

CUMULATIVE EFFECTS ON VISUAL RESOURCES

Spatial Boundary

The spatial boundary used to evaluate direct and indirect consequences and cumulative impacts is the Northeast Lake Project area and the adjoining property, private and government, for a distance of 1 mile. This area was used because it would adequately address any effects related to vegetative management on scenery resources.

Temporal Boundary

The temporal boundary was set to analyze 10 years prior to this decision, plus 10 years following implementation of activities.

Cumulative Effects

Vegetation and ground disturbing activities would be necessary to implement Alternative 2. These activities would result in short-term increases of slash on the ground due to timber management activities. Various items such as the mitigation measures in this Environmental Assessment and 2005 Forest Plan standards and guidelines would be implemented to minimize any short-term impacts.

All options would follow the 2005 Forest Plan standards and guidelines. There would be no long-term negative impacts on visual quality for this area. In fact, over time, this activity would improve the quality and quantity of most visual resources and recreational activities.

Past and present actions on private and national forest lands were considered in forming the affected environment of the area as described. No anticipated future actions are known that would be inconsistent with the visual quality objectives for the analysis area.

Under all alternatives, there would continue to be open woods due to naturally low soil fertility, natural disturbance (such as windstorm, insects, disease, and so on), or wildfire. Most existing roads would continue to be maintained. Over time, the area may no longer meet the desired future conditions of the Visual Quality Objectives if Alternative 1 were implemented.

The cumulative effects for Alternative 2 would meet the Visual Quality Objectives for all variety classes and sensitivity levels. Under Alternative 2, the cumulative effects of visual enhancements and development would move this area toward the desired conditions of the Visual Quality Objectives for the area, particularly along travelways which would encourage visitors to continue enjoying this area.

Irreversible or Irretrievable Commitment on Visual Resources

None of the alternatives would have an irreversible or irretrievable commitment on the visual resources in the proposed Northeast Lake Project area.

SUMMARY OF EFFECTS ON VISUAL RESOURCES

There would be no significant cumulative effects on the area's Visual Resources because of the limited nature and extent of the cumulative effects discussed above. This conclusion was reached after analyzing all of preceding information regarding past, present, and future visual resources.

RECREATION RESOURCES

AFFECTED ENVIRONMENT/EXISTING CONDITIONS

The Northeast Lake Project area is classified as a General Forest Area and consists of undeveloped forested land with some gravel roads present. There are no developed recreation areas, sites, or trails on national forest land within the Northeast Lake Project area, nor water sources capable of supporting water-based recreation. The U.S. Army Corps of Engineers Wappapello Lake Project is located in the project vicinity as a 45,000-acre area of lake, shores, and adjacent land with developed recreation facilities such as campgrounds, lodges, showers, picnic areas, shelters, trails, and other facilities that primarily support water-based recreation.

Dispersed recreation occurs throughout the Northeast Lake Project area. Recreation activities that likely occur in the area include: small game, turkey and deer hunting, and dispersed primitive camping in conjunction with deer hunting; hiking; driving for pleasure; and motorized recreation on forest roads. Other activities may include viewing wildlife and natural features, nature study, relaxing, and gathering forest products. Recreation activities dependent upon developed facilities, water, or trails is not available in the project area. As examples, horseback riding and backpacking are not known to occur in the area and no trails are present to support such activities.

Forest Service studies suggest that most visits are likely by local users (within 25 miles from home), with an average group size of 2.4 people, to general forest areas, that last nearly 11 hours per visit, and who spend \$110 during their trip (USDA Forest Service, Natural Resource Manager, 2011). Estimates of visitor spending vary by group and are available at the forest level for numerous categories such as overnight versus day users, local versus nonlocal users, type of activity, and so on (e.g., Stynes & White, 2005; United States Department of Agriculture, Forest Service, Natural Resource Manager, 2012). National Visitor Use Monitoring visitation and economic data (United States Department of Agriculture, Forest Service, Natural Resource Manager, 2012) is available at the forest-level, but not at the project-level.

It is presumed that most visits to the Northeast Lake Project area are by local users for day use with some visits lasting overnight, primarily as primitive camping during deer hunting season. This assumption is supported by Forest Service staff observations and estimates of use in the Northeast Lake Project area (R. Harris, personal communication, November 19-20, 2012; B. Paxton, personal communication, November 20, 2012). Based on National Visitor Use Data and

input from Eric White (personal communication, January 24, 2013), it is assumed that 75% of visits is local day use, 11% is not local day use, and 14% is not primary, and per person spending with some day and some overnight users ranges from \$10.21-\$49.67, with an average of \$21.60.

The Fair Share Approach may serve as a reasonable approach to estimating the number of visits within the Northeast Lake Project area. The Fair Share Approach seeks to use data from the whole forest to estimate values for a smaller area. National Visitor Use Monitoring data is the best available data for estimating recreation visitation in the Northeast Lake Project area, with the recognition that issues of reliability exist when adapting this data at finer scales than the forest level.

According to National Visitor Use Monitoring data (United States Department of Agriculture, Forest Service, Natural Resource Manager, 2012), the Mark Twain National Forest receives 591,000 visits to General Forest Areas. There are approximately 1.5 Million acres within the Mark Twain National Forest, which includes the Northeast Lake Project area (a General Forest Area).

The Northeast Lake Project area includes 8,631 acres which is an estimated $1/173.792$ of the total national forest acres. Using the Fair Share Approach, national forest visits by activity can be divided by 173.792 to estimate the number of Fair Share visits to the Northeast Lake Project area. Using the Fair Share Approach, it could be expected that of the 591,000 visits across the forest, the Northeast Lake Project area would likely generate 3,401 visits.

Table 12 displays data on Visits to the Mark Twain National Forest and Estimated Fair Share Visits for the Northeast Lake Project area. This table reflects data on relevant recreational activities that are likely to occur in the project area. Activities associated with developed recreation, water-based recreation, trail based recreation, and so on are not included in these estimates as such infrastructure or setting characteristics are not present on national forest land in the Northeast Lake Project area. As an example, no trails are present and little backpacking or horseback riding likely occurs.

National Visitor Use Monitoring percentages for “Participation by Main Activity” for relevant activities were multiplied by the 591,000 visits to General Forest Areas to estimate the number of visits by activity across the forest. As an example, of the 591,000 visits to General Forest Areas, National Visitor Use Monitoring data indicate that 20.8% of people engaged in Viewing Natural Features as their main activity. Forestwide, it is estimated that 122,928 visits occurred for Viewing Natural Features. The selected focal activities summed to 350,463.

Estimates of visits to the Northeast Lake Project area were made by dividing the relevant Mark Twain National Forest visits by activity by 173.792. As an example, for “Viewing Natural Features,” dividing the 122,928 visits across the national forest by 173.792 suggests that the Northeast Lake Project area yielded 707 unweighted visits. The unweighted activity estimates summed to 2,017 visits.

At the suggestion of Dr. Don English (personal communication, January 7, 2013), USDA Forest Service National Visitor Use Monitoring Manager, the unweighted estimates visits were “normalized” to reflect the expected 3,401 visits via the use of a normalization factor. The total forestwide visits of 591,000 were divided by the estimated 350,463 relevant visits and yielded a normalization factor of 1.686341. The normalization factor was then applied to each unweighted expected number of visits to yield 3,401 estimated normalized visits to the Northeast Lake Project area.

The Fair Share Approach suggests that the Northeast Lake Project Area likely receives 3,401 recreation visits per year as shown in Table 12.

Table 12—Visits to the Mark Twain National Forest and Estimated Visits for the Northeast Lake Project Area

NVUM Main Activity	Part. % as Main Activity	Mark Twain National Forest Visits	Unweighted Proportional Share Expected	Estimated Northeast Lake Project Area Visits via Fair Share with Normalization
Viewing Natural Features	20.8%	122,928	707	1,193
Relaxing	6.9%	40,779	235	396
Hiking / Walking	12.5%	73,875	425	717
Viewing Wildlife	3.7%	21,867	126	212
Picnicking	1.4%	8,274	48	80
Driving for Pleasure	1.4%	8,274	48	80
OHV Use	2.2%	13,002	75	126
Hunting	4.6%	27,186	156	264
Nature Study	1.8%	10,638	61	103
Gathering Forest Products	0.7%	4,137	24	40
Primitive Camping	*0.5%	*2,955	*17	*29
Bicycling	0.2%	1,182	7	11
No Activity Reported	1.7%	10,047	58	97
Some Other Activity	0.9%	5,319	31	52
Total		350,463	2,017	3,401

*NVUM data for Primitive Camping report that 0% of visitors report primitive camping as their main activity. Staff visits and dialogue with visitors at hunter camps indicate that some relatives or friends engage in primitive camping to be with family or others. For this segment of visitors their main activity is primitive camping, so 0.5% was identified as a reasonable estimate for use in this project.

The effects of the proposed project activities would vary by the type of recreational user group and what they do in the forest. Some recreational user groups would be affected positively by activities such as timber harvest, road-building and clearing, while other user groups would be affected negatively (e.g., Harshaw & Sheppard, 2003; Levine & Langenau, 1979). These effects are discussed in the following sections.

Past, Present, and Reasonably Foreseeable Actions That May Affect Recreation

Past national forest actions likely have relevance to recreation to the Northeast Lake Project area. Landscape scale vegetation management projects have occurred, and minor management activities continue to occur in nearby forest areas. Past projects involved timber harvest, transportation system management, prescribed burning, and wildlife pond maintenance activities.

The activities that were implemented for those past projects are similar to actions proposed in the Northeast Lake Project.

The past projects likely have had similar effects on recreation as those described in this analysis. Potentially affected or displaced recreational users from past projects potentially sought and or seek recreation opportunities in other project areas creating new impacts to those areas such as increased demand, increased number of users, increased environmental impacts, and impacts to the recreational experiences of other users and conflict.

Changes in technology have created new challenges in outdoor recreation management. ATVs and other motorized and mechanized transportation (e.g., mountain bikes) enable visitors to travel deeper into the forest, often where no routes exist (e.g., Moore & Driver, 2005). These means of transportation promote user-created trails, environmental impacts and conflicts with other recreational visitors seeking remote experiences (e.g., Moore & Driver, 2005).

Inventions such as cell phones, GPS, and personal locator beacons encourage visitors to venture into remote areas (e.g., Moore & Driver, 2005). Many of these visitors lack outdoor knowledge, skills, and gear which can result in increased emergency incidents requiring agency response. These trends are likely to continue as new technology emerges and visitors begin to recreate in new ways.

There is increased demand for resources and outdoor recreation participation. As the region's population grows, and demand for outdoor recreation increases, there would be increased environmental impacts and user conflict. Studies show that increasing visitation generates more environmental impacts, increased crowding, decreased solitude, more competing uses, and increased conflict among recreation users (e.g., Manning, 1999; Moore & Driver, 2005). If substantial increases in demand and activity occur, trails, restrooms, picnic areas, trash collection, law enforcement patrols and response, and other maintenance and or management actions may be needed in the future (e.g., Moore & Driver, 2005).

For more details on past, present and reasonably foreseeable actions related to the project, see Chapter 2, Alternative 1 sections on *Past Actions Relevant to Resource Conditions*, *Present Actions of Relevance*, and *Reasonably Foreseeable Actions of Relevance*.

DIRECT AND INDIRECT EFFECTS ON RECREATION

Alternative 1—No Action Alternative

Under Alternative 1, the No Action Alternative, existing resource and setting conditions would continue within the project area. The area would continue to grow dense until a natural event such as a windstorm develops openings. The dense growth of vegetation would continue degrading views, develop ladder fuels, and create hazard trees and hazardous fuel conditions. This growth would continue in the absence of silvicultural treatments and other resource management actions.

Most of the area consists of dense forest and vegetation during leaf-on periods with limited visual penetration. Few open areas exist along or near roads across the project area. Visitors view a wall of green vegetation adjacent to the road throughout much of the project area. Visual penetration along main forest roads provides a typical maximum depth of 50 or so yards, and is often limited to 20 yards, or less.

Quality wildlife viewing and sightseeing opportunities are limited. Viewing opportunities are limited by dense vegetation, vegetation growing to the edge of the road, lack of unique natural features, and lack of open areas. No unique natural features such as rock features or substantial water features are present and viewable along forest roads across most of the project area. Under Alternative 1, vegetation density would likely continue to increase thus negatively impacting wildlife viewing and sightseeing.

Limited views, low visual penetration, and a lack of unique natural features and wayfinding indicators often yield low levels of psychological interest and perceptions of discomfort, boredom, fear, and lack of safety (e.g., Appleton, 1975; Gobster, 2001; Hill & Daniel, 2008; Kaplan & Kaplan, 1998; Tlusty & Bacon, 1989). Trash dumps, evidence of local party spots, and illegal user-created trails exist and detract from perceptions of safety, the recreation setting, and the experience of other recreational visitors (e.g., Manning, 1999; Moore & Driver, 2005).

Alternative 1 would allow these conditions to further degrade. Over time, some visitors may displace and substitute activities, locations, or use times (e.g., Hall & Cole 2007; Manning, 1999; Schneider, 2007).

Under Alternative 1, many roads would go unmaintained and further deteriorate. Deterioration would continue reducing access for various recreational user groups until the roads became totally inaccessible and unusable. One by one, various user groups would become excluded from forest areas as vegetation and or degraded roads prevent their automobile, ATV, or other mode of transportation from safely traveling the roads. Eventually only hikers and horseback riders would be able to access the forest area. At some point, however, even their travel may be impeded.

Some roads and trails exist that are not part of the National Forest System and promote unknowing illegal use by forest visitors. Some users may not know that they are breaking the law, damaging resources, or disrupting other visitors' recreational experience when pursuing motorized recreation. Motorized recreation on user-created trails and non-System roads is subject to law enforcement actions.

Illegal use of forest lands by motorized recreationists on user-created or non-System roads and trails damages resources, disrupts wildlife, and degrades the recreational experiences of other user groups (e.g., Hunt et al., 2009). Illegal user-created trails are often used for poaching, illegal drug activity, and arson (e.g., Hunt et al., 2009). If the Forest Service fails to close the user-created and illegal trails and roads and remove trash dumps, the existing sites serves as a releaser cue to promote these and other depreciative and or illegal behaviors (e.g., Manning, 1999; Moore & Driver, 2005).

A releaser cue is an artifact of past activity such as trash or trash dumps or ATV tracks on a trail. The visitor observes the artifact(s) of the past behavior which cues or encourages them to perform a similar action. As an example, other visitors left trash, so it is alright for me to leave trash.

Under Alternative 1, the forest would continue growing under successional processes to climax conditions reducing hunting opportunities for several species such as deer and turkey. Climax forests are associated with lower populations of deer and certain other game animals. These lower populations are due to having less suitable habitat available. Hunter harvest opportunities would be expected to decrease as the forest moves toward these climax conditions.

Alternative 2—Proposed Action

Alternative 2, the Proposed Action, would increase sightseeing and wildlife viewing opportunities. Visitor satisfaction would likely increase as visual and recreational opportunities increase.

Silvicultural treatments would increase visual penetration into the forest. Vegetation management and increased visual penetration would increase perceptions of visual interest, comfort, and safety (e.g., Appleton, 1975; Gobster, 2001; Hill & Daniel, 2008; Kaplan & Kaplan, 1998). Perceptions of safety and satisfaction would also increase as the Forest Service removes evidence of depreciative actions by cleaning-up trash dumps and closing illegal user-created ATV trails. These various actions would improve the recreational setting, recreational experience, and visitor satisfaction.

Designating old growth stands would improve visual and recreational opportunities for those seeking natural areas and larger trees. Designated old growth would likely attract hikers, multi-day backpackers, mountain bikers, horseback riders, and members of environmental or outdoor clubs (Hunt & others, 2000).

Visual enhancements and the designation of old growth would enhance visitor satisfaction. As visitor satisfaction increases and the public learns about improved views and recreation opportunities, visitation is expected to increase.

Under Alternative 2, reconstructing roads and conducting road maintenance would benefit all forest road travelers, including recreational visitors. Well-maintained roads provide forest access and safe transportation routes into the forest. Designating roads as System Roads would enhance public safety, provide for resource management, and reasonable recreation access. Motorized recreationists would be able to legally use these roads consistent with state and local laws.

Decommissioning old unimproved dirt roads and non-System roads would benefit forest resources and recreationists who travel into the forest interior. These decommissioned roads would be allowed to naturally regenerate vegetation. Closed roads and regenerated vegetation would reduce illegal motorized use and its associated resource damage.

Increased recreation opportunities would be generated for non-motorized visitors. Hikers, mountain bikers, horseback riders, hunters, and those engaged in viewing would benefit from decommissioned roads as new routes that they could use. These visitors as well as those engaged in photography, gathering, and similar dispersed recreation would benefit from this action.

In Alternative 2, conducting silviculture treatments and reconstructing and maintaining wildlife ponds would increase opportunities to view wildlife, plants, and other natural features. These actions would increase recreational opportunities for nature viewing, photography, and hunting. Ponds benefit amphibians and wildlife, while open areas support wildflowers, grasses, and forbs that attract numerous wildlife species and birds. Many wildlife species would migrate into the area and increase population as new browse emerges and they are drawn to “edge” areas where vegetation types and densities merge (Bolen & Robinson, 2003).

Under Alternative 2, conducting silviculture treatments and creating open areas would increase the number of game wildlife and opportunities to view and or hunt wildlife. Open areas with grasses and forbs benefit turkey, quail, rabbits, birds, and many other wildlife species. Early

seral stage habitat following timber harvest with herbaceous and shrubby understory, forbs, and grasses benefits deer, turkey, woodcock and other wildlife for 10-20 years following treatment (e.g., Bolen & Robinson, 2003; DeByle, 1985; deCalesta & Stout, 1997; Gobster, 2001; Langenau & others. 1980).

Wildlife-oriented recreationists (e.g., hunters, wildlife photographers, and birders) seek wildlife habitat and understand that removing vegetation increases wildlife visibility (e.g., Gobster, 2001; Hunt & others, 2000; Levine & Langenau, 1979). The resulting early successional habitat (small openings, edges, and young broadleaf upland forests) becomes wildlife habitat for many species and “recreation habitat” for visitors (Gobster, 2001, p .478).

Under Alternative 2, the proposed timber harvest activities would increase opportunities for dispersed camping, hunting, and other activities. New entry areas, temporary roads, log landings, and trails increase recreational access and use, increase visual penetration, and make it easier to observe and harvest game (e.g., Hunt & others, 2000, 2009). These areas also provide primitive campsites for the future. Screening and hiding cover that is retained in these areas enhance user sites in semi-primitive, roaded natural or rural settings (Tlusty & Bacon, 1989).

These various habitat improvement actions would improve wildlife viewing and hunting opportunities, which would likely increase visitor interest, satisfaction, and perceived safety and comfort. Increased visitor satisfaction would likely increase visitor demand as others learn about viewing opportunities. Similarly, the increase in game populations would likely increase hunter success and generate additional demand to participate in hunting. Increased hunter demand would likely increase hunting participation.

Under Alternative 2, recreational visitors would experience some temporary negative impacts during, or as a result of, implementation. Some forest areas used for outdoor recreation may be temporarily unavailable or closed during proposed resource management actions. These temporary delays or closure may be necessary for visitor safety and resource work. Such actions may occur during road reconstruction and maintenance; restoration and maintenance of wildlife ponds; creation of temporary logging roads and landings; silvicultural treatments over the next 15 years; site preparation; and transporting timber to the mill.

Most of the resource management activities would use equipment similar to that used for construction and have similar impacts to recreational users. Silvicultural activities would include the use of heavy equipment such as bulldozers, trucks, and chainsaws. The reconstruction and maintenance of wildlife ponds typically involves the use of chainsaws, hand tools, and or a small bulldozer. Road reconstruction and maintenance typically includes the use of graders, bulldozers, trucks, chainsaws, tractors, and or mowing equipment. Site preparation uses tractors and other equipment. In addition, for timber harvest, logging trucks are used to transport harvested timber to mills.

Implementation of project resource activities may generate some impacts to recreation visitors. During project activities, visitors may observe and hear heavy equipment. These various activities would generate dust, smoke from some equipment, and audible and visual effects. People tend to view the sights and sounds of logging and logging vehicles and industrial vehicles as undesirable (Hunt & others, 2000).

Recreational users in the immediate vicinity of project activities may experience impacts from sounds. Construction sounds and sounds from timber harvest are similar (California State Board

of Forestry and Fire Protection, 2008). An analysis of sounds from timber harvest operations similar to the proposed project was found to range from 68 to 83 decibels dBA Leq at a distance of 50 feet, which was similar to an electric lawn mower at 3 feet (California State Board of Forestry and Fire Protection, 2008).

These sounds have the potential to impact sensitive receptors such as areas used as dispersed camping sites near timber harvest or road maintenance areas. There may also be certain times in which specific user groups are more sensitive to sounds from project activities. As examples, when hunters are afield during deer and turkey seasons, they are likely to be sensitive to sounds from project activities. However, many logging operations shut down in this region during key hunting seasons, such as during deer season.

Sounds associated with project activities, while potentially significant for users in the immediate vicinity, would typically be separated by time and space from recreational visitors. Project activities would primarily occur during the week, and most recreational use occurs on weekends. Further, these sounds are often attenuated by surrounding trees, soft earth, and topographical surfaces. The impact of sounds to recreational users should be minimal and have only short-term impacts.

Timber harvest traffic may have impacts on recreation traffic, but these effects should be minimal. A similar size timber sale (i.e., 2 million board feet) was shown to generate approximately three log truck trips per day (California State Board of Forestry and Fire Protection, 2008).

During the week, recreational visitors may encounter one to three semi-trailer trucks associated with a specific timber sale unit. However, these logging trucks primarily operate during the week and most recreational use occurs on weekends. The level of traffic generated by logging trucks would not likely be significant, either individually or cumulatively.

Some recreational visitors may perceive certain harvest treatment areas as visually unacceptable in the years and decades following timber harvest (e.g., Bolen & Robinson, 2003; Gobster, 2001; Tlusty & Bacon, 1989). For this geographical area and vegetation types, recreational visitors would likely find re-growth and effective green-up visually acceptable within 15-20 years, or less, following silvicultural treatment (S. Robinson, personal communication, June 15, 2011). Studies have shown visual acceptability of green-up and vegetation for most visitors within 15-30 years following treatment (e.g., Gobster, 2001; Harshaw & Sheppard, 2003; Pâquet & Bélanger, 1997).

The Forest Service uses mitigation methods to reduce visual impacts from timber harvest. Numerous standards and guidelines in the Mark Twain National Forest 2005 Land and Resource Management Plan (2005 Forest Plan) exist to mitigate visual impacts. The *Visual Resources* section describes visual mitigation practices, such as the management of timber slash and residual debris along forest roads.

Timber slash and debris that remains on the ground has the potential to negatively affect hikers, horseback riders, and other recreational visitors who travel into the forest interior. Recreational visitors often travel into the forest interior to camp, use the restroom or for similar purposes. The presence of slash and debris may affect visitors' visual perceptions, but more importantly, affect visitor movement.

The amount and type of debris and or slash that remains vary by timber harvest treatment as do the potential effects (S. Robinson, personal communication, June 15, 2011). Thinning would not likely impact users the next day, while many visitors would not want to traverse an area for at least five years following regeneration harvests and clearcuts (S. Robinson, personal communication, June 15, 2011). Large diameter materials may impacts some users for 10-15 years (S. Robinson, personal communication, June 15, 2011). The Mark Twain National Forest 2005 Land and Resource Management Plan (2005 Forest Plan) specifies management direction for slash and debris in general forest areas.

While some recreational visitors would find slash as a negative impact, others may perceive it as a positive impact. Some hunters would likely perceive openings and slash as beneficial to them. From a management perspective, slash and debris at some locations can restrict illegal and unauthorized motorized use. Also, slash and debris can be used to restrict user-created trails.

Wood debris and slash that remains on the ground following timber harvest would have mixed impacts to hunters. While debris and slash can impede travel, some would view the location as a great hunting area. These visitors would consider the area as cover and habitat for deer and other game. Many deer hunters would likely seek these edge habitat areas and openings as desirable hunting locations.

Some hunters and campers may experience negative impacts from timber harvest. During actual timber harvest, it is estimated that 1-2 dispersed camp sites used by deer hunters, with possibly 6-8 hunters per camp, may be affected per active timber sale area.

Recreational visitors who hunt and camp or engage in other recreation activities at a perceived “special spot” may experience negative emotional impacts from changes to the site and or access. These emotional impacts are associated with their “place attachment” to the site or area (e.g., Hammitt & Cole, 1998; Krueger & Williams, 2007; Manning, 1999; Schroeder, 2007). Changes to forest areas and sites perceived as special may negatively affect visitor satisfaction, past memories, emotional bonds to the site, and relationship with the agency.

Due to changes within particular sites, some recreational visitors may seek substitute activities and or displace to other locations (e.g., Manning, 1999). Some visitors may substitute different activities and or locations or simply forego the desired or similar recreation activity due to displacement (e.g., Hall & Cole, 2007; Manning, 1999; Schneider, 2007).

Many recreation user group may engage in substitution or displacement behaviors as a result of forest management activities impact a specific site or area. As examples, sightseers, mountain bikers, hikers, horseback riders, multi-day backpackers, and members of environmental or outdoor clubs often seek undisturbed areas, have low tolerance for timber harvest and are displaced (e.g., Hunt & others, 2000; Langenau & others, 1980). Squirrel hunters displace to other sites as mast-producing species are cut (Langenau & others, 1980). Similarly, archery hunters have been shown to experience lower satisfaction when they are unable to see deer in regeneration areas or shoot across large cut areas and displace to other locations (Langenau & others, 1980).

Displacement may occur as some recreational users shift use from one site to another, or to sites outside the project area. Displacement in recreational use to other locations may negatively affect users at the new site generating user conflict.

User conflict occurs between recreational user groups with incompatible goals, social values, activities, or impacts; users in the same group vying for the same space at the same time; and with increased recreational use and impacts to natural resources (e.g., Cordell & Tarrant, 2002; Hammitt & Cole, 1998; Hunt & others, 2009; Manning, 1999).

Actual displacement from the Northeast Lake Project area would likely be minimal, as would the associated impacts to other public lands or users in the area.

In summary, the proposed action in Alternative 2 would have varying impacts, positive and negative, to various user groups. Affected recreational visitors would have various responses to project activities. Some visitors may choose to pursue their desired activity at the desired location and time where management activities occur at the expense of a potentially degraded recreational setting and experience. Others may engage in substitute activities or be displaced.

Application of the 2005 Forest Plan standards and guidelines would reduce many of the potential impacts to recreation from proposed project actions. Relevant standards (bold face and require compliance) and guidelines related to recreation include the following:

Goal 2.8 – Recreation Opportunities

Provide a diversity of recreational opportunities and benefits through a variety of settings. (Adapted from 2005 Forest Plan, p. 1-6.)

Contribute to local, regional, and national economies by providing recreational opportunities in a socially and environmentally acceptable manner. (Adapted from 2005 Forest Plan, p. 1-6.)

Manage area to meet, as a minimum, roaded natural ROS objectives. (Adapted from Forest Plan, p. 3-11.)

Recreational opportunities provide for interaction between users ranging from moderate to high depending on the specific location. (Adapted from 2005 Forest Plan, p. 3-11.)

Dispersed and developed recreation uses and resource management activities shall conform to the Recreation Opportunity Spectrum (ROS) classification for the management area in which it occurs. Occasionally, small structures that are out of character with the ROS class may be needed to provide for safety, resource protection, or visitor management needs. (Adapted from Forest Plan, p. 2-21.)

Regulate use only to stay within the following carrying capacity, prevent site deterioration, maintain the ROS settings classification, protect sensitive resources, or provide for public health, safety, and enjoyment. [Manage visitor use within the ROS Class for the Northeast Lake Management Prescription 6.2 Semi-Primitive Motorized (Terrestrial) setting to comply with a carrying capacity of 3.7 Recreation Visitor Days/Acre/Year for dispersed recreation.] (Adapted from Adapted from 2005 Forest Plan, pp. 2-21 and 2-22).

Make investments in recreation management as needed to meet the needs and desires of the public being served or targeted to be served at the facility, protect the site, follow riparian guidelines, and meet ROS classification objectives. (Adapted from 2005 Forest Plan, p. 2-22.)

Provide recreation facilities only if needed to protect public health and safety; for site protection within ROS capacity levels; and, to meet documented demands of existing or targeted users. (Adapted from 2005 Forest Plan, p. 2-22.)

Apply the pack-in/pack-out philosophy to non-fee campgrounds, day use only developments, and dispersed activity areas whenever its success is likely. (Adapted from 2005 Forest Plan, p. 2-22.)

Decommission user-defined trails that are causing resource damage. (Adapted from 2005 Forest Plan, p. 2-24.)

Off-road vehicles that comply with State and local laws are allowed on all National Forest System roads that are open and have a National Forest System road number. (Adapted from 2005 Forest Plan, p. 2-24.)

Other use of off-road vehicles on National Forest System lands is prohibited unless on designated off-road vehicle trails Show motorized trails in the Transportation Atlas. (Adapted from 2005 Forest Plan, p. 2-24.)

Recreational opportunities provide for interaction between users ranging from moderate to high depending on the specific location. (Adapted from 2005 Forest Plan, p. 3-11.)

Additional management direction for recreation resources can be found in Forest Service Manual 2300, 2710, 2720, as well as Forest Service Handbooks 2309.18, 2309.23, and 2709.11. (Adapted from 2005 Forest Plan, p. 2-21.)

During implementation of project activities, the Forest Service typically applies additional mitigation measures that minimize the visual impacts of timber harvest. Feathering, thinning, selective tree harvest, or no harvest is often used to reduce impacts as harvests approach campsite areas and other sensitive areas (e.g., DeByle, 1985; Pâquet and Bélanger 1997). Such actions help preserve the character of the campsites and reduce impacts associated with high place attachment (e.g., Hammitt & Cole, 1998; Krueger & Williams, 2007; Manning, 1999; Schroeder, 2007).

Feathering and minimizing the size of openings near trails and roads reduces visual impacts to recreational visitors. Avoiding spanning ridgelines, reducing the size of harvest areas, modifying harvest areas to reflect topography and natural patch shape, and leaving standing trees along harvest edges also reduces visual impacts. Incorporating slash abatement within the Near Foreground further reduces visual impacts. Some of these methods are described in the *Visual Resources* section.

Over time, the proposed actions would enhance recreational access and opportunities, public safety, wildlife habitat for certain species, and opportunities for wildlife viewing and hunting. The proposed actions would also enhance visitor perceptions of visual interest, comfort, and safety. As viewing and recreational opportunities increase, recreation demand and participation may increase.

Forest Service research (USDA Forest Service Southern Research Station, 2006) suggests that substantial demand for outdoor recreation exists within 75 miles of the Mark Twain National Forest. This recreation demand and outdoor participation includes the activity categories of: sightseeing; viewing and photographing natural elements; gathering non-timber forest products; visiting a primitive area; day hiking; driving off-road; hunting; mountain biking; primitive camping; horseback riding; and backpacking. The Northeast Lake Project area is capable of supporting many of these and other dispersed recreation activities. While demand exists for driving off-road which is not allowed off of System roads, many of these recreationists would likely enjoy driving approved national forest System roads within the project area.

Recreation demand by activity category for the area near the Mark Twain National Forest ranges from 350,000-3,000,000 people (USDA Forest Service Southern Research Station, 2006). Substantial demand and participation in outdoor recreation may emerge on this national forest as people learn about recreation opportunities on national forest lands.

Roads in the Northeast Lake Project area are used regularly by the public. The Missouri Department of Transportation, Transportation Planning (2011) estimates use of these roads, in average annual daily vehicle trips, as follows: D Highway - 1,608; E Highway - 1,682; and BB Highway - 162. These travelers pass through or near the project area and represent potential recreation demand as they learn about project actions that would create new recreation opportunities within the area.

The proposed Northeast Lake Project may help fulfill some recreational demand and needs identified by the Ozark Foothills Regional Planning Commission in the Missouri 2008-2012 Revised Statewide Comprehensive Outdoor Recreation Plan (SCORP) (Missouri Department of Natural Resources 2008). (The Ozark Foothills Region includes several counties, including Wayne County.) Relevant needs within the Ozark Foothills Region identified within the Missouri SCORP include: better access roads, fish and wildlife habitat, walking trails, bicycle trails, equestrian trails, nature trails, multipurpose trails, and campsites.

While no developed or designated trails are being proposed in this project, recreational visitors often use temporary roads created for forest management as hiking trails for walking or as routes for riding bicycles or horses. The Northeast Lake Project area has the potential to support these and other dispersed recreation activities that may help meet some outdoor recreation needs.

Participation in outdoor recreation can have a substantial economic impact on the local community. Outdoor recreation generates economic impacts in local economies as visitors spend money on goods and services for their recreational trip, and as the money circulates within the local economy through a multiplier effect. As an example, each dollar spent on hunting/wildlife viewing in Alabama was found to generate \$2.047 in economic benefits, which was comparable to similar studies (Kebede & others, 2008).

As an application of this concept for deer hunting, assuming that 500 people hunt with an average group size of 2.4 people for one visitor day of 11 hours while spending \$110 on the trip per group, hunting groups may generate approximately \$23,000 in direct expenditures per day. An additional \$47,000 may be generated in the local economy through multiplier effects. In sum, approximately \$70,000 in net benefits per day may accrue to the local economy. This example illustrates how a single outdoor recreation activity may financially affect local communities.

While some project impacts may be potentially significant, most impacts would be separated in time and space from most recreational visitors. Most project activities would occur during the week, and most recreational use occurs on weekends. Also, project activities would be spread out over the course of weeks, months, or years. Many would be spaced over various short periods of time which would likely minimize project effects during specific time periods.

Most of the project effects are short-term and limited in scope with low potential for significant cumulative effects. In contrast, the proposed actions would enhance recreational access, the recreation setting and opportunities, and would ultimately be likely to increase outdoor recreation demand and participation within the project area.

CUMULATIVE EFFECTS ON RECREATION

Alternative 1—No Action Alternative

The No Action Alternative would allow project area conditions to continue to degrade and would eventually generate potentially dangerous conditions. These conditions would result from successional processes, oak decline, and weather that create hazard trees and hazardous fuel buildup. Conditions for successful hunter game harvest would also continue to degrade for many big game species such as deer and turkey.

Vegetation is likely to grow denser until a natural process such as insects, disease, or high winds occur blowing down trees and vegetation. Over time, degraded conditions with hazard trees and hazardous fuels may endanger recreational visitors and forest resources.

Under Alternative 1, the No Action alternative, no management actions would be taken and conditions within the Northeast Lake Project area would continue to decline. As the recreation setting and opportunities decline, so would visitor and recreational user satisfaction. These declines would likely result in reduced demand and outdoor recreation participation within the project area. Further, recreational users may also substitute different activities and or locations or simply forego the desired or similar recreation activity due to displacement (e.g., Hall & Cole, 2007; Manning, 1999; Schneider, 2007).

Alternative 2—Proposed Action

Given the nature of the project area and proposed management actions, potential cumulative negative impacts to recreation would be negligible. The various impacts to recreation would be limited, and of short duration. Conducting the proposed management actions should have long-term positive impacts on recreation access and opportunities resulting in a beneficial cumulative effect.

Spatial Boundary

The Northeast Lake Project area is the unit of spatial analysis for the recreation analysis. The geographic boundary for cumulative effects analysis includes all lands within the project area. Dispersed recreation occurs throughout the project area. This boundary is appropriate because potential effects of the proposed activities would likely be insignificant or not occur outside this boundary.

Temporal Boundary

The temporal boundary for cumulative effects analysis is the past fifteen years, the present, and the next twenty years. Effects considered include those that are short-term (e.g., within 1–10 years), and long-term, up to 20 years, as these are most appropriate time frames for analyzing recreational impacts.

The rationale for this time bounding included the following considerations. Timber sale contracts are typically issued 0-5 years following the NEPA decision. Then, silvicultural treatments and timber harvest typically occur 1- 3 years following issuance of the timber sale contract.

Cumulative Effects

Following timber harvest, early- to mid-seral stage forage and habitat may be available for 10-20 years attracting deer, turkey, and other game. Concurrently, wildlife viewing and hunting demand and opportunities would likely match the 10-20 years of optimal habitat and game populations.

Following timber harvest, slash and debris on the ground may affect recreational visitors who travel into the forest interior for up to approximately 15 years after treatment. Visual effects from some timber harvest methods may also affect recreational visitors' visual preferences for approximately 15 years after harvest.

Ongoing project implementation and maintenance activities may affect recreational visitors for 15 years or more. Timber Stand Improvement and other stand tending measures may be implemented for up to 15 years. These activities would involve mechanical and hand tool treatments that may generate sights and sounds that could affect some recreational visitors. Further, recurring road maintenance would be conducted which would generate sights and sounds that may temporarily affect some recreational visitors.

Many project activities would be implemented in the next few years. Effects of these actions would be most evident during implementation and immediately upon completion of specific activities. Some project outcomes such as improved wildlife habitat and visual impacts may affect recreational visitors for up to 20 years following implementation. Many other activities would be much less apparent and have fewer impacts approximately 15 years following implementation of specific activities.

Irreversible or irretrievable commitment on resources

None of the alternatives would have an irreversible or irretrievable commitment on the recreation resource in the Northeast Lake Project area.

SUMMARY OF EFFECTS ON RECREATION

There would be no significant long-term cumulative effects on recreation and opportunities with the Northeast Lake Project area because of the limited nature and extent of the cumulative effects discussed previously. This conclusion was reached after analyzing information regarding the past, present and reasonably foreseeable future activities within the specified spatial and temporal boundaries.

Other Relevant Disclosures

The proposed Northeast Lake Project complies with the Federal Land Policy Management Act, Forest and Rangeland Renewable Resources Planning Act (commonly referred to as RPA), the Multiple-Use Sustained-Yield Act, and National Forest Management Act, by considering multiple uses and outdoor recreation in this land management planning processes. Further, this recreation analysis complies with requirements of the Federal Land Policy Management Act, which specifically states that land use plans coordinate with the statewide [comprehensive] outdoor recreation plan (SCORP). This analysis considers the Missouri 2008-2012 Revised Statewide Comprehensive Outdoor Recreation Plan (SCORP) (Missouri Department of Natural Resources, 2008).

The proposed Northeast Lake Project is also compatible with the USDA Forest Service’s “Connecting people with America’s Great Outdoors: A Framework for Sustainable Recreation” (United States Forest Service, USDA, 2010). The framework’s guiding principles, as related to the Northeast Lake Project, include connecting people with their natural and cultural environment, recreational activity in the outdoors, sustainability, community engagement, national forests are part of a larger landscape, and recreation is integrated into the agency mission.

ECONOMICS

AFFECTED ENVIRONMENT/EXISTING CONDITIONS

Missouri forests and the forest products industries contribute significantly to Missouri’s economy (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). Reports advance that forestry and forest products industries contribute \$5.7-\$7.3 Billion to Missouri’s economy annually and employ 32,000-41,200 people (Missouri Department of Conservation 2012c; Missouri Forest Products Association, 2012). It is also reported that these industries provide \$1.9 billion in payroll, \$610 million in taxes and \$77 million in state sales tax (Missouri Forest Products Association, 2012).

Forestry and forest products industries provide direct, indirect and induced economic benefits (Missouri Forest Products Association, 2012). Direct economic impacts are generated by jobs in the primary wood processing industry such as logging and sawmills. Indirect impacts arise from the secondary wood products industries such as flooring and furniture producers. Induced impacts occur as these employees buy fuel, groceries, and so on.

Missouri forestry produces much more than logs that are converted to timber and railroad ties. Missouri is a leader in forest products such as charcoal, barrels, walnut nutmeats, shell products, and red cedar gifts (Missouri Department of Conservation, 2012c). Missouri’s forest products also include furniture, cabinets, flooring, veneers, pallets, shavings, tool handles, gunstocks, posts, firewood and other wood products (Missouri Department of Conservation, 2012d; Missouri Department of Conservation and U.S.D.A Forest Service, 2010).

Forestry and the wood products industries provide substantial economic benefits to Wayne County, Missouri, and the surrounding area. In 2011, *Forestry and Logging* contributed \$73,417 in wages to Wayne County, and \$1,500,939 to the South Central Region (Missouri Economic Research and Information Center (n.d.a). (The South Central Region consists of 12 counties including Wayne County.) *Wood Product Manufacturing* contributed \$2,370,743 in wages in Wayne County, and \$5,341, 988 to the South Central Region. *Agriculture and Forestry Support Activities* contributed an additional \$677,072 to the South Central Region.

Missouri Economic Research and Information Center (n.d.a) 2011 employment data indicates that approximately 3 people were employed in Forestry and Logging and 108 employed in the Wood Product Manufacturing industry in Wayne County. Employment data for the South Central Region shows that 73 people were employed in Forestry and Logging, 1,803 were employed in Wood Product Manufacturing and 33 people worked in Agriculture and Forestry

Support Activities. This data does not include other employment sectors such as transportation, which also benefit from the wood products industries.

Missouri Forest Industries Directories (Tuttle, Treiman, Baldwin, 2009; Tuttle, Treiman, Morris, 2010) list 12 primary and secondary wood producers in Wayne County. Nearly all of the sawmill primary producers use wood sources from within a 60 mile radius. Approximately 27% of primary producers are dependent upon sources within a 30 mile radius. All of these producers have 10 or fewer employees, and about ½ have less than 5 employees.

In addition to industry-related economic benefits, Wayne County also receives direct payments from the federal treasury. Federal “Payments in Lieu of Taxes” are disbursed to local governments to offset lost property taxes due to the presence of nontaxable federal lands (U.S. Department of Interior, n.d.a). These payments are made as consistent with Public Law 94-565 and Chapter 69, Title 31 of the United States Code.

Wayne County received \$168,026 in 2012 for federal lands located within the county boundary (U.S. Department of Interior, n.d.b). These federal lands included portions of the Mark Twain National Forest and U.S. Army Corps of Engineers Wappapello Lake Project. Payments in Lieu of Taxes are used for local government services such as public safety, the environment, housing, social services, transportation, and government administration.

Wayne County benefits from payments made to the state and county as a result of the presence of the Mark Twain National Forest. The Secure Rural School and Community Self-Determination Act, Public Law 110-34, was enacted to provide financial assistance to rural communities that depend upon national forests (United States Department of Agriculture, Forest Service, 2012, August).

Funding via the Secure Rural School and Community Self Determination Act is awarded to the state and distributed to the counties, subject to various options and provisions. In Fiscal Year 2011, \$3,438,634 was paid to the state and distributed across state counties (United States Department of Agriculture, Forest Service, n.d., ASR 10-1 FY2011).

In Fiscal Year 2011, Wayne County received \$205,246 under the Secure Rural School and Community Self-Determination Act (United States Department of Agriculture, Forest Service, n.d.). (See reports for ASR 18-1 FY2011, ASR 18-2 FY2011.) Of that amount, \$164,197 was allocated under Title I to benefit public education and transportation. The remaining \$41,049 was allocated under Title III. Title III funds can be used by Wayne County for search, rescue, and emergency services; community service work camps; easement purchases; forest-related education; fire prevention and county planning; and community forestry.

The Secure Rural School and Community Self-Determination Act was recently reauthorized for one year through Fiscal Year 2012 (United States Department of Agriculture, Forest Service 2012, August). For Fiscal Year 2012, Wayne County’s share is projected to be \$220,048 (United States Department of Agriculture, Forest Service, n.d., Projected FY2012 Payments, July 24, 2012).

Past and Present Actions That May Affect Economics

Historically, forest management focused on timber production. In the 1960’s, forest management began to move toward multiple-use management. The Multiple-Use Sustained-Yield Act directed that public lands be managed for multiple-uses that included timber, range,

watershed, fish and wildlife and outdoor recreation purposes. The Act also directed that lands be managed for sustained yields and benefits over time.

In recent decades, public values have shifted demanding more from forests than strictly timber and economic values. Forests provide innumerable and invaluable social and environmental benefits that cannot always be tied to direct economic benefits. Examples of these benefits include clean water, wildlife habitat, outdoor recreation, landscape stabilization, environmental stability, and carbon storage to name a few (Missouri Department of Conservation, n.d.e). Trees also improve air quality, reduce the heat island effect such as near hard-surfaced areas, decrease energy demands, and much more (Missouri Department of Conservation and U.S.D.A Forest Service, 2010).

Gathering and collecting forest products has emerged as activities that may be conducted for personal interest, personal consumption and some economic benefits (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). Demand exists for medicinal products, herbs, mushrooms, nuts, fruits, and decorative products among numerous others.

A study of people gathering nontimber forest products near the Daniel Boone National Forest showed that 43 plant species were sold commercially and 120 used in local households (Hembram & Hoover, 2008). The study indicates that people who gathered and collected these products earned \$200-\$15,000 annually, with most full-time harvesters earning \$3,000 per year. While most of this activity was conducted without a Forest Service permit, the findings do demonstrate that such activity occurs on national forests and contributes to household use and incomes.

The last decade has had divergent effects on the timber industry. Timber markets reflect the economy, popularity of type of wood at the time, and volume being sold in the area (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). Softwood timber demand has declined as has the housing market and declines in new home building starts. At the same time, private land owners have dealt with increasing property values and taxes on timber and inheritances (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). During tough economic times, timber harvest on private land can be delayed until market conditions are more favorable.

Reasonably Foreseeable Actions That May Have an Effect on Economics

The demand for softwood lumber for housing continues to be off, and a trend may emerge toward smaller homes with less hardwood and millwork (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). The depressed economy will likely continue to affect the logging and forest products industries.

Potential overharvest has been identified as a concern for the Missouri Ozarks and nearby region in southeast Missouri (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). Many communities in the region are dependent upon the forest products industry. A major decline in available harvests would likely cause forest-dependent communities to continue to suffer.

The Missouri Department of Conservation (2012f) projects that future forest management issues and needs will relate to climate change, ecosystems management and social considerations. The Department advances that forests will be needed for climate protection, carbon reduction, water

quality, preservation of plant and animal diversity and recreation and scenic values. Making forests more resilient to climate change will benefit forest health, productivity, wildlife habitat and soil and water resources (Missouri Department of Conservation and U.S.D.A Forest Service, 2010; Missouri Department of Conservation, 2012f).

Timber production on public lands is projected to diminish in the future as greater emphasis is given to other forest values and forest ecosystem maintenance (Missouri Department of Conservation 2012f). As a result, there would likely be more demand for private landowners to supply the timber and forest products industries.

Missouri's Forest Resource Assessment and Strategy: Seeking a Sustainable Future for Missouri's Forest Resources (Missouri Department of Conservation and U.S.D.A Forest Service, 2010) identifies numerous factors that may impact forest production and economics. Most of Missouri's forest land is in private ownership, and most of these owners are now elderly. The rate of land ownership turnover will likely increase.

Private lands and forests are threatened by conversion of land to other uses, fragmentation, and parcelization (dividing into smaller land areas) (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). Forest conversion reduces wildlife habitat, natural communities, water quality, carbon storage, and the production of forest products. Collectively, conversion, fragmentation, and parcelization may reduce timber production on private lands which would impact the timber industry and markets.

Parcelization results in higher management costs, such as for logging areas of 25 acres or less in size (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). As land size diminishes, forest thinning, timber stand improvement and wildlife habitat practices become more expensive. At some point, such management actions become impractical.

In the future, the total consumption of wood is expected to increase due to population increases and emerging markets for biofuels (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). New markets for woody biomass may develop for combustion heat, to generate electricity, and as bio-oil and ethanol (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). This niche area would support the removal of poor quality trees from crowded forests, which currently have little current or future economic value.

Missouri's Forest Resource Assessment and Strategy: Seeking a Sustainable Future for Missouri's Forest Resources (Missouri Department of Conservation and U.S.D.A Forest Service, 2010) states the intent of developing sustainable biomass markets and forest product markets. Sustainable forestry would assure a sustainable supply of logs of desired species, size and quality within sustainable harvest rates and balanced with other forest values (Missouri Department of Conservation and U.S.D.A Forest Service, 2010).

Sustainable forest management allows periodic harvests and income streams (Missouri Department of Conservation and U.S.D.A Forest Service, 2010). Consistently, Forest Service forest management practices seek to provide sustainable timber volumes over time. Sustainable management allows periodic harvests without overharvesting or flooding the market.

Sustainable forestry and volumes benefit the forest products industry and local economy by providing a steady stream of materials. Sustainable harvests also benefit long-term forest productivity and health. Importantly, sustainable forest management provides these benefits and forest health while also supporting other benefits such as wildlife habitat.

For more details on past, present and reasonably foreseeable actions related to the project, see Chapter 2, Alternative 1 sections on *Past Actions Relevant to Resource Conditions*, *Present Actions of Relevance*, and *Reasonably Foreseeable Actions of Relevance*.

DIRECT AND INDIRECT EFFECTS ON ECONOMICS

Alternative 1—No Action Alternative

Under Alternative 1, no actions would be taken. Salvage and timber harvests would not be conducted. The forest and forest products industries would not have access to project timber and wood products. Foregoing harvests would mean no Forest Service project-related jobs and expenditures associated with forest management.

Mature trees would be allowed to decline, die, and rot. The economic value of the affected timber would be lost. Substantial losses of trees that would have otherwise been harvested reduce the inventory of timber for the market, increase prices and may force some businesses out of the market (Prestemon & Holmes, 2008).

Allowing these trees to die would likely increase fuel loadings and wildfire potential. Resulting wildfires may occur and generate substantial costs for firefighting. Such wildfires may also result in additional economic losses as private homes and other forest lands are consumed or damaged by fire.

Improvement to roads would not be made. Deteriorating roads would negatively impact travelers who cross forest roads for jobs and other economic purposes. Travelers may be endangered by deteriorating roads which could cause damage to vehicles, accidents, and result in repair costs and medical expenses.

Failure to close and decommission non-System roads and illegal trails would result in increased damages to forest resources and lost economic value. Illegal use of these roads and trails typically results in ongoing damage to resources, harassment of wildlife, and is often associated with arson, poaching, and other illegal activities (Hunt & others, 2009). These activities generate costs due to loss of resources, and response and enforcement requirements. Continued use by illegal users may endanger trespassers on non-System roads and trails and forest visitors, and result in medical expenses.

Continued use of non-System roads and trails negatively affects the recreation setting, forest visitors, and may lead to displacement of recreational visitors (e.g., Hall & Cole, 2007; Manning, 1999; Schneider, 2007). Displacement of recreational visitors may result in decreased or lost recreational expenditures in the local area.

Recreational visitors may displace to other locations at increased personal economic and social costs. Alternately, they may forego their desired recreation setting and experience all together. Altered or ceased recreational activity could reduce or prevent social and health benefits and increase individual and societal costs due to decreased mental and physical health and fitness.

Wildlife habitat and vegetation management would not be conducted. Wildlife habitat conditions would continue to degrade. Some species populations would decline or no longer be present. Declining wildlife populations (or their absence) may reduce wildlife viewing, recreation, and hunting opportunities. Decreases in wildlife viewing, recreation, and hunting opportunities would reduce or eliminate the associated recreational uses and financial

expenditures in the local area. Such changes would also incur individual and or costs to social values via displacement or cessation of the recreation opportunities.

Failure to remove trash dumps from the area has the potential to create several negative effects and costs. Trash dumps would continue to increase in size and quantity increasing future costs for removal. The existence of trash dumps may also release harmful contaminants into the environment that could result in costs for environmental clean-up. The existence of trash dumps in the project area has the potential to reduce visitor use, recreational expenditures, and local property values.

Trash dumps decrease aesthetics, the recreational setting and experience, and may result in displacement of forest visitors and reduced recreation expenditures. Trash dumps near private property may also decrease private property values. Trash dumps often attract rodents that can cause diseases, and snakes in search of rodents. Trash dumps may also contain materials that pose dangers to forest visitors and or forest employees. Such materials could be harmful and result in illness, injuries and medical expenses.

Areas with trash dumps also imply a lack of agency stewardship and law enforcement (e.g., Moore & Driver, 2005). The presence of trash dumps suggests that the agency is not caring for the land and adequately monitoring the area and or providing adequate law enforcement. The presence of trash dumps promotes illegal activity and perceived threats to forest visitors from criminal acts.

Alternative 2—Proposed Action

Under Alternative 2, the Proposed Action, salvage harvests and other vegetative treatments would be conducted. Vegetation management activities would generate timber sales receipts for the forest. Logging operations would directly employ log harvest crews and equipment operators in timber harvest operations and hauling materials to sawmills. These actions would benefit primary wood products industries. Once the raw materials are processed, they typically then flow to secondary wood products industries for use in furniture and so on.

Participating forest product industries would produce direct and indirect economic benefits from wages, income taxes, product sales, and sales taxes. Induced economic benefits would occur as employees of forest and wood products industries spend money within the local economies. Local economies would also benefit as products are “exported” into other markets. As a result of exports, new outside money would be “imported” into the local economy. Induced economic benefits and import of new money would likely generate enhanced economic benefits through “multiplier effects.”

Sustainable forest management would provide relatively stable revenue streams over time. Planned timber harvest schedules and sales would be spaced over time. Timed treatments would support stable local forest industries and economics as well as continued forest health and productivity.

The Northeast Lake Project’s timber harvest and sales would be planned to minimize potential negative impacts to the timber market. Harvests would be planned to include several smaller timber sales over about 5 years. Such action would avoid inputting a large supply of salvage timber into the market and causing a timber price decline during the salvage period (Prestemon & Holmes, 2008; Prestemon, Pye, & Holmes, 2001).

Conducting harvests over time would reduce effects on timber markets, nontimber values and ecosystem services. Maintaining stable prices may extend the rotation lengths of timber inventories and enhance land values in the market area benefiting the private sector (Prestemon, Pye, & Holmes, 2001).

Future timber stand improvement, thinning, and understory control activities would improve forest health and timber quality. These activities would increase the future productivity and economic value of forest products in the project area. These future treatments would also likely result in contract opportunities and additional revenues for local contractors. These contractors would pay wages that would benefit the employees and local economy.

Forest treatments that create forest openings and or early successional habitat would create wildlife habitat for wildlife dependent upon early seral habitat. Openings and early successional habitat would increase opportunities for wildlife viewing and some types of recreation and hunting. These increased opportunities for wildlife viewing, recreation, and hunting would likely generate increased local financial expenditures as visitor use increases. These expenditures would occur as visitors purchase fuel, food, and so on in the local area.

Wildlife management and dam maintenance activities would benefit certain types of wildlife habitat and wildlife. Improved wildlife habitat would benefit wildlife and may increase wildlife viewing, recreation, and hunting. Increased wildlife viewing, recreation, and hunting would likely generate increased local financial expenditures as visitor use increases as described in the previous paragraph.

Road maintenance and reconstruction activities would improve the quality of roads. Improved roads would decrease costs associated with vehicle wear and tear, and damage to vehicles. Improved road conditions may also reduce the potential for accidents and the associated vehicle repair expenses and medical expenses.

Decommissioning non-System roads and illegal user-created trails would reduce both perceived and potential dangers to trespassers and forest visitors, potential medical expenses, and negative effects to the recreation setting. Importantly, decommissioning non-System roads and illegal user-created trails would reduce illegal access, damages to forest resources, and loss of economic value (e.g., Hunt et al., 2009; Manning, 1999; Moore & Driver, 2005).

Decommissioning non-System roads and illegal user-created trails would reduce harassment of wildlife, and help prevent arson, poaching, and other illegal activities (Hunt & others, 2009). Closing illegal, user-created trails would reduce the loss of resources and their economic value. Such closures would also reduce agency costs for responding to arson fires that often occur in these areas. Further, closing these areas would reduce agency costs required for law enforcement and response activities in these areas.

Maintaining a desirable recreation setting would likely prevent or reduce displacement of recreational visitors. Preventing or reducing displacement of recreational visitors may increase recreational expenditures in the local area. Preventing or reducing displacement would also reduce personal economic and social costs associated with displacement. Preventing or reducing displacement would increase visitor satisfaction, length of stay, and desired recreational benefits. Recreational visitors may benefit from recreational experiences that increase mental and physical fitness and reduce health care costs.

The removal of trash dumps has the potential to create several positive effects. The early removal of trash dumps prevent them from increasing in size and quantity. This action avoids the increased cost of removal of a larger and more hazardous dump that grows over time. The early removal of trash dumps also reduces or prevents the release of harmful contaminants. The potential release of contaminants could require substantial expenditure for environmental clean-up.

Removing trash dumps removes materials that may endanger forest visitors and cause injury or illness. Removing trash dumps reduces the potential for illness and injuries and associated medical expenses. The removal of trash dumps also eliminate sites that often attract rodents that can cause diseases, and snakes searching for rodents.

Removing trash dumps improves area aesthetics and the recreational setting and experience. The removal of trash dumps may increase recreation visitation and expenditures in the area. Likewise, removing trash dumps near private may increase property value(s). The removal of trash dumps also shows Forest Service presence and activity. Evidence of Forest Service stewardship may reduce potential criminal activity and impact to forest visitors.

CUMULATIVE EFFECTS

Spatial Boundary

The cumulative effects spatial boundary includes Wayne County. Timber harvests conducted on the forest may involve several harvest crews from these and or other counties. Once logs are milled, these products would likely be purchased by secondary wood industries located across the area. Secondary wood industries process material into finished products such as furniture. The finished products may then be sold to consumers within the region or beyond.

Temporal Boundary

Project effects may last up to 15 years, or longer. Most logging activities would likely last up to 4 years following the decision. Harvested logs would then be milled and dried for approximately 3 years. Timber stand improvement activities and other physical activities would likely occur during years 5-15. These activities would likely produce employment and revenue streams across much of the life of the project.

Cumulative Effects

The Northeast Lake Project would generate timber sales receipts for the forest, employment opportunities, and benefit wood products industries. Direct benefits would occur through employment, wages, and wood product sales, and induced economic benefits as employees spend money in the local economy. Sustainable forest management would allow continued periodic harvests and income streams over time.

Northeast Lake Project activities would create wildlife habitat and increase opportunities for wildlife viewing, recreation, and hunting and their associated economic impacts. Decommissioning non-System roads would reduce resource damage, and with the cleanup of trash dumps, would enhance the quality of the environment and recreation setting. Maintaining a desirable setting may increase visitor satisfaction, length of stay, desired recreational benefits, and local recreational expenditures.

Forest lands are increasingly being valued for ecosystems services that they provide. These ecosystems services include benefits such as clean water, wildlife habitat, outdoor recreation, landscape stabilization, environmental stability, carbon storage, biodiversity, recreation and scenic values. While not easily quantified, numerous ecosystems services benefit the environment, human health and quality of life that are likely associated with substantial indirect social and economic benefits. The value of ecosystems services produced by national forest lands are likely to increase in value in the future.

Economic Analysis

The National Environmental Policy Act requires that project-level analysis consider environmental amenities and values along with economic and technical considerations. Externalized costs and benefits of ecosystem services are to be analyzed, however, there is no presumption that these values must be reduced to dollar amounts, and it is presumed that many of these values cannot be quantified. Implementing Regulations at 40 Code of Federal Regulation Part 1502.23 (CEQ, n.d.) specifically states that “. . . the weighting of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations.”

The Northeast Lake Project was proposed primarily to benefit forest health and wildlife. In addition, the Northeast Lake Project would produce a myriad of environmental, economic and social benefits, many of which cannot be quantified. As examples, how would the social, economic, and environmental benefits of forest health, clean air, clean water, carbon sequestration, scenic beauty, and so on, be quantified at the project-level?

While numerous project costs can be estimated, the resulting social and economic benefits are often unquantifiable. The cost of removing trash dumps can be calculated, but the economic benefit of cleaner water and improved aesthetics is not quantifiable in this project. The costs of road maintenance can be estimated, but it is not feasible to quantify the economic benefits of use of forest roads for travel to work, business activities, or for travel to pursue recreational activities that benefit personal health and reduce medical costs at the project level.

While direct project costs or benefits to the Forest Service can be estimated, total economic benefits that result from harvest, transportation, processing, distribution, and disposition of finished forest products is not readily quantifiable. While timber harvests would produce such benefits, these actions as well as timber stand improvement would move the forest closer to natural conditions and improved forest health which would produce substantial future environmental and economic benefits which are not readily quantifiable.

Timber harvests would open forest areas and create early successional habitat that will benefit certain wildlife species and increase opportunities for wildlife viewing and hunting, but the economic and social benefits of these open areas are not readily quantifiable. In addition, improvements to wildlife ponds would benefit numerous wildlife and amphibian species, but these benefits cannot be quantified. The Northeast Lake Project would likely benefit numerous wildlife species, including federally-listed species, management indicator species, and species of state concern, however, these benefits are unquantifiable.

These various qualitative comparisons, suggest that qualitatively, the Northeast Lake Project would provide substantial benefits that cannot be readily quantified. Forest Service projects

consider various values, benefits, and economics, but decisions are not required to be made primarily for the greatest dollar return or unit output.

Economic analyses were conducted for the Northeast Lake Project. Known and quantifiable benefits and costs were estimated. These values were based on respective resource management specialists input that reflected data from recent similar projects. Costs were estimated for road reconstruction, road maintenance road decommissioning, trash dump removal, pond reconstruction, pond maintenance, and watershed treatment. Expenditures for cultural studies and National Environmental Policy Act analysis were estimated. Expenditures and revenues were estimated for proposed timber management practices. Recreation benefits were estimated in terms of recreation visits to general forest areas and average expenditures that benefit the local economy.

Data on project activities and their associated costs and benefits were entered into Quick-Silver 7.0, a Forest Service program for financial analysis of resource management projects (USDA Forest Service, Planning and Analysis Group, 2012). Assumptions for economic analysis included use of a 4% Discount Rate and a 2% Inflation Rate. Results of the economic analysis are provided in Table 13.

Table 13—Economic Analysis Results

Economic Criterion	Alternative 1 (No Action Alternative)	Alternative 2 (Proposed Action)
Benefit/Cost Ratio	0.37	2.62
Composite Rate of Return (%)	-25.30	14.51
Investment Length (Years)	3	10
Net Annual Equivalent (\$)	-\$55,046.93	\$246,821.03
Present Net Value	\$152,760.26	\$2,001,939.67
Present Value Benefits	\$89,926.68	\$3,239,417.13
Present Value Costs	-\$242,686.94	-\$1,237,477.46

The *Benefit/Cost Ratio* equals the sum of the discounted benefits divided by the sum of the discounted costs. Projects with a Benefit/Cost Ratio above 1.0 are economically desirable as the value of the benefits exceed the costs. Benefit/Cost Ratios can often be used to rank similar projects with the higher ratio being desirable and excepted. The Benefit/Cost Ratios indicate that Alternative 2 is desirable, as it is above 1.0, and it is above that of Alternative 1. This ratio indicates that the benefits in Alternative 2 exceed the costs 2.62 times. In contrast, the costs of Alternative 1 exceed the benefits which yield a ratio below 1.0.

The *Composite Rate of Return* assumes that early revenues are reinvested at the discount rate. A return of nearly 15% in Alternative 2 is more desirable than a loss of 25% in Alternative 1.

The *Investment Length* indicates the number of years from the first investment period to the year when the last cost or benefit occurs.

The *Net Annual Equivalent* is a measure of annual profit from the investment. Alternative 2 yields a Net Annual Equivalent of nearly \$247,000, as compared to approximately \$55,000 in losses incurred by Alternative 1.

Present Values reflect the sum of future benefits or costs, or their net value discounted to today's value. The Net Present Value of Alternative 2 is over \$2 Million Dollars, as compared to Alternative 1, which is nearly \$153,000.

Economic criterion and Benefit/Cost analysis and data indicate that Alternative 2 (Proposed Action) is more beneficial than Alternative 1 (No Action Alternative).

From an economic perspective, Alternative 2 is more beneficial than Alternative 1 (No Action Alternative), however, this economic analysis does not consider economic benefits that are not readily quantifiable or qualitative benefits such as those associated with a clean environment, clean water, aesthetic beauty, quality of life, and so on.

SUMMARY OF EFFECTS ON ECONOMICS

The Northeast Lake Project would produce a myriad of environmental, economic and social benefits, many of which cannot be quantified. From a qualitative perspective, Alternative 2 (Proposed Action) best meets the project's purpose to benefit forest health and wildlife. These and other environmental benefits are unquantifiable. From an economic perspective, Alternative 2 is more beneficial than Alternative 1 (No Action Alternative), and will generate an estimated \$2 Million Dollars of economic benefits over the project life. However, this estimate is likely conservative as employment and other economic benefits associated with the wood products industries will create substantially greater economic value.

The Northeast Lake Project would increase the future productivity and economic value of forest products in the project area and generate economic benefits over time. Northeast Lake Project activities would enhance the quality of the environment and recreation setting, create wildlife habitat, and increase opportunities for wildlife viewing, recreation, and hunting. Enhanced environmental conditions and recreation settings also have the potential to generate increased economic benefits to the geographic area. Importantly, national forest lands are increasingly being valued for ecosystems services that they provide, and the importance of these values and benefits are likely to increase in importance over time.

ENVIRONMENTAL JUSTICE

ENVIRONMENTAL JUSTICE BACKGROUND

This section on environmental justice analyzes and considers the effects of the proposed action on low-income and minority populations. Executive Order Number 12898 (1994), "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" directs that:

. . . each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States . . . (Exec. Order No. 12898 1994, Section 1-101.)

Environmental justice is defined ". . . as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development,

implementation, and enforcement of environmental laws, regulations, and policies” (U.S. Environmental Protection Agency, 2010, July, p. 3). According to the U.S. Environmental Protection Agency (2010, July), fair treatment considers activities in term of how burdens and benefits (such as environmental effects) are distributed across all populations.

The U.S. Environmental Protection Agency defines fair treatment as:

Fair Treatment means that no group of people should bear a disproportionate burden of environmental harms and risks, including those resulting from the negative environmental consequences of industrial, governmental, and commercial operations or programs and policies. (U.S. Environmental Protection Agency, 2010, July, p. 3)

Meaningful involvement is defined as:

Meaningful Involvement means that: 1) potentially affected community members have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; 2) the public’s contribution can influence the regulatory agency’s decision; 3) the concerns of all participants involved will be considered in the decision-making process; and 4) the decision-makers seek out and facilitate the involvement of those potentially affected. (U.S. Environmental Protection Agency, 2010, July, p. 3)

During implementation of environmental justice, special attention is given to “. . . populations that have historically borne a disproportionate share of environmental harms and risk . . .” (U.S. Environmental Protection Agency, 2010, July, p. 3). But, agencies are “. . . also encouraged to look at the distribution of the positive environmental and health consequences from . . . activities” (U.S. Environmental Protection Agency, 2010, July, p. 3).

CONSIDERATION OF ENVIRONMENTAL JUSTICE IN THE NORTHEAST LAKE PROJECT

According to the U.S. Environmental Protection Agency (2010), agency environmental justice processes should be able to answer the following questions:

1. How did your public participation process provide transparency and meaningful participation for minority, low-income, and indigenous populations, and tribes?
2. How did you identify and address existing and new disproportionate environmental and public health impacts on minority, low-income, and indigenous populations?
3. How did actions taken under #1 and #2 impact the outcome or final decision?

(Adapted from U.S. Environmental Protection Agency, 2010, July, p. 26.)

Transparency and Meaningful Participation

The Northeast Lake Project has sought to provide transparency and engage in meaningful involvement across all populations. Public involvement activities have sought to contact and involve all populations.

As detailed in the *Public Involvement* section, mailings were conducted to recognized Native American Tribes. Public service announcements were submitted to local newspapers and legal notices were published. These announcements and legal notices were conducted to notify the public of the proposed action and to seek their input and involvement in this decision making

process. In addition, the proposed action and documents were posted on the Mark Twain National Forest web page.

Outreach letters and notices for the Northeast Lake Project have stated that all project documents can be mailed to individuals who request such materials. This offer was made to mitigate potential environmental justice concerns that may exist as related to individuals that may lack Internet access, appropriate technology, or technical skills. In addition, outreach letters and notices have stated that individuals can submit written or oral comments to the Poplar Bluff Ranger District office. Accepting written or oral comments may help mitigate potential concerns related to individuals that lack Internet access, appropriate technology, technical skills, or communication skills.

Outreach materials have incorporated tailored messages (U.S. Environmental Protection Agency, 2010, July) that have sought to be concise, understandable, and readily accessible. These materials included simple messages in public service announcements and letters. These materials included or directed the reader to summary overviews of the project. Instructions were also provided as to how individuals could access full project reports and detailed maps and documents of the proposed actions.

Public comments, including those that may have been submitted from tribes, minorities, and or low-income groups, and that may relate to environmental justice were fully considered. Such comments and consideration are describe in the *Public Involvement* section of this document.

Identification of Minority, Low-Income, and Indigenous populations

This environmental justice analysis serves to identify and address existing and new disproportionate environmental and public health impacts on minority, low-income, and indigenous populations. Available demographic and socio-economic resources such as those provided by the U.S. Census Bureau have been reviewed and analyzed to characterize populations in the geographic area that are likely to be most affected by the proposed action. The analysis examines and considers indicators that may suggest potential environmental justice concerns.

Impacts on Outcome or Decision

The remainder of this section examines the environmental justice implications of the Northeast Lake Project and the impacts of the alternatives.

ENVIRONMENTAL JUSTICE METHODS USED

The Environmental Protection Agency began developing new criteria for environmental justice analysis with the release of Plan EJ 2014 and subsequent development of EPA's new environmental justice assessment tool, EJ View (U.S. Environmental Protection Agency, n.d.). According to Brendan Corazzin, EPA Region 7 Program Management Analyst (Personal Communication, September 11, 2012), EPA Region 7 is currently using state level data to assist in the identification of potential environmental justice communities. This method is being used regionally until new criteria are developed at the national level.

For the State of Missouri, the poverty level is 14% as indicated by the number of households with an income at or below \$14,999. The minority population in Missouri represents 17.2% of

the total population. EPA Region 7 considers a community to have the potential for environmental justice concerns when demographic indicators exceed state averages and the community is disproportionately exposed to environmental hazards.

AFFECTED ENVIRONMENT/EXISTING CONDITIONS

Table 14—2006-2010 American Community Survey 5-Year Estimates of Wayne County and the State of Missouri provides the demographics for the project area and state. Demographics for the EJ View area were generated using the U.S. Environmental Protection Agency's (n.d.) EJ View with a 5.5 mile radius around the project area's approximate center near Latitude 37.067, Longitude -90.383.

Table 14—2006-2010 American Community Survey 5-Year Estimates of Wayne County and the State of Missouri

Demographic Characteristics	EJ View Area @ 5.5 Mi. Radius	Wayne County	Missouri
Population ^{a, b, c}	989	13,433	5,922,314
Gender ^{a, b}			
Male	49%	49.7%	48.9%
Female	51%	50.3%	51.1%
Race/Ethnicity ^{a, b, c}			
White	96.0%	96.9%	83.4%
Black	0.0%	0.0%	11.5%
American Indian	3.0%	1.1%	0.4%
Asian	0.0%	0.3%	1.6%
Hispanic	0.0%	0.5%	3.4%
Persons Reporting Two or More Races	1.0%	1.6%	2.1%
Age ^{a, b}			
Under 5 Years	4.0%	5.3%	6.5%
Under 18 Years	22.0%	21.0%	24.1%
65 Years and Over	24.0%	21.1%	13.7%
Median Household Income ^{d, e}	Not Available	\$30,621	\$46,262
Per Capita Income ^{a, d, e}	\$16,467	\$17,105	\$24,724
Persons Below Poverty Level ^{a, d, e}	Not Available	19.8%	14.0%
Households with Income \$14,999 or Less	25.0%	24.7%	14.1%

Notes. ^aEJ View data adapted from U.S. Environmental Protection Agency's (n.d.) EJ View mapping tool and U.S. Census Bureau, American Community Survey (ACS) 2006-2010 ACS Summary Report. ^bCounty data adapted from U.S. Census Bureau (n.d.a). ^cState data adapted from U.S. Census Bureau (n.d.b). ^dCounty data adapted from U.S. Census Bureau (n.d.c). ^eState data adapted from U.S. Census Bureau (n.d.d).

Statistics for these areas can be compared to provide insights related to population and income. Visual comparison of data shows that the gender ratios for the EJ View Area and county are

similar to the state. However, statistics for race/ethnicity, age and median household income show some substantial differences that warrant further consideration.

The following sections provide additional exploration of race/ethnicity, age, income, and education as related to potential environmental justice concerns.

Low-Income Population

Analysis of the Table 14 demographic characteristics of the EJ View area, Wayne County and the State of Missouri indicates that the percentage of households with income below \$14,999 is approximately 75.2% - 77.3% higher in the EJ View Area and Wayne County than that for the State of Missouri. As compared to per capita income for the State of Missouri, the per capita income is approximately 30.8% lower in Wayne County and 33.4% lower for the EJ View area. The poverty rate in Wayne County is approximately 40.4% higher than that reported for the State of Missouri. As compared to the Median Income for the State of Missouri, the Median Household Income in Wayne County is 33.8% lower.

U.S. Census Bureau (n.d.a) data indicate a population estimate of 5,838 total households in Wayne County for 2010 and reported income and benefits by category in 2010 inflation adjusted dollars. That data estimated that 1,445 households had a median household income of less than \$14,999. The data indicates that 24.75% of the population in Wayne County had an income of \$14,999 or less. The EJ View area report indicates that 25% of the population in the project area had an income of \$14,999 or less. Data for both Wayne County and the EJ View area exceeds the Missouri state average of 7.2% of households with an income of \$14,999 or less. The poverty rate for Wayne County may suggest potential environmental justice concerns.

The U.S. Environmental Protection Agency's (n.d.) EJ View mapping tool was used to generate detailed data at the census tract scale using Demographics (ACS) 2010. (Census block scale data was not available within the viewer.) Results of analysis with EJ View showed that 20-30% of the population were below the poverty level.

EJ View was also used to estimate the number of people that exist within the project area (U.S. Environmental Protection Agency, n.d.). The ACS Summary Report for the EJ View area indicated that there were 12 people per square mile in this area. The most relevant project area was estimated to be within 5.5 miles of the center of the project which would then be used to estimate the potentially affected number of people.

The land area within a 5.5 mile radius from the approximate project center (Latitude 37.067, Longitude -90.383) was estimated using the formula Πr^2 . It is estimated that the area contained within a 5.5 mile radius of the approximate project center includes approximately 95.04 square miles. The Northeast Lake Project Geographical Information System (GIS) was used by the zone GIS specialist to confirm the size of the land area. The EJ View ACS Summary Report indicated that the area included 84.36 square miles.

Land ownership of the 95.04 square miles within the 5.5 mile radius of the project center was analyzed in GIS. The Forest Service and U.S. Army Corps of Engineers Wappapello Lake Project lands and water occupy an estimated 36,912 acres or 57.68 square miles within the area. Private land is estimated to occupy approximately 23,909 acres or 37.36 square miles.

The EJ View American Community Survey Report indicated that 989 people live with the 5.5 radius. This amount may be high given the high proportion of public land within the area. EJ

View also provides an estimated population density for the area of 12 people per square mile. It is estimated that 448 (12 people per square mile X 37.36 Square miles) people live on private lands within a 5.5 mile radius of the project center.

EJ View estimates that up to 25% of the population in the area live at or below the poverty level. Multiplying the 25% rate by the estimated populations of 448 and 989 suggest that 112-247 people within the 5.5 mile radius may live at or below the poverty level.

The United States Department of Agriculture, Economic Research Service (2008) has identified Wayne County, Missouri, (and other counties in the area) as a persistent poverty county and persistent child poverty county. The Economic Research Service has defined persistent poverty counties as those counties with poverty rates of 20% or more in each census from 1970 through 2000. The persistent child poverty county indicator applies to children under 18 years of age and was added in 2009.

Minority Population

Minority populations account for 3.1% of the total population of Wayne County. This is well below the state average of 17.2% and does not indicate significant concern.

Unemployment

Local Area Unemployment Statistics for Wayne County during July 2012 reports an unemployment rate of 9.7% (Missouri Economic Research and Information Center, n.d.b). In comparison, the unemployment rate for the State of Missouri for this same time period was 8.6%. High levels of unemployment have been a persistent problem in Wayne County.

While employment opportunities in many industries is likely to remain relatively flat, the Forestry and Logging industry is expected to have substantially higher levels of employment growth. According to the Missouri Economic Research and Information Center (n.d.c) industry employment projections, the projected change for employment for all industries is 0.51% between 2011-2013. In comparison, the Forestry and Logging industry is projected to increase 6.25%, while the Wood Product Manufacturing industry is expected to have slow growth at .03%. The Northeast Lake Project would provide employment opportunities in the Forestry and Logging industry which may benefit Wayne County residents.

Education

According to the U.S. Department of Commerce, U.S. Census Bureau (n.d.), 72.9% of Wayne County residents age 25 and over are high school graduates or higher. In comparison, 86.2% of residents of the State of Missouri, age 25 and over are high school graduates or higher. It is further estimated that 8.7% of Wayne County residents completed a bachelor's degree or higher, as compared to 25.0% for the State of Missouri.

Past, Present, and Reasonably Foreseeable Actions of Relevance

Past actions in the geographic region have included timber harvest, fire suppression, road construction, and timber stand improvement thinnings. These activities have been conducted under the Mark Twain National Forest 2005 Land and Resource Management Plan (2005 Forest Plan). These activities have not resulted in long-term negative effects on the natural forested character of the project area.

Foreseeable actions include timber harvest, fire suppression, road construction, and timber stand improvement thinnings. These activities will likely continue into the future under the Mark Twain National Forest 2005 Land and Resource Management Plan (2005 Forest Plan). The landscape would continue to be forested and provide a natural appearing environment.

For more details on past, present and reasonably foreseeable actions related to the project, see Chapter 2, Alternative 1 sections on *Past Actions Relevant to Resource Conditions*, *Present Actions of Relevance*, and *Reasonably Foreseeable Actions of Relevance*.

DIRECT AND INDIRECT EFFECTS ON ENVIRONMENTAL JUSTICE

Alternative 1—No Action Alternative

No project activities would occur, so there would be no project impacts to low-income residents or minority populations. Opportunity costs may be incurred by these populations due to the foregone jobs that may have been available during project-related actions.

As no road work would be conducted under Alternative 1, roads would continue to degrade. Unmaintained roads may result in damage to vehicles and or danger to those travelling roads. Eventually, the roads may become unusable and prevent use by these populations. Unusable roads may result in reduced opportunities for recreation, hunting, and gathering and collecting non-timber forest products such as fruits, mushrooms, and so on. The gathering and collection of forest products has been found to be important for household use and for sale by low income populations (Hembram and Hoover, 2008).

Under Alternative 1, no vegetation management practices would occur. Lack of treatments would prevent the creation of forest openings and early seral habitat. Opportunity costs to these populations would include foregone recreational opportunities for activities such as wildlife viewing or hunting in early seral habit. As the forest continues to move toward climax conditions, game populations for certain species such as deer would continue to decline. Reduced populations of game such as deer reduce opportunities for recreation as well as hunting and obtaining game as food.

Alternative 2—Proposed Action

Proposed activities would result in silvicultural operations that are likely to produce positive economic benefits to the local area. Silvicultural activities would provide direct economic benefits through employment of people engaged in logging, equipment operations, trucking of materials, and saw mill operations. Connected actions for timber stand improvement would involve some employment and potentially the sale of some small roundwood and firewood. Indirect activities resulting from the project may include employment in wood processing and manufacturing.

These various activities would likely generate local revenue from direct expenditures and taxes for purchases of fuel, oil, and food. These operations may also add tax revenues from employment incomes. Employees of forest and wood product industries would likely spend money in the local economy for personal goods and services as well. The local area may also benefit from potential multiplier effects of infusing money into the local area from outside

sources. Project activities have the potential to provide economic benefits to low-income populations, minorities, and other demographic groups within the project area.

Other project benefits may include increased recreation and hunting opportunities and harvested game. Project activities would provide more habitat diversity such as early successional habitat and variation in age classes of vegetation. These landscape changes would likely provide openings for new recreation activities such as wildlife viewing, and draw more game animals. These increased recreation and hunting opportunities as well as potentially increased harvests of game could benefit low-income and or minority populations.

Road improvements would benefit everyone including these populations. Traffic counts indicate that state and county roads in or near the project area carry from 162 to 1,682 vehicles per day (Missouri Department of Transportation, Transportation Planning 2011). Conducting maintenance on these roads would likely reduce potential wear, tear, and damage to vehicles on these roads. This maintenance would also reduce danger to those travelling forest roads.

Conducting maintenance on these forest roads would keep them usable by all people including these populations. Usable roads support transportation for employment, school, and to obtain food and medical care. These roads also provide opportunities for recreation, hunting, and gathering and collecting non-timber forest products such as fruits, mushrooms, and so on. The gathering and collection of forest products has been found to be important for household use and for sale by low income populations (Hembram & Hoover, 2008).

As no road work would be conducted under Alternative 1, roads would continue to degrade. Unmaintained roads may result in damage to vehicles and or danger to those travelling roads. Eventually, the roads may become unusable and prevent use by these populations. Unusable roads may result in reduced opportunities for recreation, hunting, and gathering and collecting non-timber forest products such as fruits, mushrooms, and so on.

Negative project impacts should be limited and temporary in nature. Negative externalities such as noise and dust from logging operations would have little effect beyond the specific site(s) where operations are being conducted. Most of these effects would possibly extend up to several hundred yards beyond the site. Effects should rarely extend beyond the national forest boundary, except for sites located near boundary lines and private lands. Local residents may encounter some logging trucks and or other equipment and traffic in support of the silvicultural operations during the time that the activities are being conducted. It is estimated that 3 or fewer logging trucks would be encountered per day.

CUMULATIVE EFFECTS ON ENVIRONMENTAL JUSTICE

Cumulative Effects Area

Spatial Boundary

The cumulative effects spatial boundary is Wayne County, as the project is being conducted within the county. Most actual effects (such as sound and dust) would be limited to the specific action site, or within a few hundred yards, and within the national forest boundary.

Temporal Boundary

Project effects may last up to 15 years, or longer. Most logging activities would likely last up to 4 years following the decision. Harvested logs would then be milled and dried for approximately 3 years. Timber stand improvement activities and other physical activities would likely occur during years 5-15. These activities would likely produce employment and revenue streams across much of the life of the project.

Cumulative Effects

This project may have some positive economic benefits to low-income and minority populations, but would have no negative cumulative impacts.

Using the U.S. Environmental Protection Agency's (2010, p. 20-21) environmental justice question screening process, there does not appear to be environmental justice concerns. This action is not likely to be of particular interest to or have particular impact upon minority, low-income, or indigenous populations, or tribes. The action is unlikely to impact the health of these populations. The action is unlikely to impact the environment of these populations.

The action is unlikely to present an opportunity to address an existing disproportionate impact on these populations. The action is unlikely to result in the collection of information or data that could be used to assess potential impacts on their health or environmental conditions. The action is unlikely to affect the availability of information to these populations or tribes.

The Northeast Lake Project is unlikely to have any negative cumulative effects on low-income and minority populations. The project may have some positive cumulative economic impacts to numerous local residents, including low-income and minority populations, associated with employment and revenues that may flow into the local community or communities over the life of the project.

Effects on Consumers, Civil Rights, Minority Groups and Women

Any contract work would include specific clauses protecting civil rights. This project would have limited direct, indirect, or cumulative effects on low-income populations and minorities. The proposed actions do not pose disproportionately high or adverse environmental, human health, economic, or social effects to residents in the project area or Wayne County.

Irreversible or Irretrievable Commitment of Resources

Neither alternative would involve irreversible or irretrievable commitment of resources as related to environmental justice.

Consultation with the Environmental Protection Agency

Informal consultation occurred with the U.S. Environmental Protection Agency due to EPA changing their methods of Environmental Justice analysis, criteria, and evaluation of potential environmental justice concerns. Brendan Corazzin, EPA Region 7 Environmental Justice Manager, consulted on and reviewed the methods, analysis, findings, and conclusions for this Environmental Justice Analysis. Mr. Corazzin issued a response that this Environmental Justice Analysis is consistent with methods used by the EPA, and stated agreement with analysis findings and conclusions that the project had a very low potential for Environmental Justice Concerns, and commented that the project should produce positive benefits for the surrounding

community (P. Whitworth, Personal Communication, E-Mail from Brendan Corazzin, October 16, 2012).

SUMMARY OF EFFECTS ON ENVIRONMENTAL JUSTICE

There would be no significant cumulative effects on Environmental Justice. This conclusion is based on information that was analyzed and considered in this section as related to the spatial and temporal boundaries. The Northeast Lake Project should produce positive environmental justice benefits for the surrounding community area.

Chapter 4 — Consultation and Coordination

The Forest Service consulted the following individuals, Federal, state and local agencies, tribes and non-Forest Service persons during the development of this environmental assessment.

INTERDISCIPLINARY TEAM MEMBERS

Forest Service staff who participated as interdisciplinary team members in the development of the Northeast Lake Project and or Environmental Assessment are listed in Table 15 Interdisciplinary Team Members. A listing of staff that provided project support follows the table.

Table 15—Interdisciplinary Team Members

Individual	Position	Expertise	Professional Discipline
Doug Oliver	Poplar Bluff District Ranger	Forest Management	B.S., Resource Forest Management
Paul Whitworth, Ph.D.	National Environmental Policy Act (NEPA) Planner, IDT Leader	Forest Planning and Outdoor Recreation Management	Ph.D., Parks, Recreation & Tourism Management; Certificates in Urban Planning (Environmental Law Emphasis) & FEMA Hazard Reduction M.B.A., Business Administration M.S., Parks & Recreation Administration M.A., Secondary Education B.S., Agriculture Education, Minor Agriculture Economics
Heather Carey	Acting Zone Archeologist	Archeology	M.A., Anthropology B.S., Historic Preservation
Sueanne Cmehil-Warn	Forester / Zone Geographic Information System Specialist	Planning/GIS, Forestry	B.S., Natural Resource Management
Wallace Dillon, Jr.	Forest Soil Scientist	Soils	M.S., Environmental Soil Science B.S., Plant & Soil Science
Larry Furniss	Forest Fisheries Biologist	Fisheries and Aquatics	M.S., Wildlife B.S., Forestry, Minor-Fisheries

Table 15—Interdisciplinary Team Members (Continued)

Bruce Gibson	Zone Archeologist	Archeology	M.S., Plant Biology B.A., Anthropology B.A., Botany
Ken Haberl	Forester	Forestry, Lands and Special Uses	B.S., Forest Management
Keith Kelley	Zone Fire Management Officer	Fire	B.S., Wildlife Biology
Shawn Maijala	Forester	Forestry	B.S., Forest Management
Bill Paxton	Environmental Coordinator	Forest Planning and Outdoor Recreation Management	M.A., Forest Recreation Planning & Management B.S., Public Administration / Urban & Economic Geography
Michael Stevens	Silviculturist	Forestry	B.S., Forest Management
Margaret Van Praag	Landscape Architect	Landscape Management	B.L.A., Landscape Architecture
Amy Wilson, P.E.	Forest Engineer	Engineering and Roads	B.S., Civil Engineering

Geographical Information Systems Support

Sueanne Cmehil-Warn, Zone GIS Coordinator, Popular Bluff and Eleven Point Ranger Districts

Administrative Support and Research Assistance

Don Hughes, Customer Services Representative, Popular Bluff Ranger District

Jeff Serrano, Support Services Specialist, Popular Bluff Ranger District

FEDERAL, STATE, AND LOCAL AGENCIES

Appropriate federal, state, and local government agencies were mailed Scoping and 30-Day Comment Letters and or other project materials (Project File, Popular Bluff Ranger District Mailing Lists). These agencies were invited to review and or comment on the Northeast Lake Project. Greater levels of communication and consultation occurred with agencies such as the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and Missouri State Historic Preservation Office as the Forest Service sought review and concurrence on specialists' analysis and findings. Governmental agencies contacted or consulted include those listed in Table 16 Federal, State, and Local Government Agencies Consulted.

Table 16—Federal, State, and Local Government Agencies Consulted

Agency	Contact	Location
Butler County Commission	Ed Strenfel, Presiding Commissioner Joe Humphrey, Commissioner	Poplar Bluff, MO
Missouri Department of Conversation	Bob Ziehmer, Director	Jefferson City, MO
Missouri Department of Conservation, Piedmont Office	Dave Rowold	Piedmont, MO
Missouri Dept. of Natural Resources	Doyle Childers, Director Robert Stout, Policy Coordinator	Jefferson City, MO
Missouri Federal Funding Clearinghouse	Sara VanderFeltz, Administrative Assistant	Jefferson City, MO
Missouri National Guard Wappapello Training Site	Tim Schulte	Wappapello, MO
Missouri State Historic Preservation Office, Department of Natural Resources	Mark Miles, Director and Deputy, State Historic Preservation Officer	Jefferson City, MO
Oregon State University, College of Forestry, Department of Forest Engineering, Resources and Management	Eric M. White, Ph.D., Assistant Professor, National Visitor Use Monitoring Researcher	Corvallis, OR
US Army Corps of Engineers, Little Rock District	Louis Clarke	Walnut Ridge, AR
US Army Corps of Engineers, St. Louis District Regulatory Branch	Robert Gramke, Section Chief, Missouri Team	St. Louis MO
US Army Corps of Engineers, Wappapello Lake Project	Eric Lemons	Wappapello, MO
USDA Forest Service, Planning Analysis Group, Ecosystems Management Coordination	Doug Smith, Analyst/Economist	Washington, D.C.
USDA Forest Service, Planning Analysis Group, Ecosystems Management Coordination	Susan Winter, Economist	Ft. Collins, CO
USDA Forest Service, Recreation & Heritage Resources	Don English, Ph.D., Visitor Use Program Manager	Washington, D.C.
USDA Forest Service, Rocky Mountain Research Station	Cindy S. Swanson, Ph.D. Human Dimensions Program Manager	Missoula, MT
U.S. Environmental Protection Agency Region 7, Environmental Justice Program	Brendan Corazzin, Kansas Environmental Justice State Coordinator	Kansas City, KS

Table 16—Federal, State, and Local Government Agencies Consulted (Continued)

U.S. Fish & Wildlife Service, Columbia Ecological Services Field Office	Amy Salveter, Field Supervisor Shauna Marquardt, Fish and Wildlife Biologist	Columbia, MO
Wayne County Commission	Brian Polk, Presiding Comm.	Greenville, MO

TRIBES

Tribal representatives on the Mark Twain National Forest’s list of recognized Tribes were mailed Scoping and 30-Day Comment Letters and invited to comment on the Northeast Lake Project (Project File, Mark Twain National Forest Tribal Mailing Lists). Recognized tribes that were sent project materials are shown in Table 17 Mailing List of Recognized Tribes.

Table 17—Mailing List of Recognized Tribes

Tribe	Tribal Leader	Historic Preservation Official
Absentee-Shawnee Tribe of Indians of Oklahoma	George Blanchard, Governor	Henryetta Ellis, Tribal Historic Preservation Officer
Caddo Nation	Brenda Shemayme Edwards, Chairperson	Robert Cast, Tribal Historic Preservation Officer
Cherokee Nation	Bill John Baker, Principal Chief	Dr. Richard L. Allen, NAGPRA
Chickasaw Nation of Oklahoma	Bill Anoatubby, Governor	Gingy Nail, Tribal Historic Preservation Officer
Delaware Nation	Kerry Holton, President	Tamara Francis, Cultural Preservation Director
Delaware Tribe of Indians	Paula Pechonick, Chief	Dr. Brice Obermeyer Director, Tribal Historic Preservation Office
Eastern Shawnee Tribe of Oklahoma	Glenna J. Wallace, Chief	Robin Dushane, Cultural Preservation Director
Iowa Tribe of Kansas and Nebraska	Tim Rhodd, Chairman	F. Martin Fee and Allan Kelley, Tribal Historic Preservation Officers
Iowa Tribe of Oklahoma	Janice Rowe-Kurak, Chairperson	Bobbie Roush, Historic Preservation
Kaw Nation	Guy Munroe, Chairman/CEO	Crystal Douglas, Museum Director, Kanza Museum
Kialegee Tribal Town of the Creek Nation of Oklahoma	Tiger Hobia, Town King	Melissa Harjo, NAGPRA
Kickapoo Traditional Tribe of Texas	Juan Garza, Chairman	None Listed

Table 17—Mailing List of Recognized Tribes (Continued)

Kickapoo Tribe in Kansas	Steve Cadue, Chairperson	Nellie Cadue, NAGPRA Director
Kickapoo Tribe of Oklahoma	Gilbert Salazar, Chairman	Kent Collier, NAGPRA
Miami Tribe of Oklahoma	Thomas Gamble, Chief	George Strack, Tribal Historic Preservation Officer
Muscogee (Creek) Nation of Oklahoma	Georg Tiger, Principal Chief	Ted Isham, Tribal Historic Preservation Officer
Omaha Tribe of Nebraska & Iowa	Amen Sheridan, Chairman	Calvin R. Harlan, Tribal Historic Preservation Officer
Osage Nation	John D. Red Eagle, Principal Chief	Dr. Andrea Hunter, Tribal Historic Preservation Officer
Otoe-Missouria Tribe of Oklahoma	John R. Shotton, Tribal Chairman	Barbara Childs-Walton, Tribal Council Secretary
Peoria Tribe of Indians of Oklahoma	John P. Froman, Chief	Frank Hecksher Special Projects, Manager/NAGPRA
Ponca Tribe of Indians of Oklahoma	Douglas G. Rhodd, Chairman	Stan Smith, NAGPRA
Ponca Tribe of Nebraska	Rebeca White, Chairwoman	Gary Robinette, Tribal Historic Preservation Officer
Quapaw Tribe of Oklahoma (O- Gah-Pah)	John L. Berrey, Chairman	Jean Ann Lambert, Tribal Historic Preservation Officer
Sac and Fox Nation of Missouri in Kansas and Nebraska	Twen Barton, Chairperson	None Listed
Sac and Fox Nation of Oklahoma	George Thurman, Principal Chief	Sandra Kaye Massey, NAGPRA Coordinator
Sac and Fox Tribe of the Mississippi in Iowa/Meskwaki	Frank Blackcloud, Chairman	Jonathan L. Buffalo, Director of Historic Preservation / NAGPRA Rep.
Shawnee Tribe	Ron Sparkman, Tribal Chairman	Kim Jumper, NAGPRA Representative
United Keetoowah Band of Cherokee Indians of Oklahoma	George Wickliffe, Chief	Lisa C. Larue-Baker, Acting Tribal Historic Preservation Officer

OTHERS

Scoping and 30-Day Comment Letters and notifications were sent to organizations and business listed on the Popular Bluff Ranger District Mailing Lists (Project File). Organizations and businesses that were sent project materials are shown in Table 18 Mailing List of Organizations and Businesses.

Table 18—Mailing List of Organizations and Businesses

Organization	Contact	Location
Blue Ribbon Coalition	Ric Foster, Public Lands Department Manager	Pocatello, ID
Cave Research Foundation	Michael Sutton	Annapolis, MO
East Ozarks Audubon Society	Michael Sutton	Annapolis, MO
Mark Twain Forest Watchers	Hank and Katie Dorst	Elk Creek, MO
Missouri Coalition for the Environment	Edward J. Heisel Kathleen L. Smith	St. Louis, MO
Missouri Forest Alliance	Jim Bensman	Alton, IL
Missouri Forest Products Association	Steve Jarvis Jerry Pressley	Jefferson City, MO
Missouri Sierra Club	Caroline Pufelt	St. Louis, MO
Missouri Wilderness Coalition	Scott Merritt	NA
National Wild Turkey Federation	Dan Zerr	O'Fallon, MO
National Wild Turkey Federation, George Clark Missouri Chapter	John Burk	Steedman, MO
Nature Conservancy	Fred Fox	Van Buren, MO
Ozark Trail Association	Steve Coates, President	Kirkwood, MO
Pioneer Forest LLC	Greg Iffrig	St. Louis, MO
Reynolds Brothers Lumber	Johnny & David Reynolds	Ellsinore, MO
River Hills Traveler	Jo Schaper, Assistant Editor	Valley Park, MO
Show-Me Missouri Back Country Horsemen	Allison Schottenhaml, President	Lonedell, MO
Sierra Club (Missouri Chapter)	Caroline Pufelt	St. Louis, MO

PRIVATE CITIZENS/ADJACENT LANDOWNERS

Scoping and 30-Day Comment Letters and notifications were mailed to private citizens listed on the Popular Bluff Ranger Districts Master Mailing List and Project List (Project File, Popular Bluff Ranger District Mailing Lists). Project materials were sent to the following individuals:

Kevin Anderson
Ellsinore, MO

Mark Donham
Brookport, IL

Sherry Lucas
Poplar Bluff, MO

Dick Artley
Grangeville, ID

Donal Elder
Galesburg, MI

Albert Marler
Greenville, MO

Austin Bullington
Greenville, MO

Robert Cacchione
Williamsville, MO

Al Carr
Greenville, MO

Robert Chaligoj
Doniphan, MO

Lynn Crutchfield
Greenville, MO

Dr. Gary Dausmann
Poplar Bluff, MO

Jeff Davis
St. James, MO

Steve Fuchs
Poplar Bluff, MO

David Galloway
Greenville, MO

Dr. Max Harkey
Mansfield, MO

Jerry Haynes
Poplar Bluff, MO

Barbara Johnson
Poplar Bluff, MO

Jeffrey Kinder
Springfield, MO

Edward Kindrick
Ellsinore, MO

Clyde Marlor
Greenville, MO

Tom Oldham
Doniphan, MO

William Thomas
St. Charles, MO

Andy Wells
Poplar Bluff, MO

Rodney White
Greenville, MO

Dan Zimmerman
Summersville, MO

Project E-MAIL LIST

Scoping and 30-Day Comment Letters and notifications were sent to individuals listed on the Popular Bluff Ranger District's list of individuals requesting notification by e-mail (Project File, Popular Bluff Ranger District Mailing Lists). E-mails were successfully sent to e-mail addresses

abi.jackson@_
brrichard@_
eric.lemons@_
jbensman1@_
klogansmith@_
Louis.E.Clarke@_

pmwhitworth@_
prrowell@_
steve@_
steve.coates@_
timothy.schulte@_

UNSUCCESSFUL MAILINGS

Attempts to send Scoping and 30-Day Comment Letters to some parties listed on the Popular Bluff Ranger District Mailing Lists were unsuccessful. Responses indicated that the addresses were undeliverable. Attempted contacts included:

Lonnie Thurston
Greenville, MO

Rodney White
Greenville, MO

andersonkl@
davidgenereynolds@
wilber94@

GLOSSARY

Advanced Regeneration: Seedlings or saplings that develop or are present in the understory (Helms, 1998).

Basal Area: Basal Area (BA) is the cross section area of the trunks of trees in a stand, measured at 4.5 feet above the ground. Basal area is generally expressed as square units per unit area, in this case, square feet of tree trunk per acre. Foresters use basal area to describe how crowded or open a stand of trees is. Basal area blends both the number of trees and their diameters into one number that can be used to compare the density of all types and ages of forest.

Canopy: Part of any stand of trees represented by the tree crowns. It usually refers to the uppermost layer of foliage, but it can be used to describe lower layers in a multi-storied forest. See USDA Forest Service, Mark Twain National Forest, 2005, Final Environmental Impact Statement to Accompany the 2005 Land and Resource Management Plan (2005 Forest Plan), Chapter 5-4. This document will be hereafter referred to as the FEIS.

Clearcut with Reserves: Clearcutting with reserves is the cutting of essentially all trees except for reserve trees (2005 Forest Plan, Appendix D-1). Clearcutting with reserves produces a fully exposed microclimate for the development of a new age class. Regeneration can be from natural seeding, direct seeding, planted seedlings, or advance reproduction. Varying numbers of reserve trees are not harvested to attain goals other than regeneration.

Commercial Thinning: Any type of thinning producing merchantable material at least equal to the value of the direct costs of harvesting (Helms, 1998).

Compartment: a portion of a forest, usually contiguous and composed of a variety of forest stand types, defined for purposes of locational reference and as a basis for forest management.

Composition: As used in ecology, the mix of species present on a site or landscape or population and species' relative abundance (FEIS, Chapter 5-6).

Crown Closure: The point at which the vertical projections of crown perimeters within a canopy touch (Helms, 1998).

Desired Condition: Land or resource conditions that are expected to result if planning goals and objectives are fully achieved (FEIS, Chapter 5-9).

Diameter at Breast Height or DBH: The diameter of the stem of a tree measured at 4.5 feet above the ground (Helms, 1998).

Early Seral Habitat/Early Successional Habitat//Temporary Opening: Habitat composed primarily of a combination of shrubs and saplings intermixed with dominant or characteristic native herbaceous plants (FEIS, Chapter 5-10). The combination varies for savanna, woodland, and forest natural communities. Early successional habitat may be created through regeneration harvest, prescribed fire or through a combination of management activities or natural events.

Ecological Land Type or ELT: An ecological map unit with a distinct combination of natural, physical, chemical, and biological properties (FEIS, Chapter 5-11). These properties cause the land type to respond in a predictable and relatively uniform manner to the application of management practices. In a relatively undisturbed state or stage of plant succession, an ELT is usually occupied by a predictable and uniform plant community. Size generally ranges from 10 to a few hundred acres.

Ecosystems Management: The skillful, integrated use of ecological knowledge and management that addresses all species, communities, environments, and ecological processes in a land area (FEIS, Chapter 5-12).

Even-aged: A term which identifies a stand containing a single age class (FEIS, Chapter 5-13). The range of tree ages is usually less than 20% of the normal rotation or life span. Clearcut, shelterwood, or seed-tree harvest methods produce even-aged stands.

Group Selection: A method of regenerating uneven-aged stands in which trees are removed, and new age classes are established, in small group (2005 Forest Plan, Appendix D-2). The objective of this method is to establish regeneration at each harvest cycle, thereby producing an uneven-aged stand. The removal of groups permits more light to reach the forest floor than with single tree selection. Group selection can be used to encourage a higher proportion of shade intolerant species. The width of smaller groups is commonly twice the height of the mature trees. The width of larger openings is up to 2 acres.

Intermediate Harvest/Thinning: The removal of some trees prior to final harvest, to enhance growth, quality, vigor, and composition of the stand after establishment (FEIS, Chapter 5-21). Thinning is an intermediate harvest.

Jeopardy: A finding made through consultation under the Endangered Species Act of 1976. A jeopardy finding indicates that a federal agency's action is likely to jeopardize the continued existence of a threatened or endangered specie.

Microclimate: The climate of small areas, such as under a plant or other cover (Helms, 2009). The climate at the specific site differs in extremes of temperature and moisture from the climate outside that site and cover.

Management Indicator Species or MIS: Plant and animal species, communities, or special habitats selected for emphasis in planning (FEIS, Chapter 5-20). These species are monitored during forest plan implementation. Monitoring assesses the effects of management activities on their population. Monitoring also assesses the effects of management activities on populations of other species with similar habitat needs which they may represent.

Natural Disturbance: Disruption of existing conditions by wind, tornado, fire, flood, drought, insects, or disease across 1 to 1,000 acres of land (FEIS, Chapter 5-27).

Natural Vegetative Community Types: The consolidation of respective natural communities sharing similar structural and compositional characteristics (FEIS, Chapter 5-27). Examples include forest, open woodland, savanna, glade, prairie, cliff, fen, cave, and so on. Types consist of combinations of natural, physical, chemical and biological properties. These properties cause each type to respond in a predictable and relatively uniform manner to management practices. Appropriate management objectives are specified by ecological subsection.

Old Growth: Old growth is loosely defined as an area distinguished by older trees and old growth related structural characteristics (Final Environmental Impact Statement to Accompany the 2005 Land and Resource Management Plan (2005 Forest Plan) USDA Forest Service, Mark Twain National Forest, September 2005, pp. 3-91 through 3-99, p. 5-30). Old growth characteristics may include: large trees, wide variation in tree species and sizes and spacing, and large-sized dead standing and fallen trees. Old growth trees may have broken or deformed tops or trunks and root decay. Old growth may have multiple canopy layers. Old growth reflects the range of natural variability of forest, woodland and savanna natural communities.

Pre-commercial Thinning: Pre-commercial thinning is used to maintain or improve species composition (2005 Forest Plan, Appendix D-3). Thinning improves composition by favoring desired species and to obtain desired stocking levels for forest health and increased growth.

Prescription: A planned series of treatments designed to change current stand structure to one that meets management goals (Helms, 1998).

Range of Natural Variability: Variation of physical and biological conditions and disturbance factors that influenced the composition, structure, distribution and dynamics of natural communities before European settlement (FEIS, Chapter 5-34).

Release: Release is a treatment to free young trees from undesirable competition (2005 Forest Plan, Appendix D-2). Release can be used to improve the composition, structure, condition, health, and growth of a stand.

Regeneration: The establishment of a tree crop by either natural or artificial means (FEIS, Chapter 5-35). The term is also used to refer to the young crop itself.

Recruitment Snag: A live tree showing signs of decline intentionally left standing in a harvest area to provide future dead tree habitat for the Indiana Bat.

Reserve Tree: A tree retained in either a dispersed or aggregated manner after the regeneration period following treatment. Reserve trees may remain under clearcutting, seed tree, shelterwood, and group selection.

Salvage: Removal of dead, damaged or dying trees to recover value that would otherwise be lost (FEIS, Chapter 5-40).

Sanitation Harvest: A cutting method in which dead, damaged, or susceptible trees are removed (FEIS, Chapter 5-40). This method is primarily to prevent the spread of pests or disease and promote forest health.

Seed Tree: A tree or group of trees that is left uncut to provide seed for forest reproduction.

Shelterwood with Reserves: The cutting of most trees, leaving those needed to produce sufficient shade to produce a new age class in a moderated microenvironment (2005 Forest Plan, Appendix D-2). The sequence of cutting can include three types of cuttings. An optional preparatory cut can be used to enhance conditions for seed production. An establishment cut can be used to prepare the seed bed and create a new age class. A removal cut can be used to release established regeneration from competition with the overwood. Some shelterwood trees or other reserve trees are retained after regeneration has become established to attain goals other than regeneration.

Snag: A standing, generally unmerchantable, dead tree from which the leaves and most of the branches have fallen.

Stand: A community of trees or other vegetation sufficiently uniform in composition, age, spatial arrangement, or condition to be distinguishable from adjacent communities (FEIS, Chapter 5-46). The community of trees that form a silvicultural or management group. On the Poplar Bluff Ranger District, most stands are from 5 to 40 acres in size. Most of these stands have a more or less consistent age, tree species mix, and site productivity when compared to adjacent forest areas (Poplar Bluff District Stand Recon Sheet Field Notes 2009, 2010).

Stand Structure: The horizontal and vertical distribution of components of a forest stand (Helms, 1998). These components include the height, diameter, crown layers and stems of trees, shrubs, herbaceous understory, snags and down woody debris.

Take: "The term 'take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." See Section 3(18) of the Federal Endangered Species Act: at <http://www.fws.gov/midwest/endangered/glossary/index.html>

Temporary Opening: Area of grass/forb and shrubs usually resulting from timber harvest that will be replaced by tree saplings over a period of a few years (FEIS, Chapter 5-48).

Uneven-aged: A term usually which identifies a stand or containing three or more age classes of trees (FEIS, Chapter 5-41). A planned sequence of treatments designed to maintain and regenerate a stand with three or more age classes. Examples are individual tree and group selection harvests. The term is often used as "uneven-aged stand" or "uneven-aged management."

References

- Appleton, J. (1975). *The experience of landscape*. London: Wiley & Sons.
- Bolen, E.G., & Robinson, W.L. (2003). *Wildlife ecology and management* (5th ed.). New Jersey: Prentice Hall.
- Boyle, M. (2002, January-February). Erosion's contribution to greenhouse gases. *Erosion Control*, (9), 64-67. Retrieved December 4, 2012, from http://www.erosioncontrol.com/EC/Articles/Erosions_Contribution_to_Greenhouse_Gases_4384.aspx
- Brady, N.C. (1974). *The nature and properties of soils*. New York: MacMillan Publishing Co., Inc.
- Brais, S. (2001). Persistence of soil compaction and effects on seedling growth in northwestern Quebec. *Soil Science Society of America Journal*, 65(4), 1263-1271. Retrieved December 4, 2012, from <https://www.soils.org/publications/sssaj/articles/65/4/1263>
- California State Board of Forestry and Fire Protection. (2008, January). *Final environmental impact report [EIR] for the Jackson Demonstration State Forest Plan SCH# 2004022025*. Retrieved June 1, 2011, from http://www.fire.ca.gov/resource_mgt/resource_mgt_stateforests_jackson_deir.php.
- CEQ. (n.d.). Regulations for implementing NEPA. Retrieved February 22, 2013, from http://ceq.hss.doe.gov/nepa/regs/ceq/toc_ceq.htm
- Clawson, R.L., Faaborg, J., Gram, W.K., & Porneluzi, P.A. (2002). Landscape-level effects of forest management of bird species in the Ozarks of Southeastern Missouri. In S.R. Shifley & J.M. Kabrick (Eds.), *Proceedings of the second Missouri Ozark forest ecosystem symposium: Post-treatment results of the landscape experiment* (pp. 147-160). 2000, October 17-18, St. Louis, MO. Gen. Tech. Rep. NC-227. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. Retrieved October 1, 2012, from http://www.ncrs.fs.fed.us/pubs/gtr/gtr_nc227.pdf
- Clawson, R.L., Faaborg, J., & Seon, E. (1997). Effects of selected timber management practices on forest birds in Missouri oak-hickory forests: pre-treatment results. In B. Brookshire & S.R. Shifley (Eds.), *Proceedings of the Missouri Ozark forest ecosystem project symposium: an experimental approach to landscape research* (pp. 274-288). 1997, June 3-5, St. Louis, MO. Gen. Tech. Rep. NC-193. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. Retrieved October 1, 2012, from http://nrs.fs.fed.us/pubs/gtr/gtr_nc193.pdf
- Comments sought on Wayne Co. forest project*. (2012, May 31). *Daily American Republic*, p. 8B.
- Cordell, K.C., & Tarrant, M.A. (2002). Chapter 11 (SOCIO-6): forest-based outdoor recreation, 4.5 potential conflicts between different forms of recreation. In D.N. Wear & J.G. Greis (Eds.), *Southern forest resource assessment*. Gen. Tech. Rep. SRS-53. Asheville, NC: U.S.

- Department of Agriculture, Forest Service, Southern Research Station. Retrieved June 15, 2012, from <http://www.srs.fs.usda.gov/sustain/report/socio6/socio6.htm>
- Corns, I.G.W. (1988). Compaction by forestry equipment and effects on coniferous seedling growth on four soils in the Alberta foothills. *Canadian Journal of Forest Research*, 18, 75-84. Retrieved December 4, 2012, from <http://www.nrcresearchpress.com/doi/pdf/10.1139/x88-012>
- Council on Environmental Quality. (n.d.). *CEQ regulations for implementing NEPA*. Retrieved October 1, 2012, from http://ceq.hss.doe.gov/nepa/regs/ceq/toc_ceq.htm
- Cunningham, R.J., & Hauser, C. (1989, April 18-19). The decline of the Missouri Ozark forest between 1820 and 1920. In T.A. Waldrop (Ed.), *Proceedings of pine-hardwood mixtures: a symposium on management and ecology of the type*, pp. 34-37. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station, General Technical Report SE-58. Retrieved December 4, 2012, from http://www.srs.fs.usda.gov/pubs/gtr/gtr_se058.pdf
- DeByle, N.V. (1985). Management for esthetics and recreation, forage, water, and wildlife. In: N.V. DeByle & R.P. Winokur (Eds.), *Aspen: ecology and management in the western United States*. Gen. Tech. Rep. RM-119, Fort Collins, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, pp. 223-232. Retrieved May 17, 2011, from http://www.fs.fed.us/rm/pubs_rm/rm_gtr119/rm_gtr119_223_232.pdf
- deCalesta, D.S., & Stout, S.L. (1997). Relative deer density and sustainability: a conceptual framework for integrating deer management with ecosystem management. *Wildlife Society Bulletin*, 25(2), 252-258. Retrieved May 17, 2011, from <http://www.deerandforests.org/resources/Relative%20deer%20density%20and%20sustainability.pdf>
- Dechant, J.A., Sondreal, M.L., Johnson, D.H., Igl, H.L.D., Goldade, C.M., Parkin, B.D., & Euliss, B.R. (1999). *Effects of management practices on grassland birds: field Sparrow* (Rev. ed.). Jamestown, ND: Northern Prairie Wildlife Research Center. Retrieved October 1, 2012, from <http://www.npwrc.usgs.gov/resource/literatr/grasbird/download/fisp.pdf>
- Dillon, W. (2012, September 26). *Monitoring item #3 – Soil quality field inspection form, Mark Twain National Forest*. Unpublished report, on file with the Poplar Bluff Ranger District, Mark Twain National Forest, district silviculturist, 1420 West Maude, Poplar Bluff, MO 63901.
- Donley, D.E., & Acciavatti, R.E. (1980). Red oak borer. In *Forest Insect & Disease Leaflet 163*, U.S. Department of Agriculture, Forest Service, U.S. Government Printing Office, 1980 0-325-427. Retrieved May 8, 2012, from <http://www.na.fs.fed.us/spfo/pubs/fidls/Red%20Oak%20Borer/redoak.htm>
- Durkin, P.R. (2003, March 1). *Glyphosate – human health and ecological risk assessment: final report* (SERA TR 02-43-09-04a, GSA Contract No. GS-10F-0082F). Fayetteville, NY: Syracuse Environmental Research Associates, Inc. Retrieved October 1, 2012, from http://www.fs.fed.us/r5/hfqlg/publications/herbicide_info/2003_glyphosate.pdf

- Dwyer, J.P., Kabrick, J.M., & Wetteroff, J. (2007). Do improvement harvests mitigate oak decline in Missouri Ozark forests? *Northern Journal of Applied Forestry*, 24(2), 123-128. Retrieved October 1, 2012, from <http://naldc.nal.usda.gov/download/10047/PDF>
- Elliot, W.J., & Hall, D.E. (2010). *Disturbed WEPP Model 2.0. Ver. 2011.11.22*. Moscow, ID: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Retrieved December 4, 2012, from <http://forest.moscowfsl.wsu.edu/cgi-bin/fswcpp/wd/wcppdist.pl>
- Exec. Order No. 12898 of Feb. 11, 1994. 59 FR 7629. (1994, February 16). *Federal actions to address environmental justice in minority populations and Low-Income Populations*. Retrieved September 18, 2012, from <http://www.archives.gov/federal-register/executive-orders/pdf/12898.pdf>
- Fan, Z., Kabrick, J.M., Spretich, M.A., Shifley, S.R., & Jensen, R.G. (2008). Oak mortality associated with crown dieback and oak borer attack in the Ozark Highlands. *Forest Ecology and Management*, 255, 2297-2305. Retrieved May 8, 2012, from http://www.srs.fs.usda.gov/pubs/ja/ja_fan003.pdf
- Federal Highway Administration, Eastern Federal Lands Highway Division. (2007, March). The road inventory for Mark Twain National Forest for Missouri. Sterling, VA: Author.
- Fitzgerald, J.A., & Pashley, D.N. (2000, August 25). *Partners in flight bird conservation plan for the Ozark/Ouachitas (physiographic area 19)*. Retrieved May 2, 2012, from http://www.partnersinflight.org/bcps/plan/pl_19_10.pdf
- Froehlich, H.A., Miles, D.W.R., & Robbins, R.W. (1985). Soil bulk density recovery on compacted skid trails in central Idaho. *Soil Science Society of America Journal*, 49(4), 1015-1017. Retrieved December 4, 2012, from <https://www.soils.org/publications/sssaj/abstracts/49/4/SS0490041015>
- Gibson, B. (2012, August). *Determination of eligibility and effect for Northeast Lake Project Area, Wayne County, Missouri* (Report No. R2012-09-05-04-462). Unpublished report, on file with the Eleven Point Ranger District, Mark Twain National Forest, Zone Archaeologist, 4 Confederate Ridge Road, Doniphan, MO 63935.
- Gobster, P.H. (2001). Human dimensions of early successional landscapes in the eastern United States. *Wildlife Society Bulletin*, 29(2), 474-482. Retrieved June 14, 2011, from http://nrs.fs.fed.us/pubs/jrnl/2001/nc_2001_Gobster_003.pdf
- Greacen, E.L., & Sands, R. (1980). Compaction of forest soils: A review. *Australian Journal of Soil Research*, 18, 163-189. Retrieved December 4, 2012, from http://www.publish.csiro.au/?act=view_file&file_id=SR9800163.pdf
- Gucinski, H., Furniss, M.J., Ziemer, R.R., & Brookes, M.H. (2001, May). Forest roads: A synthesis of scientific information. U.S. Department of Agriculture, Forest Service, *General Technical Report, PNW-GTR-509*. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Retrieved December 4, 2012, from <http://www.fs.fed.us/rm/boise/publications/fisheries/PNW-GTR-509.pdf>
- Guyette, R.P., & Spretich, M.A. (2003). Fire history in the Lower Boston Mountains, Arkansas, USA. *Forest Ecology Management*, 180, 463-474. Retrieved December 4, 2012, from http://www.srs.fs.usda.gov/pubs/ja/ja_guyette001.pdf

- Hall, T. E., & Cole, D.N. (2007, April). *Changes in the motivations, perceptions, and behaviors of recreation users: displacement and coping in wilderness*. Research Report RMRS-RP-63. Ft. Collins, CO: US. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Retrieved June 22, 2012, from http://www.fs.fed.us/rm/pubs/rmrs_rp063.pdf
- Hammitt, W.E., & Cole, D.N. (1998). *Wildland recreation: ecology and management* (2nd ed). New York: John Wiley & Sons, Inc.
- Harrison, H.H. (1979). *A field guide to western birds' nests*. Boston, MA: Houghton Mifflin Co.
- Harshaw, J.H.W., & Sheppard, S.R.J. (2003). Assessing timber harvesting impacts in areas adjacent to parks and protected areas: an example from British Columbia. In: *The 5th International Science and Management of Protected Areas Association (SAMPAA) Conference: Making ecosystem based management work: connecting researchers and managers*. University of Victoria, May 11-16, 2003. Retrieved May 17, 2011, from Available: http://www.harfolk.ca/Publications/harshaw-2004_ros.pdf
- Haulton, S. (2008, October). *Effects of silvicultural practices on bird communities in deciduous forests of Eastern and Central North America: a literature review with recommendations for management*. Indianapolis, IN: Indiana Department of Natural Resources, Division of Forestry. Retrieved October 1, 2012, from <http://www.in.gov/dnr/forestry/files/fo-ManagedForestBirdReview.pdf>
- Heikens, A.L. (1999). Savanna, barrens, and glade communities of the Ozark Plateaus Province. In R.C. Anderson, J.S. Fralish, & J.M. Baskin (Eds.), *Savannas, barrens, and rock outcrop plants communities of North America*, pp. 220-230. New York, N.Y: Cambridge University Press.
- Helms, J.A. (Ed.). (1998). *The dictionary of forestry*. Bethesda, MD: Society of American Foresters. Retrieved May 8, 2012, from <http://dictionaryofforestry.org/>
- Hembram, D., & Hoover, W.L. (2008). Nontimber forest products in Daniel Boone National Forest region—economic significance and potential for sustainability. In: D.F. Jacobs & C.H. Michler (Eds.). *Proceedings, 16th Central Hardwood Forest Conference*; 2008 April 8-9; West Lafayette, IN. Gen. Tech. Rep. NRS-P-24. Newton Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 148-156. Retrieved September 18, from <http://nrs.fs.fed.us/pubs/gtr/gtr-p-24%20papers/17hembram-p-24.pdf>
- Hill, D., & Daniel, T.C. (2008). Foundations for an ecological aesthetic: can information alter landscape preferences? *Society and Natural Resources*, 21(1), 34-49. Retrieved June 15, 2011, from http://pdfserve.informaworld.com/902596_927824495_788589459.pdf.
- Hunt, L., Twynam, G.D., Haider, W., & Robinson, D. (2000). Examining the desirability for recreating in logged settings. *Society and Natural Resources*, 13(8): 717-734. Retrieved June 15, 2011, from <http://www.tandfonline.com/doi/pdf/10.1080/089419200750035584>
- Hunt, L.M., Lemelin, R.H., & Saunders, K.C. (2009). Managing forest road access on public lands: a conceptual model of conflict. *Society and Natural Resources*, 22(2), 128-142. Retrieved June 15, 2011, from http://pdfserve.informaworld.com/115982_927824495_907427062.pdf

- Hutchinson, J.T., & Lacki, M.J. (1999, January). Foraging behavior and habitat use of red bats in mixed mesophytic forests of the Cumberland Plateau, Kentucky. In J.W. Stringer & D.L. Loftis (Eds.), *Proceedings: 12th central hardwood forest conference* (pp. 171-177). 1999, February 28-March 1-2; Lexington, KY. Gen. Tech. Rep. SRS-24. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. Retrieved October 1, 2012, <http://www.ncrs.fs.fed.us/pubs/ch/ch12/CHvolume12page171.pdf>
- Jacobs, B., & Wilson, J.D. (1997). *Missouri breeding bird atlas: 1986-1992*. (Natural history series, No. 6). Jefferson City, MO: Missouri Department of Conservation.
- Jacobson, R.B. (2004). Downstream effects of timber harvest in the Ozarks of Missouri. In S.L. Flder (Ed.), *Toward sustainability for Missouri forests*, pp. 106-128. St. Paul, MN: United States Department of Agriculture, Forest Service, North Central Research Station General Technical Report NC-239. Retrieved December 5, 2012, from: <http://www.tennesseeforests.org/Sustainable-Forestry-Conference/downloads/Toward%20Sustainability%20for%20Missouri%20Forests.pdf>
- Jacobson, R.B., & Primm, A.T. (1997). Historical land-use changes and potential effects on stream disturbance in the Ozark Plateaus, Missouri. *U.S. Geological Survey Water-Supply Paper 2484*. Retrieved December 4, 2012, from <http://pubs.usgs.gov/wsp/2484/report.pdf>
- Johnson, P.S., Shifley, S.R., & Rogers, R. (2009). *The ecology and silviculture of oaks*. Wallingford, UK: CABI Publishing, CABI International.
- Jordan, D., Ponder, F., Jr., & Hubbard, V.C. (2003). Effects of soil compaction, forest leaf litter and nitrogen fertilizer on two oak species and microbial activity. *Applied Soil Ecology*, 23(1), 33-41. Retrieved December 4, 2012, from http://nrs.fs.fed.us/pubs/jrnl/2003/nc_2003_jordan_001.pdf
- Kabrick, J.M., Day, D.C., Jensen, R.G., & Wallendorf, M. (2008). The role of environmental factors in oak decline and mortality in the Ozark Highlands. *Forest Ecology and Management*, 225, 1409-1417. Retrieved May 4, 2012, from http://nrs.fs.fed.us/pubs/jrnl/2008/nrs_2008_kabrick_001.pdf
- Kaplan, R., Kaplan, S., & Ryan, R. (1998). *With people in mind: design and management of everyday nature*. Washington, DC: Island Press.
- Kebede, E., Schelhas, J., & Haslerig, J. (2008). Alternative forest resource use – outdoor recreation and rural economies. *Journal of Monitoring and Restoration*, 5, 20-29. Retrieved June 14, 2011, from <http://www.treesearch.fs.fed.us/pubs/36256>
- Keefe, J.F. (1987). *The first 50 years*. Jefferson City, MO: Missouri Department of Conservation.
- Kessler, K.J., Jr., & Houston, D.R. (1989). Oak decline. In F.B. Clark & J.G. Hutchinson (Eds.), *Central Hardwood Notes*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. Note 8.12. Retrieved May 15, 2012, from <http://www.treesearch.fs.fed.us/pubs/11675>
- King, B. (2010, October 8). *Pond inventory field notes*. Unpublished report, on file with the Poplar Bluff Ranger District, Mark Twain National Forest, District Biologist, 1420 West Maude, Poplar Bluff, MO 63901.

- Krueger, L.E., & Williams, D.R. (2007, June). Place and place-based planning. Special places. In: L.E. Krueger, R. Mazza, & K. Lawrence (Eds.), *Proceedings: national workshop on recreation research and management*. Gen. Tech. Rep. PNW-GTR-698. Portland, OR: U.S. Department of Agriculture Forest Service, Pacific Northwest Research Station: 83-88. Retrieved June 29, 2011, from <http://www.treesearch.fs.fed.us/pubs/28620>
- Langenau, E.E., Jr., O'Quin, K., & Duvendeck, J.P. (1980). The response of forest recreationists to clearcutting in northern lower Michigan: a preliminary report. *Forest Science*, 26(1), 81-91. Retrieved June 29, 2011, from <http://www.ingentaconnect.com/content/saf/fs/1980/00000026/00000001/art00013>
- Law, J. (1992, March 27-28). The development of modern management. In A.R.P. Journet & H.G. Spratt, Jr. (Eds.), *Towards a vision for Missouri's public forests* (pp. 20-34). Proceedings of a Conference at Southeast Missouri State University, Cape Girardeau, MO.
- Levine, R.L., & Langenau, E.E., Jr. (1979). Attitudes towards clearcutting and their relationships to the patterning and diversity of forest recreation. *Forest Science*, 25(2), 317-327. Retrieved June 29, 2011 from <http://docserver.ingentaconnect.com/deliver/connect/saf/0015749x/v25n2/s24.pdf?expires=1360699371&id=72846315&titleid=4023&accname=National+Forest+Service+Library&checksum=1CD9A986A4CF71B377E6B303F6D4156F>
- Litvaitis, J.A. (2001, Summer). Importance of early successional habitats to mammals in eastern forests. *Wildlife Society Bulletin*, 29(2), 466-473. Retrieved November 9, 2011, from <http://www.jstor.org/stable/pdfplus/3784170.pdf>
- Loftis, D.L. (1990). A shelterwood method for regenerating red oak in the Southern Appalachians. *Forest Science*, 36(4), 917-929. Retrieved May 4, 2011, from http://www.srs.fs.usda.gov/pubs/ja/ja_loftis001.pdf
- Lorimer, C.G. (1994, September). *Timber harvest effects on nongame birds: What does the evidence show?* University of Wisconsin-Madison, Department of Forest Ecology and Management, School of Natural Resources; Forestry Facts, No. 77. Madison, WI: University of Wisconsin Extension. Retrieved October 12, 2012, from http://basineducation.uwex.edu/woodland/oww/Pubs/FEM/FEM_077.pdf
- Manning, R.E. (1999). *Studies in outdoor recreation* (2nd ed). Corvallis, OR: Oregon State University Press.
- McClanahan, R.D. (n.d.). *Indiana bat surveys of project activity areas*, Mark Twain National Forest. Popular Bluff, MO: Popular Bluff Ranger District, Mark Twain National Forest.
- McGee, C.E. (1981). *Response of overtopped white oak to release*. U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, U.S. Government Printing Office, 1980 771-081. Research Note SO-273, pp. 1-4. Retrieved May 4, 2012, from <http://www.srs.fs.usda.gov/pubs/1909>
- McMurray, E.R., Muzika, R., Loewenstein, E.F., Grabner, K.W., & Hartman, G.W. (2007). Initial effects of prescribed burning and thinning on plant communities in the Southeast Missouri Ozarks. In *Proceedings of the 15th Central Hardwood Forest Conference*; e-Gen. Tech. Rep. SRS 101. U.S. Department of Agriculture, Forest Service, Southern Research Station: 198-205). Retrieved May 8, 2012, from <http://www.treesearch.fs.fed.us/pubs/27832>

- Miller, C., Grayson, S., Houser, A., Clatterbuck, W., & Kuers, K. (2011). Thirty-year assessment of released, overtopped white oaks. In S. Fei, J.M. Lhotka, J.W. Stringer, K.W. Gottschalk, & G.W. Miller (Eds.), *Proceedings of the 17th Central Hardwood Forest Conference*, 2010, April 5-7, Lexington, KY; Gen. Tech. Rep. NRS-P-78. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 514-520. Retrieved May 8, 2012, from <http://www.treearch.fs.fed.us/pubs/38090>
- Miller, D.E., & Vandike, J.E. (1997). Water resources report number 46, *Missouri state water plan series, volume II, groundwater resources of Missouri*. Rolla, MO: Missouri Department of Natural Resources, Division of Geology and Land Survey. Retrieved December 5, 2012, from <http://www.dnr.mo.gov/pubs/WR46.pdf>
- Miller, R.E., Colbert, S.R., & Morris, L.A. (2004, October). *Effects of heavy equipment on physical properties of soils and on long-term productivity: a review of literature and current research*. National Council for Air and Stream Improvement, Inc., Technical Bulletin No. 887. Research Triangle Park, N.C.: National Council for Air and Stream Improvement, Inc. Retrieved December 4, 2012, from http://www.fs.fed.us/pnw/olympia/silv/publications/opt/499_MillerEtal2004.pdf
- Missouri Department of Conservation. (n.d.). *Natural heritage review*. Retrieved July 11, 2012, from <http://newmdcgis.mdc.mo.gov/EnvReview/Default.aspx>
- Missouri Department of Conservation. (2012a). *Missouri watershed inventory and assessment*. Retrieved December 5, 2012, from <http://mdc.mo.gov/your-property/greener-communities/missouri-watershed-inventory-and-assessment>
- Missouri Department of Conservation. (2012b). *St. Francis River*. Retrieved December 5, 2012, from <http://mdc.mo.gov/landwater-care/stream-and-watershed-management/missouri-watersheds/st-francis-river>
- Missouri Department of Conservation. (2012c). *Forest products and best management practices*. Retrieved September 18, 2012, from <http://mdc.mo.gov/landwater-care/forest-management/forest-products-and-best-management-practices>
- Missouri Department of Conservation. (2012d). *Missouri forests today*. Retrieved September 18, 2012, from <http://mdc.mo.gov/discover-nature/trees-work/missouri-forests-today>
- Missouri Department of Conservation. (2012e). *Missouri forest values*. Retrieved September 18, 2012, from <http://mdc.mo.gov/discover-nature/trees-work/missouri-forest-values>
- Missouri Department of Conservation. (2012f). *Forests for the future*. Retrieved September 18, 2012, from <http://mdc.mo.gov/landwater-care/forest-management/forests-future>
- Missouri Department of Conservation and U.S.D.A Forest Service. (2010). *Missouri's forest resource assessment and strategy: seeking a sustainable future for Missouri's forest resources*. Retrieved September 18, 2012, from http://mdc.mo.gov/sites/default/files/resources/2010/08/9437_6407.pdf
- Missouri Department of Conservation, USDA Natural Resources Conservation Service, and University of Missouri Extension. (2010, Winter). Get it together for quail. *The Covey Headquarters*, 9(4). Retrieved October 1, 2012, from http://mdc.mo.gov/sites/default/files/resources/2010/12/2010_winter_covey_headquarter_newsletter.pdf

- Missouri Department of Natural Resources. (2008, February 29). *Missouri 2008-2012 revised statewide comprehensive outdoor recreation plan*. Retrieved May 17, 2012, from <http://www.dnr.mo.gov/pubs/pub2363.pdf>
- Missouri Department of Natural Resources, Water Protection Program. (n.d.). *Missouri's 303(d) streams and lakes, EPA approved 2010 303(d) list*. Retrieved December 5, 2012, from <http://dnr.mo.gov/env/wpp/waterquality/303d/2010-epa-approved-list.pdf>
- Missouri Department of Natural Resources, Water Protection Program. (2011, November 28). *November 28 public notice version: proposed 2012 303(d) list*. Retrieved December 5, 2012, from <http://dnr.mo.gov/env/wpp/waterquality/303d/2012-proposed-list.pdf>
- Missouri Department of Natural Resources, Water Pollution Control Program. (2004, January). *State of Missouri nonpoint source management plan (Rev. ed.)*. Retrieved December 4, 2012, from http://www.dnr.mo.gov/env/wpp/nps/mgmtplan/nps_mp_appen_a-e.pdf
- Missouri Department of Transportation, Transportation Planning. (2011). *Southeast district traffic volume and commercial vehicle count map*. Retrieved September 27, 2012, from http://www.modot.mo.gov/safety/documents/2011_Traffic_SE-District.pdf
- Missouri Department of Transportation. (n.d.a). *2010-2014 Statewide transportation improvement program*. Retrieved October 1, 2012, from http://www.modot.org/plansandprojects/construction_program/STIP2010-2014/index.htm
- Missouri Department of Transportation. (n.d.b). *2013-2017 Statewide transportation improvement program*. Retrieved October 1, 2012, from http://www.modot.mo.gov/plansandprojects/construction_program/STIP2013-2017/index.htm
- Missouri Department of Transportation. (n.d.c). *Plans and projects: 800 better bridges*. Retrieved October 1, 2012, from <http://www.modot.gov/safeandsound/BridgeProjectListing.htm>
- Missouri Economic Research and Information Center, Missouri Department of Economic Development. (n.d.a). *Quarterly census of employment and wages industry information by NAICS sectors*. Retrieved September 7, 2012, from <http://www.missourieconomy.org/industry/qcew/default.aspx>
- Missouri Economic Research and Information Center, Missouri Department of Economic Development. (n.d.b). *Missouri local area unemployment statistics (LAUS)*. Retrieved September 7, 2012, from <http://www.missourieconomy.org/indicators/LAUS/default.aspx?PeriodYear=2012&Month=07>
- Missouri Economic Research and Information Center, Missouri Department of Economic Development. (n.d.c). *Industry employment projections*. Retrieved September 7, 2012, from http://www.missourieconomy.org/industry/ind_proj.stm
- Missouri Forest Products Association. (2012). *News – Forest industry facts – forest economics*. Retrieved September 18, 2012, from <http://www.moforest.org/newsffforesteco.html>
- Missouri Secretary of State. (2010, May 31). *Rules of Department of Natural Resources, Code of State Regulations, title 10—Department of Natural Resources, Division 20—Clean Water*

- Commission, Chapter 7—Water Quality*. Retrieved December 5, 2012, from <http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf>
- Moerbe, A.L., & Gannon, T.N. (2011, August). *Final report: An archaeological survey of 6,069 acres in the Northeast Lake Project Area, Poplar Bluff Ranger District, Mark Twain National Forest, Wayne County, Missouri*. USFS Report No. R2011-09-05-00-367. Overland Park, KS: Effigy Archeological Services, Inc.
- Moore, R.L., & Driver, B.L. (2005). *Introduction to outdoor recreation: providing and managing natural resource based opportunities*. State College, PA: Venture Publishing, Inc.
- Natural Resources Conservation Service; Wildlife Habitat Council. (2007, January). Early successional habitat. *Fish and Wildlife Management Habitat Leaflet, Number 41*. Retrieved November 9, 2011, from: <http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=18527.wba>
- Neary, D.G., Ryan, K.C., & DeBano, L.F. (Eds.). (2008). *Wildland fire in ecosystems: effects of fire on soils and water* (Rev. ed.). General Technical Report RMRS-GTR-42-Volume 4. Ogden, UT: United States Department of Agriculture, Forest Service, Rocky Mountain Research Station. Retrieved December 5, 2012, from http://www.fs.fed.us/rm/pubs/rmrs_gtr042_4.pdf
- Nelson, P.W. (2005). *The terrestrial natural communities of Missouri*. Jefferson City, Missouri: Missouri Natural Areas Committee.
- Nicholson, C.P. (1997). *Atlas of the breeding birds of Tennessee*. Knoxville, TN: University of Tennessee Press.
- Nigh, T.A. (1992, March 27-28). The forests prior to European settlement. In A.R.P. Journet & H.G. Spratt, Jr. (Eds.), *Towards a vision for Missouri's public forests*, pp. 6-13. Cape Girardeau, MO: Southeast Missouri State University.
- Northeast Regional Strategy Committee of the National Cohesive Wildland Fire Management Strategy Committee. (2012, October 15). *A national cohesive wildland fire strategy: northeast regional risk analysis report*. Retrieved October 5, 2012, from <http://sites.nemac.org/northeastcohesivefire/about-you/>
- Nowacki, G. J., & Abrams, M.D. (2008, February). The demise of fire and “mesophication” of forests in the eastern United States. *BioScience*, 58(2), 123-138. Retrieved May 11, 2012, from http://www.nrs.fs.fed.us/pubs/jrnl/2008/nrs_2008_nowacki_001.pdf
- Oliver, D. (2012, August 30). Letter for the Northeast Lake Project 29409 – dear interested public. Retrieved August 30, 2012, from http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/60404_FSPLT2_271517.pdf
- Oliver, D. (2012, May 25). Scoping letter for the Northeast Lake Project 29409 – dear interested public. Retrieved May 25, 2012, from http://www.fs.usda.gov/wps/portal/fsinternet!/ut/p/c5/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gDfxMDT8MwRydLA1cj72BTUwMTAwgAykeaxRtBeY4WBv4eHmF-YT4GMHkidBvgAI6EdIeDXIvdrAJuM3388jPTdUvyA2NMMgyUQQAyrgQmg!!/dl3/d3/L2dJQSEvUUt3QS9ZQnZ3LzZfS000MjZOMDcxT1RVODBJN0o2MTJQRDMwODQ!/?project=29409

- Pagen, R.W., Thompson, F.R., III, & Burhans, D.E. (2000). Breeding and post-breeding habitat use by forest migrant songbirds in the Missouri Ozarks. *The Condor*, 102(4): 738–747. Retrieved October 1, 2012, from <http://www.bioone.org/doi/pdf/10.1650/0010-5422%282000%29102%5B0738%3ABAPBHU%5D2.0.CO%3B2>
- Pâquet, J., & Bélanger, L. (1997). Public acceptability thresholds of clearcutting to maintain visual quality of boreal balsam fir landscapes. *Forest Science*, 43(1), 46-55. Retrieved June 29, 2011, from <http://docserver.ingentaconnect.com/deliver/connect/saf/0015749x/v43n1/s7.pdf?expires=1360701514&id=72846965&titleid=4023&acname=National+Forest+Service+Library&checksum=737D1E525D665E013F302CA52C8D8847>
- Perry, R.W., Thill, R.E., & Carter, S.A. (2007). Sex-specific roost selection by adult red bats in a diverse forested landscape. *Forest Ecology and Management*, 253, 48-55. Retrieved October 1, 2012, from http://www.srs.fs.usda.gov/pubs/ja/ja_perry016.pdf
- Pierzynski, G.M., Sims, J.M., & Vance, G.F. (2000). *Soils and environmental quality* (2nd ed.). Boca Raton, FL: CRC Press.
- Ponder, F., Jr., & Tadros, M. (2002). Phospholipid fatty acids in forest soil four years after organic matter removal and soil compaction. *Applied Soil Ecology*, 19(2), 173-182. Retrieved December 5, 2012, from <http://www.sciencedirect.com/science/article/pii/S0929139301001822>
- Poplar Bluff Ranger District. (n.d.). *Northeast Lake compartment folders*. On file with the Poplar Bluff Ranger District, Mark Twain National Forest, district silviculturist, 1420 West Maude, Poplar Bluff, MO 63901.
- Poplar Bluff Ranger District. (n.d.). *Northeast Lake FS Veg database*. Poplar Bluff Ranger District, Mark Twain National Forest, district silviculturist, 1420 West Maude, Poplar Bluff, MO 63901.
- Poplar Bluff Ranger District. (n.d.) *Northeast Lake Project GIS database*. Poplar Bluff Ranger District, Mark Twain National Forest, zone GIS specialist, 1420 West Maude, Poplar Bluff, MO 63901.
- Poplar Bluff Ranger District. (2009-2010). *Stand recon sheet field notes*. Unpublished report, on file with the Poplar Bluff Ranger District, Mark Twain National Forest, district silviculturist, 1420 West Maude, Poplar Bluff, MO 63901.
- Poplar Bluff Ranger District. (2011-2012). *Northeast Lake stand prescription forms*. Unpublished report, on file with the Poplar Bluff Ranger District, Mark Twain National Forest, district silviculturist, 1420 West Maude, Poplar Bluff, MO 63901.
- Prestemon, J.P., & Holmes, T.P. (2008, June). Timber salvage economics. In: T.P. Holmes, J.P. Prestemon, & K.L. Abts (Eds.), *The economics of forest disturbances: Wildfires, storms, and invasive species*. 167-190. New York: Springer-Verlag. Retrieved September 20, 2012, from <http://treesearch.fs.fed.us/pubs/32962>
- Prestemon, J.P., Pye, J.M., & Holmes, T.P. (2001). Timber economics of natural catastrophes. In: M. Pelkki (Ed.) *Proceedings of the 2000 southern forest economics workshop*, pp. 132-141. Lexington, KY. Retrieved September 20, 2012, from <http://treesearch.fs.fed.us/pubs/3212>

- Pritchett, W.L., & Fisher, R.F. (1987). *Properties and management of forest soils* (2nd ed.). New York, NY: John Wiley and Sons, Inc.
- Reisinger, T.W., Pope, P.E., & Hammond, S.C. (1992). Natural recovery of compacted soils in an upland hardwood forest in Indiana. *Northern Journal of Applied Forestry* 9(4), 138-141. Retrieved December 4, 2012, from <http://www.ingentaconnect.com/content/saf/njaf/1992/00000009/00000004/art00006>
- Robinson, S. (2008, November 9). *Report of field visit*. Unpublished report, on file with the Poplar Bluff Ranger District, Mark Twain National Forest, district silviculturist, 1420 West Maude, Poplar Bluff, MO 63901.
- Robinson, S.K., Grzybowski, J.A., Rothstein, S.I., Brittingham, M.C., Petit, L.J., & Thompson, F.R., III. (1993). Management implications of cowbird parasitism on neotropical migrant songbirds. In D.M. Finch & P.W. Stangel (Eds.), *Status and management of neotropical migratory birds* (pp. 93-102). September 21-25, 1992, Estes Park, CO. Gen. Tech. Rep. RM-229. Fort Collins, CO: Rocky Mountain Forest and Range Experiment Station, U.S. Dept. of Agriculture, Forest Service. Retrieved October 12, 2012, from http://www.fs.fed.us/rm/pubs_rm/rm_gtr229/rm_gtr229_093_102.pdf
- Roesch, L.F.W., Fulthorpe, R.R., Riva, A., Casella, G., Hadwin, A.K.M., Kent, A.D., Daroub, S.H., Camargo, F.A.O., Farmerie, W.G., & Triplett, E.W. (2007). Pyrosequencing enumerates and contrasts soil microbial diversity. *The ISME Journal*, 1(4), 283-290. Retrieved December 4, 2012, from <http://www.nature.com/ismej/journal/v1/n4/pdf/ismej200753a.pdf>
- Sander, I.L. (1990). *Quercus velutina* Lam. black oak. In R.M. Burns, B.H Honkala, Technical Coordinators. *Silvics of North America: Volume 2. Hardwoods*. U.S. Department of Agriculture, Forest Service Agriculture Handbook 654. Washington, DC: U.S. Department of Agriculture Forest Service: 744-750. Retrieved May 4, 2011, from <http://www.treearch.fs.fed.us/pubs/1548>
- Schanta, M. (2010, June 17). *Inventory report for Northeast Lake, Poplar Bluff District*. Mark Twain National Forest. Unpublished report, on file with the Poplar Bluff Ranger District, Mark Twain National Forest, district silviculturist, 1420 West Maude, Poplar Bluff, MO 63901.
- Schneider, I. E. (2007, December). The prevalence and significance of displacement for wilderness recreation management and research. *International Journal of Wilderness*, 13(3), 23-27. Retrieved June 29, 2011, from <http://ijw.org/wp-content/uploads/2007/04/Dec-2007-IJW-vol-13-no-3small.pdf>
- Schroeder, H. (2007, June). Understanding forest recreation visitors: special places. In: L.E. Kruger, R. Mazza, & K. Lawrence (Eds.), *Proceedings: national workshop on recreation research and management*. Gen. Tech. Rep. PNW-GTR-698. Portland, OR: U.S. Department of Agriculture Forest Service, Pacific Northwest Research Station: 51-54. Retrieved June 29, 2011, from www.fs.fed.us/pnw/pubs/pnw_gtr698.pdf
- Scrivner, C.L., Baker, J.C., & Miller, B.J. (1966). *Soils of Missouri: a guide to their identification and interpretation*. Columbia, MO: University of Missouri, Extension Division.

- Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. (2005, November). *Soil survey of Wayne County, Missouri*. Retrieved December 4, 2012, from http://soildatamart.nrcs.usda.gov/Manuscripts/MO223/0/Wayne_MO.pdf
- Streby, H.M., Peterson, S.M., McAllister, T.L., & Andersen, D.E. (2011, November). Use of early-successional managed northern forest by mature-forest species during the post-fledging period. *The Condor*, 113(4), 817-824. Retrieved October 12, 2012, from <http://www.jstor.org/stable/pdfplus/10.1525/cond.2011.110012.pdf?acceptTC=true>
- Stynes, D.J., & White, E.M. (2005, May). *Spending profiles of national forest visitors, NVUM four year report* (joint venture agreement #01-JV-111301149-203). Retrieved November 21, 2012, from <http://www.fs.fed.us/recreation/programs/nvum/NVUM4YrSpending.pdf>
- Styron, H. (n.d.). *Harry Styron's Missouri stream law*. Retrieved December 5, 2012, from <http://styronblog.com/law/harry-styrons-missouri-stream-law/>
- Switalski, T.A., Bissonette, J.A., DeLuca, T.H., Luce, C.H., & Madej, M.A. (2004). Benefits and impacts of road removal. *Frontiers in Ecology and the Environment*, 2(1), 21-28. Retrieved December 4, 2012, from http://www.fs.fed.us/rm/pubs_other/rmrs_2004_switalski_t001.pdf
- The Cornell Lab of Ornithology. (n.d.). *All about birds, bird guide: Summer Tanager*. Retrieved October 1, 2012, from http://www.allaboutbirds.org/guide/Summer_Tanager/lifehistory
- Thompson, F.R., III, & DeGraaf, R.M. (2001, Summer). Conservation approaches for woody, early successional communities in the eastern United States. *Wildlife Society Bulletin*, 29(2), 483-494. Retrieved November 9, 2011, from <http://www.jstor.org/stable/pdfplus/3784172.pdf>
- Thompson, F.R., III, Reidy, J.L., Kendrick, S.W., & Fitzgerald, J.A. (2007). Songbirds in managed and non-managed savannas and woodlands in the central hardwoods region. In D.C. Dey, M.C.; Stambaugh, S.L.; Clark, and C.J. Schweitzer (Eds.), *Proceedings of the 4th fire in eastern oak forests conference* (pp. 159-169). May 17-19, 2011, Springfield, MO. Gen. Tech. Rep. NRS-P-102. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. Retrieved October 1, 2012, from <http://www.nrs.fs.fed.us/pubs/gtr/gtr-nrs-p-102papers/11thompson-p-102.pdf>
- Trusty, W.G.; Bacon, W.R. (1989, September). Effects of timber management practices on recreation and esthetics (visual resources). In: Burns, R.M., technical compiler. *The scientific basis for silvicultural and management decisions in the national forest system*. Gen. Tech. Rep. WO-55. Washington, DC: USDA Forest Service. Retrieved June 29, 2011, from: ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/10095/Sci_Bas_Sil_Man.pdf?... PDF file
- Tuttle, J.; Treiman, T.; Baldwin, D. (2009). *Missouri forest industries 2009 directory of secondary wood processors*. Jefferson City, Missouri: Missouri Department of Conservation, Forestry Division. Retrieved September 18, 2012, from <http://mdc4.mdc.mo.gov/Documents/373.pdf>

- Tuttle, J.; Treiman, T.; Morris, M. (2010). *Missouri forest industries 2010 directory of primary wood processors*. Jefferson City, Missouri: Missouri Department of Conservation, Forestry Division. Retrieved September 18, 2012, from <http://mdc4.mdc.mo.gov/Documents/373.pdf>
- US Army Corps of Engineers. (n.d.) Corps lakes gateway: US Army Corps of Engineers Wappapello Lake. Retrieved October 5, 2012, from <http://corpslakes.usace.army.mil/visitors/projects.cfm?Id=B319420>
- U.S. Army Corps of Engineers, St. Louis District, Environmental Compliance Branch. (2011, October). *Environmental assessment with draft findings of no significant impact: Wappapello Lake (compartments 2, 6, and 8) timber stand improvement management strategies*. Retrieved August 3, 2012, from http://www.mvs.usace.army.mil/pm/wappapello/Wappapello%20Lake%20with%20Appendices_3_OCT_2011.pdf
- U.S. Census Bureau. (n.d.a). *American Fact Finder DP05 ACS demographic and housing estimates, 2006-2010 American community survey 5-year estimates, Wayne County, Missouri*. Retrieved September 13, 2012, from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_5YR_DP05&prodType=table
- U.S. Census Bureau. (n.d.b). *American Fact Finder DP05 ACS demographic and housing estimates, 2006-2010 American community survey 5-year estimates, Missouri*. Retrieved September 13, 2012, from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_5YR_DP05&prodType=table
- U.S. Census Bureau. (n.d.c). *American Fact Finder DP03 Selected economic characteristics, 2006-2010 American community survey 5-year estimates, Wayne County, Missouri*. Retrieved September 13, 2012, from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_5YR_DP03&prodType=table
- U.S. Census Bureau. (n.d.d). *American Fact Finder DP03 Selected economic characteristics, 2006-2010 American community survey 5-year estimates, Missouri*. Retrieved September 13, 2012, from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_5YR_DP03&prodType=table
- U.S. Department of Commerce, U.S. Census Bureau. (n.d.) *State and county quick facts: Wayne County, Missouri*. Retrieved September 13, 2012, from <http://quickfacts.census.gov/qfd/states/29/29223.html>
- U.S. Department of Interior, Bureau of Land Management, Eastern States. (2012, March 8). *Managing a land office business: commemorating 200 years of the General Land Office*. Retrieved September 13, 2012, from <http://www.blm.gov/es/st/en/prog/glo.html>
- U.S. Department of the Interior. (n.d.a). *Payment in lieu of taxes*. Retrieved September 13, 2012, from <http://www.doi.gov/pilt/index.cfm>
- U.S. Department of the Interior. (n.d.b). *Payment in lieu of taxes: County payments*. Retrieved September 18, 2012, from <http://www.doi.gov/pilt/county-payments.cfm>

- U.S. Environmental Protection Agency. (n.d.). *EJView*. Retrieved September 13, 2012, from <http://epamap14.epa.gov/ejmap/ejmap.aspx?wherestr=37.1%2C-90.4%20%20>
- U.S. Environmental Protection Agency. (2010, July). *EPA's action development process: Interim guidance on considering environmental justice during the development of an action*. Retrieved September 13, 2012, from <http://www.epa.gov/environmentaljustice/resources/policy/considering-ej-in-rulemaking-guide-07-2010.pdf>
- United States Environmental Protection Agency, Office of Water. (2005, April). *National management measures to control nonpoint source pollution from forestry* (EPA-841-B-05-001). Washington, D.C.: Author. Retrieved December 5, 2012, from http://water.epa.gov/polwaste/nps/forestry/upload/2005_05_09_NPS_forestrygmt_guidance.pdf
- United States Environmental Protection Agency, Office of Water. (1993, January). *Guidance specifying management measure for sources of nonpoint pollution in coastal waters EPA 840-B-92-002*. Washington, D.C.: Author. Retrieved December 4, 2012, from <http://www.epa.gov/owow/NPS/MMGI/Chapter3/ch3-1.html>
- United States Department of Agriculture, Economic Research Service. (2008). *County typology codes: 2004 county typology codes*. Retrieved September 26, 2012, from <http://www.ers.usda.gov/data-products/county-typology-codes.aspx>
- United States Department of Agriculture, Forest Service. (n.d.) *Secure rural schools, payments and receipts*. Retrieved September 19, 2012, from http://www.fs.usda.gov/wps/portal/fsinternet!/ut/p/c4/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gjAwhwtDDw9_AI8zPwhQoY6BdkOyoCAPkATIA!/?ss=119985&navtype=BROWSEBYSUBJECT&cid=null&navid=101130000000000&pnavid=101000000000000&position=BROWSEBYSUBJECT&ttype=main&pname=Secure%20Rural%20Schools-%20Payments%20and%20Receipts
- United States Department of Agriculture, Forest Service. (2012, September). *Motor vehicle use map, Mark Twain National Forest Poplar Bluff unit*. Retrieved October 1, 2012, from http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5127709.pdf
- United States Department of Agriculture, Forest Service. (2012, August 1). *Secure Rural Schools and Community Self-Determination Act*. Retrieved September 19, 2012, from <http://www.fs.usda.gov/main/pts/home>
- United States Department of Agriculture, Forest Service. (1995, December). *Landscape aesthetics: A handbook for scenery management*. Agriculture Handbook Number 701. Washington, DC: United States Department of Agriculture, Forest Service.
- United States Department of Agriculture, Forest Service, Mark Twain National Forest. (2011, November). *Fiscal Year 2010 monitoring and evaluation report*. Retrieved September 19, 2012, from http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5401002.pdf
- United States Department of Agriculture, Forest Service, Mark Twain National Forest. (2005a, September). *Mark Twain National Forest 2005 land and resource management plan (2005*

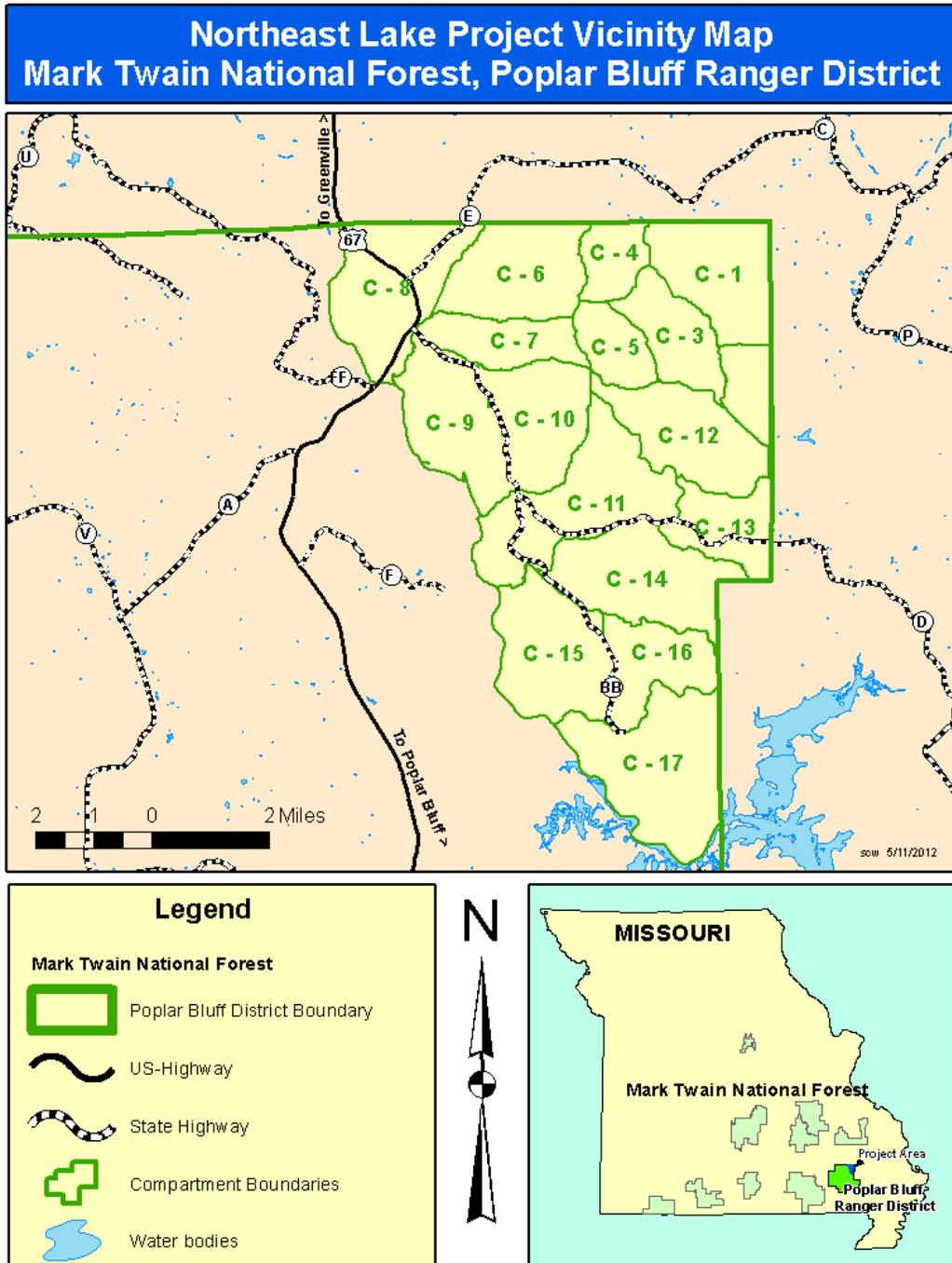
- forest plan*). Available: <http://www.fs.usda.gov/main/mtnf/landmanagement/planning> (2 May 2012).
- United States Department of Agriculture, Forest Service, Mark Twain National Forest. (2005b, September). *Final environmental impact statement to accompany the 2005 land and resource management plan (2005 forest plan)*. Retrieved May 2, from http://www.fs.usda.gov/detail/mtnf/landmanagement/planning/?cid=FSM8_045642
- USDA Forest Service. (n.d.). *FS WEPP: Forest Service WEPP interfaces*. Retrieved October 1, from <http://forest.moscowfsl.wsu.edu/fswepp/>
- USDA Forest Service, Mark Twain National Forest. (2012, August 30). Legal Notice of 30-Day Comment Period. *Daily American Republic*, p.78.
- USDA Forest Service, Mark Twain National Forest. (2012, August 30). Legal Notice of 30-Day Comment Period. *Wayne County Journal-Banner*, p. 6.
- United States Department of Agriculture, Forest Service, National Headquarters (WO). (2010, November 23). *Forest Service manual fsm 2500 – watershed and air management, chapter 2550- soil management*. Retrieved May 2, 2012, from http://www.fs.fed.us/biology/resources/pubs/soils/wo_fsm2550.pdf
- United States Department of Agriculture, Forest Service, Natural Resource Manager, National Visitor Use Monitoring Program. (2011, April 6). *Visitor use report, Mark Twain*. Retrieved May 17, 2012, from http://apps.fs.fed.us/nrm/nvum/results/ReportCache/Rnd2_A09005_Master_Report.pdf
- USDA Forest Service, Planning and Analysis Group. (2012, August 18). Quick-Silver 7.0. Retrieved October 15, 2012, from http://fsweb.ftcol.wo.fs.fed.us/PAG/Economics_Center/software/Quick-Silver/index.shtml
- USDA Forest Service, Southern Research Station. (2006, June). *Recreation and tourism statistics update: participation in outdoor recreation activities by people living near the Mark Twain National Forest, Missouri*. Retrieved September 19, 2012, from <http://www.srs.fs.usda.gov/trends/RECUPDATES/NFR9/marktwain.html>
- United States Department of Agriculture, Forest Service, Technology and Development Program. (2005, December). *Guidelines for road maintenance levels, 7700-transportation management 0577 1205-SDTDC*. Retrieved October 18, 2012, from <http://www.fs.fed.us/eng/pubs/pdf/05771205.pdf>
- United States Forest Service, USDA. (2010, June 25). *Connecting people with America's great outdoors: a framework for sustainable recreation*. Retrieved June 8, 2011, from <http://fsweb.wo.fs.fed.us/rhwr/Framework.pdf>
- U.S. Fish and Wildlife Service, Columbia Missouri Ecological Services Field Office. (2005, September 16). *Programmatic biological opinion for the Mark Twain National Forest 2005 Forest Plan, Missouri*. Columbia, Missouri. Retrieved May 2, 2012, from http://www.fs.usda.gov/detail/mtnf/landmanagement/planning/?cid=FSM8_045642
- Voorhees, W.B. (1983). Relative effectiveness of tillage and natural forces in alleviating wheel-induced soil compaction. *Soil Science Society of America Journal*, 47, 129-133. Retrieved

December 4, 2012, from

<https://www.soils.org/publications/sssaj/abstracts/47/1/SS0470010129>

- Waters, T.F. (1995). *Sediment in streams: sources, biological effects and control*. Bethesda, MD: American Fisheries Society.
- York-Harris, M. (2012, October 16). *Northeast Lake project biological for regional forester sensitive species and state endangered species*. Unpublished report, on file with the Poplar Bluff Ranger District, Mark Twain National Forest, district biologist, 1420 West Maude, Poplar Bluff, MO 63901.
- York-Harris, M. (2012, August 24). *Northeast Lake project federal biological evaluation for federally-listed and candidate species*. Unpublished report, on file with the Poplar Bluff Ranger District, Mark Twain National Forest, district biologist, 1420 West Maude, Poplar Bluff, MO 63901.
- York-Harris, M. (2011, September 1). *Field observation notes*. Unpublished report, on file with the Poplar Bluff Ranger District, Mark Twain National Forest, district biologist, 1420 West Maude, Poplar Bluff, MO 63901.

APPENDIX A NORTHEAST LAKE PROJECT VICINITY MAP



APPENDIX B RELEVANT 2005 FOREST PLAN DIRECTION

The Mark Twain National Forest 2005 Land and Resource Management Plan (2005 Forest Plan) (USDA Forest Service, Mark Twain National Forest 2005a) describes how the Mark Twain National Forest should be managed. Applicable goals, objectives, standards and guidelines for the proposed actions with the Northeast Lake Project have been extracted and adapted from the 2005 Forest Plan and are presented in the following sections.

RELEVANT 2005 FOREST PLAN FORESTWIDE GOALS AND OBJECTIVES

The following 2005 Forest Plan forestwide goals and objectives apply to the proposed Northeast Lake Project:

Goal 1.1 – Terrestrial Natural Communities (Adapted from 2005 Forest Plan, p. 1-2)

Maintain, enhance, or restore site-appropriate natural communities, including the full range of vegetation composition and structural conditions.

Goal 1.3 – Soils, Watersheds, and Water Quality (Adapted from 2005 Forest Plan, p. 1-3)

Maintain healthy, sustainable, and diverse natural communities.

Goal 1.4 – Wildlife and Aquatic Habitat (Adapted from 2005 Forest Plan, pp. 1-3 through 1-4)

Provide the range of natural habitats necessary to support populations of existing native plant and animal species.

Support recovery of Federal and State listed species, protection and management of habitat for regionally listed species, and protection and management of habitat for other identified species of concern.

Provide specialized habitats that are a healthy, functioning part of the larger landscape and require no special protection or additional management considerations. Provide specialized habitat components (such as standing dead trees, cavity and den trees, downed woody material, temporary pools, ephemeral springs and seeps) across the landscape in amounts and types commensurate with the natural communities in which they occur.

Encourage habitat that responds to demand for both consumptive and non-consumptive fish and wildlife use.

Objective 1.4e

Designate permanent old growth on 8 percent to 12 percent of each . . . 6.2 management area

Goal 2.1 – Public Values (Adapted from 2005 Forest Plan, p. 1-4)

Within the capability of sustainable ecosystems, offer multiple benefits that contribute to the social and economic well-being of local and regional communities by providing a variety of uses, values, products, and services in a cost effective manner for present and future generations.

Goal 2.3 – Transportation System (Adapted from 2005 Forest Plan, p. 1-5)

Develop and maintain a transportation system which provides the minimum permanent road access needed to meet resource management objectives.

Provide temporary road access that complements the permanent road system for effective resource management.

Decommission unneeded roads.

Goal 2.4 – Timber Management (Adapted from 2005 Forest Plan, pp. 1-5 through 1-6)

Use timber management, where appropriate, to restore or enhance degraded natural communities, sustain healthy and productive forests, and reduce hazardous fuels to reach the desired condition of the forest.

Respond to disturbance events (storms, wildfires, disease, or insect attacks, etc.) in a timely manner. Salvage damaged forest resources when compatible with management prescriptions.

Provide timber and wood products to help support sustainable local industry and economic interests.

Goal 2.8 – Recreation Opportunities (Adapted from 2005 Forest Plan, p. 1-6)

Provide a diversity of recreational opportunities and benefits through a variety of settings.

Contribute to local, regional, and national economies by providing recreational opportunities in a socially and environmentally acceptable manner.

Goal 2.9 – Visual Management (Adapted from 2005 Forest Plan, p. 1-7)

Maintain or enhance the quality of scenic resources to provide desired landscape character.

RELEVANT 2005 FOREST PLAN FORESTWIDE STANDARDS AND GUIDELINES

Applicable 2005 Forest Plan standards and guidelines for the proposed actions with the Northeast Lake Project have been extracted and adapted from the 2005 Forest Plan and are presented in the following sections. Bold section headers (such as Vegetation Management below) introduce the section only and are not a standard or guideline. Standards from the 2005 Forest Plan requiring compliance appear as statements in bold.

The following 2005 Forest Plan forestwide goals and objectives apply to the proposed Northeast Lake Project:

Vegetation Management (Adapted from 2005 Forest Plan, p. 2-2)

Mimic ecosystem dynamics, patterns, and disturbance processes to achieve desired conditions except where ecological recovery is unlikely or unfeasible.

Plan salvage activities to retain 10-15% of the affected area, unless the area presents an unacceptable risk to public health or safety, or threatens forest health. These areas should be in a variety of patch sizes and distributions on the landscape.

Water and Soil Resource Management (Adapted from 2005 Forest Plan, pp. 2-3 through 2-5)

Delineate the RMZs [Riparian Management Zones] at the project level, using the best available information for landform, terrestrial natural communities, soils, and hydrology for each location.

Allow vegetation management within the RMZ only to move toward the desired condition.

Within the riparian management zones (RMZs) and watercourse protection zones (WPZs) the following activities are prohibited: pond fertilization (for RMZs only); fertilization; timber management (unless needed to move toward desired condition, or for some salvage in the RMZ or within 25 feet in the WPZ); servicing of equipment; wildlife pond construction; log landings; use of chemicals (unless needed to move towards desired condition) and Temporary roads except at designated locations (WPZs only).

Within the RMZs and WPZs the following activities should be avoided whenever possible: Equipment operation; Temporary roads; and Stream channel crossings (RMZ only), and the use of chemicals (WPZs only) unless needed to move towards the desired condition.

Threatened, Endangered, and Sensitive species (Adapted from 2005 Forest Plan, p. 2-6)

Carry out Forest Service responsibilities for the conservation of endangered and threatened species and habitat identified through interagency consultation with the U.S. Fish and Wildlife Service.

Manage federally listed species in accordance with approved species recovery plans (FSM [Forest Service Manual] 2672.21). Manage Regional Forester Sensitive Species . . . in accordance with approved Conservation Agreements and Strategies.

Bald Eagle (Adapted from 2005 Forest Plan, p. 2-6)

Maintain suitable habitat for nesting, roosting, and foraging bald eagles. Protect all occupied nest sites from disturbance from January through July (or during active breeding, incubation, and brood rearing periods).

Designate a ¼ mile permanent old growth corridor along the waters' edge of . . . Lake Wappapello (traditional bald eagle wintering areas).

Indiana Bat (Adapted from 2005 Forest Plan, p. 2-6)

Maintain trees with characteristics of suitable roosts (i.e., dead or dying with exfoliating bark or large living trees with flaking bark) wherever possible with regard for public safety and accomplishment of overall resource goals and objectives.

Using the current, accepted technology, determine the location of summer roost trees and foraging areas for female Indiana bats.

Maternity Colonies (Adapted from 2005 Forest Plan, p. 2-7)

If occupied Indiana bat maternity roost trees are discovered, protect them from physical disturbance until they naturally fall to the ground.

Based on site-specific consultation, designate an area of use (foraging and roosting) based on site conditions, radio-tracking or other survey information, and best available information regarding maternity habitat needs.

Old Growth Habitat (Adapted from 2005 Forest Plan, pp. 2-8 through 2-9)

Use the following criteria when designating areas of permanent old growth:

- **A minimum of 15 acres in size, and preferably over 100 acres in size;**
- **Represent all forest, woodland, and savanna natural community types;**
- **Normally include the oldest or largest average diameter stands that are at least 70 years old;**
- **Designate as permanent old growth all stands or groupings of trees at least two acres in size and greater than 175 years old.**

Apply management activities in old growth only when the objective is enhancement of natural communities and old growth characteristics.

Regeneration Habitat (Adapted from 2005 Forest Plan, p. 2-9)

Intermediate harvests should generally leave the oldest and or largest trees to meet basal area objectives.

All even-aged regeneration harvests shall retain a minimum of 7%-10% of the harvest unit in reserve trees and/or reserve tree groups.

Reserve trees, or reserve tree groups, should include a combination of:

- **The largest, long-lived species occurring on the site (pine, white oak, post oak, hickory, black gum); standing dead trees; and cavity or den trees.**

Reserve trees and reserve tree groups should be spaced to mimic natural community structure and composition.

Reserve tree groups should include a combination of at least five trees. Where opportunities permit, locate some reserve tree groups within drainages.

Leave downed woody material on-site whenever possible.

Aquatic Habitat (Adapted from 2005 Forest Plan, p. 2-10)

Where determined to be a problem, aquatic species may be chemically controlled only when mechanical or biological control is impractical or not likely to be effective.

Constructed Waterholes and Wildlife Ponds (Adapted from 2005 Forest Plan, p. 2-14)

Manage and rehabilitate existing waterholes as a priority over constructing new ones.

When rehabilitating waterholes they should be irregular in shape and natural in appearance.

Place one or more brush piles or rock piles along the north bank of artificial ponds as needed to provide amphibian habitat.

Maintain several large (at least 4-inch dbh) pieces of downed woody material (logs, stumps, and large branches) along the north bank of constructed ponds, partially submerged in the water.

Remove trees and shrubs along the pond bank only if needed to prevent roots from penetrating the dam.

Snags, Dens, Cavity Trees, and Downed Woody Debris (Adapted from 2005 Forest Plan, p. 2-14)

Whenever vegetation management is undertaken, leave standing dead trees, cavity or den trees, and downed woody material whenever possible, while providing for public safety and the achievement of resource management goals and objectives.

Pesticide Use (Adapted from 2005 Forest Plan, pp. 2-19 through 2-20)

Use pesticides only after alternative analysis clearly demonstrates that pesticide use is the most effective means to meet overall management objectives.

The use of pesticides must comply with the product label.

Areas treated with pesticides shall be signed, as appropriate, to ensure users are informed of possible exposure.

Use the least impacting application method needed for effective control of the target species.

Wash and rinse equipment used in the mixing and application of pesticides and fertilizers in areas where runoff will not reach surface waters, wetlands, fens, sinks, or special other habitats.

Recreation Management (Adapted from 2005 Forest Plan, p. 2-21)

Dispersed and developed recreation uses and resource management activities shall conform to the Recreation Opportunity Spectrum (ROS) classification for the management area in which it occurs.

Visual Management (Adapted from 2005 Forest Plan, p. 2-24)

Determine the Visual Quality Objective (VQO) for a specific area by referring to the visual quality matrix found in the standards and guidelines for each management prescription. Use variety classes and sensitivity levels as mapped for each district. They may be changed based on field conditions. Criteria for determining variety class and sensitivity level are documented in Forest Plan, Appendix G.

Resource management activities must meet or exceed the established VQO.

Allow a short-term reduction, the equivalent of one VQO, for central hardwood regeneration or similarly impacting activities. **Foreground sensitivity level 1 (fg1) or foreground sensitivity level 2 (fg2) areas must not be reduced below modification. Retain the original VQO for adjusted areas, and meet it within 20 years after initial entry into the**

corridor or viewshed. Residue treatment requirements must meet those specified for the original VQO.

Within fg1 and fg2 areas with a VQO of retention or partial retention:

- **Mitigate negative visual impacts concurrently with or immediately after each phase or activity;**
- **Complete mitigating measures for each cutting unit or project area before beginning activities in the next sequential block or project area in the same corridor or viewshed; and**
- **Complete obligations specified by a contract or a project prescription within one year from initiation of activities for any single cutting unit or project area. Emphasize completing all work within these areas in a systematic manner within the shortest practical time.**

Within fg1 and fg2 areas with a VQO of modification, the standards are the same as above except the total lapsed time from initiation of activities to completion of obligations specified by a contract or a project prescription shall not exceed two years for any sale block or project area.

Heritage Resources (Adapted from 2005 Forest Plan, pp. 2-26 through 2-27)

Comply with current Memorandum of Understanding (between the State Historic Preservation Office (SHPO) and Mark Twain National Forest), Programmatic Agreements, or other requirements regarding implementation of the forest heritage program.

Consult with the State Historic Preservation Office and Advisory Council on Historic Preservation regarding mitigation or treatment of significant heritage resources for which an adverse effect from forest projects is anticipated.

Consult with Native American groups and appropriate cultural or ethnic groups who may have a potential interest in heritage resources, including traditional cultural properties and sacred sites.

Ensure that adequate heritage surveys are complete and assess project effects on significant heritage resources prior to decisions related to management activities.

Project activities should avoid known potentially significant heritage resources whenever possible, including sites which have not been evaluated or which have been determined to be eligible for listing in the National Register of Historic Places.

Where avoidance is not possible, consider project deferral or relocation as a means of protecting heritage resources.

Evaluate sites which cannot be avoided, or when project cannot be deferred or relocated.

If heritage resources or human remains are discovered during project implementation, the work shall be halted near the find until a professional archaeologist assesses the situation.

Preserve and protect human remains in their original interred location.

If unintentional discovery of human remains occurs, follow provisions set forth in the Native American Graves Protection and Repatriation Act of 1990 and Provisions set forth in Chapter 214, Cemeteries, and Chapter 194, Unmarked Human Burials, Revised Statutes of Missouri.

Timber Management

Harvesting (Adapted from 2005 Forest Plan, p. 2-27 through 2-28)

Use silvicultural systems, harvest methods, and intermediate treatments to move the forest towards the desired condition. Base the decision on which type of systems, methods, and treatments to use on a particular site on management objectives, natural community type, stand conditions, and the silvical characteristics of the species present or desired.

Designate as permanent old growth all stands or groupings of trees at least two acres in size and greater than 175 years old.

Apply management activities in old growth only when the objective is enhancement of natural communities and old growth characteristics.

Provide for sufficient shade and large woody material recruitment to meet WPZ [Watercourse Protection Zone] objectives when developing silvicultural prescriptions.

Intermediate harvests should generally leave the oldest and or largest trees to meet basal area objectives.

All even-aged regeneration harvests shall retain at least 7%-10% of the harvest unit in reserve trees and/or reserve tree groups.

Reserve trees and reserve tree groups should include a combination of the following:

- The largest, long-lived species occurring on the site (pine, white oak, post oak, hickory, black gum); standing dead trees; and cavity or den trees.

Space reserve trees and reserve tree groups to mimic natural community structure and composition.

Include a combination of at least five trees in reserve tree groups. Where opportunities permit, locate some reserve tree groups within drainages.

Leave downed woody material on site whenever possible.

Rotation Ages (Adapted from 2005 Forest Plan, p. 2-28)

With the exception of Management Prescriptions 1.1 and 1.2, the following rotation ages should normally apply: 70 years for Red, Black, and Scarlet oak; 70 years for Shortleaf pine; and 90 years for Post and White oak.

Temporary Openings Created by Even-aged Regeneration Harvest (Adapted from 2005 Forest Plan, pp. 2-28 through 2-29)

The maximum size of a temporary opening created by an even-aged regeneration harvest is 40 acres except as provided for in Management Prescriptions 1.1 and 1.2 or as noted below.

Temporary openings created by even-aged regeneration harvest in excess of the maximum size allowed by management prescription standards and guidelines may occur if one of the following applies:

- On an individual sale basis after 60 days public notice and review by the Regional Forester; and
- In areas of salvage or sanitation activities resulting from disturbance events caused by fires, weather events, or outbreaks of disease or insect attacks.

A temporary opening created by even-aged regeneration harvest is:

- **a clearcut, a seed tree cut, or a shelterwood cut with a total basal area (including reserve trees) of less than 50.**

Although not defined as a temporary opening, shelterwoods with a total basal area greater than 50 should be 40 acres or less in size.

Do not locate new even-aged regeneration harvest temporary openings adjacent to existing temporary openings when the combined total of the areas exceeds the maximum opening size.

Separate temporary openings by a stand of at least manageable size and configuration (normally 10 acres or larger).

Temporary openings should be at least 330 feet apart.

A temporary opening shall no longer be considered a temporary opening when the stand has reached a height of 15 feet.

Reforestation (Adapted from 2005 Forest Plan, p. 2-29)

When shortleaf pine seeding or planting is prescribed, use genetically improved seed or stock developed from native Mark Twain National Forest superior trees.

Adequate advanced regeneration should be present in oak types where a final regeneration harvest is prescribed.

Mechanical site preparation that exposes bare soil on more than 25% of the treated area is not allowed.

Timber Stand Improvement (Adapted from 2005 Forest Plan, p. 2-29)

Release treatments for even-aged management should be made only once per rotation. The treatments should be made no later than 10 years of age for pine stands, and no later than 15 years of age for hardwood or hardwood-pine stands.

Precommercial thinning for even-aged management should only be scheduled in stands that will not be merchantable within 10 years.

Apply precommercial treatments to each entry to achieve structural objectives for stands managed under uneven-aged silvicultural systems.

Management objectives should be met through commercial practices or through firewood cuts when feasible.

Salvage (Adapted from 2005 Forest Plan, p. 2-29 through 2-30)

Salvage timber resources damaged by natural or man-caused disturbance events when salvage activities are compatible with overall resource goals and objectives, management prescriptions, or to protect public safety.

Plan salvage activities to leave at least 10%-15% of the affected area, unless the area presents an unacceptable risk to public health or safety, or threatens forest health. These areas should be in a variety of patch sizes and distributions on the landscape.

Salvage of dead or dying timber and other sanitation removals may occur in the RMZ [Riparian Management Zone], when the riparian values are protected and the activities are needed to protect public safety, resource values, and maintain the health of the forest.

RELEVANT MANAGEMENT PRESCRIPTION 6.2 STANDARDS AND GUIDELINES

The 2005 Forest Plan specifies standards (that convey mandatory compliance) and guidelines (that should be followed) for Management Prescription 6.2 management areas. Both forestwide standards and guidelines and Management Prescription 6.2 standards and guidelines apply to projects. Where forestwide standards and guidelines are different from those for a management prescription, the management prescription standard applies.

The following relevant **standards (in bold)** and guidelines apply to Management Prescription 6.2 areas:

Limit investments for vegetation management treatments to those necessary for restoration and/or maintenance of natural communities, or provides a specific resource output.

Distribute regeneration openings across the landscape proportional to ELT's [*Ecological Land Types*] and natural communities present in the area. Sizes of openings should encompass the full range from ¼ to 15 acres.

Manage area to meet, as a minimum, semi-primitive motorized ROS [Recreation Opportunity Spectrum] objectives.

All resource management activities shall meet applicable Visual Quality Objectives.

Prescribe no more than 20 percent of an individual management area for harvest during the 10 year Plan period.

Salvage harvests are not subject to the 20 percent limit on timber harvest.

Limit the size of a *temporary opening* created by even-aged management to a maximum of 15 acres.

Manage National Forest System roads to meet, as a minimum, the semi-primitive motorized ROS criteria. (Adapted from 2005 Forest Plan, pp. 3-37 through 3-39).

Note that the 2005 Forest Plan includes other standards and guidelines that apply to the implementation of project activities (such as the use of temporary roads) that will be followed as the project is implemented.